Nephrology Services in Maharashtra

Abstract

Maharashtra is India's third largest, second-most populous state, and its economic and financial hub. Nephrology is a progressive medical specialty in Maharashtra, continuing the legacy of early pioneering ventures from the country. Strong professional networks, state-of-the-art infrastructure, specialized diagnostics, affordable cost models for hemodialysis, easy access and consistent performance in kidney transplantation, state funding, and community involvement are the key strengths of nephrology in Maharashtra. The state has top-tier hospitals and medical colleges, making it a preferred destination for healthcare and medical education. This article describes the current state of nephrology services in Maharashtra.

Keywords: *Hemodialysis, History of nephrology, Interventional nephrology, Kidney transplantation, Maharashtra, MJPJAY*

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Introduction

Maharashtra is the third largest state of India, occupying 307,713 sq. km (9.36%). Maharashtra is home to >10% of India's population (12.67 crores in July 2024), making it the second most populous state of the country. With a projected gross state domestic product (GSDP) of 42.67 trillion rupees (2024-2025), Maharashtra contributes the most (13.3%) to national GDP. Maharashtra has 36 districts and six administrative zones. It is the country's most industrialized and third most urbanized state, with a literacy rate of 82.34% (2011 census) and a high Human Development Index (National Statistical Commission of India).

Burden of kidney diseases in the state

Chronic kidney disease (CKD) is substantially prevalent in South Asia (14%).[1] Maharashtra is estimated to have a high burden of kidney diseases. As per the Indian CKD registry, including 10 centers from different regions of Maharashtra, diabetic nephropathy was the most common cause of CKD (29.3%) in the west zone, followed by CKD of undetermined etiology (15.7%), hypertensive nephrosclerosis (14.4%), and glomerulonephritis (GN) (14.2%).[2] Focal segmental glomerulosclerosis and membranous nephropathy are the most frequently encountered glomerulonephritides.[3]

Maharashtra, especially in the north and east, is known to harbor hotspots of CKD of unknown origin (CKDu), experiencing heat waves from central India. Nineteen of 357 patients from the Yavatmal district were diagnosed with criteria-defined CKDu.[4] The mean age of patients was ~55 years, with a preponderance in men and those engaged in farm labor or outdoor work. Studies from the Buldhana district found elevated cadmium, copper, and lead concentrations in clay soil and drinking water.[5,6] In one study, 18 of 23 recorded deaths were attributable to CKDu.[5] Sporadic news of villages with a high CKDu incidence may hint toward a tip-of-the-iceberg phenomenon.[7] Global warming, regional climate changes, and water scarcity have been implicated in nephrolithiasis.[8,9] Maharashtra is a part of the 'Indian Stone Belt'.[10,11] The state also reports a high burden of acute kidney injury (AKI) in association with tropical fever (malaria, dengue, leptospirosis).[12] Rural areas exhibit high snake bite rates and associated AKI.[13,14] Pregnancy-associated AKI is a frequent occurrence, though specific estimates from the state are lacking.[15] Inherited kidney disorders are prevalent due to endogamous marriage patterns. These constitute specific

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challenges for the state, warranting more clinical work and research.

Hemodialysis in Maharashtra

One study on maintenance hemodialysis (MHD) in 464 patients noted 50% with CKD of undetermined etiology, highlighting a higher burden of non-diabetic kidney disease in causing end-stage-renal-disease.[16] Majority (83%) had temporary dialysis catheters, and 87% had an arterio-venous fistula (AVF) as the current HD access. Hospitalizations occurred in 24% cases (catheter-related sepsis-20%, hypertension -15%), and 6% and 2% were HBsAg and anti-HCV antibody positive, respectively. Mumbai itself caters to an estimated HD population of ~10,000.[17] The 5-year survival of a large urban HD cohort from Mumbai was 61.98% (unpublished data, Apex Kidney Care).

The state currently has >1100 HD centers, majorly private sector. [Table 1]. The state government's Mahatma Jyotirao Phule Jan Aarogya Yojana (MPJAY) has empaneled 665 dialysis centers. They have served 75,576 beneficiaries till May 2024 (Assistant Manager-MIS, MJPJAY: personal communication, May 2024). Coverage has steadily expanded the number of patients availing state funds for HD (22,257 beneficiaries in 2023). A total of 793,131 MHD claims have been utilized to date.[18]

Table 1: Nephrology services and personnel in the state of Maharashtra (as of August 2024)

Nephrology services	Number
HD centers	1126 (5729 HD machines)
KT centers	141
CAPD centers	78
Nephrologists	347
Nephrology training centers	
DM nephrology training	
Government	3
Private	5
DNB nephrology training	
Government	1
Private	12
MUHS* fellowship (Dialysis Medicine, Clinical Nephrology)	2
Pediatric nephrology fellowship	2
MUHS nephropathology fellowship	1
Total capacity of training programs in nephrology	
DM nephrology	19
DNB nephrology	25
MUHS fellowship	8
Pediatric nephrology	5
Diagnostics	
Nephropathology services	15
Electron microscopy for kidney biopsy	3
HLA and tissue-typing laboratory	6
Heavy metal testing	2
Complement laboratory	1

HD: Hemodialysis, CAPD: Chronic ambulatory peritoneal dialysis, DM: Doctorate of Medicine, DNB: Diplomate of National Board, HLA: Human leukocyte antigen, KT: Kidney transplantation, MUHS: Maharashtra University of Health Sciences

Mumbai provides the most affordable HD in the country through innovative setups like many charity-backed and free-standing dialysis units. The current average cost is Rs. 1500 per session (range: Rs. 100 to Rs. 2500).[19] Cost for conducting dialysis for human immunodeficiency virus (HIV)/hepatitis B virus (HBV)/hepatitis C virus (HCV) positive patients varies from Rs. 2500-5000 per session. MHD for hemodiafiltration is offered by >10 private-sector hospitals from major cities in the state. Home HD services have been operational since 2008, with ~650 patients having used this modality till date (currently ~100 in Mumbai, Pune, and Nashik). The cost per session is Rs. 4000.

Peritoneal dialysis

Maharashtra offers CAPD services in ~78 centers [Figure 1], accounting for 6-7% of prevalent CAPD patients in the country. There has been a 63.6% growth in the number of patients initiated on CAPD in the past decade (337 patients in 2023 vs 206 patients in 2013: industry data). Chiefly through out-of-pocket expenditure (OPEs), the running cost for CAPD and automated PD is approximately Rs. 30,000 and Rs. 65,000 per month, respectively. Beneficiaries of the Central Government Health Scheme (CGHS), Employee's State Insurance Scheme (ESIS), and Defense Personnel can access CAPD free of cost. CAPD fluid expenses are covered in public hospitals of Mumbai through the Brihanmumbai Municipal Corporation. More recently, the new revised MJPJAY has covered CAPD under a package of Rs. 35,000 per month. This is expected to positively affect CAPD use. Cost barriers, sparse catheter insertion services, and trained persons (CAPD nurse/technician) unavailability, especially in interior regions, are the chief challenges in successfully maintaining this modality in the state.

Kidney transplantation

The state currently has 141/ approved centers for KT in India [Figure 1],[20] increased ~3.5 fold from 42 centers in 2013. Till May 2024, 7654 live-related and 1720 deceased-donor KTs had been performed in the state (data courtesy: ROTTO-SOTTO, Western region, and Maharashtra). The state also has facilities for combined kidney-liver/kidney-heart transplants, and 39 kidney-pancreas transplants have been performed to date since 2016. Mumbai has pioneered the establishment of living-donor paired exchange registries [ASTRA, Apex kidney care: for blood group incompatible pairs, and SORTER, ATDI Labs Mumbai: for Human Leucocyte Antigen (HLA) sensitized recipients]. AIIMS, Nagpur, performed central India's 1st Donation after Cardiac Death KT in December 2023.

KT expenses are universally covered under MJPJAY, backed by the Prime Minister (PM) fund, Chief Minister fund, and other

Figure 1: Centers of kidney transplantation (approved by NOTTO) and centers offering CAPD services in Maharashtra. CAPD: Chronic ambulatory peritoneal dialysis, NOTTO: National organ and tissue transplant organization.

charitable initiatives. Emergence of KT centers, improved laboratory facilities, faster legal approvals (1-2 weeks for live-related and 1-3 months for swap KTs depending on whether the pair is within- or inter-state), strengthening of zonal transplant coordination centers (ZTCCs), establishment of green corridors and improved public awareness have played a big role in improved transplantation services in the state. Non-governmental organizations (NGOs) in Mumbai conduct activities like Organ Donor Day (since 1997) and National Transplant Games (since 2008) to promote organ donation. Since introducing an online donor registration facility, Maharashtra has been one of the leading states for organ donation pledges.

Interventional Nephrology

Interventional Nephrology is slowly emerging as an integral part of care for patients suffering from kidney diseases. All nephrologists across Maharashtra perform HD catheter placements (non-tunneled/tunneled) and ultrasound-guided kidney biopsies. PD catheter placement (open surgical or laparoscopic) is predominantly done by surgeons (~75% of centers), while nephrologists themselves perform percutaneous placement (~25% of

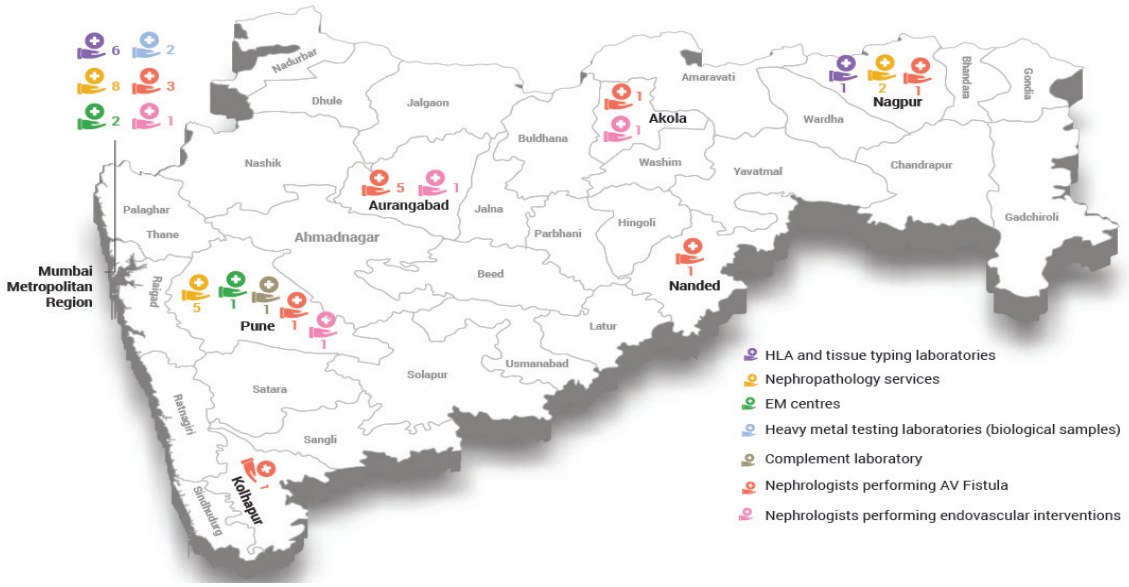

Figure 2: Specialized services related to Nephrology in Maharashtra. EM: Electron microscopy, HLA: Human leucocyte antigen, AV: Arterio-venous.

centers). AVF surgeries, including complex procedures like superficialization, transposition, and prosthetic AVF (AV graft), are performed by >10 nephrologists, most from the Marathwada region. Endovascular AVF interventions (surgical or percutaneous salvage) are largely performed by radiologists or cardiologists [Figure 2].

Diagnostic services

The state has seven HLA and tissue-typing laboratories [Figure 2, Supplementary material]. Low turn-around-time, improved immunological risk assessment, and allograft function monitoring have proved valuable, especially in deceased-donor KTs. Mumbai houses the only laboratory processing complement-binding HLA and non-HLA antibodies in the country. Fifteen centers offer nephropathology services, including three equipped with electron microscopy. Since 2015, the state has a unique complement testing laboratory in Pune, primarily dedicated to kidney diseases. Facilities for heavy metal screening (blood, urine and kidney-tissue) are available in Mumbai. Commercial and public hospital-based nuclear scans are available in major cities across the state.

Acute and chronic kidney care

The practice of critical-care nephrology is advancing throughout the state. Continuous renal replacement therapy (CRRT)/Sustained low-efficiency dialysis for AKI in the critically ill, advanced organ support-Ventricular Assist Device, Extracorporeal Membrane Oxygenation, plasmapheresis, and hemoperfusion facilities are available in major cities. Notably, few dedicated centers also offer these facilities to pediatric patients. Acute PD is utilized for AKI, especially in neonatal and pediatric age groups and those ineligible for HD. Preventive CKD care is integrated into outpatient clinics at health posts in municipal hospitals of Mumbai and focuses on the management of diabetes and hypertension.

Nephrology Education

The state has 21 training institutes for nephrology, pediatric nephrology, and nephropathology [Figure 3, Supplementary material]. Accredited training courses and continued medical education programs are regularly conducted for renal dieticians and dialysis technicians (including one for pediatric dialysis). Regional societies (Mumbai Nephrology Group, Pune branch of Indian Society of Nephrology (ISN), and the Nephrology Society, Central India) conduct monthly educational meetings. 'ApEx Pathshala-the Nephrology Board Review Course' and 'Dialysis beyond text-books' are popular annual educational meetings.

Policy initiatives

MJPJAY, operational since July 2012, is the flagship health insurance scheme of the State Government. Since April 2020, MJPJAY has been integrated (60:40) with the Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana [Table 2]. The most recent revision (July 2024) is a significant step towards rolling out universal healthcare, making Maharashtra one of the few states moving rapidly toward achieving this objective. MJPJAY 2.0 expands the number of covered medical procedures from 996 to 1356 and

Figure 3: Training centers for Nephrology and Nephropathology in Maharashtra, number (capacity). DM: Doctorate of medicine, DNB: Diplomate of national board, MUHS: Maharashtra university of health sciences.

Table 2: Utilization of services of Ayushman Bharat-Mahatma Jyotiba Phule Jan Arogya Yojana (AB-MJPJAY) for 2023-2024

MJPJAY beneficiaries	No. of patients availing service (till 28/05/2024)
Total no. of dialysis centers providing dialysis through MJPJAY in Maharashtra (May 2024)	665
Total no. of HD patients till May 2024	75576
Total no. of HD patients in the year 2023	22257
Total no. of KTR till May 2024	1671
Total no. of KTR in the year 2023	150
Total no. of patients under MJPJAY coverage for any kidney disease in Maharashtra in the year 2023	39332
Total no. of utilizations in 2023 for the following codes-(M15W1.19, M8T2.2, M8T2.3, M8T2.4, M8T2.5, M8T2.6, M6PM1.4, M6S12.3, M6S12.4)	93006

HD: Hemodialysis, KTR- Kidney transplant recipients

impaneled hospitals from 1000 to 1900. The inclusion of more nephrology-specific codes (for, e.g. CAPD, AVF) and increased cost-coverage (for, e.g. total package for KT) are promising developments [Table 3]. Maharashtra State Road Traffic Corporation offers free travel to patients traveling for dialysis and KT consultations.

Community involvement

Many dedicated NGOs and patient groups work toward the welfare of patients with kidney disease and conduct exemplary advocacy and support activities [Supplementary material]. Apart from providing a social platform, raising awareness, and extending financial aid, they partake in the training of paramedical staff (dialysis technicians, nurses, and dieticians). Notably, a CAPD outreach program was conducted in 33 districts by an NGO focusing on children with kidney diseases. Funding from charitable institutions

Table 3: Integrated Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana-Mahatma Jyotiba Phule Jan Arogya Yojana packages for procedures related to nephrology (July 2024 revision).

Specialty name	Name of the procedure	100% package amount (INR)
Nephrology	NS	20000
Nephrology	Resistant nephrotic syndrome	20000
Nephrology	RPRF	35000
Nephrology	Acute renal failure	40000
Nephrology	Chronic renal failure (initial treatment, dialysis, and supportive therapy)	20000
Nephrology	AVF at elbow or wrist (Day care)	20000
Nephrology	MHD for chronic renal failure (12 dialysis per 28 days or, as advised, Rs. 1300/- per dialysis including erythropoietin and iron)	23400
Nephrology	CAPD	35000
Nephrology	CRRT	100000
Nephrology	Plasmapheresis	40000
Nephrology/Neurology	Immunoglobulin therapy	200000
Nephrology	Pyelonephritis	20000
Nephrology/Pediatrics	Acute renal failure (without dialysis)	15000
Nephrology/Pediatrics	Acute renal failure (with dialysis/PICU stay)	56000
Urology	KT	310000
Nephrology	Post-transplant immunosuppression (first 6 months)	50000
Nephrology	Post-transplant immunosuppression (second 6 months to be continued further as per advice of nephrologist)	50000
Neonatal & Pediatric	Acute GN	10000
Neonatal & Pediatric	Steroid-resistant NS	35000
Interventional Radiology	Permanent tunneled catheter insertion	40000
Interventional Radiology	Endovascular intervention for salvaging AVF	120000
Interventional Radiology	Peripheral stent graft for AVF	150000
Interventional Radiology	Renal artery embolization with coils and microcatheter	100000
Interventional Radiology	Central venous balloon plasty for central venous occlusion	70000
Interventional Radiology	Central venous stenting for central venous occlusion	125000

NS: Nephrotic syndrome, RPRF: Rapidly progressive renal failure, AVF: Arterio-venous fistula, MHD: Maintenance hemodialysis, CAPD: Chronic ambulatory peritoneal dialysis, CRRT: Continuous renal replacement therapy, KT: Kidney transplantation, GN: Glomerulonephritis.

76 procedure codes under Urology for surgical treatment of diseases of kidney and the urinary tract.

22 procedure codes under Pediatric surgery for urogenital surgeries including congenital disorders and pediatric tumors.

Other utilizable codes-parathyroidectomy (ENT), Rituximab treatment for nephrological indication (General medicine), Vasculitis, including kidney biopsy (Rheumatology), Renal angioplasty (Cardiology).

and other public-private partnership initiatives has made HD affordable to the under-resourced.

History and timelines

Maharashtra has many firsts to its credit, thanks to the vision and lifework of the 'Iron Lady' Dr. Vidya N. Acharya, Mother of Indian Nephrology. KEM Hospital, Mumbai. She acquired the first dialysis machine- an Alwall's dialyzer donated to the Department of Medicine by the Swedish philanthropist Mr. Alex Johnson in 1962 [Figure 4].[21] The unit performed its first HD session on May 31st, 1963, and until 1971, was one of the only four institutes in the country operating an HD unit.[22] As KT was making great strides globally, the KEMH team, under urologist Dr. Karanjawala and cardiothoracic surgeon Dr. P.K. Sen, whose team was experimenting on liver, heart, and kidney transplants in dogs through the 1950s, performed the first two deceased-donor KTs ever in India in 1965.[23] The first live-donor KT took place in March 1974. Other hospitals soon followed suit. Jaslok Hospital, Mumbai was the first multispecialty hospital in India and pioneered various organ transplant activities. In 1977, Dr. Samuel Kountz and Dr. TK Sreepada Rao from Downstate Medical Centre, Brooklyn, flew two cadaver kidneys from New York to be transplanted into two patients with ESRD at Jaslok Hospital.[24] Dr. VN Acharya was instrumental in drafting and getting the Transplantation of Human Organs and Tissues Act (THOA) passed in Parliament, a landmark that changed the face of organ transplantation in India. ZTCC, Mumbai, established in 2000, was the first center for coordinating organ transplant activities. The standard operating procedures laid down by ZTCC were subsequently adopted by many states.

Figure 4: Senior dialysis technician Mr. Claude Lobo, Dr. Carl Kjellstrand, Dr. P. Raghavan, Dr. Vidya Acharya photographed in the Nephrology Department Museum in 1987, standing alongside the Nils Alwall's Rotating Drum Kidney, donated to KEM Hospital, Mumbai in 1962.

KEM Hospital, Mumbai, was one of the first in the country to set up acute PD in 1960s, employing in-house catheters and pharmacy-compounded dialysate. CAPD came into practice once PD connectology became commercially available throughout the country in the 1990s. The earliest use of CRRT in the state dates back to the late 1990s, with innovative use of circuitry at Bombay Hospital, Mumbai, and KEM Hospital, Pune. KEM Hospital, Pune, set up one of the first endotoxin laboratories in the country in 2004 to ensure water quality in HD.

Dr. VN Acharya was a pioneer, researcher, teacher, and global leader. She was a founding member of various national nephrology societies-*Indian Society of Nephrology* (founded in Mumbai in 1970), *Indian Society of Organ Transplantation*, and *Hypertension Society of India*. She was elemental in starting the first accredited postgraduate courses of DNB Nephrology (1977) and DM Nephrology (1986) at KEM Hospital, Mumbai. Dr. MV Divekar and Dr. VV Shanbag headed the nephrology departments at Lokmanya Tilak Municipal General Hospital, Sion, and BYL Nair Charitable Hospital, respectively. In 1976, Dr. Kumud P. Mehta started one of the country's first pediatric nephrology subspecialty programs at BJ Wadia Children's Hospital, Mumbai. Dr. Balswarup S. Choubey (Vidarbha), Dr. Farrokh F. Wadia (Pune) were contemporary stalwarts who propelled nephrology in other regions of Maharashtra, followed by Dr. Prashant P. Pargaonkar (Marathwada), Dr. Devdutta Chafekar (Nashik) and others.

Challenges and future directions

Government health expenditure is comparatively lower than GSDP.[25] The state allocates 4.6% of total expenditure towards health and family welfare, lower than other states.[26] The state has the least number of government hospitals per lakh population compared to the national average (0.4 vs 2.6). The state has curtailed its expenditure on state-sponsored health schemes in 2024-2025, which is concerning.[27] Increasing privatization of healthcare coupled with lack of family insurance accounts for higher OPEs.[26] Catastrophic health expenditure is remarkably high, though kidney-specific estimates are lacking.[26] Outside public health schemes, the majority deem KRT non-affordable.

Inter-regional differences

Regional imbalances are a striking feature of healthcare in the state, and nephrology services are no exception.

Though well-developed in major cities, strengthening care delivery in interiors is a prime need. Most district hospitals have dialysis centers; however, many lack full-time nephrologists. Laboratory support for routine screening/monitoring activities and specialized investigations (kidney biopsy and immunological work-up) is less available. More nephrologists need to be be trained for independent interventional nephrology work, especially for procedures of immediate utility like vascular access creation and salvage. Facilitating organ transplant networks, state-wide registries for CKD, GN, dialysis, and KT, systematic audits for quality of delivered dialysis, supply chains, cost-effectiveness, and periodic competency training for healthcare professionals in all tiers of nephrology practice are areas requiring advanced initiatives.

Modern-day achievements

With good professional networks, state-of-the-art infrastructure, affordable HD, and easy access to KT, Maharashtra remains a hub for medical tourism in nephrology. Unique cost-saving models for HD are a boon for under-privileged patients. 'Project Victory' (an innovative citywide dashboard) is a laudable example of concerted work between public and private hospitals that enormously simplified the challenging task of dialyzing ~10000 patients impacted by the pandemic in Greater Mumbai.[17] Third, for the number of KTs in the country, transplantation in the state benefits from expanded state coverage, the availability of specialized diagnostics, community funding, and participation. Maharashtra hosts many top-tier coveted medical colleges, affording excellent educational opportunities across higher specialties. Focus on scientific research is increasing with higher participation in clinical trials, ongoing cohort studies (dialysis, nephrotic syndrome, aHUS, renal tubular disease), and registries (VN Acharya Glomerulonephritis Registry, IPNA ISN KRT registry). The state is also expanding the spectrum of services to newer areas like kidney-centered palliative-care, telemedicine, and integrated nephrology practice (onco-nephrology, critical-care nephrology).

Concluding remarks

Despite challenges, Maharashtra is making consistent strides towards advancing nephrology. There is a pressing need to tap the potential of current growth, existing socio-economic resources, and progressive stature of the state for the larger benefit of patients with kidney disease.

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