

University of Michigan Health System
Internal Medicine Residency
Nephrology Consultation Service Curriculum

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Rotation Goals and Educational Purpose

The kidneys play a key role in fluid, electrolyte, and acid-base regulation and are affected by a wide range of systemic disorders, drugs, and toxins. The general internist should be competent to detect and evaluate intrinsic renal disorders, asymptomatic urine abnormalities, renal vascular disease, nephrolithiasis, urinary tract infections, and neoplasms of the urinary system. S/he should also be able to manage fluid, electrolyte, and acid-base disorders; understand the ways in which systemic diseases may affect the kidneys; and recognize the potential nephrotoxicity of various therapeutic and diagnostic agents. The general internist must also be familiar with guidelines for pre-dialysis management of patients with renal failure, and be able to recognize indications for dialysis and referral to a nephrologist.

This rotation is elective for residents at the HO1 and HO2/3 levels.

Rotation Competency Objectives

In supplement to the University of Michigan Longitudinal Learning Objectives, the following provide an overview of the knowledge, skills, and behaviors promoted in this rotation.

- I. Patient Care and Medical Knowledge
 - a. Core knowledge – By completion of the rotation, residents are expected to:
 - i. Recognize risk factors for chronic kidney disease and acute renal failure.
 - ii. Use serum creatinine concentration to estimate Glomerular Filtration Rate (GFR); explain the assumption of steady-state concentration; and discuss shortcomings of creatinine-based methods of estimating GFR. Discuss the physiological concept of clearance; apply this to GFR, principles governing solute clearance by dialysis, and handling of medications by the kidney
 - iii. Interpret spot protein-to-creatinine ratio and spot albumin-to-creatinine ratio on a random urine sample as a marker of kidney damage and a quantitative measure of proteinuria. Relate spot testing to 24-hour urine

- results, recognizing that 24 hour urine collections are not generally superior to spot tests for GFR estimation or proteinuria evaluation.
- iv. Identify the fundamental renal mechanisms underlying regulation of Na⁺, K⁺, Ca²⁺, and acid/base.
 - v. Identify the role of the kidney in blood pressure regulation, and identify the relationships between hypertension and renovascular disease.
 - vi. Discuss the pathophysiology underlying normal and abnormal proteinuria. Define nephrotic-range proteinuria, glomerular proteinuria, tubular proteinuria, and Bence-Jones protein
 - vii. Categorize based on both frequency and on dominant pathological site(s) of injury (pre-renal, intra-renal and post-renal) the causes of chronic kidney disease and acute renal failure.
 - viii. Define and List the most common causes of nephrotic syndrome and rapidly progressive glomerulonephritis.
 - ix. Define and List the most common causes of isolated hematuria and isolated proteinuria.
 - x. Describe the basic metabolic, homeostatic regulatory functions and endocrine functions of the kidney.
 - xi. Identify chronic kidney disease as an indication for aggressive cardiovascular risk factor reduction.
 - xii. Identify indications for dialysis, relative advantages / disadvantages of hemodialysis vs. peritoneal dialysis, and preferred vascular access for maintenance hemodialysis.
 - xiii. Identify indications for kidney transplant, side effects of common transplant drugs, and differential diagnosis of increased creatinine in transplant patients.
- b. History and Physical Examination
 - i. By completion of the rotation, HO1 residents should be able to elicit
 1. a complete nephrologic history, distinguishing risk factors for and temporal duration of kidney disease;
 2. a genitourinary systems review;
 3. palpable renal abnormalities (ballotable kidneys and/or kidney transplant)
 4. symptoms and signs of diseases associated with renal involvement (enlarged urinary bladder, vasculitis, SLE, atheroembolic disease);
 5. symptoms and signs of complications related to kidney failure (uremia, accelerated atherosclerosis, hypertension, anemia, salt and water retention, mineral and bone disease, malnutrition, sexual dysfunction, neuropathy, electrolyte & acid-base disturbance); and
 6. a complete medication history (prescribed and over-the-counter) to explore potential risks for adverse drug effects.
 - ii. By the conclusion of the rotation, HO2/3 residents will additionally perform nephrologic history and physical examinations with appropriate efficiency and increasing autonomy.
 - c. Laboratory and radiologic testing – By completion of the rotation, residents will

- i. interpret urinalysis and microscopy of urine sediment, including RBCs, WBCs, tubular, transitional and squamous epithelial cells, bacteria, and hyaline/granular/cellular casts.
 - ii. interpret quantitative estimates of proteinuria (dipstick, spot protein-to-creatinine ratio, 24 hour urine collection).
 - iii. interpret measurements of serum electrolytes & osmolarity, urine electrolytes & osmolarity, and arterial blood gas parameters.
 - iv. in the context of the pretest probabilities for specific renal diseases, interpret, common serologic tests for intrinsic renal disease (e.g. ANCA, anti-GBM, ANA).
 - v. describe the indications for, and information gained from, diagnostic imaging studies including ultrasound, CT, IVP, conventional and MR angiography, MR urography, antegrade and retrograde urography, cystoscopy, and radioisotope studies.
- d. Diagnostic decision making - By completion of the rotation, residents will
 - i. integrate history, physical exam, and diagnostic studies to formulate a differential diagnosis for common nephrologic syndromes:
 1. Acute renal failure
 2. Chronic kidney disease
 3. Disorders of salt and water metabolism
 4. Disorders of major electrolytes (Na⁺, K⁺, Ca²⁺, Mg²⁺, PO₄²⁻)
 5. Clinical acid-base disorders
 - ii. recognize indications for renal biopsy
- e. Management of common nephrologic conditions
 - i. By completion of the rotation, HO2 residents should demonstrate knowledge of the etiology, risk factors, preventive interventions, pathophysiology, natural history, clinical presentations, diagnostic strategies, laboratory and radiologic evaluation, initial management strategies, interventional indications, potential surgical interventions, and chronic care management for the following common nephrologic conditions:
 1. Pre-renal kidney failure
 2. Diabetic nephropathy
 3. Hypertensive nephrosclerosis
 4. Atheroembolic kidney disease
 5. Renovascular disease
 6. Nephritic syndrome
 7. Nephrotic syndrome
 8. Acute tubular necrosis
 9. Tubulo/interstitial renal diseases
 10. Cystic kidney diseases
 11. Iatrogenic renal toxins (e.g., NSAIDs, contrast dye, etc.)
 12. Nephrolithiasis
 13. Post-renal kidney failure
 14. Electrolyte, fluid, and acid/base disorders

- ii. HO3 residents should additionally be able to independently develop initial management plans based on medical evidence for patients across the full spectrum of nephrologic diseases
- f. Procedures
 - i. Residents are encouraged to perform bladder catheterization when necessary, under supervision unless independently credentialed.
 - ii. Residents may, under supervision and with faculty permission, obtain central intravascular access.

II. Interpersonal and Communication Skills

- a. By completion of the rotation, HO1 residents will
 - i. Under supervision, communicate with primary care and/or subspecialty physicians about the patient's course, the results of specific tests, long-term follow-up plans, and issues regarding risk-factor modification.
 - ii. Develop an organized approach to communication surrounding transitions of care, including post-discharge treatment.
 - iii. [throughout the rotation], present oral and written communication that develops a constructive relationship with colleagues on referring services.
- b. Additionally, HO2 residents will
 - i. Effectively communicate with patients and other professionals regarding the indications, risks and benefits of renal biopsy. Under supervision, engage patients in informed consent for renal biopsy, respecting patient autonomy and promoting patient participation in health care decisions.
 - ii. Under supervision, effectively engage patients in counseling regarding indications for dialysis, mechanics of dialysis, and common potential dialysis-associated symptoms.
 - iii. Engage in patient-centered counseling regarding kidney disease risk factors, ESRD management, renal replacement modality selection, and vascular access preparation.
- c. Additionally, HO3 residents will
 - i. Provide counseling, with increasing autonomy, regarding initiation of dialysis.
 - ii. Under supervision, effectively communicate with patients regarding kidney transplant evaluation.

III. Professionalism

- a. Throughout the rotation, HO1 residents are expected to
 - i. Respond in a timely manner to consultative requests and patient care needs. Complete all dictations, and letters in a timely manner.
 - ii. Recognize and compassionately respond to factors affecting treatment plans, including personal economic factors, complexities of family care at home, and other factors affecting adherence with medical therapy.
 - iii. Recognize and compassionately respond to patients' emotional and social stressors related to chronic kidney disease.
- b. HO2 residents additionally are expected to reflect understanding of appropriate indications to discuss end-of-life decision making in ESRD (including withdrawal

from dialysis) with patients and families. Sensitively respond to patient and family decisions regarding palliative care.

- c. HO3 residents additionally are expected to reflect awareness of the ethical foundations of kidney transplantation, including principles of scarce resource distribution.

IV. Practice-Based Learning and Improvement

- a. HO1 residents are expected to
 - i. Demonstrate self-initiative in the use of information technology to access and retrieve materials for self-education. Utilize National Kidney Foundation clinical practice guidelines and current literature to generate appropriate diagnostic and therapeutic plans.
 - ii. Constructively respond to and internalize feedback from faculty, nursing, and allied healthcare providers. Demonstrate willingness to change identified behaviors and ability to learn from errors.
- b. HO2 residents are additionally expected to critically review clinical trial data.
- c. HO3 residents are additionally expected to demonstrate personally investigated knowledge of the evidence base for national guidelines on diagnosis and management of common acute and chronic kidney diseases.

V. Systems-Based Practice

- a. Effectively coordinate multidisciplinary team care (primary service, consult services, social work, nursing, pharmacy, nutrition, and other allied health professionals) in patient care.
- b. Apply evidence-based, cost-conscious strategies to prevention, diagnosis, and management of common kidney diseases.
- c. Reflect awareness of societal cost for the epidemic growth in end-stage renal disease within the greater healthcare system. Acknowledge the extent of undiagnosed and inadequately treated chronic kidney disease and the necessity of a systematic scope for prevention of ESRD.

Teaching Methods

I. Supervised Patient Care

- a. The emphasis of the rotation is on experiential learning through consultative management of inpatients. Primary assignment is made either to University Hospital or to Ann Arbor Veterans Administration Hospital. One ½ day weekly is spent in supervised care of ambulatory nephrology patients, at either the University of VA medical campus. See the rotation schedule below. Residents are under the full supervision of a faculty nephrologist and a nephrology fellow. Patient-centered, case-based faculty discussions review each patient. Patients present from a broad age range and socioeconomic backgrounds, with a spectrum of local to quaternary care needs.
- b. Residents analyze urinalyses and urinary sediment under the supervision of faculty physicians and laboratory personnel.

- c. Residents interact with dialysis specialists and nephrology fellows; residents should consider all such interactions as opportunities for education.
- II. Structured Didactics and Small Group Learning**
- a. Tuesday noon didactic series: attendance required for fellows and rotating residents. This core content series covers clinical topics central to the practice of nephrology.
 - b. Wednesday afternoon conferences: attendance required, 4-6 PM. Weekly clinical case conference is accompanied by one of the following:
 - i. Clinical Journal Club (first Wednesday of month).
 - ii. Nephrology Clinical Science Research Conference (second and fifth Wednesdays).
 - iii. Nephrology Basic Science Conference (fourth Wednesday).
 - c. Residents with focused interest in kidney transplantation may speak with faculty and fellows regarding optional attendance at transplantation conference (if core rotation clinical duties allow.)
- III. Special opportunities - Interested residents should discuss with nephrology fellowship program director (Dr. Holzman) support available for attending the annual American Society of Nephrology meetings.**
- IV. Independent study - Residents are expected to actively read core content regarding both their patient-based experiences and the common conditions as noted under the rotation learning objectives. They are expected to search primary literature databases (PubMed, Ovid) for evidence to support individual patient care. The following additional resources are suggested and are available on line:**
- a. Textbooks and manuals
 - i. UptoDate nephrology chapters. This online textbook was founded by the noted nephrologist and educator, Dr. Burton Rose. The nephrology sections remain highly recommended for their clinical clarity. Free access provided through institutional subscription.
 - ii. Burton David Rose, *Clinical Physiology of Acid Base and Electrolyte Disorders*. Most recent edition. Available in hard copy at Taubman library.
 - iii. Residents are encourage to review the nephrology section, including questions, from the most recent MKSAP collection.
 - b. Clinical practice guidelines
 - i. <http://www.kidney.org/professionals/KDOQI/guidelines.cfm> National Kidney Foundation K/DOQI clinical practice guidelines
 - ii. <http://www.idsociety.org/Content.aspx?id=9088> Infectious Diseases Society of America.
 - 1. Genitourinary guideline: Catheter-Associated Urinary Tract Infections.
 - 2. Other guidelines: Prevention of Catheter-related Infections, Management of Catheter-related Infections

- c. General nephrology websites
 - i. <http://www.asn-online.org/> American Society of Nephrology
 - ii. <http://www.hdcn.com/> Hypertension, Dialysis & Clinical Nephrology (HDCN) maintains practical information and current news for a broad spectrum of nephrologic conditions
 - iii. <http://kidney.niddk.nih.gov/index.htm> The National Institute of Diabetes and Digestive and Kidney Diseases (a.k.a. NIDDK, a branch of the NIH) maintains the National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC)
- d. Core clinical journals, with free access available through the Taubman Medical Library e-journal resources:
 - i. Journal of the American Society of Nephrology: JASN, available at: <http://www.jasn.org/>
 - ii. Clinical Journal of the American Society of Nephrology, available at: <http://cjasn.asnjournals.org/>
 - iii. Kidney International, available at: <http://www.nature.com/ki/archive/>
- e. Other online resources
 - i. Residents are encouraged to access the most recent versions of the following Johns Hopkins Internet Learning Center modules, available to all Michigan residents using their ambulatory care login (select from the list of available modules): <http://www.hopkinsilc.org/>
 1. Acid/Base Disorders
 2. Chronic Kidney Disease
 3. Hypertension
 - ii. <http://www.acid-base.com/> Acid-base tutorial. Alan W. Grogono, Tulane Department of Anesthesiology. This site is highly recommended for all. Peer-reviewed, light-hearted, and interactive, it provides an alternative and in-depth approach.

Evaluation Methods

Formative face-to-face feedback to residents by attendings occurs at mid-month. Each month, attendings complete online competency-based evaluations of each resident. The evaluation is shared with the resident, is available for on-line review by the resident at his/her convenience, and is sent to the residency office for internal review. The evaluation is part of the resident file and is incorporated into semiannual performance reviews for directed resident feedback.

Residents also complete a service evaluation of the rotation faculty monthly.

Rotation Schedule

First day protocol: All University Hospital inpatient care rounds meet on 7D in the acute dialysis conference room. Arrive by 7:30 AM. VA hospital rotators should contact the nephrology fellow prior to the first morning to determine a meeting location and time.

Weekend duty: One duty day per weekend is standard.

Call duty: There is no night call.

Weekly schedule: In-patient consults at either University Hospital or Ann Arbor Veterans hospital occur throughout the day. One ½ day per week of nephrology clinic is scheduled for each rotating resident. The clinic may be at either the VA or UH, and is selected based on the resident’s continuity clinic requirements and the attending physician’s preferred rounding schedule.

	Monday	Tuesday	Wednesday	Thursday	Friday	Sat/Sun
AM	<p>Consults, Continuity Clinic, or nephrology clinic</p> <p>10:30 Morning Report</p>	<p>Consults, Continuity Clinic, or nephrology clinic</p> <p>10:30 Morning Report</p>	<p>Consults, Continuity Clinic, or nephrology clinic</p> <p>10:30 Morning Report</p>	<p>Consults, Continuity Clinic, or nephrology clinic</p> <p>10:30 Morning Report</p>	<p>Consults, Continuity Clinic, or nephrology clinic</p> <p>10:30 Morning Report</p>	<p>One day of consults per weekend</p>
PM	<p>12:00 Noon Conference</p> <p>Consults, Continuity Clinic, or nephrology clinic</p>	<p>12:00 – 1 PM Nephrology Didactic</p> <p>12:30 Intern Report</p> <p>Consults, Continuity Clinic, or nephrology clinic</p>	<p>12:00 Noon Conference</p> <p>Consults, Continuity Clinic, or nephrology clinic</p> <p>4-6 PM Clinical Case Conference, Journal Club, Basic Science, Clinical Research</p>	<p>12:00 Noon Conference</p> <p>Consults, Continuity Clinic, or nephrology clinic</p>	<p>12:00 Grand Rounds</p> <p>Consults, Continuity Clinic, or nephrology clinic</p>	