International Journal of Scientific Advances
ISSN: 2708-7972
Volume: 7 | Issue: 6 | Nov – Dec 2026 Available Online: www.ijscia.com
DOI: 10.51542/ijscia.v7i6.22

Early Detection of Chronic Kidney Disease in High-Risk Populations in Indonesian Primary Care: A Narrative Review

Adimas Aditya Rudiananda[1*], Shafira Meidyana[2]

[1]Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia

[2]Department of Public Health and Preventive Medicine, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia

*Corresponding author: Adimas Aditya Rudiananda; adimas.rudiananda2005@gmail.com

ABSTRACT

Chronic kidney disease (CKD) prevalence in Indonesia is 0.18–0.38%, but most patients are diagnosed late due to its asymptomatic nature, increasing hemodialysis cases and BPJS health insurance spending. This study synthesizes Indonesia's CKD burden, identifies high-risk groups and early detection tests, evaluates primary-care platforms, and proposes an implementable care pathway. This narrative review of peer-reviewed literature, international guidelines, and Indonesian policy and programme documents published between 2009 and October 2026, in English and Bahasa Indonesia. A Jakarta clinic showed a 14.8% CKD prevalence among adults with diabetes or hypertension, with nearly half at moderate-to-very-high risk. However, 90% of dialysis patients at a national referral hospital were referred late, driving BPJS spending from Rp6.5 trillion in 2019 to Rp11 trillion in 2024. Despite primary care screening platforms reaching 70 million people in 2025, current methods are flawed, relying only on urea/creatinine for adults aged ≥40, omitting albuminuria tests, and failing to link detection to treatment. Introducing point-of-care albumin-to-creatinine testing and targeted screening alongside SGLT2 inhibitors would be highly cost-effective. Indonesia must transition from one-off, creatinine-only checks to a closed-loop primary-care pathway. This system should identify high-risk individuals, test both eGFR and albuminuria, confirm chronicity, and stage patients using KDIGO criteria. Finally, it must manage treatment at the primary-care level and refer patients based on explicit clinical criteria.

Keywords: chronic kidney disease; early detection; screening; albuminuria; primary health care; puskesmas; Indonesia

INTRODUCTION

More than 10% of adults worldwide, an estimated more than 800 million people, are affected by chronic kidney disease (CKD). This disease is predicted to become one of the five leading causes of death worldwide by 2040 [1–3]. The effects of it are beyond kidney failure. The reduction in estimated glomerular filtration rate (eGFR) and increasing albuminuria are each independently and incrementally associated with all-cause and cardiovascular mortality, from the earliest stages of disease [4]. Chronic kidney disease (CKD) is usually asymptomatic until a large proportion of nephron mass has been lost; most patients do not know they have it, and the clinical window in which progression can still be slowed is frequently missed [5].

The case for early identification rests on two developments. First, CKD can be detected with two inexpensive tests, serum creatinine converted to eGFR and the urine albumin-to-creatinine ratio (uACR), which together define, stage, and risk-stratify the disease [6]. Second, the therapeutic landscape has changed. In addition to blood pressure control and renin–angiotensin system inhibition, sodium-glucose cotransporter-2 (SGLT2) inhibitors, non-steroidal mineralocorticoid receptor antagonists and glucagon-like peptide-1 receptor agonists now have randomised evidence of kidney and cardiovascular protection, which means that a diagnosis made early can be followed by treatment that alters prognosis [5,6]. The 2019 KDIGO Controversies Conference concluded that CKD fulfils the classical Wilson–Jungner criteria for screening and that efforts should begin with people at high risk, particularly those with hypertension, diabetes or cardiovascular disease [5,7].

Indonesia illustrates both the size of the problem and the opportunity. National household surveys based on self-reported physician diagnosis place CKD prevalence at well under 1% of adults [8,9], yet the number of people receiving maintenance haemodialysis exceeded 130,000 by 2018 and expenditure on kidney failure has become one of the largest catastrophic-illness items for the national health insurance scheme, Jaminan Kesehatan Nasional (JKN) [10,11]. At the same time, the country has invested heavily in primary care: Integrated Primary Health Care (Integrasi Layanan Primer, ILP)

transformation launched in 2023 and the Free Health Screening programme (Cek Kesehatan Gratis, CKG) launched in February 2025, which reached about 70 million participants in its first year, have created a national platform through which people at high risk of CKD can be reached [12].

Whether that platform will translate into earlier detection and better kidney outcomes depends on details: who is tested, with which tests, how abnormal results are confirmed and recorded, and whether detection is linked to treatment and referral. This narrative review therefore aims to (i) summarise the burden of CKD in Indonesia and explain the gap between reported and measured prevalence; (ii) define the high-risk groups most relevant to Indonesian primary care; (iii) appraise the tests available for early detection in resource-limited settings; (iv) map existing primary-care programmes and their gaps with respect to CKD; and (v) propose a pragmatic, guideline-concordant detection-to-treatment pathway and research agenda for Indonesian primary care.

METHODS

This is a narrative review. Literature was identified through PubMed/MEDLINE and Google Scholar, supplemented by targeted searches of Indonesian journals indexed in SINTA/Garuda and of grey literature from the Ministry of Health (Kementerian Kesehatan, Kemenkes), the Health Development Policy Agency (BKPK), BPJS Kesehatan, the Indonesian Society of Nephrology (PERNEFRI) and the Indonesian Renal Registry (IRR). Search terms combined “chronic kidney disease” OR “penyakit ginjal kronik” with “Indonesia”, “screening” OR “skrining” OR “early detection”, “primary care” OR “puskesmas” OR “FKTP”, “albuminuria”, “eGFR”, “Prolanis”, “Posbindu”, “Integrasi Layanan Primer” and “Cek Kesehatan Gratis”. Publications in English or Bahasa Indonesia from January 2009 to October 2026 were eligible, together with landmark trials and international guidelines regardless of date.

Priority was given to (a) population-based or multicentre Indonesian data on CKD prevalence, aetiology and outcomes; (b) international guidelines, systematic reviews and meta-analyses on screening tests and cost-effectiveness; (c) randomised trials of kidney-protective therapies that make early detection actionable; and (d) Indonesian regulations and programme documents describing the primary-care delivery platform. Because the purpose was to synthesise heterogeneous evidence across epidemiology, diagnostics, therapeutics and health-systems research, no formal risk-of-bias scoring or quantitative pooling was performed; instead, methodological limitations of key sources are discussed in the text where they affect interpretation. Programme data released through official statements rather than peer-reviewed publications are identified as such and interpreted cautiously.

RESULT AND DISCUSSION

Reported prevalence: a measure of diagnosis, not disease

Indonesia's principal sources of national CKD prevalence are the Basic Health Research surveys (Riset Kesehatan Dasar, Riskesdas) and their successor, the Indonesian Health Survey (Survei Kesehatan Indonesia, SKI). Both ask respondents whether a physician has ever diagnosed them with CKD. Riskesdas reported a rise from 2.0 per 1,000 in 2013 to 3.8 per 1,000 (0.38%) in 2018, with marked provincial variation, from 0.18% in West Sulawesi to 0.64% in North Kalimantan [9,13]. A re-analysis of Riskesdas 2018 restricted to adults estimated 0.5% and identified viral hepatitis, in addition to conventional cardiometabolic factors, as an independent correlate of CKD [14]. SKI 2023 reported 0.18% among people aged 15 years and over [8,15].

These figures should not be read as estimates of disease frequency. A question about prior physician diagnosis measures the proportion of people who have both been tested and been told the result; in a disease that is asymptomatic until late, it is dominated by advanced cases already in contact with hospitals. The apparent halving between 2018 and 2023 is far more plausibly explained by differences in questionnaire, sampling frame, and the age denominator than by a true fall in disease, given that kidney replacement therapy (KRT) volumes rose sharply over the same period [11,16]. For planning purposes, the self-reported figures are best interpreted as a lower bound on diagnosed CKD and as an indirect indicator of how little early-stage disease is currently being detected.

Measured prevalence in high-risk groups

Studies that measure kidney function tell a very different story (Figure 1, Table 1). The first large community screening programme run by PERNEFRI in urban and semi-urban areas in 2005–2006 enrolled 9,412 adults; persistent proteinuria was present in almost 3%, and among participants with hypertension, proteinuria and/or diabetes, CKD (eGFR <60 mL/min/1.73 m^2) was found in 8.6% using the MDRD equation [17]. More recently, a multicentre study in 14 primary-care centres (puskesmas) in Jakarta enrolled 1,263 adults with diabetes and/or hypertension and assessed both eGFR and albuminuria. CKD prevalence was 14.8%, the incidence of new CKD was 9.1 per 100 person-years, and the number needed to screen to detect one case was only 7. Almost half of participants (48.9%) fell into KDIGO moderate-, high-, or very-high-risk categories, and eGFR declined by a mean of 4.7 mL/min/1.73 m^2 per year, several-fold faster than age-related decline [18].

The Jakarta study also documented substantial treatment gaps among people who were already registered at puskesmas: only 32.3% received renin–angiotensin system inhibitors and 1.2% used insulin despite a median glycated haemoglobin of 7.5% [18]. These are precisely the people whom existing chronic-disease programmes are designed to reach, which suggests that the problem is not only access to primary care, but what happens during the encounter.

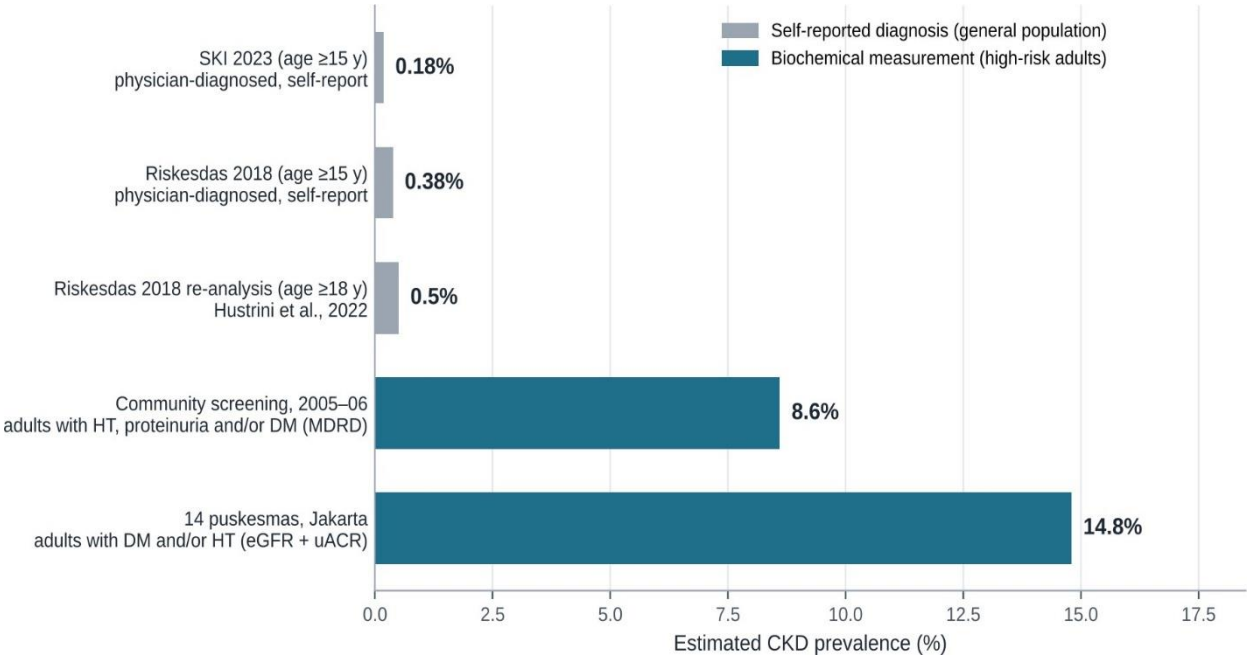


FIGURE 1: The gap between reported and measured CKD prevalence in Indonesia. Grey bars show national survey estimates based on self-reported physician diagnosis in the general population; blue bars show prevalence measured biochemically among adults with hypertension and/or diabetes. The populations differ, so the bars are not directly comparable; the contrast illustrates how much CKD remains undiagnosed. Data from [8,14,17,19].

TABLE 1: Key Indonesian data sources on the burden of chronic kidney disease.

Source	Population and method	Key estimate	Interpretation
Riskesdas 2018 [9,13]	National household survey, age ≥15 y; self-reported physician diagnosis	0.38% (range 0.18–0.64% by province)	Diagnosed CKD only; strongly underestimates true prevalence
Riskesdas 2018 re-analysis [14]	Adults ≥18 y; multivariable analysis of correlates	0.5%; viral hepatitis independently associated	Supports adding hepatitis B/C to risk-based screening
SKI 2023 [8,15]	National survey, Age ≥15 y; self-reported diagnosis	0.18%	Fall versus 2018 is likely methodological, not real
PERNEFRI community screening 2005–06 [17]	9,412 adults, urban/semi-urban; dipstick, BP, creatinine in high-risk subset	Persistent proteinuria ~3%; CKD 8.6% (MDRD) in those with HT, proteinuria and/or DM	Early evidence that targeted screening has high yield
Primary-care study, 14 puskesmas, Jakarta [18]	1,263 adults with DM and/or HT; eGFR + uACR	Prevalence 14.8%; Incidence 9.1/100 PY; NNS 7; 48.9% at moderate-to-very-high KDIGO risk	Most directly relevant estimate for puskesmas-based screening
Indonesian Renal Registry 2016–19 [16]	122,449 adults starting haemodialysis	Hypertensive kidney disease 43.7%, diabetic nephropathy 23.8%; 1-year survival 91.5%	Registry aetiology based on clinical labels at late presentation
Tertiary-care aetiology study, Jakarta [19]	Patients on KRT in five tertiary centres; structured aetiological work-up	Diabetic kidney disease 27.2%, glomerulonephritis 13.0%, hypertension 11.5%, urolithiasis 10.3%	Hypertension may be over-attributed in registry data
BPJS Kesehatan / PERNEFRI [11,20]	Claims and society data	134,057 people on haemodialysis in 2024; CKD spending Rp6.5 trillion (2019) to Rp11 trillion (2024)	Fiscal burden concentrated at the most expensive stage

The end of the pathway: kidney failure, late referral and cost

Data from the end of the care pathway confirm that most CKD in Indonesia is recognised late. In a cohort of 210 patients starting dialysis at the national referral hospital in Jakarta, 90% had been referred to a nephrologist late [21]; in tertiary care, 83% of patients started dialysis urgently, 95.2% through a temporary catheter, at a median eGFR of only 5.3 mL/min/1.73 m^2 [10]. The IRR recorded more than 132,000 people on maintenance haemodialysis in 2018, and a registry cohort of 122,449 incident haemodialysis patients from 2016 to 2019 had a mean age of only 52 years, with diabetic nephropathy carrying the poorest one-year survival among aetiologies [10,16]. Peritoneal dialysis and transplantation remain marginal (about 2% and well below 1% of KRT, respectively), and most patients receive haemodialysis twice weekly; almost seven in ten patients with recorded dialysis adequacy did not reach the national Kt/V target [16].

Financially, JKN funds the overwhelming majority of dialysis [16,22]. BPJS Kesehatan reports that 134,057people underwent haemodialysis in 2024 and that spending on CKD rose from Rp6.5 trillion in 2019 to Rp11 trillion in 2024, driven by both rising patient numbers and tariff increases in 2023 [11,20]. Internationally, the median annual cost of haemodialysis is about US$19,000 per person [23]. In a system where most expenditure occurs after kidney failure, even modest reductions in the number of people progressing to dialysis would release substantial resources, which is the core economic argument for early detection in primary care.

Aetiology: what the registry may be missing

Registry data attribute most kidney failure in Indonesia to hypertension (43.7%), followed by diabetic nephropathy (23.8%) [16]. However, when patients on KRT in five Jakarta tertiary centres underwent a structured aetiological work-up, diabetic kidney disease was the leading cause (27.2%), followed by glomerulonephritis (13.0%), hypertension (11.5%) and urolithiasis (10.3%) [19]. Discrepancy is methodologically important. When patients present with small kidneys and end-stage disease, the underlying cause can rarely be established, and hypertension, which is almost universal in advanced CKD, becomes a default label. The implication for screening is twofold: diabetes may be an even more important target than the registry suggests, and a meaningful minority of kidney failure arises from glomerular disease and stones that a strategy restricted to hypertension and diabetes will not capture. Including urinalysis for haematuria, and prior kidney disease, stones and recurrent acute kidney injury (AKI) among screening triggers, partly addresses this gap.

Defining high-risk populations for targeted screening

KDIGO 2024 recommends testing people at risk of CKD with both eGFR and uACR, and lists hypertension, diabetes, cardiovascular disease, family history of kidney failure, and other conditions associated with kidney injury as indications [6]. In Indonesia, the size of the two dominant risk groups is striking. SKI 2023 measured hypertension in 30.8% of adults aged 18 years and over, yet only 8.6% reported a previous diagnosis; diabetes, defined by blood glucose, was present in 11.7% [24]. Because a large share of people with hypertension and diabetes are themselves undiagnosed, CKD screening in Indonesia cannot simply draw on existing disease registers; it must be coupled to case-finding for the underlying risk factors. Table 2 summarises the groups most relevant to Indonesian primary care.

TABLE 2: High-risk groups for targeted CKD screening in Indonesian primary care.

Risk group	Evidence and rationale	Indonesia-specific Considerations and entry point
Diabetes mellitus	Leading cause of kidney failure globally; KDIGO recommends annual eGFR and uACR [6,25]	Prevalence 11.7%; leading aetiology in structured work-up [19]; Prolanis, PTM clinic, CKG
Hypertension	Cause and consequence of CKD; albuminuria testing underused worldwide [26]	Prevalence 30.8%, mostly undiagnosed [24]; CKG, Posyandu ILP, Prolanis
Cardiovascular disease and heart failure	Shared pathophysiology; CKD modifies CV risk and drug choice [6]	Usually identified at hospital level; capture through back-referral (PRB) lists
Obesity and metabolic syndrome	Promotes hyperfiltration, diabetes and hypertension	Central obesity 32.9% and overweight/obesity 24.4% among adult CKG participants [27]
Older age (≥40–60 y)	eGFR declines with age; CKD prevalence rises steeply	CKG kidney testing begins at age 40 in people with HT/DM [28]
Viral hepatitis B/C	Independent correlate of CKD in Riskesdas 2018 [14]	CKG already screens adults for hepatitis B and C; link positive results to kidney testing
Family history of kidney failure	Familial aggregation; genetic and shared environmental risk	Easy to capture in the CKG self-screening questionnaire

Risk group	Evidence and rationale	Indonesia-specific Considerations and entry point
Prior AKI, glomerulonephrit is, urolithiasis	Recognised precursors of CKD; GN and stones account for ~23% of KRT in Jakarta tertiary centres [29]	Not captured by HT/DM-only rules; include urinalysis for haematuria
Chronic nephrotoxin exposure	Regular NSAID use and other nephrotoxic agents increase risk [6]	Over-the-counter analgesic use is common; ask explicitly at screening

Two points deserve emphasis. First, the Jakarta primary-care data show that the yield of screening among people with diabetes and/or hypertension is high enough (number needed to screen of 7) to justify routine testing of every person in these groups, not only those with additional features [18]. Second, the incidence of new CKD in that cohort (9.1 per 100 person-years) means that a single negative test does not end the need for testing; screening must be repeated, generally annually, to remain effective [6,18].

Estimated GFR

Serum creatinine is widely available, inexpensive, and already performed in many puskesmas laboratories. KDIGO 2024 recommends estimating GFR from creatinine using a validated equation, with the race-free CKD-EPI 2021 equation now standard in many settings [6,29]. Three practical caveats apply in Indonesia. First, creatinine methods vary; Jaffe-based assays are subject to interference and calibration drift, and equations perform best with assays traceable to isotope-dilution mass spectrometry, so external quality assurance across puskesmas laboratories is a prerequisite for reliable eGFR reporting. Second, creatinine-based eGFR is affected by muscle mass and diet, which matters in older, sarcopenic or malnourished people; cystatin C improves accuracy but is not currently feasible at primary-care level [6]. Third, eGFR is a late marker: it may remain above 60 mL/min/1.73 m^2 for years while albuminuria is already present, so screening based on creatinine alone misses most early disease [3,6].

Albuminuria

Albuminuria is the earliest marker of kidney damage in diabetic and hypertensive CKD, one of the strongest predictors of progression and cardiovascular events, and a treatment target whose reduction tracks with reduced risk of kidney failure [4,30]. KDIGO recommends a spot urine albumin-to-creatinine ratio (uACR), preferably on an early-morning sample, with ≥30 mg/g (≥3 mg/mmol) defining increased albuminuria and two of three samples over 3–6 months required to confirm persistence [6]. Despite this, albuminuria testing is consistently underused worldwide, especially in hypertension [26].

For primary care, the key question is testing accuracy. A meta-analysis of 16 studies found that quantitative point-of-care (POC) uACR analysers had a pooled sensitivity of 96% and specificity of 98% against laboratory measurement, whereas semi-quantitative POC strips had a sensitivity of only 76% [31]. A later meta-analysis of urine dipsticks reported a sensitivity of 0.82 and specificity of 0.88 for uACR >30 mg/g, falling to 0.72 and 0.82 for the moderately increased range (30–300 mg/g), with very low certainty of evidence [32]. Conventional protein dipsticks are therefore poorly suited to excluding early albuminuria: roughly one in five to one in four people with moderately increased albuminuria would be missed. They remain useful for detecting heavy proteinuria and haematuria, but should be positioned as a fallback rather than the primary screening test.

Combining the two tests and confirming chronicity

CKD is defined by abnormalities persisting for more than three months, and is staged by cause, GFR category (G1–G5) and albuminuria category (A1–A3) [6]. The combined "heat map" classifies risk into low, moderate, high, and very high, and these categories determine monitoring frequency and referral [6]. A single abnormal result is therefore a positive screen, not a diagnosis: transient reductions in eGFR occur with dehydration and acute illness, and transient albuminuria with fever, urinary infection, exercise, marked hyperglycaemia, or uncontrolled blood pressure. A screening programme that reports single-occasion results as "kidney disorder" will over-diagnose, create anxiety and divert scarce follow-up capacity. Table 3 compares the tests.

TABLE 3: Tests for early CKD detection in primary care.

Test	What it detects	Accuracy and limitations	Suggested role at puskesmas
Serum creatinine → eGFR (CKD-EPI 2021)	Reduced filtration (G3a–G5)	Late marker; affected by muscle mass, diet, assay method [6,29]	Core test for all at-risk adults; requires assay quality assurance
Laboratory uACR	Albuminuria A2–A3 (early damage)	Reference standard for screening; needs 2 of 3 positives to confirm [6]	Core test, paired with eGFR at the same visit
Quantitative POC uACR	Albuminuria	Sensitivity 96%, specificity 98% vs laboratory [32]	Preferred where no laboratory uACR; suitable for Pustu and outreach

Test	What it detects	Accuracy and limitations	Suggested role at puskesmas
Semi-quantitative uACR strip	Albuminuria (categorical)	Sensitivity ~76% [32]	Acceptable only with laboratory confirmation of positives
Urine protein dipstick	Overt proteinuria; haematuria	Sensitivity 0.72 for uACR 30–300 mg/g; very low certainty	Fallback; useful for haematuria and heavy proteinuria
Serum urea	Non-specific	Strongly influenced by protein intake, hydration, catabolism	Not useful for screening; should not replace eGFR
Cystatin C (eGFRcr-cys)	Filtration, less muscle-dependent	More accurate; costly and not widely available [6]	Referral level for borderline eGFR or extremes of body composition

Where testing happens

Most cost-effectiveness models assume screening in a clinician's office, but the setting matters. In the Dutch THOMAS trial, home-based urine albuminuria testing reached a large population at low cost [33]and economic analyses suggest that home-based or community-based approaches improve the value of screening by avoiding clinic visits [3]. Indonesia's community health posts (Posyandu ILP), auxiliary health centres (Pustu) and home visits by community health workers (kader) offer an analogous channel: urine collection and POC uACR can be decentralised, with venous blood for creatinine drawn at the puskesmas.

Primary-care platforms for CKD detection in Indonesia

Indonesia does not lack delivery platforms. It has several overlapping ones, each designed for a different purpose, and none designed specifically for CKD. Table 4 summarises them and their current contribution to early CKD detection.

National guidance

The national clinical practice guideline for CKD (PNPK Tata Laksana Penyakit Ginjal Kronik), issued in 2023, adopts KDIGO definitions and emphasises prevention and early detection in high-risk groups [34]. The 2025–2029 action plan of the Directorate General of Disease Control explicitly targets CKD screening in adults aged 40 years and over with hypertension and/or diabetes, using serum urea–creatinine (eGFR) and/or uACR, and notes that systematic CKD screening only began with the free screening programme in February 2025 [15]. In September 2026, the Ministry announced that the 2023 guideline is under revision, with stronger emphasis on screening, patient education and shared decision-making before kidney failure develops [35].

Prolanis

The Chronic Disease Management Programme (Program Pengelolaan Penyakit Kronis, Prolanis), run by BPJS Kesehatan through primary-care providers (FKTP), targets JKN members with type 2 diabetes and hypertension through club activities, education, regular consultation and periodic monitoring. It is the natural home for longitudinal kidney monitoring, but its reach has been limited: participation rose from about 11,000 in 2014 to just over 250,000 in 2016, a small fraction of the tens of millions of Indonesians with these conditions, with marked cost differences between Java and other islands. Outcome data are mixed. A 2026 study in the eastern border region found that most participants with diabetes met blood-pressure targets, but fewer than half achieved glycaemic targets [36]and the Jakarta primary-care data show low use of kidney-protective drugs among registered patients [18].

Posbindu PTM and Posyandu ILP

Community-based posts for non-communicable disease risk factors (Posbindu PTM) have long provided blood pressure, glucose, and anthropometric checks run by trained volunteers. Since 2023, they have been absorbed into life-course Posyandu under the ILP transformation, which reorganises puskesmas services by life-course clusters and extends them through Pustu and Posyandu, with targets of 10,000 puskesmas and 300,000 Posyandu [37]. ILP is well suited to the identification step of a CKD pathway (finding people with high blood pressure, high glucose, or obesity) and to adherence support, but kidney tests themselves are not part of the routine Posyandu package.

Cek Kesehatan Gratis (CKG)

CKG, launched on 10 February 2025, offers every resident one free age-specific health check per year at the puskesmas. In 2025, it reached about 70 million participants across 10,225 puskesmas [12]. For adults, the technical guideline restricts kidney function testing to people aged 40 years and over with hypertension and/or diabetes and specifies serum urea and creatinine [27]; the ministry's action plan lists eGFR and/or uACR [15], so albuminuria testing is permitted but not mandatory, and its availability depends on local reagents. Early statements from the Ministry in March 2025 reported that roughly 30,000 participants had undergone kidney testing and that about half had abnormal results [38]. That figure should be interpreted with caution: it reflects single-occasion tests in a risk-selected group, without confirmation of chronicity, and includes urea, which is not a specific marker of kidney function. It does, however, confirm that the yield in this population is high and that the follow-up system will be stretched. The Ministry has itself emphasised that the value of CKG lies in follow-up of abnormal findings rather than participant numbers [12].

TABLE 4: Indonesian primary-care platforms and their role in early CKD detection.

Platform	Design and reach	Current contribution to CKD detection	Main gaps
PNPK CKD 2023 (under revision) [34,35]	National clinical guideline adopting KDIGO definitions	Defines diagnosis, staging, prevention	Implementation tools for FKTP limited; revision announced 2026
Prolanis (BPJS) [36,39]	JKN members with T2DM/HT at FKTP; clubs, education, monitoring	Longitudinal contact with highest-risk group	Low coverage; uACR not routine; variable treatment quality
Posbindu PTM → Posyandu ILP [34]	Community posts and kader; life-course integration since 2023	Finds people with high BP, glucose, and obesity	No kidney tests; weak data linkage to puskesmas
Cek Kesehatan Gratis	Annual free check; ~70 million participants in 2025	Creatinine-based kidney test for age ≥40 with HT/DM	Urea and creatinine only by default; no confirmation step; follow-up capacity
Uro-nephrology referral network (pengampuan) [10]	Strengthening hospital nephrology and KRT services since 2022	Improves secondary/tertiary care and dialysis access	Focus on late-stage care; limited feedback to primary care

Why early detection matters: the treatment that follows

Screening is justified only if detection changes outcomes. For CKD, the evidence base for intervention at early stages is now strong (Table 5). Renin–angiotensin system blockade reduced the risk of doubling of creatinine, kidney failure or death in type 2 diabetes with nephropathy in the RENAAL and IDNT trials [40,41]. SGLT2 inhibitors reduced major kidney outcomes by roughly 30–40% in CREDENCE (diabetic CKD), DAPA-CKD and EMPA-KIDNEY, the latter two including people without diabetes and, in EMPA-KIDNEY, people with low-level albuminuria [44,45,46]. Finerenone and semaglutide provide additional protection in people with type 2 diabetes and albuminuric CKD [45,46]. KDIGO 2024 now recommends SGLT2 inhibitors for most adults with CKD and eGFR ≥20 mL/min/1.73 m^2, alongside blood-pressure control, renin–angiotensin system inhibition for albuminuric CKD, and statins [6].

TABLE 5: Kidney-protective interventions that make early detection actionable.

Intervention	Key evidence	Effect on kidney outcomes	Implication for primary care
ACE inhibitor / ARB	RENAAL (losartan), IDNT (irbesartan) in T2DM with nephropathy [40,41]	Relative risk reduction 16–20% vs placebo	Generic, low cost; should be standard for albuminuric CKD at FKTP
SGLT2 inhibitor	CREDENCE [43]; DAPA-CKD [44]; EMPA-KIDNEY [42]	HR 0.70, 0.61 and 0.72 for primary kidney composites	Benefit independent of diabetes; access at FKTP is a policy prerequisite
Non-steroidal MRA (finerenone)	FIDELIO-DKD [46]	HR 0.82 in T2DM with albuminuric CKD	Specialist-initiated; requires potassium monitoring
GLP-1 receptor agonist (semaglutide)	FLOW [45]	HR 0.76 for major kidney disease events in T2DM with CKD	Cost currently limits wide use
Risk-factor control and safe prescribing	KDIGO 2024 [6]	BP and glycaemic targets, statins, avoidance of NSAIDs, dose adjustment	Deliverable through Prolanis and PTM clinics

Cost-effectiveness

A 2023 systematic review of 21 economic evaluations concluded that screening high-risk populations is cost-effective, with a median incremental cost-effectiveness ratio (ICER) of about US$27,000 per quality-adjusted life year (QALY) in diabetes and about US$54,000 in hypertension and found screening to be more cost-effective in middle-income countries than in high-income countries; no studies were available from low-income countries [3,47]. Almost all included models considered only renin–angiotensin system inhibition and kidney outcomes.

When SGLT2 inhibitors are included, even population-wide albuminuria screening becomes cost-effective in the United States, at about US$86,000 per QALY for one-time screening at age 55 [48], and models that also count cardiovascular benefit and use home-based testing are likely to be more favourable still [3]. These thresholds cannot be transferred directly to Indonesia, where willingness to pay per QALY is far lower and drug prices differ; an Indonesia-specific economic evaluation, built on local prevalence, test costs, drug prices and dialysis costs, is a clear research priority.

Lessons from community-based models in the region

Thailand, whose primary-care system relies on village health volunteers in a manner comparable to Indonesia's kader, offers the most relevant regional evidence. In the ESCORT cluster-randomised trial, 442 patients with stage 3–4 CKD who received integrated care from a district multidisciplinary team linked to subdistrict health officers and village health volunteers had a significantly slower decline in eGFR over two years than those receiving usual care (mean difference 2.74 mL/min/1.73 m^2) [49]. A subsequent community programme in which volunteers targeted salt intake, smoking and self-medication with NSAIDs reduced these risk behaviours and slowed eGFR decline [50]. The lesson for Indonesia is that the community layer is most valuable not for performing laboratory tests but for finding people, supporting adherence and reducing nephrotoxic exposures after diagnosis.

Regulatory scope of primary care: competence standards and prescribing authority

Early detection in primary care is only as effective as what general practitioners are trained and permitted to do once CKD is found. Two sets of national rules frame this: the competence standard for medical doctors, which defines what a general practitioner is expected to manage independently, and the national formulary, which determines which medicines can be provided under JKN and at which facility level.

Competence standards. Under the 2012 Indonesian Medical Doctor Competence Standard (Standar Kompetensi Dokter Indonesia, SKDI), chronic kidney failure is listed at competence level 2, meaning that the graduate is expected to make a clinical diagnosis and refer, whereas essential hypertension and type 2 diabetes are listed at level 4A, meaning that the graduate is expected to manage them completely [51]. In July 2026, the Indonesian Health Council (Konsil Kesehatan Indonesia), acting under Law No. 17/2023 on Health, issued a new competence standard for medical doctors that replaces graded levels with two categories: conditions managed completely (tuntas) and conditions requiring initial management and referral (tatalaksana awal dan rujuk) [52,53]. In its disease spectrum, type 2 diabetes and grade 1–2 stable hypertension are classified as tuntas and acute kidney injury as initial management and referral, while CKD is not listed explicitly [52]. Both standards therefore place the main CKD risk factors, which are precisely the target of screening, within the general practitioner's complete competence, and the first steps of the pathway (identifying people at risk, ordering eGFR and uACR, interpreting and repeating abnormal results, and controlling blood pressure and glucose) fall within this scope. Definitive management of established CKD is treated as a referral-level responsibility. This is consistent with the national CKD guideline, which advises that patients with eGFR <60 mL/min/1.73 m^2 be discussed with an internist–nephrologist (SpPD-KGH) and lists eGFR <30 mL/min/1.73 m^2, rapid loss of kidney function, uACR >300 mg/g and urinary erythrocyte casts as the main indications for nephrology referral [34].

Prescribing authority for SGLT2 inhibitors. Clinical authority and reimbursement must be distinguished. No statutory provision restricts SGLT2 inhibitors to specialists: under Law No. 17/2023, a physician holding a valid registration certificate (STR) and practice licence (SIP) may prescribe registered prescription medicines within their competence [53]. Both the national CKD guideline and the 2025 PERNEFRI guideline recommend SGLT2 inhibitors for CKD, the latter for adults with eGFR ≥20 mL/min/1.73 m^2 and type 2 diabetes, uACR ≥200 mg/g, or heart failure [34,56]. Under JKN, however, medicines are provided according to the Formularium Nasional (Fornas), which specifies for each drug the facility level at which it may be used, any restriction on indication or prescriber, and whether it may be continued at FKTP through the back-referral programme (PRB) [54]. National heart failure guidance published in 2023 noted that SGLT2 inhibitors had not yet been included in the Fornas and were therefore not covered by BPJS Kesehatan [55]. In practice, SGLT2 inhibitors are therefore initiated by internists or cardiologists at referral hospitals (FKRTL), and FKTP physicians can continue them only when the drug is listed for PRB in the Fornas or when patients purchase it themselves.

These rules have two consequences for an early detection programme. First, the realistic division of roles is not “detection at FKTP, treatment at hospital” but a shared model (Table 6): primary care identifies, tests, confirms and stages CKD, controls risk factors and starts renin–angiotensin system inhibition and statins, while initiation of SGLT2 inhibitors and management of higher-risk categories occur after referral, with stable patients returned to primary care for continuation and monitoring. Second, the policy lever with the greatest potential to shorten the gap between detection and kidney-protective treatment is the Fornas listing of SGLT2 inhibitors for confirmed CKD, including PRB eligibility, together with explicit inclusion of CKD early detection and follow-up in the competence standard and in the primary-care clinical practice guidance used by general practitioners.

TABLE 6: Division of roles in CKD early detection and kidney-protective treatment under current Indonesian regulations.

Task	Primary-care physician (FKTP)	Internist/internist–nephrologist (FKRTL)
Identify at-risk adults; order eGFR and uACR	Yes; within complete competence for HT and T2DM [51,52]	For patients already under hospital care
Repeat abnormal results after ≥3 months; KDIGO staging	Yes	Confirms aetiology when atypical (e.g., haematuria, suspected GN)
BP and glucose control, ACEi/ARB, statin, NSAID avoidance, dose adjustment	Yes; initiate and titrate	Adjusts in complex or refractory cases
Initiate SGLT2 inhibitor	Clinically permitted with valid STR/SIP [53], but not reimbursed at FKTP unless listed in Fornas [54,55]	Usual initiator under JKN; KDIGO and PERNEFRI eligibility [6,56]
Continue SGLT2 inhibitor and monitor	Via PRB if listed in Fornas; sick-day rules, volume status, initial eGFR dip	Reviews at agreed intervals
eGFR <30, uACR >300 mg/g, rapid decline, GN, resistant HT, KFRE 5-year risk ≥3–5%	Refer [34,56]	Definitive management; KRT preparation

ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; GN, glomerulonephritis; HT, hypertension; KFRE, Kidney Failure Risk Equation; KRT, kidney replacement therapy; PRB, Program Rujuk Balik; SIP, Surat Izin Praktik; STR, Surat Tanda Registrasi; T2DM, type 2 diabetes mellitus.

BARRIERS TO EFFECTIVE EARLY DETECTION IN INDONESIA

Synthesising the evidence above, barriers operate at four levels;

Patient level: Awareness of the underlying risk factors is low: fewer than one in three adults with measured hypertension had previously been diagnosed [24]. CKD is asymptomatic, and the cultural salience of dialysis may make a kidney diagnosis frightening rather than motivating. Out-of-pocket costs for transport and time, rather than tests, are often the main barrier to repeat visits needed for confirmation.

Provider level: Even among patients already registered at puskesmas, renin–angiotensin system inhibitors were prescribed to only about a third, and insulin was rarely used despite poor glycaemic control [18]. Primary-care physicians face high patient volumes and may be uncertain about interpreting eGFR and uACR together, about drug dosing in reduced eGFR, and about when to refer.

Health-system level: The default CKG kidney test relies on urea and creatinine [28]; uACR reagents, POC analysers and quality assurance are not uniformly available. There is no routine mechanism to repeat abnormal tests after three months, to record KDIGO stage in the electronic record, or to recall people with normal results the next year. Data sit in separate systems (the CKG application, BPJS primary-care records and the IRR), so the pathway from a first abnormal test to treatment, referral or dialysis cannot be followed. Specialist capacity is concentrated in large cities, and late referral remains the norm [10,21]. Globally, the median density of nephrologists is about 12 per million population, with severe shortages reported in lower-middle-income countries [23].

Policy and financing level: Capitation payments to FKTP may provide little incentive to perform additional tests or intensify treatment, whereas hospital-based dialysis is reliably reimbursed. Access to SGLT2 inhibitors and other newer agents at the primary-care level is limited by their Fornas status and by competence standards that place CKD management largely at the referral level [51,52,55], weakening the link between detection and benefit. Finally, kidney health has been framed mainly as a dialysis-access problem; as of the latest international survey, only a quarter of countries had a CKD-specific national strategy [23].

A proposed detection-to-treatment pathway for Indonesian primary care

Drawing on KDIGO 2024 and the Indonesian programme architecture, we propose a six-step closed-loop pathway (Figure 2) that uses existing platforms rather than creating new ones [6,34,37].

Step 1. Identify: Posyandu ILP, CKG self-screening, Prolanis registers, and Pustu home visits are used to identify adults with hypertension, diabetes, obesity, cardiovascular disease, age ≥40 years, family history of kidney failure, hepatitis B/C, prior AKI, glomerulonephritis or stones, or chronic NSAID use. Newly detected hypertension and diabetes trigger kidney testing at the same contact.

Step 2. Test: Serum creatinine with eGFR reported automatically by CKD-EPI 2021 is paired with uACR on the same visit, using laboratory uACR or a quantitative POC analyser. Urea alone is not used.

Where uACR is unavailable, a dipstick may serve as a fallback, but positive results are confirmed with uACR.

Step 3. Confirm: Abnormal results (eGFR <60 mL/min/1.73 m^2 or uACR ≥30 mg/g) are repeated after at least three months, after excluding transient causes. Only persistent abnormalities are labelled CKD; the participant is informed that the first result is a screening finding.

Step 4. Stage and record: Confirmed CKD is staged by cause, G category and A category, and the KDIGO risk colour is recorded in the electronic record (ASIK/SATUSEHAT), enabling recall and population-level monitoring.

Step 5. Treat at FKTP: Most people with G1–G2 disease, and those with G3a disease after the specialist consultation advised by the national guideline [34], can be managed in primary care: blood pressure and glycaemic control, titrated ACE inhibitor or ARB for albuminuria, continuation of an SGLT2 inhibitor where eligible (initiated after referral, or at FKTP once covered by the Fornas and PRB) [54], statins, avoidance of NSAIDs, dose adjustment of renally cleared drugs, salt reduction and adherence support through Prolanis and kader. Monitoring frequency follows the heat-map colour, from annually to several times a year [6].

Step 6. Refer and back-refer: Referral to an internist or nephrologist (SpPD or SpPD-KGH) is triggered by eGFR <30 mL/min/1.73 m^2, persistent uACR ≥300 mg/g, rapid progression, haematuria with albuminuria, resistant hypertension, suspected glomerular disease or a 5-year kidney failure risk of 3–5% or higher on a validated equation [6]. Stable patients are returned to primary care through the back-referral programme (PRB) with a written plan.

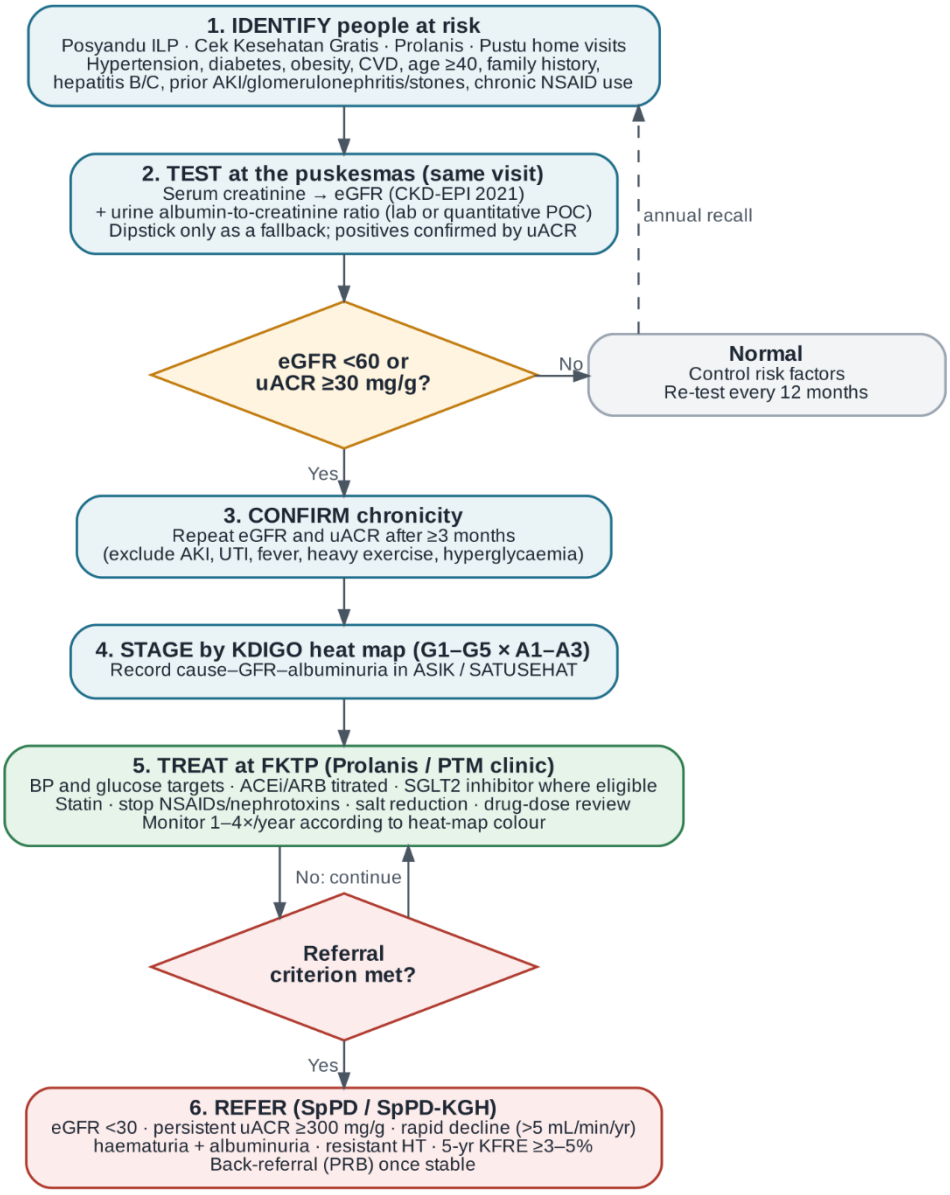


FIGURE 2: Proposed closed-loop pathway for early detection and management of CKD in Indonesian primary care, adapted from KDIGO 2024 to existing Indonesian platforms [6,34,38]. ASIK, Aplikasi Sehat IndonesiaKu; CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; FKTP, primary-care facility; KFRE, Kidney Failure Risk Equation; POC, point-of-care; PRB, Program Rujuk Balik; SpPD-KGH, internist–nephrologist; uACR, urine albumin-to-creatinine ratio.

Recommendations and research priorities

Table 7 translates the pathway into actions for policymakers, primary-care facilities, communities, and researchers. The emphasis is on modest changes to existing programmes: adding uACR to the CKG adult kidney package, adding a scheduled confirmation visit, recording KDIGO stage, and making kidney-protective medicines available where people are diagnosed.

TABLE 7: Recommendations for strengthening early CKD detection in Indonesian primary care.

Level	Recommendations
Policy (Kemenkes, BPJS)	Include uACR alongside creatinine-based eGFR as the standard CKG kidney test for at-risk adults, and drop urea as a screening test. Fund a confirmation test at ≥3 months. Align the revised PNPK, CKG technical guidance and Prolanis with KDIGO 2024. List SGLT2 inhibitors in the Fornas for confirmed CKD, with PRB eligibility so that specialist-initiated therapy can be continued at FKTP. Make CKD early detection and follow-up explicit in the competence standard and primary-care clinical guidance for general practitioners. Consider performance-based incentives for annual eGFR + uACR testing in Prolanis members.
Puskesmas / FKTP	Report eGFR automatically with every creatinine result. Implement laboratory or quantitative POC uACR with external quality assurance. Use a one-page KDIGO heat-map algorithm for monitoring, prescribing, and referral. Record CKD stage in ASIK/SATUSEHAT and generate recall lists.
Community (Posyandu ILP, kader)	Use kader to identify people with risk factors, deliver urine containers and results, support medication adherence, and counsel on salt reduction and avoidance of over-the-counter NSAIDs, building on the Thai volunteer model.
Hospitals and nephrology network	Provide structured referral criteria and timely written back-referral plans; offer tele-consultation to puskesmas; feed IRR data back to the regions where patients were first identified.
Research	Evaluate the CKG kidney component: yield, confirmation rate, linkage to treatment and referral. Validate CKD-EPI 2021 and POC uACR in Indonesian populations. Conduct an Indonesia-specific cost-effectiveness analysis including SGLT2 inhibitors and cardiovascular outcomes. Test implementation strategies (task-shifting, decision support, kader-led follow-up) in pragmatic cluster trials. Characterise non-traditional causes (glomerulonephritis, stones, hepatitis, environmental exposures) outside Java.

Strengths and limitations of this review

This review integrates epidemiological, diagnostic, therapeutic, economic and health-system evidence with current Indonesian programme documents, including developments up to October 2026. Its limitations are those of the narrative method: the search was not systematic, study selection and appraisal were not duplicated, and no quantitative synthesis was attempted, so selection bias cannot be excluded. Measured CKD prevalence data from Indonesian primary care come largely from Jakarta and may not represent rural or eastern regions. Several programme figures, particularly those from CKG, are drawn from official statements rather than peer-reviewed analyses, and the Ministry's ongoing revision of the national CKD guideline may change the policy context described here.

CONCLUSION

CKD in Indonesia is common, rising and largely undetected. National surveys based on self-report capture only a small fraction of the disease, whereas measured prevalence among adults with diabetes or hypertension attending puskesmas is about one in seven, and most patients still reach a nephrologist only when dialysis is imminent. Indonesia now has the essential ingredients for early detection: a national guideline, a large primary-care network reorganised under ILP, a chronic disease programme in Prolanis, and an annual free health check that reached tens of millions of people in its first year. The missing elements are specific and achievable: pairing eGFR with albuminuria testing, confirming abnormal results before labelling disease, recording KDIGO stage, linking every confirmed case to kidney-protective treatment in primary care, and following the pathway with data. Closing these gaps would turn screening activity into prevention of kidney failure.

ABBREVIATIONS

ACE, angiotensin-converting enzyme; AKI, acute kidney injury; ARB, angiotensin receptor blocker; ASIK, Aplikasi Sehat IndonesiaKu; BPJS, Badan Penyelenggara Jaminan Sosial; CKD, chronic kidney disease; CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; CKG, Cek Kesehatan Gratis; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; FKRTL, Fasilitas Kesehatan Rujukan Tingkat Lanjutan; FKTP, Fasilitas Kesehatan Tingkat Pertama; Fornas, Formularium Nasional; HT, hypertension; ICER,

incremental cost-effectiveness ratio; ILP, Integrasi Layanan Primer; IRR, Indonesian Renal Registry; JKN, Jaminan Kesehatan Nasional; KDIGO, Kidney Disease: Improving Global Outcomes; KFRE, Kidney Failure Risk Equation; KRT, kidney replacement therapy; MRA, mineralocorticoid receptor antagonist; NNS, number needed to screen; NSAID, non-steroidal anti-inflammatory drug; PNPK, Pedoman Nasional Pelayanan Kedokteran; POC, point-of-care; PRB, Program Rujuk Balik; Prolanis, Program Pengelolaan Penyakit Kronis; PTM, Penyakit Tidak Menular; PY, person-years; QALY, quality-adjusted life year; SGLT2, sodium-glucose cotransporter-2; SIP, Surat Izin Praktik; SKDI, Standar Kompetensi Dokter Indonesia; SKI, Survei Kesehatan Indonesia; STR, Surat Tanda Registrasi; uACR, urine albumin-to-creatinine ratio.

REFERENCES

[1] Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 2020;395:709–33. https://doi.org/10.1016/S0140-6736(20)30045-3.

[2] Kovesdy CP. Epidemiology of chronic kidney disease: an update 2022. Kidney International Supplements 2022;12:7–11. https://doi.org/10.1016/j.kisu.2021.11.003.

[3] Van Mil D, Pouwels XGLV, Heerspink HJL, Gansevoort RT. Cost-effectiveness of screening for chronic kidney disease: existing evidence and knowledge gaps. Clinical Kidney Journal 2024;17:sfad254. https://doi.org/10.1093/ckj/sfad254.

[4] Chronic Kidney Disease Prognosis Consortium. Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality in general population cohorts: a collaborative meta-analysis. The Lancet 2010;375:2073–81. https://doi.org/10.1016/S0140-6736(10)60674-5.

[5] Shlipak MG, Tummalapalli SL, Boulware LE, Grams ME, Ix JH, Jha V, et al. The case for early identification and intervention of chronic kidney disease: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. Kidney International 2021;99:34–47. https://doi.org/10.1016/j.kint.2020.10.012.

[6] Stevens PE, Ahmed SB, Carrero JJ, Foster B, Francis A, Hall RK, et al. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney International 2024;105:S117–314. https://doi.org/10.1016/j.kint.2023.10.018.

[7] Wilson J, Jungner G. Principles and practice of screening for disease. World Health Organization; 1968.

[8] Badan Kebijakan Pembangunan Kesehatan. Survei Kesehatan Indonesia (SKI) 2023 dalam angka. Jakarta: Kementerian Kesehatan Republik Indonesia; 2023.

[9] Badan Penelitian dan Pengembangan Kesehatan. Laporan nasional Riskesdas 2018. Jakarta: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan; 2019.

[10] Hustrini NM. Chronic Kidney Disease Care in Indonesia: Challenges and Opportunities. Acta Med Indones - Indones J Intern Med 2023;55.

[11] ANTARA. BPJS ungkap pembiayaan gagal ginjal melonjak karena kenaikan jumlah pasien [Internet] 2025. https://megapolitan.antaranews.com/berita/372605/bpjs-ungkap-pembiayaan-gagal-ginjal-melonjak-karena-kenaikan-jumlah-pasien (accessed October 28, 2026).

[12] Kementerian Kesehatan Republik Indonesia. Kesuksesan program CKG tidak hanya pada jumlah peserta, tetapi follow up temuan kritis [Internet] 2026. https://kemkes.go.id/id/kesuksesan-program-ckg-tidak-hanya-pada-jumlah-peserta-tetapi-follow-up-temuan-kritis (accessed October 28, 2026).

[13] Hidayangsih PS, Tjandrarini DH, Sukoco NEW, Sitorus N, Dharmayanti I, Ahmadi F. Chronic kidney disease in Indonesia: evidence from a national health survey. PHRP 2023;14:23–30. https://doi.org/10.24171/j.phrp.2022.0290.

[14] Hustrini NM, Susalit E, Rotmans JI. Prevalence and risk factors for chronic kidney disease in Indonesia: An analysis of the National Basic Health Survey 2018. J Glob Health 2022;12:04074. https://doi.org/10.7189/jogh.12.04074.

[15] Direktorat Jenderal Penanggulangan Penyakit. Rencana aksi program Direktorat Jenderal Penanggulangan Penyakit tahun 2025–2029. Jakarta: Kementerian Kesehatan Republik Indonesia; 2025.

[16] Andhika R, Afiatin -, Supriyadi R, Bandiara R, Sukesi L, Sudarmadi A, et al. One-year Survival of End-Stage Kidney Disease Patients Undergoing Hemodialysis in Indonesia. IJNRD 2025;Volume 18:87–101. https://doi.org/10.2147/IJNRD.S508012.

[17] Prodjosudjadi W, Suhardjono, Suwitra K, Pranawa, Widiana IGR, Loekman JS, et al. Detection and prevention of chronic kidney disease in Indonesia: Initial community screening. Nephrology 2009;14:669–74. https://doi.org/10.1111/j.1440-1797.2009.01137.x.

[18] Hustrini NM, Susalit E, Harimurti K, Haryoso IS, Legrans AE, Damarjati K, et al. Prevalence, incidence and risk factors of chronic kidney disease in people with diabetes and hypertension, and the prognosis and kidney function decline in Indonesia: a multicentre cross-sectional study in primary care centres. BMJ Open 2025;15:e103779. https://doi.org/10.1136/bmjopen-2025-103779.

[19] Hustrini NM, Susalit E, Lydia A, Marbun MBH, Syafiq M, Yassir, et al. The Etiology of Kidney Failure in Indonesia: A Multicenter Study in Tertiary-Care Centers in Jakarta. Agh 2023;89:36. https://doi.org/10.5334/aogh.4071.

[20] Azizah K. 134 ribu orang di RI cuci darah di 2024, dipicu gagal ginjal. detikSumut [Internet] 2025. https://www.detik.com/sumut/berita/d-7823577/134-ribu-orang-di-ri-cuci-darah-di-2024-dipicu-gagal-ginjal (accessed October 28, 2026).

[21] Lydia A, Rachmaningrum G, Shatri H, Nugroho P. Faktor-Faktor yang Berhubungan dengan Keterlambatan Rujukan Pasien Penyakit Ginjal Kronik-Stadium Akhir di RSUPN Dr. Cipto Mangunkusumo. JPDI 2020;7:110. https://doi.org/10.7454/jpdi.v7i2.433.

[22] Afiatin, Khoe LC, Kristin E, Masytoh LS, Herlinawaty E, Werayingyong P, et al. Economic evaluation of policy options for dialysis in end-stage renal disease patients under the universal health coverage in Indonesia. PLoS ONE 2017;12:e0177436. https://doi.org/10.1371/journal.pone.0177436.

[23] Bello AK, Okpechi IG, Levin A, Ye F, Damster S, Arruebo S, et al. An update on the global disparities in kidney disease burden and care across world countries and regions. The Lancet Global Health 2024;12:e382–95. https://doi.org/10.1016/S2214-109X(23)00570-3.

[24] Badan Kebijakan Pembangunan Kesehatan. Prevalensi, dampak, serta upaya pengendalian hipertensi & diabetes di Indonesia [Factsheet SKI 2023] 2024.

[25] Rossing P, Caramori ML, Chan JCN, Heerspink HJL, Hurst C, Khunti K, et al. KDIGO 2022 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. Kidney International 2022;102:S1–127. https://doi.org/10.1016/j.kint.2022.06.008.

[26] Shin J-I, Chang AR, Grams ME, Coresh J, Ballew SH, Surapaneni A, et al. Albuminuria Testing in Hypertension and Diabetes: An Individual-Participant Data Meta-Analysis in a Global Consortium. Hypertension 2021;78:1042–52. https://doi.org/10.1161/HYPERTENSIONAHA.121.17323.

[27] Kementerian Kesehatan Republik Indonesia. 50 juta warga ikut cek kesehatan gratis, Kemenkes ungkap masalah kesehatan masyarakat [Internet] 2025. https://kemkes.go.id/id/50-juta-warga-ikut-cek-kesehatan-gratis-kemenkes-ungkap-masalah-kesehatan-masyarakat (accessed October 28, 2026).

[28] Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Nomor HK.01.07/MENKES/33/2025 tentang Petunjuk Teknis Pemeriksaan Kesehatan Gratis. Jakarta: Kemenkes RI; 2025.

[29] Inker LA, Eneanya ND, Coresh J, Tighiouart H, Wang D, Sang Y, et al. New Creatinine- and Cystatin C–Based Equations to Estimate GFR without Race. N Engl J Med 2021;385:1737–49. https://doi.org/10.1056/NEJMoa2102953.

[30] Heerspink HJL, Greene T, Tighiouart H, Gansevoort RT, Coresh J, Simon AL, et al. Change in albuminuria as a surrogate endpoint for progression of kidney disease: a meta-analysis of treatment effects in randomised clinical trials. The Lancet Diabetes & Endocrinology 2019;7:128–39. https://doi.org/10.1016/S2213-8587(18)30314-0.

[31] McTaggart MP, Newall RG, Hirst JA, Bankhead CR, Lamb EJ, Roberts NW, et al. Diagnostic Accuracy of Point-of-Care Tests for Detecting Albuminuria: A Systematic Review and Meta-analysis. Ann Intern Med 2014;160:550–7. https://doi.org/10.7326/M13-2331.

[32] Mejia JR, Fernandez-Chinguel JE, Dolores-Maldonado G, Becerra-Chauca N, Goicochea-Lugo S, Herrera-Añazco P, et al. Diagnostic accuracy of urine dipstick testing for albumin-to-creatinine ratio and albuminuria: A systematic review and meta-analysis. Heliyon 2021;7:e08253. https://doi.org/10.1016/j.heliyon.2021.e08253

[33] Van Mil D, Kieneker LM, Evers-Roeten B, Thelen MHM, De Vries H, Hemmelder MH, et al. Participation rate and yield of two home-based screening methods to detect increased albuminuria in the general population in the Netherlands (THOMAS): a prospective, randomised, open-label implementation study. The Lancet 2023;402:1052–64. https://doi.org/10.1016/S0140-6736(23)00876-0.

[34] Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Nomor HK.01.07/MENKES/1634/2023 tentang Pedoman Nasional Pelayanan Kedokteran Tata Laksana Penyakit Ginjal Kronik. Kemenkes RI; 2023.

[35] iNews.id. Kemenkes revisi pedoman penyakit ginjal kronis, skrining dan edukasi bakal diperkuat [Internet] 2026. https://www.rctiplus.com/news/detail/terkini/5475568 (accessed October 28, 2026).

[36] Widiarti W, Salamah S, Tan F, Swannjo JB, Fa'iq MAS, Rusli AA, et al. Health-related outcomes of chronic disease management program for diabetes mellitus in the Indonesian Eastern border region. Med J Indones 2026;35. https://doi.org/10.13181/mji.oa.268179.

[37] Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Nomor HK.01.07/ MENKES/2015/2023 tentang Petunjuk Teknis Integrasi Pelayanan Kesehatan Primer. Jakarta: Kemenkes RI; 2023.

[38] Liputan6.com. 30 ribu orang sudah skrining ginjal di cek kesehatan gratis, setengahnya didiagnosis bermasalah [Internet] 2025. https://www.liputan6.com/health/read/5958478.

[39] Khoe LC, Wangge G, Soewondo P, Tahapary DL, Widyahening IS. The implementation of community-based diabetes and hypertension management care program in Indonesia. PLoS ONE 2020;15:e0227806. https://doi.org/10.1371/journal.pone.0227806.

[40] Lewis EJ, Hunsicker LG, Clarke WR, Berl T, Pohl MA, Lewis JB, et al. Renoprotective Effect of the Angiotensin-Receptor Antagonist Irbesartan in Patients with Nephropathy Due to Type 2 Diabetes. N Engl J Med 2001;345:851–60. https://doi.org/10.1056/NEJMoa011303.

[41] Brenner BM, Cooper ME, De Zeeuw D, Keane WF, Mitch WE, Parving H-H, et al. Effects of Losartan on Renal and Cardiovascular Outcomes in Patients with Type 2 Diabetes and Nephropathy. N Engl J Med 2001;345:861–9. https://doi.org/10.1056/NEJMoa011161.

[42] The EMPA-KIDNEY Collaborative Group. Empagliflozin in Patients with Chronic Kidney Disease. N Engl J Med 2023;388:117–27. https://doi.org/10.1056/NEJMoa2204233.

[43] Perkovic V, Jardine MJ, Neal B, Bompoint S, Heerspink HJL, Charytan DM, et al. Canagliflozin and Renal Outcomes in Type 2 Diabetes and Nephropathy. N Engl J Med 2019;380:2295–306. https://doi.org/10.1056/NEJMoa1811744.

[44] Heerspink HJL, Stefánsson BV, Correa-Rotter R, Chertow GM, Greene T, Hou F-F, et al. Dapagliflozin in Patients with Chronic Kidney Disease. N Engl J Med 2020;383:1436–46. https://doi.org/10.1056/NEJMoa2024816.

[45] Perkovic V, Tuttle KR, Rossing P, Mahaffey KW, Mann JFE, Bakris G, et al. Effects of Semaglutide on Chronic Kidney Disease in Patients with Type 2 Diabetes. N Engl J Med 2024;391:109–21. https://doi.org/10.1056/NEJMoa2403347.

[46] Bakris GL, Agarwal R, Anker SD, Pitt B, Ruilope LM, Rossing P, et al. Effect of Finerenone on Chronic Kidney Disease Outcomes in Type 2 Diabetes. N Engl J Med 2020;383:2219–29. https://doi.org/10.1056/NEJMoa2025845.

[47] Yeo SC, Wang H, Ang YG, Lim CK, Ooi XY. Cost-effectiveness of screening for chronic kidney disease in the general adult population: a systematic review. Clinical Kidney Journal 2024;17:sfad137. https://doi.org/10.1093/ckj/sfad137.

[48] Cusick MM, Tisdale RL, Chertow GM, Owens DK, Goldhaber-Fiebert JD. Population-Wide Screening for Chronic Kidney Disease: A Cost-Effectiveness Analysis. Ann Intern Med 2023;176:788–97. https://doi.org/10.7326/M22-3228.

[49] Jiamjariyapon T, Ingsathit A, Pongpirul K, Vipattawat K, Kanchanakorn S, Saetie A, et al. Effectiveness of Integrated Care on Delaying Progression of stage 3-4 Chronic Kidney Disease in Rural Communities of Thailand (ESCORT study): a cluster randomized controlled trial. BMC Nephrol 2017;18:83. https://doi.org/10.1186/s12882-016-0414-4.

[50] Theeranut A, Methakanjanasak N, Lertsinudom S, Surit P, Panyaek N, Leeladapattarakul S, et al. Integrated Care Model by the Village Health Volunteers to Prevent and Slow down Progression of Chronic Kidney Disease in a Rural Community, Thailand. J Prim Care Community Health 2024;15:21501319241240355. https://doi.org/10.1177/21501319241240355.

[51] Konsil Kedokteran Indonesia. Peraturan Konsil Kedokteran Indonesia Nomor 11 Tahun 2012 tentang Standar Kompetensi Dokter Indonesia. Jakarta: Konsil Kedokteran Indonesia; 2012.

[52] Konsil Kesehatan Indonesia. Keputusan Ketua Konsil Kesehatan Indonesia Nomor HK.01.02/KKI/2183/2026 tentang Standar Kompetensi Dokter. Jakarta: Konsil Kesehatan Indonesia; 2026.

[53] Republik Indonesia. Undang-Undang Nomor 17 Tahun 2023 tentang Kesehatan. Lembaran Negara Republik Indonesia Tahun 2023 Nomor 105. Jakarta; 2023.

[54] Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Nomor HK.01.07 /MENKES/1199/2025 tentang Formularium Nasional. Jakarta: Kemenkes RI; 2025.

[55] Kelompok Kerja Gagal Jantung dan Kardiometabolik, Perhimpunan Dokter Spesialis Kardiovaskular Indonesia. Farmakoterapi pada Gagal Jantung. Jakarta: PERKI; 2023. https://inahfcarmet.org/wp-content/uploads/ 2023/06/ISBN-Farmakoterapi-pada-Gagal-Jantung_Rev080623_Clean_Rev1806_.pdf (accessed November 4, 2026).

[56] Perhimpunan Nefrologi Indonesia (PERNEFRI). Pedoman Pengelolaan Penyakit Ginjal Kronik. Edisi I. Jakarta: PERNEFRI; 2025. https://www.pernefri.org/konsensus/Pedoman%20Pengelolaan%20Penyakit%20Ginjal%20Kronik%20PERNEFRI%202025.pdf (accessed November 4, 2026).