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Review Article

Global Patterns, Prevalence and Evidence-Based Management of Biopsy-Proven Renal Diseases: A Comprehensive Review

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ABSTRACT

Biopsy-proven renal diseases constitute an important subset of intrinsic kidney diseases and contribute substantially to chronic kidney disease and kidney failure worldwide. Renal biopsy remains the gold standard for diagnosing intrinsic kidney disease, providing histopathological information that guides diagnosis, prognosis, and individualized therapy. Epidemiology varies considerably by region due to genetics, ethnicity, environmental exposure, socioeconomic status, and biopsy practices, with IgA nephropathy frequently reported as a predominant primary glomerular disease in East Asia and several European populations, while focal segmental glomerulosclerosis is frequently reported in North American and African biopsy cohorts. Secondary glomerular diseases, including lupus nephritis and diabetic kidney disease, remain a substantial proportion of biopsy-confirmed disorders globally. Recent international clinical practice guidelines, including the 2025 update to global kidney disease guidelines for IgA nephropathy and IgA vasculitis, have transformed care, emphasizing early diagnosis, optimized supportive therapy, risk stratification, and disease-specific pharmacological intervention. Recent therapeutic advances, including sodium-glucose cotransporter-2 inhibitors, finerenone, targeted-release budesonide, sparsentan, rituximab, and emerging complement-targeted therapies, have expanded disease-specific and supportive treatment options and demonstrated renal and/or proteinuria benefits in selected kidney diseases. This review synthesizes worldwide prevalence data from major kidney biopsy registries and critically evaluates current evidence-based management strategies across the principal biopsy-proven renal diseases, highlighting regional variation, therapeutic advances, and priorities for future research.

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INTRODUCTION

Chronic kidney disease (CKD) is a major and increasingly recognized global health problem, with substantial variation in prevalence across populations and regions. The 2021 Global Burden of Disease (GBD) Study estimated that approximately 673 million individuals were affected by CKD worldwide, with CKD affecting 9-13% of adults [1].

Rising diabetes, hypertension, obesity, autoimmune disease, aging populations, and environmental risk factors continue to increase CKD incidence. CKD is projected to become an increasingly important contributor to premature mortality and disability over the coming decades [1]. Renal diseases affect the glomeruli, tubules, interstitium, and vasculature; clinical features such as proteinuria, hematuria, and declining renal function overlap across disorders and are often insufficient for a definitive diagnosis.

Renal biopsy remains the gold standard for diagnosing intrinsic kidney disease, providing direct histopathological evaluation. Since its introduction in the mid-twentieth century, percutaneous renal biopsy has enabled direct histopathological assessment of kidney disease, facilitating diagnosis, classification, prognostic assessment, and treatment selection [2,3].

Large biopsy registries in Japan, China, South Korea, Italy, Spain, the Czech Republic, Brazil, Australia, and the United States have expanded understanding of disease epidemiology. IgAN is frequently reported as the predominant primary glomerular disease in several East Asian and European biopsy cohorts, whereas FSGS is frequently reported in North American cohorts and among populations with APOL1 risk variants [4,5].

Renal biopsy also guides evidence-based therapy. The KDIGO Clinical Practice Guidelines for Glomerular Diseases (2021), Diabetes Management in CKD (2022), and Chronic Kidney Disease (2024) have significantly advanced management of biopsy-proven renal disease [6,7,8].

Despite progress in diagnostics and therapeutics, disparities persist in access to renal biopsy, histopathological expertise, and evidence-based treatment, particularly in low- and middle-income countries. This review synthesizes worldwide prevalence data from

major kidney biopsy registries and critically evaluates current evidence-based management strategies and future research priorities.

2. BACKGROUND AND RATIONALE

2.1 Global Burden of Chronic Kidney Disease

The global burden of CKD has increased substantially over recent decades, driven by diabetes, hypertension, obesity, population aging, and other metabolic and environmental factors [1]. However, biopsy registries capture only patients selected for kidney biopsy and therefore should not be interpreted as direct estimates of population-level disease prevalence.

2.2 Role of Renal Biopsy in the Diagnosis of Renal Diseases

Renal biopsy remains the gold standard for diagnosing intrinsic kidney disease, providing histopathological evidence unattainable through laboratory or imaging studies alone; since the 1950s it has enabled precise diagnosis, classification, prognosis, and individualized therapy [2,3]. Because clinical features such as proteinuria, hematuria, and declining renal function overlap across disorders, histopathological examination—combining light microscopy, immunofluorescence, and electron microscopy—is often required to differentiate diseases with similar presentations but distinct treatment needs [2].

Biopsy is generally reserved for patients in whom histopathology is expected to change management, such as nephrotic or nephritic syndrome, unexplained proteinuria, hematuria, or renal impairment, rapidly progressive glomerulonephritis, and suspected lupus nephritis, vasculitis, or allograft dysfunction, and is approached cautiously in uncorrectable bleeding disorders, active infection, or a solitary kidney [3]. Biopsy decisions should account for bleeding risk, infection, kidney anatomy, comorbidities, and whether the expected diagnostic information is likely to alter management [3]. Beyond diagnosis, histopathological findings indicate disease activity and chronicity that directly inform treatment; classification systems such as the Oxford MEST-C score and the ISN/RPS lupus nephritis classification standardize severity assessment and underpin precision nephrology [9].



MATERIALS AND METHODS

3.1 Search Strategy

A comprehensive literature search was conducted using PubMed, Scopus, Web of Science, and Google Scholar for articles published between January 2000 and July 2026. Search terms included combinations of “renal biopsy,” “biopsy-proven kidney disease,” “glomerular disease epidemiology,” “IgA nephropathy,” “focal segmental glomerulosclerosis,” “lupus nephritis,” “diabetic kidney disease,” and “KDIGO guidelines,” combined using the Boolean operators AND and OR.

3.2 Eligibility Criteria

Original research articles, large biopsy registry reports, systematic reviews, meta-analyses, and current clinical practice guidelines published in English were eligible for inclusion. Case reports, conference abstracts, non-peer-reviewed sources, and articles without accessible full text were excluded.

3.3 Study Selection

Titles and abstracts identified through the search strategy were screened for relevance to biopsy-proven renal disease epidemiology and management. Duplicate records were removed, and the full texts of potentially eligible articles were reviewed against the eligibility criteria before inclusion. Reference lists of key articles and guidelines were also examined to identify additional relevant sources.

3.4 Data Extraction

Relevant data on regional prevalence, histopathological patterns, and management strategies for biopsy-proven renal diseases were extracted from the selected sources, including study population, geographic setting, biopsy diagnosis frequencies, and key treatment recommendations.

3.5 Data Synthesis

Extracted data were synthesized narratively under thematic headings corresponding to global epidemiology and evidence-based management, in line with current KDIGO recommendations. As this is a literature-based comprehensive review rather than a field or laboratory study, no specific geographic study area, patient cohort,

or primary data collection site was involved; the review instead draws on data reported by major national and international kidney biopsy registries.

RESULTS

4.1 Global Distribution of Biopsy-Proven Renal Diseases

International kidney biopsy registries and comparative surveys indicate that the frequency of specific biopsy-proven glomerular diseases differs considerably by geographic region, reflecting genetic, environmental, healthcare-access, and biopsy-selection factors. Table 1 summarizes the most commonly reported primary and secondary glomerular diseases by region, and the following sections describe regional patterns and the factors underlying this variation in more detail.

4.2 Regional Patterns

Asia

Asia had the largest number of renal biopsy registries, led by China, Japan, South Korea, India, and Sri Lanka. IgA nephropathy (IgAN) was frequently reported as a predominant primary glomerular disease in several Asian biopsy cohorts, although the relative frequencies of membranous nephropathy (MN), minimal change disease (MCD), and FSGS varied between countries and study periods.

Lupus nephritis was the predominant secondary glomerular disease, while diabetic kidney disease had increased with the growing prevalence of diabetes; variations in biopsy practice and healthcare access contributed to differences within the region.

Europe

European registries consistently identified IgAN as a predominant primary glomerular disease, followed by membranous nephropathy and FSGS. Lupus nephritis was the leading secondary glomerular disease, while diabetic kidney disease was increasingly diagnosed amid the rising burden of diabetes.

North America

In North America, FSGS was frequently reported as the predominant primary glomerular disease, particularly among individuals of African ancestry, followed by



IgAN and membranous nephropathy. Diabetic kidney disease and lupus nephritis were the most common secondary renal diseases.

South America

Studies from Brazil and other South American countries reported FSGS and IgA nephropathy as frequently observed primary glomerular diseases, with lupus nephritis as the leading secondary disease and diabetic kidney disease increasing alongside rising metabolic disorders.

Africa

FSGS was frequently reported as the predominant primary glomerular disease in Africa, largely reflecting genetic susceptibility and APOL1 risk variants. Lupus nephritis and HIV-associated nephropathy were important secondary renal diseases, though limited biopsy

facilities restricted comprehensive epidemiological reporting.

Oceania

Registries from Australia and New Zealand identified IgAN as a frequently reported primary glomerular disease, followed by FSGS and membranous nephropathy, with diabetic kidney disease as the predominant secondary disease; established registries supported evidence-based practice.

Comparative Analysis of Regional Variations

Prevalence varied significantly across regions due to genetic background, ethnicity, environmental exposure, socioeconomic status, healthcare accessibility, and biopsy indications. IgAN predominated in Asia, Europe, and Oceania, whereas FSGS was more common in North America and Africa.

Table 1: Global Prevalence of Major Biopsy-Proven Renal Diseases.

Region	Most Common Primary Glomerular Disease	Key Findings
Asia	IgA nephropathy (IgAN)	IgAN frequently reported as a predominant primary glomerular disease [4,5,10]; diabetic kidney disease increasingly recognized.
Europe	IgA nephropathy (IgAN)	Well-established biopsy registries provide reliable epidemiological data [4,5]; diabetic kidney disease increasing.
North America	Focal Segmental Glomerulosclerosis (FSGS)	High prevalence of FSGS, especially among individuals of African ancestry [4]; advanced diagnostic facilities improve detection.
South America	FSGS, IgAN	FSGS and IgAN predominate [4,5]; diabetic kidney disease increasing with rising metabolic disorders.
Africa	FSGS	Limited biopsy services; FSGS common due to genetic susceptibility (APOL1) [11]; HIV-associated nephropathy remains important.
Oceania	IgA nephropathy (IgAN)	Established national/regional biopsy registries provide longitudinal epidemiological data [4,5]; increasing prevalence of diabetic kidney disease and hereditary nephropathies.

4.3 Factors Influencing Regional Variations in Biopsy-Proven Renal Diseases

The worldwide distribution of biopsy-proven renal disease reflected the combined influence of genetic, environmental, demographic, and healthcare-related factors, which were essential for interpreting regional epidemiological differences.

Genetic and Ethnic Factors

Genetic predisposition was a major determinant: IgAN was highly prevalent among East Asian populations, while FSGS occurred more frequently in individuals of African ancestry because of APOL1 risk variants [11,12], and inherited complement abnormalities increased susceptibility to diseases such as C3 glomerulopathy in specific populations.



Environmental and Lifestyle Factors

Environmental exposures, dietary habits, infections, obesity, smoking, and rising diabetes and hypertension were found to influence renal disease occurrence and progression; chronic hepatitis B, hepatitis C, and HIV also contributed to secondary glomerular disease in several regions [11].

Healthcare Accessibility and Biopsy Practices

Access to nephrology services, biopsy facilities, and renal pathology expertise varied considerably across countries. Developed nations generally performed biopsy earlier in the disease course, whereas resource-limited settings often reserved biopsy for advanced or atypical cases, influencing reported prevalence [4, 11].

Screening Programs and Diagnostic Facilities

Routine urine screening in countries such as Japan and South Korea facilitated early detection of asymptomatic urinary abnormalities, increasing diagnosis of IgAN, whereas limited screening elsewhere contributed to delayed diagnosis and underreporting [10].

Socioeconomic Factors

Socioeconomic status was found to influence healthcare utilization, affordability of diagnostics, treatment adherence, and outcomes; limited resources reduced access to biopsy and advanced therapies in some settings, leading to delayed diagnosis and poorer prognosis.

Advances in Diagnostic Techniques

Modern diagnostic methods, including immunofluorescence, electron microscopy, genetic testing, and molecular pathology, improved classification accuracy, facilitating earlier diagnosis of rare glomerular disorders and more personalized treatment.

4.4 Evidence-Based Management of Biopsy-Proven Renal Diseases

Management of biopsy-proven renal disease was guided by histopathological diagnosis, disease severity, renal function, and progression risk. Current strategies, based on the 2021, 2022, and 2024 international clinical practice guidelines, combined supportive care with

disease-specific pharmacotherapy to preserve renal function and improve outcomes.

General Supportive Management

Supportive therapy was found to be recommended for all patients with biopsy-proven renal diseases, regardless of the underlying pathology.

Blood Pressure Control

Strict blood pressure control was identified as essential to slow CKD progression; current guidelines recommended maintaining blood pressure below 130/80 mmHg in proteinuric kidney disease. ACEIs or ARBs were the preferred first-line agents, reducing intraglomerular pressure and proteinuria.

Reduction of Proteinuria

Persistent proteinuria was found to predict CKD progression; RAAS blockade with ACEIs or ARBs was optimized to maximize its reduction while monitoring serum creatinine and potassium.

SGLT2 Inhibitors

SGLT2 inhibitors, including dapagliflozin and empagliflozin, were recommended for eligible CKD patients, as they reduced albuminuria, slowed GFR decline, and lowered the risk of kidney failure and cardiovascular events.

Lifestyle Modifications

- Restrict dietary sodium intake (<2 g/day sodium).
- Maintain a healthy body weight.
- Engage in regular physical activity.
- Stop smoking and limit alcohol intake.
- Avoid nephrotoxic medications such as NSAIDs.
- Consume an individualized protein intake according to CKD stage.

Management of CKD Complications

Comprehensive management included correcting anemia with iron or erythropoiesis-stimulating agents, treating metabolic acidosis with sodium bicarbonate when indicated, managing hyperkalemia, controlling



dyslipidemia with statins, and treating CKD-mineral and bone disorder per current guidelines.

Disease-Specific Management

IgA Nephropathy (IgAN)

IgAN management is now guided by the KDIGO 2025 Clinical Practice Guideline for IgA Nephropathy and IgA Vasculitis, which updates the 2021 guideline chapter and encourages a more liberal biopsy policy and stricter proteinuria targets (<0.5 g/d, ideally <0.3 g/d) [13]. Management begins with optimized supportive therapy - RAAS blockade, blood pressure control to a target of $\leq 120/70$ mmHg, dietary sodium restriction, and lifestyle modification; persistent proteinuria despite supportive care indicates a higher progression risk.

Current guidelines support SGLT2 inhibitors in eligible patients to reduce progression [13]. In the phase 3 NefIgArd trial, a 9-month course of targeted-release budesonide (Nefecon), which acts on gut-associated lymphoid tissue implicated in pathogenic IgA production, produced a durable reduction in proteinuria and slowed eGFR decline over 2 years compared with placebo [14]. In the phase 3 PROTECT trial, sparsentan, a dual endothelin/angiotensin receptor antagonist used without concurrent RAS inhibition, achieved significantly greater proteinuria reduction than maximally titrated irbesartan and preserved kidney function over 110 weeks [15].

Focal Segmental Glomerulosclerosis (FSGS)

FSGS encompasses distinct clinicopathological categories that require different management approaches: primary (idiopathic) FSGS, presumed to result from a circulating permeability factor and typically presenting with nephrotic-range proteinuria; secondary FSGS, arising from adaptive hyperfiltration (e.g., obesity, reduced nephron mass) or viral or drug-induced podocyte injury; and genetic FSGS, caused by monogenic podocyte-gene variants (e.g., NPHS1, NPHS2) or APOL1 high-risk genotypes. Immunosuppressive therapy is generally reserved for primary FSGS, whereas secondary and genetic forms are managed primarily with supportive and disease-specific measures rather than immunosuppression [12].

Primary FSGS was initially treated with high-dose oral corticosteroids for approximately 16–24 weeks. Patients achieving remission underwent gradual tapering of steroids.

Steroid-resistant or steroid-dependent FSGS was managed with calcineurin inhibitors (tacrolimus or cyclosporine); rituximab was considered in selected, particularly recurrent, cases. Supportive measures - RAAS and SGLT2 inhibitors, salt restriction, and lipid management - remained essential throughout.

Minimal Change Disease (MCD)

Corticosteroids were the first-line treatment and induced complete remission in the majority of adults and children. Relapses were common, particularly in adults.

Frequently relapsing or steroid-dependent MCD often required calcineurin inhibitors, cyclophosphamide, MMF, or rituximab to reduce cumulative steroid exposure and maintain remission.

Membranous Nephropathy (MN)

Membranous nephropathy management depended on progression risk: low-risk patients were treated conservatively with RAAS inhibitors, blood pressure control, and monitoring of proteinuria and renal function.

Moderate- or high-risk patients required immunosuppression; rituximab was often preferred first-line for its safety profile and durable remission, while cyclophosphamide with corticosteroids or calcineurin inhibitors remained an alternative for high-risk disease.

Lupus Nephritis (LN)

Lupus nephritis management follows the KDIGO 2024 Clinical Practice Guideline for the Management of Lupus Nephritis, a focused update of the 2021 guideline chapter reflecting the regulatory approval of belimumab and voclosporin as add-on immunosuppressives [16]. Treatment involves induction with MMF or intravenous cyclophosphamide plus corticosteroids to rapidly suppress renal inflammation, with belimumab or voclosporin considered as add-on therapy in selected patients, followed by maintenance therapy.



Maintenance generally consisted of MMF or azathioprine. Hydroxychloroquine was recommended for nearly all patients unless contraindicated, reducing flares and improving long-term outcomes; biologics such as belimumab were considered for persistent disease activity.

Diabetic Kidney Disease (DKD)

Diabetic kidney disease management focused on slowing CKD progression and cardiovascular risk; ACEIs or ARBs were recommended for patients with albuminuria and hypertension.

SGLT2 inhibitors were strongly recommended, significantly reducing progression and heart-failure hospitalization. Finerenone added renal and cardiovascular protection in patients with persistent albuminuria despite RAAS blockade.

ANCA-Associated Vasculitis

Management of ANCA-associated vasculitis follows the KDIGO 2024 Clinical Practice Guideline for AAV, a focused update reflecting the approval of avacopan and accumulating evidence supporting more rapid glucocorticoid tapering [17]. Active disease requires prompt remission induction with glucocorticoids combined with rituximab or cyclophosphamide; rituximab is increasingly preferred for comparable efficacy with lower cumulative toxicity, and reduced-dose glucocorticoid regimens are now favored where feasible to lower infection risk.

Maintenance included rituximab, azathioprine, methotrexate, or MMF based on relapse risk, with plasma exchange reserved for severe pulmonary hemorrhage or rapidly progressive renal failure.

Key Therapeutic Advances

- SGLT2 inhibitors reduced CKD progression across multiple kidney diseases.
- Targeted-release budesonide (Nefecon) specifically targeted mucosal immune activation in IgA nephropathy.
- Sparsentan provided superior proteinuria reduction in IgA nephropathy.
- Finerenone offered additional renal and cardiovascular protection in diabetic kidney disease.
- Rituximab had become an important treatment option for membranous nephropathy, ANCA-associated vasculitis, and selected cases of FSGS and minimal change disease.
- Emerging complement inhibitors and precision medicine approaches were expected to further improve outcomes in glomerular diseases.

Overall, modern management emphasized early diagnosis via renal biopsy, optimized supportive care, individualized immunosuppression, and novel targeted agents to improve renal survival and quality of life.

Table 2: Evidence-Based Management of Major Biopsy-Proven Renal Diseases.

Disease	First-Line Therapy	Recent KDIGO Recommendations
IgA Nephropathy (IgAN)	RAAS blockade	SGLT2 inhibitors and targeted therapy for persistent proteinuria [13].
FSGS	High-dose corticosteroids	Individualized therapy based on steroid response [6].
Minimal Change Disease	Corticosteroids	Steroids remain first-line; steroid-sparing agents for relapsing disease [6].
Membranous Nephropathy	Conservative therapy (low risk), Rituximab	Anti-PLA2R antibody-guided treatment recommended [6,20].
Lupus Nephritis	MMF or Cyclophosphamide + Corticosteroids	Induction followed by maintenance therapy [16].
Diabetic Kidney Disease	ACEI/ARB	Single-agent RAAS blockade (ACEI or ARB, not combined) plus SGLT2 inhibitor [18,19] and, when indicated, finerenone [23] recommended [7,8].



Disease	First-Line Therapy	Recent KDIGO Recommendations
ANCA-Associated Vasculitis	Rituximab or Cyclophosphamide + Corticosteroids	Rituximab preferred for many patients due to efficacy and safety [17].

4.5 Recent Therapeutic Advances

Management of biopsy-proven renal disease had evolved substantially with advances in disease pathogenesis, targeted therapy, and precision medicine. Beyond the disease-specific agents above, SGLT2 inhibitors provided broad renoprotection across diabetic and non-diabetic CKD, and targeted-release budesonide and sparsentan had introduced mechanism-specific treatment for IgA nephropathy, while finerenone extended renal and cardiovascular protection in diabetic kidney disease and rituximab had broadened treatment options across several immune-mediated glomerular diseases.

Precision Medicine and Artificial Intelligence

Advances in genomics, biomarkers, digital pathology, and artificial intelligence were found to be transforming nephrology: AI-assisted interpretation of biopsy specimens improved diagnostic accuracy, while genetic testing and molecular profiling supported personalized treatment and early identification of high-risk patients.

DISCUSSION

5.1 Interpretation of Regional Patterns

The findings synthesized here demonstrate striking geographical heterogeneity in biopsy-proven renal disease, shaped by genetic susceptibility, environmental exposure, healthcare infrastructure, and biopsy practice. IgA nephropathy consistently dominates in Asia, Europe, and Oceania, plausibly reflecting both genuinely higher genetic susceptibility in East Asian populations and wider routine urine screening in countries such as Japan and South Korea, which detects asymptomatic abnormalities that would otherwise go unbiopsied [9].

In contrast, FSGS predominance in North America and Africa appears strongly linked to APOL1 risk-variant carriage among individuals of African ancestry, illustrating how a single genetic determinant can reshape an entire regional disease spectrum. This IgAN- versus

FSGS-predominant distinction carries direct clinical implications, as the two diseases differ substantially in first-line therapy, prognosis, and relapse risk [12].

Within Asia, large Indian kidney biopsy series add important nuance to this regional pattern. A single-centre cohort of 3,275 native kidney biopsies from northern India found FSGS, rather than IgAN, to be the most common primary glomerulonephritis (18.2%), followed by minimal change disease (16.8%) and membranous nephropathy (16.0%), with IgAN accounting for only 10.4% of primary glomerular disease, while lupus nephritis was the leading secondary glomerular disease (10.6%) [24]. This FSGS-predominant, comparatively IgAN-lower pattern is broadly consistent with findings from the first report of the Indian CKD registry [25] and contrasts with the IgAN predominance typically reported from Japan, China, and other East Asian cohorts, plausibly reflecting a higher biopsy threshold, later disease presentation, and the relative absence of routine urine screening programmes in India compared with Japan or South Korea. This intra-regional heterogeneity illustrates that pooling all of Asia into a single epidemiological category can obscure clinically meaningful national differences in disease spectrum, and by extension, in first-line therapeutic priorities.

The consistent emergence of lupus nephritis and diabetic kidney disease as leading secondary glomerular diseases across nearly every region suggests that secondary glomerular injury from systemic autoimmune disease and the global diabetes epidemic is a comparatively universal phenomenon, reinforcing that diabetes prevention and glycemic control likely yield renal benefits regardless of geographic setting.

Regional disparities in biopsy rates and healthcare access complicate direct comparison of the prevalence figures in Table 1, since resource-limited settings tend to reserve biopsy for advanced or atypical presentations, so apparent regional prevalence may partly reflect referral and diagnostic bias rather than true differences in disease incidence - underscoring the value of standardized, harmonized



international biopsy registries [3].

5.2 Therapeutic Implications

On the therapeutic front, the emergence of SGLT2 inhibitors as a near-universal adjunct across diabetic and non-diabetic CKD represents one of the most consequential shifts in nephrology practice in recent years, given renal and cardiovascular benefits extending well beyond glycemic control [18,19].

Similarly, disease-specific advances such as targeted-release budesonide and sparsentan for IgA nephropathy, and rituximab across membranous nephropathy, ANCA-associated vasculitis, and selected FSGS and minimal change disease, mark a broader transition from indiscriminate immunosuppression toward mechanism-targeted, biomarker-guided therapy, exemplified by anti-PLA2R antibody monitoring in membranous nephropathy [20, 21, 22].

5.3 Research Gaps

Looking ahead, international biopsy registries and standardized reporting would improve data comparability, while multicenter studies are needed to clarify whether regional differences reflect true biological variation or referral bias. Novel biomarkers may enable earlier, non-invasive diagnosis, and integration of genetic testing with histopathology, together with emerging complement- and B-cell-targeted therapies and AI-assisted digital pathology, is expected to advance individualized, mechanism-based treatment.

5.4 Limitations

Nonetheless, several gaps limit these conclusions. Much epidemiological data originates from single-country cohorts rather than pooled, harmonized international datasets, and biopsy indication thresholds vary across centers, introducing selection bias. Africa and South America remain underrepresented relative to their population burden of kidney disease, reflecting disparities in access to nephropathology services. While SGLT2 inhibitors, finerenone, and rituximab have strong trial-level evidence, guideline uptake and affordability vary substantially between high- and low-/middle-income countries.

CONCLUSION

Biopsy-proven renal diseases represent a major cause of chronic kidney disease and remain an important global health challenge. Renal biopsy continues to be the gold standard for establishing a definitive diagnosis, determining disease severity, and guiding individualized treatment [2,3].

International kidney biopsy registries demonstrate substantial regional variation in the distribution of biopsy-proven renal diseases. IgA nephropathy is frequently reported as a predominant primary glomerular disease in several Asian, European, and Oceanian cohorts, whereas FSGS is frequently reported in North American and African cohorts [4, 5]. These differences should be interpreted in the context of genetic, environmental, socioeconomic, healthcare-access, and biopsy-selection factors.

Recent advances in clinical practice guidelines and pharmacotherapy have expanded evidence-based treatment options through optimized supportive care, individualized immunosuppression, and targeted therapies including SGLT2 inhibitors, targeted-release budesonide, sparsentan, finerenone, and selected biologic therapies [13, 16, 17, 18, 19, 23].

Continued research, international collaboration, and precision medicine approaches are expected to further enhance patient care and long-term renal outcomes. Future efforts should focus on expanding biopsy registries, improving access to specialized nephrology services, and developing innovative therapies that reduce disease progression and improve quality of life.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest related to this work.



REFERENCES

1. GBD Chronic Kidney Disease Collaboration. Global, regional, and national burden of chronic kidney disease, 1990–2021. *Lancet*. 2024.
2. Najafian B, Lusco MA, Alpers CE, Fogo AB. Approach to kidney biopsy: Core Curriculum 2022. *Am J Kidney Dis*. 2022; 80 (1):119-131. doi:10.1053/j.ajkd.2021.11.024.
3. Schnuelle P. Renal biopsy for diagnosis in kidney disease: Indication, technique, and safety. *J Clin Med*. 2023; 12 (20):6424. Doi: 10.3390/jcm12206424.
4. O'Shaughnessy MM, Hogan SL, Thompson BD, Coppo R, Fogo AB, Jennette JC. Glomerular disease frequencies by race, sex and region: results from the International Kidney Biopsy Survey. *Nephrol Dial Transplant*. 2018; 33 (4):661-669. doi:10.1093/ndt/gfx189.
5. McGrogan A, Franssen CF, de Vries CS. The incidence of primary glomerulonephritis worldwide: a systematic review of the literature. *Nephrol Dial Transplant*. 2011; 26 (2):414-430. doi:10.1093/ndt/gfq665.
6. Kidney Disease: Improving Global Outcomes (KDIGO) Glomerular Diseases Work Group. KDIGO 2021 Clinical Practice Guideline for the Management of Glomerular Diseases. *Kidney Int*. 2021; 100 (4 Suppl):S1-S276. doi:10.1016/j.kint.2021.05.021.
7. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Int*. 2024; 105 (4 Suppl):S1-S150.
8. Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group. KDIGO 2022 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. *Kidney Int*. 2022; 102 (5 Suppl):S1-S127. doi:10.1016/j.kint.2022.06.008.
9. Trimarchi H, Barratt J, Catran DC, et al. Oxford Classification of IgA nephropathy: update. *Kidney Int*. 2017; 91 (5):1014-1021. doi:10.1016/j.kint.2017.02.003.
10. Goto K, Imaizumi T, Hamada R, et al. Renal pathology in adult and paediatric population of Japan: review of the Japan renal biopsy registry database from 2007 to 2017. *J Nephrol*. 2023; 36 (8):2257-2267. Doi: 10.1007/s40620-023-01687-9.
11. Okpechi IG, Ameh OI, Bello AK, Ronco C, Swanepoel CR, Kengne AP. Epidemiology of histologically proven glomerulonephritis in Africa: a systematic review and meta-analysis. *PLoS One*. 2016; 11 (3):e0152203. doi:10.1371/journal.pone.0152203.
12. D'Agati VD, Fogo AB, Bruijn JA, Jennette JC. Pathologic classification of focal segmental glomerulosclerosis. *Kidney Int*. 2004; 66 (4):1241-1248. doi:10.1111/j.1523-1755.2004.00878.x.
13. Kidney Disease: Improving Global Outcomes (KDIGO) IgAN and IgAV Work Group. KDIGO 2025 Clinical Practice Guideline for the Management of Immunoglobulin A Nephropathy (IgAN) and Immunoglobulin A Vasculitis (IgAV). *Kidney Int*. 2025; 108 (4 Suppl):S1-S71.
14. Lafayette R, Kristensen J, Stone A, et al; NefIgArd trial investigators. Efficacy and safety of a targeted-release formulation of budesonide in patients with primary IgA nephropathy (NefIgArd): 2-year results from a randomised phase 3 trial. *Lancet*. 2023; 402 (10405):859-870. doi:10.1016/S0140-6736 (23)01554-4.
15. Rovin BH, Barratt J, Heerspink HJL, et al; DUPRO Steering Committee and PROTECT Investigators. Efficacy and safety of sparsentan versus irbesartan in patients with IgA nephropathy (PROTECT): 2-year results from a randomised, active-controlled, phase 3 trial. *Lancet*. 2023; 402 (10417):2077-2090. Doi: 10.1016/S0140-6736 (23)02302-4.
16. Kidney Disease: Improving Global Outcomes (KDIGO) Lupus Nephritis Work Group. KDIGO 2024 Clinical Practice Guideline for the Management of Lupus Nephritis. *Kidney Int*. 2024; 105 (1 Suppl):S1-S69. doi:10.1016/j.kint.2023.09.002.
17. Kidney Disease: Improving Global Outcomes (KDIGO) ANCA Vasculitis Work Group. KDIGO



2024 Clinical Practice Guideline for the Management of Antineutrophil Cytoplasmic Antibody (ANCA)–Associated Vasculitis. *Kidney Int.* 2024; 105 (3 Suppl):S71-S116. doi:10.1016/j.kint.2023.10.009.

18. Perkovic V, Jardine MJ, Neal B, et al. Canagliflozin and renal outcomes in type 2 diabetes and nephropathy (CREDENCE Trial). *N Engl J Med.* 2019; 380 (24):2295-2306. Doi: 10.1056/NEJMoa1811744.
19. Heerspink HJL, Stefansson BV, Correa-Rotter R, et al. Dapagliflozin in patients with chronic kidney disease (DAPA-CKD Trial). *N Engl J Med.* 2020; 383 (15):1436-1446. Doi: 10.1056/NEJMoa2024816.
20. Beck LH Jr, Bonegio RGB, Lambeau G, et al. M-type phospholipase A2 receptor as target antigen in idiopathic membranous nephropathy. *N Engl J Med.* 2009; 361 (1):11-21. Doi: 10.1056/NEJMoa0810457.
21. Barbour SJ, Reich HN. Risk stratification of patients with IgA nephropathy. *Am J Kidney Dis.* 2012; 59 (6):865-873. doi:10.1053/j.ajkd.2011.11.028.
22. Barratt J, Rovin BH, Cattran D, et al. Why target the gut to treat IgA nephropathy? *Kidney Int Rep.* 2020; 5 (10):1620-1624. doi:10.1016/j.ekir.2020.07.017.
23. Bakris GL, Agarwal R, Anker SD, et al. Effect of finerenone on chronic kidney disease in type 2 diabetes (FIDELIO-DKD Trial). *N Engl J Med.* 2020; 383 (23):2219-2229. Doi: 10.1056/NEJMoa2025845.
24. Mittal P, Agarwal SK, Singh G, Bhowmik D, Mahajan S, Dinda A, Bagchi S. Spectrum of biopsy-proven renal disease in northern India: a single-centre study. *Nephrology (Carlton).* 2020; 25 (1):55-62. doi:10.1111/nep.13582.
25. Rajapurkar MM, John GT, Kirpalani AL, et al. What do we know about chronic kidney disease in India: first report of the Indian CKD registry. *BMC Nephrol.* 2012; 13:10. doi:10.1186/1471-2369-13-10.

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