DOCTOR OF MEDICINE (DM)NEPHROLOGY CURRICULUM

COMPETENCY-BASEDPOSTGRADUATE TRAINING PROGRAMME FOR DOCTOR OF MEDICINE (DM) IN NEPHROLOGY

Department of Nephrology

Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow

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PRIORITY AREA IN CURRICULUM

Please enumerate/briefly describe the issues/diseases/health conditions (as many as you wish to) in your Program Course which you consider are the matter of prime focus at local (state), national, regional (South East Asia or Asia), or international levels.

Local level	1. **Kidney stone diseases** is a common health problem in Uttar Pradesh, particularly in the sub-Himalayan belt of Uttar Pradesh, and is an important preventable cause of chronic kidney diseases (CKD). 2. **Transplant-related immunological workup** to find suitable donor and management for kidney transplant recipients, the only centre in the state with these facilities. 3. **Acute kidney injury (AKI)** caused by acute gastroenteritisand heat stroke are **very common in Uttar Pradesh.** 4. **Tropical illness** such as dengue, malaria, kala-azar, filaria etc. which are prevalent in Uttar Pradesh and nearby stateare importantcause of kidney diseases such as AKI, CKD, glomerular diseases. 5. **Toxic AKI** after fish gall bladder ingestion, snake envenomation and bee stingarehighly prevalentin the state. 6. Strengtheningof **living and deceased donor kidney transplantprogram** in Uttar Pradesh. 7. Only center with structured **Peritoneal Dialysis Program** in the state.
National level	1. **Over-the-counter medication and alternative medication** are important cause of AKI and CKD in India. 2. **Topical AKI** caused by heat stroke, malaria, dengue, Leptospira and typhus is a common kidney health problem in India. 3. **AKI after complicated pregnancy**is common in India. 4. **Hospital-acquired AKI**among patients undergoing emergency surgery and sepsis are important causes. 5. **Diabetic kidney diseases (DKD)**- India is the capital of DM and almost 50% of CKD is related to DM. 6. Glomerular diseases such as **IgA nephropathy** are more common in India and is one of the most common glomerular causing CKD. 7. **Anemia and malnutrition** are highly prevalent among patients with CKD in India. 8. **Economic status and gender bias** in kidney donation (majority of donors are female), and renal transplant recipients (majority of recipients are male) and access to health care among CKD (Male>Female, Rich>Poor).

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Regional level	1. Leptospirosis, typhus, and envenomation are the main causes of AKI in South Asia. 2. Snake envenomation and Toxin induced AKI 3. Diabetic kidney disease is an important cause of CKD in South Asia.
Global level	1. **Chronic kidney disease** (Globally, one in every 10 patient is suffering from CKD) 2. AKI is common among patients with **polytrauma and critically sick patients** admitted to ICU. 3. **Hospital acquired AKI** – Contrast-induced AKI among those going for coronary angiography and drug-induced AKI. 4. AKI related to chronic liver diseases, cardiac diseases and cardiac interventions. 5. Nephrotic, nephritic syndrome and rapidly progressive renal failure need early diagnosis and management so that it can be reversedor slow down the progression to CKD. 6. Autoimmune conditions such as – SLE, Sjögren's syndrome, sarcoidosis and etc. are important cause of kidney disease. 7. AKI in cancer patients – it may be related to malignancy itself or its medication 8. Dyselectrolytemia is common among elderly patients and patients undergoing neurosurgical interventions.

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Program outcome

Kidney disease has been described as the most neglected chronic disease. The prevalence of chronic kidney disease (CKD) is rising in India. Currently, it affects one in every 10 people, and diabetes mellitus (DM) is the leading cause of CKD. It is also a major cause of economic burden to an individual and country and an important determinant of morbidity and mortality in an individual. Other than CKD, important kidney ailments are hypertension, renovascular diseases, acute kidney diseases (AKI), nephrotic syndrome, nephritic syndrome and rapidly progressive renal diseases, Urinary Tract infections, CAKUT (congenital abnormalities of the kidney and urinary tract) are needed to be addressed.The DM Nephrologyprogram is aimed at traininga physician in the specialized field of nephrologyencompassing the entire spectrum of kidney diseases.

1. The trainee shall acquire skills in various aspects of theoretical, clinical and practical realms of Nephrology and enable the DM student to offer skill-based diagnostic, curative and preventive care of the highest professional standards.

2. The knowledge and attitudes imparted during the program shall enable the DM student to work as an independent clinician, teacher and researcher who is well-versedindiagnostic and therapeutic acumen and research methodologies pertaining to Nephrology.

3. Such extensive training shall cater to the healthcare needs of patients of different kidney diseases at the **local, regional and national levels and help deliver quality care of international standards to our population.**

A postgraduate student pursuing DM (Nephrology) course will acquire **adequate knowledgerelated to**

(a) Basic Sciences as applied to Nephrology so that the student is at par with national and international counterpartsto help acquire a focused and knowledge-based understanding of the common and rare clinical diseases related to different aspects of Nephrology.

(b) Clinical, experimental, investigative and management issues applied to non-surgical and surgical aspects of Nephrology to gain comprehensive proficiency related to etiopathogenesis, anatomy, physiology, and the diverse clinical spectrum of acquired and congenital kidney diseases. Thefamiliarity with local

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prevalent disease trends and management practices shall help the DM Nephrologytrainees **serve their region, state, and country** in a need-based and cost-effective manner.

(c) Awareness about recent advances in the fieldof Nephrology with up-to-date skills and knowledge to apply skill-based intellectual decision-based management algorithms to benefit **the region, state, and country.**

(d) Contribute to the field of Nephrology by imparting training to colleagues, teaching future students, and getting involved in research and patient care.

EligibilityRequirements

StudentswhohavecompletedMD/**DNB**inGeneralMedicine/**Paediatrics**areeligible forDMin Nephrology. (As per NMC norm)

SUBJECT-SPECIFICLEARNINGOBJECTIVES

During the DM program of Nephrology, a student willacquire:

a. Clinical,diagnostic, analytical, self-directed motivational learning with procedural and therapeutic skills required in the care of patients with the full spectrum of kidney diseases, especially acute kidney injury, chronic kidney disease, rapidly progressive renal failure, hypertension, renovascular disease, urinary tract infections, renal replacement therapy, renal transplant & transplant immunology, critical care nephrology and interventional nephrology which are **prevalent in the region, state and country.**

b. Have comprehensive knowledge and skills in the areas of basic, clinical and translationalnephrology to understand the disease burden, epidemiology, patho-physiology and key determinants of kidney disease in the **region, state and country.**

c. **Develop mentorship, leadership and networking skills** to help teach, train and impart clinical and research skills to future nephrologists in the state and country

d. Acquire skills to establish an effective communication network with the patients, patients' relatives, health administration, policymakers, common public, community leaders, peers of medical fraternity and academicians in the field of nephrology and allied fields.

e. **Demonstrate a detailed and comprehensive**understanding about the epidemiology, pathophysiology, cellular and molecular pathology, diagnostic, management and preventive aspects of various diseases related to the entire spectrum of the genitourinary system in children and

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adults.

f. **Along with clinical Nephrology, should have skills in** formulating research questions, planning, initiating and conducting translational, clinical and epidemiologic research that **prioritizes thrust areas of nephrology at** institutional, state, national and international levels.

g. Should network to set up collaborative workforces at various levels to enhance the **research milieu of the country with a special focus on** easing access to therapy, lowering the cost of treatment modalities, novel indigenous modes of treatment and prevention aspects of different kidney diseases.

h. Demonstrate compassion for patients and their families and have anethical and holistic approach to them to help deliver evidence-based, respectful ethical care to the patients.

The student is expected to gain knowledge in the following FOUR key areas:

A. TheoreticalKnowledge:

i. The student will acquire knowledge in all aspects pertaining to the practice of nephrology with a focus on the burden of hypertension, renovascular diseases, chronic kidney diseases, acute kidney injury (AKI), nephrotic syndrome, nephritic syndrome, vasculitis, connective tissue disease-associated kidney diseases and rapidly progressive renal diseases **in the region, state and country.** This shall involve teaching and training to enable the DM Nephrology student to provide specialist care to the citizens of the country. In addition to clinical **training,** research **skills shall also be prioritized so that the DM Nephrology trainee gets the skills to** set up collaborative networking at institutional, state, national and global levels to **add to the research milieu of the country.**

j. The DM trainee shall acquire up-to-date knowledge, skills and attitudes in clinical cardiology to understand the disease burden, epidemiology, patho-physiology and key determinants of renal diseases in the **region, state and country.**

k. Shall be able to make patient-centric decisions based on the latest scientific advances in nephrology after rationally examining available data and apply these ethically in a **cost-effective manner tailored to the needs of the patients of the region, state, and country.**

l. Shall be well versed not only with **diagnostic and therapeutic modalities related to pharmacological and non-pharmacological management, interventions, cutting-edge research and their application to** diverse aspects of nephrology but shall also be trained in disease patterns, distributions, epidemiological burden and preventive aspects of nephrology.

B. Teaching skill

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a. The student will beabletoteach diverse aspectsofkidney diseasestoother residentdoctors,junior colleagues, nursing and para-medical staff to enhance **the skills of the work force at local level.**

b. Shall develop mentorship and leadership qualities to help teach, train and impart clinical and research skills to future nephrologists in the **state and country**

C. **Research methodology**

a. Shall have the skills to recognize knowledge gaps **and unmet areas of need relevant to kidney diseases of the local community.**

b. To seek solutions to such areas of unmet clinical need, should be conversant with principles of research as applied to contemporary renal disease spectrum **prevailing in the local community, state or country.**

c. Shall be trained to formulate, write and conduct research proposal using appropriate methodologies related to nephrology in accordance with ethical guidelines

d. Shall have the skills to promote inter-institutional research and help train and guide those who wish to undertake pursue research

D. **Group approach**

a. During the academic training, the students will be part of multi-disciplinary meetings with specialists in Urology, Pathology, Radiology, Nuclear Medicine departments and allied clinical disciplines.

b. This will help them to understand the concept of the kidney-team approach that seeks a multi-disciplinary approach in patient care. Inputs and insights gained during such interactions shall help in knowledge and skill building and is likely to improve patient outcomes of the **region, state and country**.

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SUBJECTSPECIFICCOMPETENCIES

At the end of the course, the DM student will acquire the following competencies under the following three domains:

(A) Cognitive domain (Knowledge domain)

By the end of the course, the DM student should:

1. Have the ability to have a complete understanding about the etiopathogenesis, diagnostic techniques, management issues, epidemiological and preventive aspects of different kidney diseases of children and adults with special focus on prevalent clinical problems in the **region, state and country**. These include **hypertension, renovascular diseases, acute kidney diseases (AKI), nephrotic syndrome, nephritic syndrome, urinary tract infections, CAKUT, rapidly progressive renal diseases, chronic kidney diseases and renal calculus disease, dialysis (hemodialysis and peritoneal dialysis), Plasmapheresis, continuous renal replacement therapies (CRRT) and renal transplantation and transplant immunology, intervention nephrology, renal nutrition and critical care nephrology.**
2. Have a comprehensive awareness of normal processes that govern the renal physiology and how they get impaired in disease states.
3. Demonstrate knowledge and expertise in relation to the clinical course, adverse effects, and short-term and long-term complications processes involved in different diseases of the kidney and urinary tract so as to identify these in an early and timely manner.
4. Have the skills to plan and order suitable investigations that are applicable for diagnosis and management in a cost-effectivemanner suitable to the needs of the **people of the region, state and country.**
5. Ability to correctly analyze and interprettheresultsofvariousroutineand other specialized investigations so that appropriate therapeutic strategies can be applied for the proper management of patients with kidney diseases.
6. The DM nephrology trainee should be able to sensibly and logically prioritize the investigations and treatment modalities for resource-limited situations commensurate with the requirements of **the state or country so as to provide the best possible treatment in all situations.**
7. Be aware of different guidelines of various national and international associations and their applications tailor-made to suit the local needs of patients.
8. Should be conversant with the recent advances inscience related to diagnostic and therapeutic techniques, novel drugs, and otherkey research areas and their application tonephrology that may continuously change and evolve over time.

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9. Have the ability to rationally analyze scientific data and apply to the needs of the **local populace of the state and country.**
10. Have a working understanding of biostatistics to enable balanced evaluation and analysis of literature.
11. Demonstrate competence in basic concepts of research design, methodology, clinical epidemiology and preventive issues of various kidney diseases.
12. Should have the skills to conceptualize, write and conduct research proposal keeping in mind all ethical principlesespecially with context to Indian beliefs and customs,related to disease of the genitourinary system focusing on indigenous needs of **local, regional, and national health priority.**
13. Work towards helping establish **low-cost diagnostic and treatment and rehabilitation-relatedalgorithms that can bring down the cost of management of kidney diseases in the country.**
14. Should have the ability to establisharesearchlaboratory, if required, even in remote areas of the region.
15. Should be able to identify, prioritize and manage **nephrology emergencies**, common as well as rare, that are **prevalent in the region or state** and take judicious decisions regarding urgent hospitalization to expedite care and/or othersuper-speciality referral, as required.
16. Haveabasicunderstanding of digital applications in nephrology and use of Artificial intelligence and machine learning.

(B) Affective domain (Attitudes including Communication and Professionalism)

1. Demonstrate kindness, empathy and compassion towards all patients and their families
2. Treat all patients in a holistic manner.
3. Respect the patient's right to information and a second opinion.
4. Communicate well with patients and make all efforts to explain the rationale of the diagnostic and treatment approach to patients and their caregivers in their own language for ease of understanding.
5. Spend time with patients explaining to them with thoughtfulness and empathy the pros and cons of all options and further courses of action.
6. Have the skills to participate in seminars, Continued Medical Education programs, panel discussions, and lectures to discuss and review recent scientific data to **further the cause of nephrology in the country and increase visibility on national and global platforms.**
7. Should have the ability to pass on such information and knowledge gained to other students and colleagues, especially those working in resource-limited settings **to improve nephrology care of the region, state, and country.**
8. Should actively cultivate skills to work in a team, with mutual respect, basic human courtesy and a supportive attitude towards others,including other

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clinicians, para-clinical staff, policymakersand health administrators to improve nephrology services **at a regional, state and national level**.

9. Communicate openly and honestly with all patients and their caregivers, hospital administrators, regulatory authorities, peers and researchers of the nephrology fraternity and other allied members of the public and community leaders.
10. Develop a habit of maintaininghonest, detailed and comprehensive medical records.
11. Maintain principles of etiquette and abide by the country's laws, adopting ethical practices at all times.
12. Be aware of ethical principles of clinical research as guided by institutional ethical committees.
13. Should demonstrate principles of equality when dealing with individuals of special groups.
14. Should be able to accept feedback and criticisms with an open mind.
15. As a skilled professional, be aware of the value of maintaining punctuality in clinical work.

(C) Psychomotor domain

At the end of the course, the student should have acquired following skills:

1. Skills to appropriately investigate and correctly and ethically manage all types of kidney diseases.
2. Plan and order the required investigations for patients in a cost-effective manner tailored to the individual needs of the patients.
3. Be able to analyze correctly the results of all frequently used as well as specialized investigations necessary in nephrology practice, including routine biochemistry, biomarkers, serological tests, ECG and basics genetic sequencing as required on a case-to-case basis.
4. After having performed under supervision during DM training, should be able to demonstrate requisite skills and confidence in:
    a. **USG-guided kidney biopsy**
    b. **USGand C-arm guidedplacement of temporary andtunneled catheters for acute and chronic hemodialysis**
    c. **Making vascular access for dialysis therapieslike arterio-venous fistula and graftformation**
    d. **Vascular accessmonitoring and surveillance**
    e. **Peritoneal dialysis catheter insertion in acute and chronic settings.**
    f. Perform and interpret angiography/venography and angioplasty/venoplasty of arteriovenous fistula, arteriovenous graft,central neck vessels and renal vessels.
    g. Interpret nuclear scans, computed tomography (CT) scan and Magnetic resonance imaging (MRI)related to kidney diseases and that a nephrologist used to face on routine life.
    h. Interpret intravenous urography, uroflowmetry, micturating

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cystourethrograms (MCU) and cystometrogram (CMG)

i. **Hemodialysis, peritoneal dialysis, hemodiafiltration, plasmapheresis and all modalities of CRRT (continuous renal replacement therapies)**

5. Have a basic understanding about the functioning of different equipment in routine use in the hemodialysis, peritoneal dialysis, distal subtraction angiography labs and minor operation theater and knowledge about how to reduce their maintenance cost for the institution.
6. Have knowledge about nephrology and its digital applications and fundamentals of the use of artificial intelligence, machine learning and wearables in nephrology.

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Syllabus

Applied Anatomy

- Anatomy of kidney, ureters, bladder, prostate and urethra
- Structural and functional relationships
- Embryology, Structural malformations & developmental anomalies.
- Structure of Nephron
- Histology of kidney
- Renal blood flow
- Anatomy of Peritoneum,including concept of abdominal hernias and intraabdominal pressure
- Anatomy Of the Vascular System
    - Upper Limb Vessels - Course, Distribution, Branches, Origin & Abnormalities
    - Neck Vessels - Course, Distribution, Branches, Origin & Abnormalities
    - Femoral Vessels - Course, Distribution, Branches, Origin & Abnormalities

Applied physiology

- Physiology of body fluids
- Acid-base and electrolyte Physiology
- Physiology of renal circulation
- Glomerular filtration
- Mechanism of urine formation - Urinary dilution & Concentration
- Sodium, Potassium, Phosphate, Calcium, Magnesium, Urate and other organic anions handling of kidney
- Renal Hormones
- Control of extra-Cellular fluid volume and pathophysiology of oedema formation
- Pathophysiology of water metabolism
- Acid-Base Abnormalities like metabolic acidosis, renal acidosis, metabolic alkalosis along with respiratory acidosis and alkalosis.
- Electrolyte abnormalities Like Hypokalemia, Hyponatremia, Hyperkalemia, Hypernatremia, Hypocalcemia, Hypercalcemia, Hypomagnesemia, and hypermagnesemia
- Hemostasis - Coagulation Cascade, Coagulation Factors, Auto Regulation, BT, CT, PT, aPTT, Thrombin Time

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- Renal Failure

Applied pharmacology

- Mechanism of action & clinical uses of diuretics, anti-hypertensives & immuno- suppressive agents
- IV fluid therapy with special emphasis in renal diseases
- Nephrotoxicity drugs
- Fate of drugs & dosage in renal failure
- Drug dosing in patients on renal replacement therapy like intermittent blood-based therapy, continuous renal replacement therapy and peritoneal dialysis
- Anticoagulants in intermittent blood-based therapy and continuous renal replacement therapy – heparin, low molecular weight heparin and newer anticoagulants
- Protamine sulphate
- Drug interaction, especially for immunosuppressants.
- Pharmacology of intraperitoneal administration of antibiotics in case of peritoneal dialysis
- Formalin, sodium hypochlorite, hydrogen peroxide, Para-acetic acidetc.- role as disinfectants& adverse effects of residual particles applicable to formalin etc.
- Hemodialysis concentrates - composition & dilution (acetate &bicarbonate)
- Peritoneal dialysis fluid, in particular hypertonic solutions - composition
- Potassium exchange resins with special emphasis on the mode of administration
- Vitamin D& its analogues, phosphate binders, iron, folic acid & other vitamins of therapeutic value
- Erythropoietin and HIF-PHI in detail

Applied pathology:

Pathogenesis &pathophysiology of

- Acute renal failure
- Chronic kidney diseases
- Classification and pathogenesis
- Primary glomerular diseases
- Secondary glomerular diseases
- Urinary tract infection
- Pyelonephritis
- Reflux nephropathy

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- Tubulointerstitial diseases
- Renovascular and renal parenchymal hypertension
- Vascular injury to kidneys and thrombotic microangiopathy
- Thromboembolic disorders of renal vessels
- Pregnancy & kidney – physiological and pathological aspect
- Diabetic nephropathy
- Inherited disorders of renal tubule function
- Cystic diseases of the kidney
- Disorders of stone formation
- Obstructive injury
- Toxic nephropathies
- Renal neoplasia
- Renal bone disease
- Hematological complications of urethra
- Renal transplantation, immunosuppression and immunology and Banff classification

Applied Microbiology

Microbiological aspects of

- Urinary tract infection & Pyelonephritis
- Catheter-related blood stream infection (CRBSI)
- Peritoneal dialysis-related peritonitis
- Various types of infection in transplant and non-transplant recipients, including patients receiving immunosuppression.
- Diarrhea in transplant and non-transplant recipients, including patients receiving immunosuppression.
- Opportunistic infections
- Sampling methodologies for culture & sensitivity
- Universal precautions
- Vaccinations

Applied immunology

Immunopathogeneses of

- Primary glomerular diseases
- Secondary glomerular diseases
- Tubulointerstitial disorders
- Immune-biology of kidney transplantation
- Immunology involved in all aspects of kidney diseases

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Applied Radiology

Invasive and noninvasive imaging procedures and techniques used in diagnosis of renal disorders, including:

- KUB
- Intravenous urogram/pyelogram
- Micturating cystourethrogram (MCU)
- Retrograde urography
- Angiograms
- Digital subtraction angiography (DSA)
- Ultrasound
- CT scan, CT angiography and use of the contrast
- MRI, MRI angiography and use of the contrast
- Radionuclide imaging

Bioengineering aspects of Nephrology:

Physical principles, technical consideration, procedures and equipment used in:

- Hemodialysis
- Peritoneal dialysis
- Sustained low-efficiency dialysis (SLED)
- Hemofiltration &Hemodiafiltration
- Hemoperfusion
- MARS/Prometheus
- Plasmapheresis
- Continuous renal replacement therapy (CRRT)
- PD catheters
- Permcath/ temporary catheters
- Arterio-venous graft/fistula

Diagnosis & Management of various renal disorders:

- Acute kidney injury (AKI)
- Rapid progressive renal failure (RPRF)
- Chronic kidney diseases (CKD)
- Glomerular diseases
- Urinary tract infections
- Pyelonephritis
- Reflux nephropathy
- Tubule interstitial diseases

- Renovascular and renal parenchymal hypertension
- Thrombotic microangiopathy
- Renal disease in pregnancy
- Inherited disorders of renal tubule function
- Diabetic nephropathy
- Disorders of stone formation
- Obstructive injury
- Toxic Nephropathies
- Renal neoplasia
- Cystic diseases of kidney
- Vascular injury of the kidney
- Acute renal failure
- Chronic renal failure
- Renal bone diseases
- Anemia in CKD
- Conservative management of uremia including various dietary therapies
- Geriatric nephrology and renal ageing

Dialysis procedures:

- Hemodialysis
- Peritoneal dialysis – CAPD& APD
- Hemodiafiltration
- Sustained Low Efficiency Dialysis (SLED)
- Continuous renal replacement therapy (CRRT)
- Plasmapheresis
- Hemoperfusion
- MARS/Prometheus
- Eco-dialysis
- Dialyzer reuse

Renal Transplantation:

- Transplantation of human organs acts (THOAs) and rules.
- Donor selection and establishment of biological relationship
- Pretransplant Evaluation of donor and recipients – Immunological & non-immunological workup

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- Deciding immunosuppressant protocol – Inducing agents & maintenance protocol for renal transplant recipients, steroid-free regimens, CNI-free regimens etc
- Monitoring renal transplant patients on OPD and trailering immunosuppressant dose
- Evaluation and management of graft dysfunction – Immunological and non-immunological caused
- Diagnosis and treatment of various complications other than graft dysfunction -infectious and non-infectious complications
- Expanding donor pool – ABO incompatible transplant, HLA incompatible transplant, swap transplant
- Deceased donor transplant – Patient evaluation and maintaining registry
- High-risk transplantation- workup and desensitization protocols

Critical Care Nephrology

- Principles of critical care and renal physiology
- Epidemiology, risk factors, clinical course, prevention, and treatment of AKI
- Biomarkers and management of AKI in critical care.
- Imaging techniques and point of care ultrasound (POCUS) in critical care nephrology
- A basic core knowledge of clinical syndromes and AKI in different settings like multiple organ dysfunction syndrome, burns and trauma, drug-induced acute kidney injury, pregnancy, oncology and tumor lysis syndrome, cardiac surgery, major surgery, heart failure, cirrhosis, kidney transplantation, acute glomerulonephritis, contrast-induced acute kidney injury, abnominal compartment syndrome, hemolytic uremic syndrome
- Fluid and electrolytes, acid-base and its disorder
- Metabolism and nutrition in critical illness and AKI
- Infectious diseases and sepsis in critical care setting
- Acute intoxication and poisoning
- Organ crosstalk between the heart and the kidney, the lung and the kidney, the liver and the kidney, the brain and the kidney
- Fluid balance and its management in the critically ill

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- Acute renal replacement therapy as intermittent renal replacement therapies (IRRT), continuous renal replacement therapies (CRRT), peritoneal dialysis in critical illness, plasmapheresis. Sorbents and hemoperfusion techniques.
- Extracorporeal liver support, coupled plasmafiltration-adsorption, thePrometheus system, polymyxin and other endotoxin adsorption systems, the plasma filtration-adsorption-dialysis system, extracorporeal membrane oxygenation for cardiac support, extracorporeal membrane oxygenation for pulmonary support and cell-based therapies
- A basic core understanding of special kidney problems in the intensive care unit like
    - Management of CKD and ESRD patients in the ICU
    - Management of AKI in patients with diabetes in the intensive care unit
    - Diagnosis and management of AKI in the emergency room
    - Anticancer drugs and the kidney
    - Anti-inflammatory drugs and the kidney
    - Calcineurin inhibitors and other immunosuppressive drugs and the kidney
    - Alternative medicine and Chinese herbs and the kidney
    - Environment, smoking, obesity, and the kidney
    - Lead and heavy metals and the kidney
    - Statins and the kidney
    - Erythropoietin therapy in critically ill patients and AKI
    - Vasoactive drugs and renal function
    - Endpoints for clinical trials in AKI
    - Hypothermia and the kidney

Intervention Nephrology

- Vascular Access for hemodialysis
    - Planning and options for vascular access
    - Insertion of non-tunneled and tunneled catheters
    - Vascular mapping for AVF – pre-op evaluation
    - Creation of arteriovenous fistula

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- Monitoring and surveillance of vascular access to diagnose impending fistula dysfunction
- Diagnosis of fistula dysfunction using compressive clinical knowledge and imaging modalities (ultrasonogram &fistulogram)
- Fistula angioplasty – Peripheral & Central

- Access for peritoneal dialysis (PD)
  - Patient selection for PD
  - Percutaneous PD catheter insertion for in AKI
  - Percutaneous PD catheter insertion for patients with end staged renal disease
  - Management of catheter dysfunction through percutaneous technique
- Kidney biopsy
  - USG-guided native kidney biopsy
  - USG-guided transplant kidney biopsy
  - Management of post-biopsy bleed – Coiling, embolization etc.
- Radiation and safety

Point of care ultrasound (pocus) in nephrology

- In the diagnosis of fluid overload in critically sick patients
- Measurement of dry weight for patients on maintenance hemodialysis
- Grayscale ultrasound of kidney, ureter and bladder
- Kidney biopsy
- Doppler for renal, neck and femoral vessels
- Insertion of non-tunneled and tunneled catheters
- Vascular mapping for AVF
- Fistula surveillance

Transplant Immunology and other renal laboratory Services

- Immunological workup prior to transplant – Luminex-based DSA, flow cytometric crossmatch, single antigen bead test, HLA and PRAetc
- Drug levels, Tacrolimus, cyclosporin, mycophenolate mofetil, Sirolimus and Everolimuslevel
- Renal function test
- Urine Analysis
- Renal Tubular acidification tests
- CKD-MBD work up

Renal Nutrition

- Diet prescription in patients suffering from acute kidney disease, various stages of chronic kidney disease, hyperuricemia and renal stone diseases.
- Diet prescription for pediatrics CKD

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- Diet prescription for patients undergoing maintenance hemodialysis and peritoneal dialysis.
- Diet prescription for renal transplant recipients
- Diet prescription for patients with metabolic syndrome
- Diet prescription for patients admitted to renal critical care units.
- Refeeding syndrome and its prevention
- Nutritional assessment in CKD – Clinical history, anthropometry, BIA, DEXA, SGA & MIS score, appetite assessment tools, dietary interviews and dietary diaries
- ISRNM recommendations for nutritional assessment
- Malnutrition among chronic kidney disease

Pediatrics Nephrology

- Epidemiology, diagnosis and management of various kidney diseases such as acute kidney injury, rapid progressive renal failure, chronic kidney diseases, glomerular diseases, nephrotic syndrome, Nephritic syndrome, CAKUT and etc. among pediatric population.
- Diet prescription for pediatrics CKD
- Psycho-social issue in management of pediatric CKD
- Growth retardation and its management in pediatric CKD.
- Blood based renal replacement therapy and planning for vascular access forpediatric CKD patients
- Peritoneal dialysis in pediatric patients
- Pediatric renal transplant – Approach, patients and donor selection and immunosuppressant protocol.

Onconephrology

- Etiopathogenesis of kidney diseases, and renal failure among patients with cancer - hematological malignancy and solid organ malignancy
- Tumor lysis syndrome
- Nephrotoxic cancer agents
- Bisphosphonate-Induced Renal Disease
- Glomerular disease in cancer patients
- Thrombotic Microangiopathy and Chemotherapy-Associated TMA.

Genetics and Nephrology

- Understand the role of genetics in various kidney disease – childhood nephrotic syndrome and familial CKD.
- Ethical issues related to genetic test and counseling prior to genetic testing.
- Interpretation of genetictests and its application in reference to kidney diseases

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Green Nephrology and Green dialysis

- Eco-dialysis
  - 3R" analysis (reduce, reuse, recycle) – to prevent generation of waste products
  - Water conservation, energy conservation in hemodialysis
  - Waste management in dialysis
- Reduce disease burden – Prevention of onset and progression of kidney diseases
- Favoring natural medicine dealing with lifestyle, exercise and diet and limiting drugs.

Recent Advances

- Artificial intelligence and machine learning in nephrology
- Bio-artificial kidney, Wearable artificial kidney and portable dialysis
- Xenotransplant
- It will be updated from time to time with advances in the field of kidney diseases
- It will be covered through seminars and journal clubs with all recent articles published in top journals.

TEACHINGANDLEARNINGMETHODS

General principles

The basic aim of postgraduate medical training and education is to produce specialists who understand the needs of community health of the state and country and enhance the quality of health care as well as provide an impetus to research, education, and training of the medical community. The postgraduate doctor after completion of the skill based competency training programme should be able to successfully address the medical requirements of the community. Learning during the programme is not only goal-oriented and didacticbut also essentiallyself-directedand emanates from clinical and academic work. The designated academic sessions are meant to supplement the student's core efforts.

TeachingMethodology

The post graduate student shall be given the responsibility of managing and caring for patients in a gradual and phased manner under supervision, after the student demonstrates skill and efficiency at each step.Teaching sessions shall be an overall judicious amalgamation of case presentations, journal clubs, seminars, group discussion related to various kidney related ailments and its management, bed-side teaching, focused brief topic presentations as allotted from time to time, case-based learning, integrated and interdepartmental meetings including any other collaborative activity with allied departments, as deemed necessary. Suggested modalities of teaching-learning methods are

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summarized below but shall not be limited to these.The frequency of the mentioned teaching and learning methods may vary based on perceived requirements, candidates' competencies, work load and overall working schedule. Self-directed motivational learning forms a key part of the training for which although the hours are not specifically ear-marked, but it shall be integrated into day to day learning.

Formalteachingsessions

These includeregularbedsidecasepresentationsanddemonstrations,didacticlectures, journal clubs, seminars, discussions related to kidney related ailments, bed-side teaching, case-based learning, interdepartmental meetings and collaborative meetings with allied departments.
Thiswillcompriseofthefollowing:

Clinical teaching will be predominantly in form of :

Bedside rounds	- Daily
Mortality meets	- once a week
Seminars	- once a week
Grand rounds	- once a week
Journal clubs	- once a week
Clinico- pathology conference	- once a fortnight
Clinical Meet/CGR	- once a week
Nephro- Urology Conference	- once a week
Nephro- Radiology conference	- once amonth
Nephro-Nuclear medicine	-once a month
Departmental Statistics	-once a week

DidacticLectures

In addition, 10 lectures per year covering recent advances in all aspects of kidney diseases would be taken by faculty members.All post graduate students are required to attend these lectures. Short term basic and clinical courses on:

- Bio-statistics
- Researchmethodologyandexperimentallabmedicinerelevanttonephrology
- Useofdigital applications, artificial intelligence and machine learning in Nephrology
- Bioethics and ethicalissuesin Nephrology

• Each student is expected to attend accredited scientific meetings

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(CME, symposia, conferences, seminars) at least once or twice a year.

- Sessions onResearch methodology, experimental methods relevant to the nephrology specialty, digital application and use of computers and artificial intelligence in nephrology, Biostatistics, pertinent ethical and legal issues in cardiology practice including teaching methodologies, hospitalwaste management, health sanitation, health economics, are additionally suggested.
- Each post graduate student of a post graduate degree course in super specialties would be required to present one poster presentation or read one paper at a national/state conference.
- The student should write a research paper from the allotted research protocol which should be published/accepted for publication/sent for publication during the tenure of the postgraduate study.
- **Log Book:** During the training period, the DM nephrology student shall maintain a detailed and comprehensive log book indicating the duration of the postings and work done in NephrologyWards, ICU, OPDs, minor OT, nephrology cath lab., hemodialysis unit and peritoneal dialysis unit. Data should include the procedures assisted and performed, and teaching sessions attended. The purpose of the Log Book is to:
  a) Maintainarecordoftheworkprofile duringtraining,
  b) Enableconsultantstoaccess informationaboutthework of the student
  c) Keep an eye on the progress and interveneif and when necessary
  d) As a means to assessfrom time to time, theexperiencegainedand quality fo work performed by the DM trainee.

  The Log Book shall also serve as a source to help in the internal evaluation of the DM trainee. The Log book shallbecross-checked and assessedperiodicallybythe facultymemberswho are involved in impartingthetraining. It shall be signed by the Head of the Department and a proficiency certificate from the Head of Department regarding the student's clinical competence, overall skillful performance of procedures and general approach towards patients will be necessary before the student is allowed to appear in the final examination.
- The**Departmentshall encouragee-learningactivities.**
- **Clinicalpostings:Recommendedscheduleforthreeyearstraining**

Eachpostgraduatestudentwillundergothefollowingrotationsinvarious clinical areasofCardiology during the three years of training in DM Cardiology:

Each candidate will be on the following rotation during the 3 years of training:

1.	Wards/ Indoor Service	- 9 months
2.	Dialysis	- 6 months
3.	Renal Transplantation	- 6 months
4.	Renal physiology,	

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Experimental & Laboratory Training		- 3 months
5.	OPD	- 6 months
6.	Optional	-6 months

Research

Eachpostgraduatestudent is requiredtoundertakeresearchunderthe guidance and mentorship of a faculty member. The DM nephrology student is requiredtosubmitaresearch protocol after due advice and approval from the faculty guide within6monthsafterjoiningthe course. In addition, the post graduate student will also participate in various departmental research activities from time to time. The DM nephrology trainee shall have at least 1 original paper accepted for publication/ready for sending to a journal for publication, to be eligible for the examination.

During the training program, patient safety is of paramount importance; therefore, skills are to be learnt and performed initially under supervision followedbyperformingindependently in a phased and guided manner. Forthispurpose, documentation of proficiency of skills is mandatory.

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RecommendedReading:

Book

Serial	Title	Editor	Year of publication	Publisher
1	Brenner And Rector's The Kidney	Alan S L Yu and Glenn Chertow	2019	Elsevier
2	Schrier's Diseases of the Kidney	Robert W. Schrier MD; Thomas M. Coffman MD; Ronald J. Falk MD; Bruce A. Molitoris MD; Eric G. Neilson MD	2012 (9th)	Lippincott Williams & Wilkins (LWW)
3	Heptinstall's Pathology of the Kidney	J. Charles Jennette; Jean L. Olson; Melvin M. Schwartz; Fred G. Silva	2014 (7th)	Lippincott Williams & Wilkins (LWW)
4	Handbook Of Dialysis	John T. Daugirdas, Peter G. Blake, Todd S. Ing	2014 (5th)	Lippincott Williams & Wilkins (LWW)
5	Kidney Transplantation - Principles and Practice	Stuart Knechtle, Lorna Marson, Peter Morris	2019 (8th)	Elsevier
6	Genitourinary Radiology: Kidney, Bladder and Urethra	Vikram S. Dogra, Gregory T. MacLennan	2013	Springer Link
7	Oxford Textbook of Clinical Nephrology	Neil N. Turner, Norbert Lameire, David J. Goldsmith, Christopher G. Winearls, Jonathan Himmelfarb, Giuseppe Remuzzi	2015	Oxford University Press
8	Comprehensive Clinical Nephrology	Richard J. Johnson, John Feehally, Jurgen Floege, Marcello Tonelli	2018	Elsevier
9	Seldin and Giebisch's The Kidney: Physiology and Pathophysiology	Robert J. Alpern, Michael J. Caplan, Orson W. Moe	2013	Elsevier

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10	Interventional Nephrology	Arif Asif, Anil K. Agarwal, Alexander Yevzlin, Steven Wu, Gerald A. Beathard	2012	McGraw Hill

Journals

- New England journal of medicine
- Lancet
- American journal of nephrology
- Kidney international
- KI Report
- Kidney 360
- American journal of kidney diseases
- Clinical nephrology
- Nephron
- Hypertension
- Nephrology, Dialysis and Transplant
- Journal of the American Society of Nephrology
- Clinical Journal of the American Society of Nephrology
- Nature Reviews Nephrology
- Kidney International Supplements
- CKJ: Clinical Kidney Journal
- Journal of Renal Nutrition
- Peritoneal Dialysis International
- Pediatric Nephrology
- Clinical and Experimental Nephrology
- Seminars in Dialysis
- Hemodialysis International
- Journal of Vascular Access
- Indian J Nephrology
- Indian J Transplantation
- American Journal of Transplantation
- Transplant International
- Clinical Transplantation
- Transplantation Reviews
- Current Opinion in Organ Transplantation
- Transplant Infectious Disease
- Annals of Transplantation
- Pediatric Transplantation
- Transplant Immunology

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E learning resources

1. https://www.uptodate.com/contents/search
2. https://www.clinicalkey.com
3. https://www.medscape.com/nephrology
4. https://qxmd.com/
5. https://read.qxmd.com/
6. https://kdigo.org/guidelines/
7. https://www.kidney.org/professionals/guidelines
8. https://ispd.org/guidelines/
9. https://www.niddk.nih.gov/about-niddk/strategic-plans-reports/usrds
10. https://professional.diabetes.org/content-page/practice-guidelines-resources
11. https://main.icmr.nic.in/sites/default/files/guidelines/ICMR_GuidelinesType2diabetes2018_0.pdf
12. https://www.who.int/news-room/fact-sheets/detail/diabetes
13. https://idf.org/e-library/guidelines.html
14. https://www.diabetes.org.uk/professionals/position-statements-reports/diagnosis-ongoing-management-monitoring/new_diagnostic_criteria_for_diabetes
15. https://nhm.gov.in/images/pdf/guidelines/nrhm-guidelines/stg/Hypertension_full.pdf
16. https://www.acc.org/latest-in-cardiology/articles/2017/11/08/11/47/mon-5pm-bp-guideline-aha-2017
17. https://www.escardio.org/Guidelines/Clinical-Practice-Guidelines/Arterial-Hypertension-Management-of
18. https://rheumatology.org/patients/lupus

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