

Executive summary for the China Kidney Disease Network (CK-NET) 2017–2018 Annual Data Report



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Chronic kidney disease (CKD) has become a public health issue. Rapid urbanization in China has been intimately linked to shifts in the spectrum of CKD, particularly as regards CKD related to diabetes mellitus. By amalgamating diverse data streams and harnessing cutting-edge technologies, the China Kidney Disease Network aspires to evolve into a comprehensive surveillance framework for kidney diseases in China. The China Kidney Disease Network 2017–2018 Annual Data Report is the fourth nationwide report produced by the China Kidney Disease Network team. Through the analysis of data from 3 large national databases and 4 provincial dialysis quality control centers, this report seeks to provide a robust foundation for understanding the current state of kidney disease in China. Specifically, in addition to providing epidemiological and economic data on CKD and dialysis from 2017 to 2018, hot topics such as environmental pollution and CKD, as well as digital intelligence in nephrology, have been addressed. This report could serve as a valuable resource for researchers, policymakers, and health care professionals alike, inspiring new ideas, fostering collaborations, and ultimately leading to improved outcomes for those affected by kidney diseases.

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Chronic kidney disease (CKD) has become a public health issue.¹ According to a recent study involving 161 countries, the global median prevalence of CKD was 9.5% (interquartile range 5.9%–11.7%) and low- and lower-middle-income countries have substantially diminished the capacity for kidney care delivery.² The findings of the Sixth China Chronic Disease and Risk Factor Surveillance revealed that the prevalence of CKD among the adult population of this country was 8.2% during the period of 2018 to 2019.³ This highlights the burden that CKD imposes as a critical health concern in China, underscoring the need for early screening and management initiatives. Furthermore, the transition from CKD to kidney failure, requiring kidney replacement therapy such as dialysis or kidney transplantation, marks a critical juncture where the disease burden intensifies exponentially.⁴

Rapid urbanization in China has been intimately linked to shifts in the spectrum of CKD, particularly as regards CKD related to diabetes mellitus.⁵ This relationship underscores the intricate interplay between societal transformations, environmental factors, and kidney health. In this context, the necessity of monitoring kidney diseases has been further highlighted. By amalgamating diverse data streams and

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harnessing cutting-edge technologies, the China Kidney Disease Network aspires to evolve into a comprehensive surveillance framework for kidney diseases in China, furnishing invaluable insights into the epidemiology of CKD and fostering efficient disease management strategies.^{6–8}

The China Kidney Disease Network 2017 to 2018 Annual Data Report delves into the intricate landscape of kidney disease, offering a nuanced and data-driven examination of its burden and evolving context in China. This annual data report is the fourth nationwide report produced by the China Kidney Disease Network team, and it stands as a testament to the relentless pursuit of knowledge within the medical and public health sectors, particularly as it pertains to the complex challenges posed by kidney diseases. Specifically, in addition to providing epidemiological and economic data on CKD and kidney failure, we have added several hot topics in nephrology, particularly the impact of environmental pollution and the application of digital technology. Overall, this report aims to illuminate the challenges surrounding CKD, including kidney failure, in China by presenting comprehensive data that shed light on the prevalent trends and dynamics in these disease conditions.

DATA SOURCES AND ANALYTICAL METHODS

For this report, we collected data from 22 provinces, 5 autonomous regions, and 4 municipalities in mainland China (excluding Hong Kong, Macao, and Taiwan). The analyses were performed using 3 large nationwide databases including Hospital Quality Monitoring System (HQMS) database, China Health Insurance Research Association (CHIRA) database, and China Organ Transplant Response System database. In addition, regional data from 4 provincial dialysis quality control centers were provided: Jiangsu, Ningxia, Zhejiang, and Hunan. For this annual data report, the main data period we analyzed was from January 2017 to December 2018. However, because of limitations in the accessibility of the CHIRA database, we provided results only for the year 2017 with regard to the burden on dialysis.

Data sources

HQMS database. The HQMS database is a mandatory national inpatient database system under the authority of the National Health Commission of the People's Republic of China. All tertiary hospitals in China have been requested to submit standardized discharge records to the HQMS on a daily basis since 2013. Chinese tertiary hospitals provide advanced medical care for complex cases and have more specialized departments. Compared with primary and secondary hospitals, they offer a broader range of services and resources. Currently, there are more than 3800 tertiary hospitals in China. Patient-level data were collected from the uniform front page of hospitalization medical records. A total of 353 variables were gathered, including demographic characteristics, diagnoses in the form of *International Classification of Diseases, Tenth Revision* codes, procedures and operations, financial breakdowns, and information on

affiliated hospitals or divisions.⁸ By the end of 2018, the HQMS had covered more than 80% of tertiary hospitals in 31 provinces in mainland China.

CHIRA database. The most common medical insurance scheme in China's urban areas is called Urban Basic Medical Insurance (UBMI). The Urban Resident Basic Medical Insurance and the Urban Employee Basic Medical Insurance are the 2 components of UBMI. The CHIRA database contains data on diagnosis, demographic characteristics, laboratory test frequency, prescription medication use, operation procedures, and medical costs for both inpatients and outpatients at all hospital levels (primary, secondary, and tertiary). A national sample of individuals insured by UBMI was extracted using a 2-stage sampling design, which has been described before.^{7,8} In 2017, there were 9,765,615 sampled beneficiaries in the CHIRA database and their full year of claims information was documented.

China Organ Transplant Response System database. Since September 2013, the allocation of organs in China has become mandatory through the utilization of the China Organ Transplant Response System, a national open and transparent computer system for organ allocation. The process of matching donor organs with recipients takes into account factors such as medical emergencies, waiting list duration, and histocompatibility.⁸ The data on the waiting list for kidney transplantation were provided by the Report on Organ Transplantation Development in China (2015–2018).⁹

Analytical methods

Three sets of *International Classification of Diseases, Tenth Revision* disease codes were used to identify adult patients (age ≥ 18 years) with CKD in tertiary hospitals by using the HQMS database: Beijing version 4.0, National Standard version 1.0, and National Clinical version 1.0.⁸ Codes for procedures and operations were derived from the Beijing version and National Clinical version. Patients with diabetes and CKD were defined as those diagnosed with both diabetes and CKD using the *International Classification of Diseases, Tenth Revision* codes and without other reported causes of CKD.¹⁰ Renal biopsy results were unavailable for the majority of patients. Patients on dialysis therapy were identified on the basis of the service items in medical billings and *International Classification of Diseases, Tenth Revision* codes, specifically categorized as individuals with CKD necessitating dialysis treatment, which includes both hemodialysis (HD) and peritoneal dialysis (PD), while excluding cases of acute kidney diseases and disorders.⁸

Statistical methods encompassed descriptive statistics, including frequency with percentage, median with interquartile range, and mean and SD. The results were predominantly delineated by sex (defined as biological gender), age groups, geographic distribution, comorbidity status, and dialysis modality. The prevalence of dialysis was estimated by multiplying the percentage of patients on dialysis therapy in the sampled data from the CHIRA database with the corresponding UBMI utilization rate.⁴ The prevalence of dialysis,

adjusted for age and sex, was standardized using the direct method with reference to the 2010 national population census data. *P* values were not reported because of the large sample sizes involved.

MAIN FINDINGS OF THE CHINA KIDNEY DISEASE NETWORK 2017 TO 2018 ANNUAL DATA REPORT

Chapter 1: Identification and characteristics of hospitalized patients with CKD

Patients with CKD accounted for 4.95% of all inpatients in 2017 and 4.59% in 2018, with an overall fluctuating trend over the past 5 years.¹¹ The prevalence of CKD was particularly high among people with diabetes and hypertension. In 2017 and 2018, 15.92% and 19.34% of patients with CKD had a diagnostic code for CKD staging. More than half of patients with CKD were 60 years or older, and a male predominance was observed across all age groups. CKD related to diabetes was the leading cause, and its proportion increased slightly in 2018 (28.78%) compared with 2017 (27.14%). The proportion of glomerulonephritis in hospitalized patients with CKD in 2017 and 2018 was 14.27% and 14.70%, respectively. The proportion of other causes of CKD, such as hypertensive nephropathy and obstructive nephropathy, showed slight fluctuations. The spectrum of CKD varied between urban and rural areas. The percentage of interprovince mobility among patients with CKD was 5.53% and 5.66% in 2017 and 2018.

Chapter 2: Cardiovascular disease in hospitalized patients with CKD

In 2018, coronary heart disease was the most common cardiovascular disease (CVD) in patients with CKD (20.20%), followed by heart failure (18.28%), stroke (14.01%), and atrial fibrillation (4.38%). Patients with diabetes-related kidney disease or hypertensive nephropathy had a higher percentage of CVD, followed by chronic tubulointerstitial nephritis and glomerulonephritis. Despite the high burden of CVD in patients with CKD, the percentages of cardiovascular procedures including conventional coronarography, percutaneous coronary intervention, and coronary artery bypass graft were much lower than those among patients without CKD. The percentage of pacemaker implantation among patients with CKD was 1.74% in 2017 and 1.57% in 2018.

Chapter 3: Health care resource utilization in hospitalized patients with CKD

The medical expenditure per person per year was 26,923 renminbi (RMB) (~3988 USD) in 2017 and 27,115 RMB (~4099 USD) in 2018. In patients with CKD, heart failure, and diabetes, medical costs increased significantly. With the increase of age, the hospitalization cost for patients generally showed an upward trend. The length of hospital stay per person per year was 19.22 days in 2017 and 18.59 days in 2018, respectively. The length of hospital stay of patients with CKD was longer than that of those with diabetes and those without CKD, and this trend existed across different subgroups of sex and age.

Chapter 4: In-hospital mortality of patients with CKD

The in-hospital mortality rate in patients with CKD was decreasing, reaching 2.33% and 2.13% in 2017 and 2018, respectively. This rate was higher than that in the overall population of patients with diabetes, irrespective of their concurrent CKD status, and lower than that in the overall population of patients with heart failure, irrespective of whether they had CKD. In 2018, patients covered by free medical care had the highest in-hospital mortality rate (6.55%), followed by those with UBMI (2.43%) and others (2.13%). The in-hospital mortality rate in male patients with CKD was higher than that in female patients, but both showed a decreasing trend over time.

Chapter 5: Acute kidney injury

There were significant regional differences in acute kidney injury (AKI) prevalence among people who stayed in an intensive care unit compared with those without an intensive care unit stay. The percentage of patients with diagnostic coding for AKI was 0.31% in 2017 and 0.30% in 2018. Patients with chronic tubulointerstitial nephritis and glomerulonephritis had higher percentages of AKI. In terms of demographic characteristics of patients with AKI, more than half of them were 60 years or older, in both male and female patients. The percentage of patients with AKI and a diagnosis of CKD was 28.22% in 2017 and 28.12% in 2018. Moreover, the percentage of diabetes among patients with AKI was 17.88% in 2017 and 18.33% in 2018, showing a slight upward trend.

Chapter 6: Identification and characteristics of patients on dialysis

For all prevalent patients on dialysis, HD was the major treatment modality (92.12%). Patients on HD and PD were mainly treated in tertiary hospitals, whereas among patients on PD, the proportion of patients treated in primary hospitals (20.51%) was slightly lower than in those treated in secondary hospitals (24.90%). The age- and sex-adjusted prevalence of HD and PD in 2017 was 384.41 and 34.98 per million population, respectively. Accordingly, it was estimated that the total number of prevalent patients on dialysis in 2017 was 581,273 (HD: 532,791; PD: 48,482). The mortality rates in patients on HD and PD have been reported to be 3.4% and 2.3%, respectively.

Chapter 7: Examinations and treatments of patients on dialysis

The adherence rates to the Kidney Disease: Improving Global Outcomes guidelines for monitoring clinical indicators were as follows: for patients on HD, 26.78% achieved the recommended frequency of hemoglobin testing, 60.77% for ferritin testing, 42.63% for phosphorus testing, and 38.75% for parathyroid hormone testing. In contrast, for patients on PD, the corresponding percentages were 12.14% for hemoglobin, 35.40% for ferritin, 14.66% for phosphorus, and 20.16% for parathyroid hormone. The percentages of patients on HD using erythropoietin, phosphorus binders, and calcitriol were

90.38%, 46.28%, and 54.24%, respectively, whereas for patients on PD, these figures were 88.66%, 56.59%, and 61.40%, respectively. Among patients with diabetes, only 6.45% and 10.65% of patients treated with HD and PD, respectively, underwent an ophthalmologic examination, lipid testing, and hemoglobin A1c testing at least once a year.

Chapter 8: Vascular access

The most common type of vascular access in patients on HD was arteriovenous fistula or arteriovenous graft, which accounted for 71.57% of cases. Regarding arteriovenous fistula or arteriovenous graft, 8.60% of patients on HD in the sample underwent new operations. A total of 16.69% underwent new PD catheter placement procedures, signifying that these individuals were diagnosed as patients on new-onset PD. Patients on stable PD were categorized as those undergoing maintenance PD therapy without the requirement for central venous catheter placement operations, accounting for 98.55% of cases. The rate of PD transfer set exchange in patients on maintenance PD was 34.63%.

Chapter 9: Cardiovascular disease and diabetes in patients on dialysis

Patients undergoing dialysis had a high prevalence of CVD, with a 2017 prevalence rate of 43.01%, which was similar to the 2016 rate of 45.92%.⁸ The 2 most prevalent CVDs among these patients were coronary heart disease and heart failure (37.26% and 14.51%, respectively), with cerebrovascular accident/transient ischemic attack (3.39%), peripheral arterial disease (0.74%), acute myocardial infarction (0.72%), and atrial fibrillation (0.12%) being less common. Diabetes was present in 26.71% of patients on dialysis, and its prevalence among patients on PD (33.33%) was higher than that among patients on HD (25.71%).

Chapter 10: Hospitalization among patients on dialysis

The all-cause hospitalization rate for patients on dialysis in 2017 was 2.42 per person per year. The overall average length of hospital stay of patients on dialysis was 41.88 days; among these patients, women, people 75 years or older, patients with diabetes, and those hospitalized in primary hospitals had a longer length of hospital stay. CVD was the most frequent cause for hospitalizations among patients on HD (33.68%). For hospitalized patients undergoing PD, the proportion of CVD events (28.77%) was slightly higher than that of access events (28.60%). The 30-day readmission rate for patients on dialysis in 2017 was 26.34%, slightly higher than the 24.18% in 2016.⁸ The in-hospital mortality rates in patients on HD and PD were 1.23% and 1.45%, respectively.

Chapter 11: Medical expenditures for patients on dialysis

The direct costs related to dialysis were the primary expenses for both patients on HD and PD (34.29% vs. 32.78%), followed by medication costs (19.15% vs. 20.70%).

The median annual cost per patient for 2017 (82,213 RMB [~12,179 USD]) had decreased compared with 2016 (87,776 RMB [~12,908 USD]).⁸ In contrast to patients on PD, those on HD had higher outpatient expenditures (51,622 RMB [~7645 USD] vs. 56,453 RMB [~8361 USD]); nevertheless, patients on PD had higher inpatient expenditures (46,446 RMB [~6880 USD] vs. 31,186 RMB [~4619 USD]). Medication was the largest expense for patients receiving HD and PD during hospital stays (21.38% vs. 21.44%), whereas direct costs associated with dialysis ranked highest (53.86% vs. 52.69%) among outpatient expenses.

Chapter 12: Regional data from the dialysis registry system

The prevalence and incidence of HD were observed to be the highest in Hunan (730.8 and 195.4 per million population in 2018), whereas the prevalence of PD was the highest in Zhejiang (130.3 per million population in 2018). The highest mortality rate in patients treated with HD was observed in Zhejiang (11.2% in 2017), whereas patients treated with PD had the highest mortality rate in Ningxia (8.3% in 2017). Glomerulonephritis was the leading cause in both incident and prevalent patients on dialysis, followed by diabetes-related kidney disease and hypertensive nephropathy. The percentage of patients on dialysis who achieved the recommended goals for laboratory tests, including hemoglobin; transferrin saturation; serum levels of ferritin, calcium, phosphorus, and intact parathyroid hormone; albumin; and single-pool Kt/V varied greatly among the 4 provinces.

Chapter 13: Kidney transplantation

At the end of 2017 and 2018, there were, respectively, 30,502 and 34,567 candidates on the kidney transplant waiting list (excluding Hong Kong, Macao, and Taiwan).⁹ Since 2015, kidney transplantation from deceased donors has developed rapidly, and the annual number of transplant cases has increased significantly, whereas the number of kidney transplantation procedures from living-related donors has decreased. There were 9040 kidney transplantation procedures from deceased donors and 1753 from living-related donors in 2017 compared with 11,302 and 1727, respectively, in 2018. The number of pediatric kidney transplantation procedures (age < 18 years) was 217 and 273 in 2017 and 2018, respectively, accounting for 2.0% and 2.1% of all kidney transplantation procedures in mainland China.⁹

Chapter 14: Environmental pollution and kidney disease

Environmental pollutants are common causes of kidney disease worldwide, especially in developing countries such as China.¹² Ambient air pollution, especially exposure to particulate matter with an aerodynamic diameter of 2.5 μm or less, has emerged as one of the risk factors for CKD.^{13,14} Urbanization also plays an important role in modifying this relationship.¹⁵ Moreover, climate change poses a serious threat to human health. The temperature increase was reported to be positively associated with increased risks of hospitalizations for CKD.¹⁶ Regulatory efforts and public

health interventions are essential to control environmental pollution and limit individual exposure.

Chapter 15: Future perspectives

In the era of digital transformation, the field of nephrology is undergoing a paradigm shift as digital intelligence permeates every aspect of diagnosis, treatment, and patient management.^{17,18} By leveraging artificial intelligence, big data analytics, and particularly large language models, nephrologists can identify patterns, correlations, and predictive models that would otherwise be impossible to discern manually.^{17,19} Large language models can be fine-tuned to perform specific tasks such as facilitating the extraction of relevant clinical information for diagnostic and prognostic purposes, but it is also crucial to address ethical and regulatory challenges.²⁰

CONCLUSIONS

Despite the interval since our last report due to the coronavirus disease 2019 outbreak, we remain committed to underscoring the resilience and ongoing relevance of leveraging big data analytics in monitoring kidney diseases. The burden of CKD in China is substantial, compounded by low awareness rates, suboptimal management status, and poor long-term outcomes, all of which necessitate urgent reforms. Digital technologies are emerging as an important additional tool to address these challenges. We hope that this report will serve as a valuable resource for researchers, policymakers, and health care professionals alike, inspiring new ideas, fostering collaborations, and ultimately leading to improved outcomes for those affected by kidney diseases.

DISCLOSURE

All the authors declared no competing interests.

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REFERENCES

1. Kalantar-Zadeh K, Jafar TH, Nitsch D, et al. Chronic kidney disease. *Lancet*. 2021;398:786–802.
2. Bello AK, Okpechi IG, Levin A, et al. An update on the global disparities in kidney disease burden and care across world countries and regions. *Lancet Glob Health*. 2024;12:e382–e395.
3. Wang L, Xu X, Zhang M, et al. Prevalence of chronic kidney disease in China: results from the Sixth China Chronic Disease and Risk Factor Surveillance. *JAMA Intern Med*. 2023;183:298–310.
4. Yang C, Yang Z, Wang J, et al. Estimation of prevalence of kidney disease treated with dialysis in China: a study of insurance claims data. *Am J Kidney Dis*. 2021;77:889–897.e1.
5. Zhang L, Long J, Jiang W, et al. Trends in chronic kidney disease in China. *N Engl J Med*. 2016;375:905–906.
6. Zhang L, Wang H, Long J, et al. China Kidney Disease Network (CK-NET) 2014 Annual Data Report. *Am J Kidney Dis*. 2017;69:A4.
7. Zhang L, Zhao M-H, Zuo L, et al. China Kidney Disease Network (CK-NET) 2015 Annual Data Report. *Kidney Int Suppl*. 2019;9:e1–e81.
8. Zhang L, Zhao MH, Zuo L, et al. China Kidney Disease Network (CK-NET) 2016 Annual Data Report. *Kidney Int Suppl*. 2020;10:e97–e185.
9. China Organ Transplantation Development Foundation. Report on Organ Transplantation Development in China (2015–2018). Accessed May 15, 2024. <http://www.cotdf.org.cn/>
10. Afkarian M, Zelnick LR, Hall YN, et al. Clinical manifestations of kidney disease among US adults with diabetes, 1988–2014. *JAMA*. 2016;316:602–610.
11. Yang C, Wang H, Zhao X, et al. CKD in China: evolving spectrum and public health implications. *Am J Kidney Dis*. 2020;76:258–264.
12. Xu X, Nie S, Ding H, Hou FF. Environmental pollution and kidney diseases. *Nat Rev Nephrol*. 2018;14:313–324.
13. Bowe B, Artimovich E, Xie Y, et al. The global and national burden of chronic kidney disease attributable to ambient fine particulate matter air pollution: a modelling study. *BMJ Glob Health*. 2020;5:e002063.
14. Li G, Huang J, Wang J, et al. Long-term exposure to ambient PM_{2.5} and increased risk of CKD prevalence in China. *J Am Soc Nephrol*. 2021;32:448–458.
15. Liang Z, Wang W, Wang Y, et al. Urbanization, ambient air pollution, and prevalence of chronic kidney disease: a nationwide cross-sectional study. *Environ Int*. 2021;156:106752.
16. Wang FL, Wang WZ, Zhang FF, et al. Heat exposure and hospitalizations for chronic kidney disease in China: a nationwide time series study in 261 major Chinese cities. *Mil Med Res*. 2023;10:41.
17. Yang C, Kong G, Wang L, et al. Big data in nephrology: are we ready for the change? *Nephrology*. 2019;24:1097–1102.
18. Zhang L, Wang H, Li Q, et al. Big data and medical research in China. *BMJ*. 2018;360:j5910.
19. Shah NH, Entwistle D, Pfeffer MA. Creation and adoption of large language models in medicine. *JAMA*. 2023;330:866–869.
20. Li H, Moon JT, Purkayastha S, et al. Ethics of large language models in medicine and medical research. *Lancet Digit Health*. 2023;5:e333–e335.