Diabetic Nephropathy: CKD Screening, Monitoring, and Treatment

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(with thanks to Dr. Andy Narva)

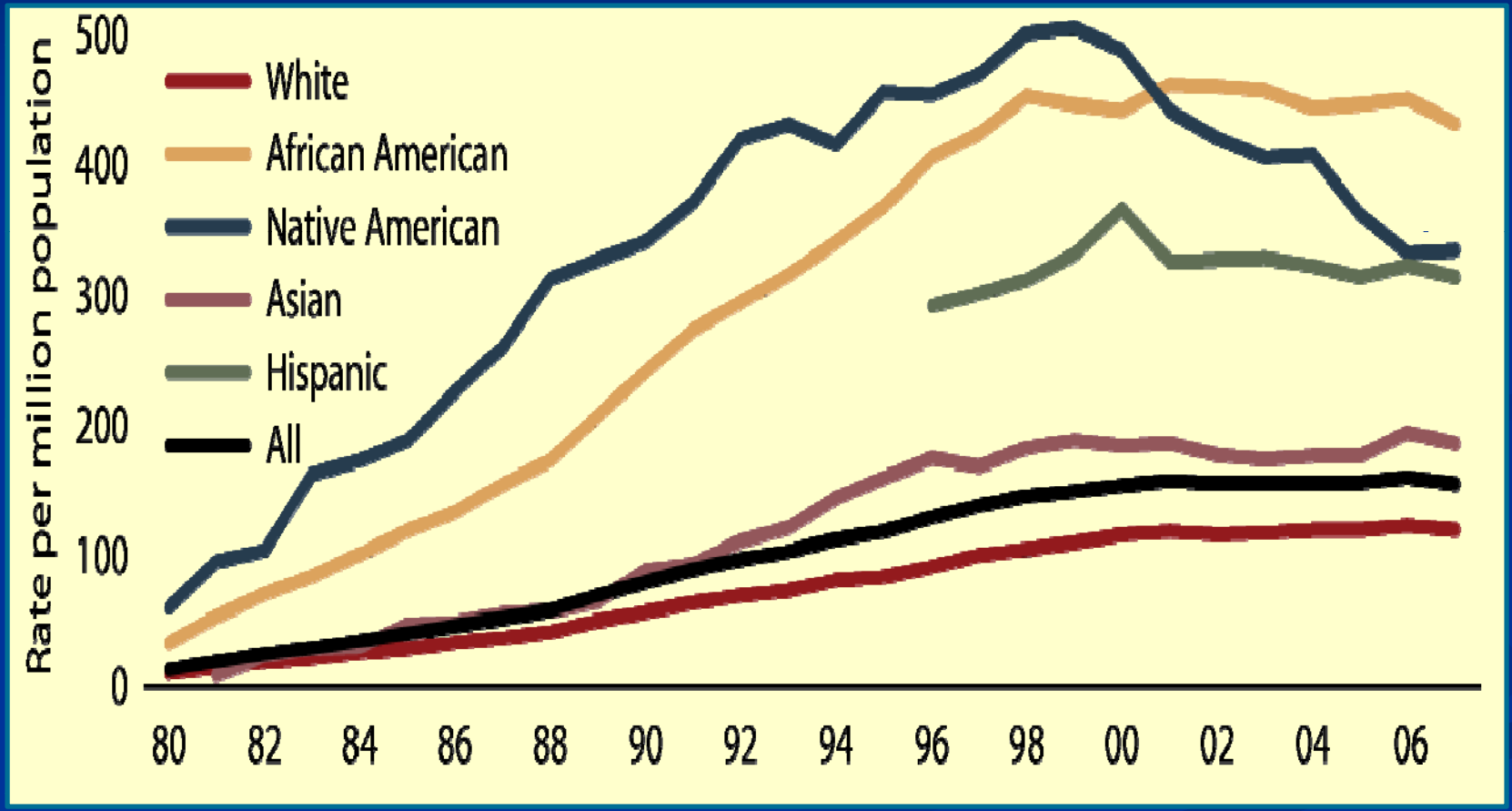
Chronic Kidney Disease

- CKD Data--good news, for a change!
- CKD Screening, Diagnosis and Monitoring:

eGFR and UACR

- CKD complications
- CKD Tools

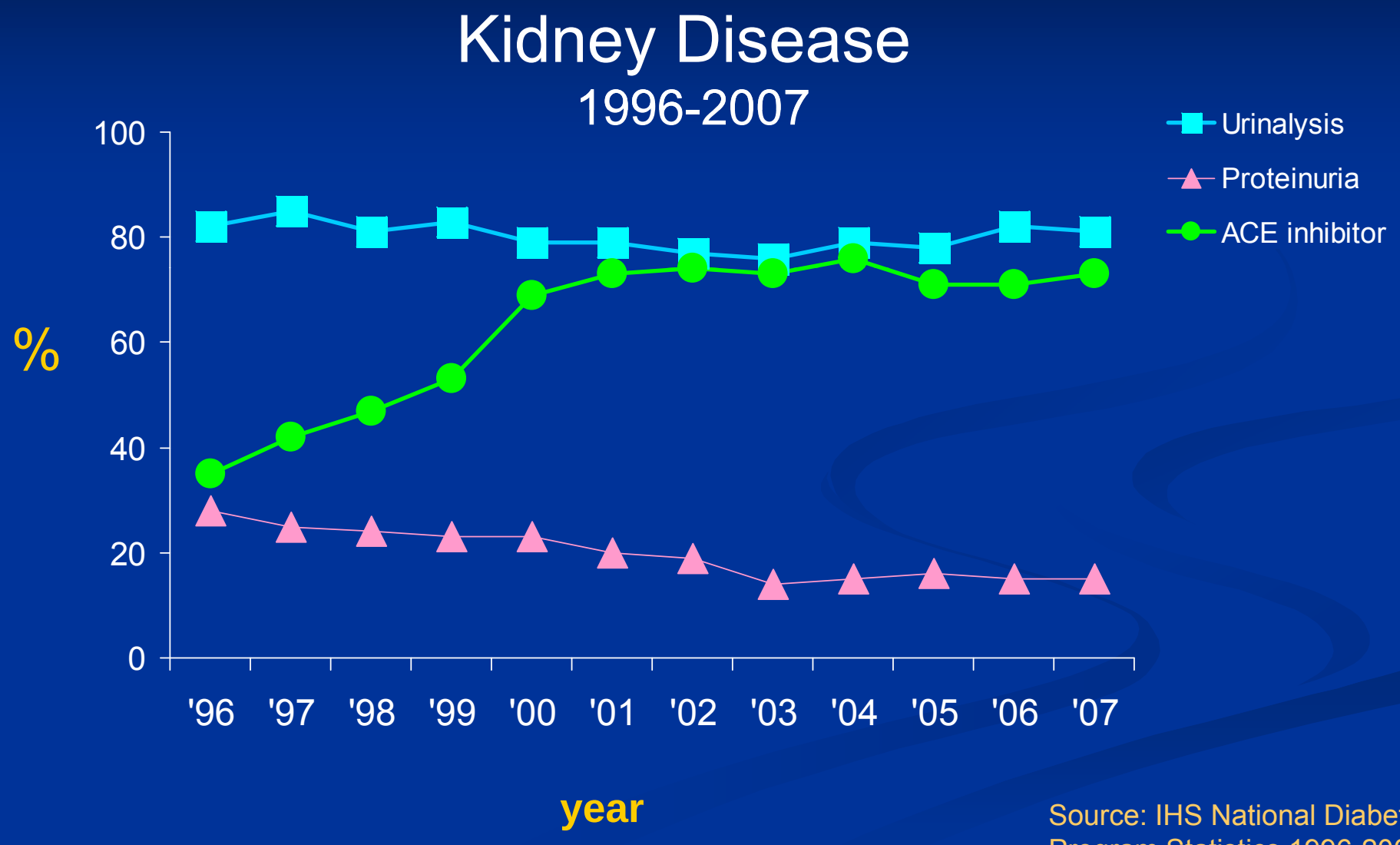
Age-adjusted* rate of persons initiating therapy for end-stage renal disease with diabetes as the primary diagnosis, by race, United States, 1994–2006



*Based on the 2000 US population

Source: CDC. Racial Differences in Trends of End-Stage Renal Disease, by Primary Diagnosis --- US, 1994--2004. MMWR March 23, 2007 / 56(11);253-256

IHS Diabetes Care & Outcomes Audit



Source: IHS National Diabetes Program Statistics 1996-2007

What is Chronic Kidney Disease?

CKD is at least 3 months ("chronic") of <u>either:</u>

- Decreased kidney FUNCTION (ability to filter the blood),

  <u>or</u>

- Evidence of kidney DAMAGE (e.g. protein in the urine)
  - Earliest indicator

- Monitoring the 2 together over time tell a lot about what diabetes and hypertension are doing to the kidneys, including where they're heading and how fast they're going there…

National Kidney Foundation (NKF) Definition of CKD

- **Kidney Function**. Glomerular filtration rate (GFR) <60 mL/min/1.73 m2 for ≥ 3 months with or without kidney damage

--**Or**--

- **Kidney damage** for ≥ 3 months, with or without decreased GFR, manifested by either:
  - Pathologic abnormalities; or
  - Markers of kidney damage, i.e. **proteinuria**

National Kidney Foundation. Am J Kidney Dis. 2002;39(suppl 1):S1-S266

Stages of Chronic Kidney Disease

Stage	Description	GFR (mL/min/1.73 m^2)
1	Kidney Damage with Normal or ↑ GFR	≥ 90
2	Kidney Damage with Mild ↓ GFR	60-89
3	Moderate ↓ GFR	30-59
4	Severe ↓ GFR	15-29
5	Kidney Failure	<15 or Dialysis

National Kidney Foundation DOQI

What is Glomerular Filtration Rate (GFR)?

- GFR is equal to the sum of the filtration rates in all of the functioning nephrons
- Estimation of the GFR gives a rough measure of the number of functioning nephrons
- GFR cannot be measured directly

What is GFR? (extra credit)

- Cardiac output = 6 L/min
- X 20% of CO goes to kidneys = 1.2L/min
- X Plasma is 50% blood volume = 600 ml/min
- X Filtration Fraction of 20% = 120 ml/min

eGFR

- Not the GFR. It's an **estimate (eGFR)**
  - based on an equation, usually MDRD (preferred over Cockroft-Gault in DM)
  - Programmed into RPMS lab package
- Like all estimates of kidney function it's based on creatinine:
  - Cr must be stable
    - --hospitalized pts
  - Affected by muscle mass
    - --body builders vs. little old ladies

Loss of Kidney Function in CKD

- Rate of GFR decline should be assessed to:
  - Predict the interval until the onset of kidney failure
  - Assess the effect of interventions to slow the GFR decline

So what about Proteinuria?

- **Albumin** is the primary protein excreted by kidneys damaged by diabetic nephropathy
  - "Proteinuria" and "Albuminuria" often used interchangeably
  - While the term is used in relation to some tests, there is no such thing as "microalbumin" (vs. microalbuminuria)
- It matters a lot:
  - How much albumin is being excreted
  - How fast that is rising
  - If an intervention manages to reduce it

Proteinuria—as important as eGFR

- Community-based cohort study of 920,000 pts
- Risks of mortality, MI, progression to kidney failure associated with a given level of eGFR are independently ↑'d with higher levels of proteinuria
- Example: who's at higher risk?
  - pt with eGFR >60 and UACR 400 mg/g= Stage 1
  - pt with eGFR of 50 and UACR <30mg/g=Stage 3
  - The first pt has 2-10x higher risk than the second!

JAMA 2010;303(5):423-429

eGFR and urine albumin—together at last

- Meta-analysis of over 105,000 pts
- Independent predictors of mortality risk:
  - eGFR <60 mL/min/1.73m2
  - UACR ≥10 mg/g
- "This study provides quantitative data for use of both kidney measures for risk assessment and definition and staging of chronic kidney disease."

Lancet 2010;doi 10.1016/S0140-6736(10)60674-5

Proteinuria: Important in Screening, Diagnosing and Treating CKD

- **Diagnosis**: ~40% of people with CKD are dx'd based on urine albumin alone. Early marker of kidney damage (UACR ≥30 mg/g) due to diabetes, hypertension
- **Prognosis**: Urine albumin is an important prognostic marker (esp. in diabetic kidney disease) and may be used to monitor and guide therapy
- **Marker for CHD:** marker of generalized endothelial dysfunction
- **Hypothesized surrogate outcome** for kidney disease progression and CHD risk reduction
- A tool for **patient education** and self-management (like eGFR, A1c)

Proteinuria in Native populations

- Pts with albuminuria:
  - NGT: 8%
  - IGT: 15%
  - DM: 47%
- 18% of DM pts develop albuminuria within 4 yrs of DM onset
- DM pts 45-74 yrs old: prevalence 35-65%
- 50% of pts with macroalbuminuria progress to ESKD within 10 yrs

Diabetic Nephropathy in American Indians, with a Special Emphasis on the Pima Indians
Current Diabetes Reports 2008;8:486-493

Proven Risk Factor for CHD in Native populations

- **Strong Heart Study Calculator**

  Predicted Risk of CHD in 10 Years:

  - Albuminuria, age, gender, TC, LDL, HDL, smoking, DM, HTN—all CHD risk factors
  - Hazard ratios for macroalbuminuria:
    - Men:2.11, Women: 2.69
  - Calculator uses UACR results--presence of either:
    - Microalbuminuria
    - Macroalbuminuria
  - http://strongheart.ouhsc.edu/CHDcalculator/calculator.html

Circulation 2006;113:2897-2905

So for something so important, we need a really good test to measure it

But which to choose??

Urine Protein Tests: Recipe for Confusion…

- Many different tests:
  - Some based on urine albumin, others on protein
  - Some quantitative, others semi-quantitative (test strips)
  - Some require timed urine collections (e.g. 24 hr, 4 hr, overnight), others on spot samples
  - Some account for urine concentration, others don't
  - Some protocols call for one test for screening, others for diagnosis and monitoring
  - Most tests not standardized
- And many different names used for each of those tests!

‘A test by any other name’… is confusing! LOINC Codes for Urine Albumin Tests

12842-1	PROTEIN	MCNC	12H	UR	QN		
21482-5	PROTEIN	MCNC	24H	UR	QN		
26034-9	PROTEIN	MCNC	PT	UR	QN		
26801-1	PROTEIN	MRAT	12H	UR	QN		
2889-4	PROTEIN	MRAT	24H	UR	QN		
13801-6	PROTEIN/CREATININE	MCRTO	24H	UR	QN		
2890-2	PROTEIN/CREATININE	MCRTO	PT	UR	QN		
34366-5	PROTEIN/CREATININE	RATIO	PT	UR	QN		
40662-9	PROTEIN^RESTING	MRAT	12H	UR	QN		
40663-7	PROTEIN^UPRIGHT	MRAT	12H	UR	QN		
18373-1	PROTEIN	MRAT	6H	UR	QN		
20454-5	PROTEIN	ACNC	PT	UR	ORD	TEST STRIP	
27298-9	PROTEIN	ACNC	PT	UR	QN		
2887-8	PROTEIN	ACNC	PT	UR	ORD		
2888-6	PROTEIN	MCNC	PT	UR	QN		
32209-9	PROTEIN	ACNC	24H	UR	ORD	TEST STRIP	
32551-4	PROTEIN	MASS	XXX	UR	QN		
35663-4	PROTEIN	MCNC	XXX	UR	QN		
5804-0	PROTEIN	MCNC	PT	UR	QN	TEST STRIP	
40486-3	PROTEIN/CREATININE	RATIO	24H	UR	QN		
34535-5	MICROALBUMIN/CREATININE RATIO PANEL	-	PT	UR	QN		
14956-7	ALBUMIN	MRAT	24H	UR	QN	DETECTION LIMIT = 20 MG/L	MICROALBU
14957-5	ALBUMIN	MCNC	PT	UR	QN	DETECTION LIMIT = 20 MG/L	MICROALBU
1753-3	ALBUMIN	ACNC	PT	UR	ORD		
1754-1	ALBUMIN	MCNC	PT	UR	QN		
1755-8	ALBUMIN	MRAT	24H	UR	QN		
21059-1	ALBUMIN	MCNC	24H	UR	QN		
30003-8	ALBUMIN	MCNC	24H	UR	QN	DETECTION LIMIT = 20 MG/L	MICROALBU
43605-5	ALBUMIN	MCNC	4H	UR	QN	DETECTION LIMIT = 20 MG/L	
43606-3	ALBUMIN	MRAT	4H	UR	QN	DETECTION LIMIT = 20 MG/L	
43607-1	ALBUMIN	MRAT	12H	UR	QN	DETECTION LIMIT = 20 MG/L	
1757-4	ALBUMIN RENAL CLEARANCE	VRAT	24H	UR	QN		
13705-9	ALBUMIN/CREATININE	MCRTO	24H	UR	QN		PROTEIN.AL
14585-4	ALBUMIN/CREATININE	SCRTO	PT	UR	QN		PROTEIN.AL
14958-3	ALBUMIN/CREATININE	MCRTO	24H	UR	QN	DETECTION LIMIT = 20 MG/L	MICROALBU
14959-1	ALBUMIN/CREATININE	MCRTO	PT	UR	QN	DETECTION LIMIT = 20 MG/L	MICROALBU
30000-4	ALBUMIN/CREATININE	RATIO	PT	UR	QN	DETECTION LIMIT = 20 MG/L	MICROALBU
30001-2	ALBUMIN/CREATININE	RATIO	PT	UR	QN	DETECTION LIMIT = 20 MG/L TEST STRIP	MICROALBU
32294-1	ALBUMIN/CREATININE	RATIO	PT	UR	QN		
44292-1	ALBUMIN/CREATININE	MCRTO	12H	UR	QN	DETECTION LIMIT = 20 MG/L	
9318-7	ALBUMIN/CREATININE	MCRTO	PT	UR	QN		

Spot Urine Albumin-to-Creatinine Ratio (UACR) recommended by NKF, ADA, NIDDK

Urine Albumin/Creatinine Ratio (UACR)

The ratio of albumin to creatinine in a spot urine specimen correlates closely, to total albumin excretion:

$$\frac{\text{Albumin (mg/dl)}}{\text{Creatinine (mg/dl)}} \approx \text{Albumin excretion in grams/24 h}$$

However, generally expressed as mg albumin/g creatinine:

normoalbuminuruia<30 mg/g

micro-albuminuria 30-300 mg/g

macro-albuminuria >300 mg/g

UACR is a continuous variable and the above terms will be replaced with a single term e.g. urine albumin

Why is UACR recommended?

- Albumin is primary protein excreted in DM pts
- Most accurate, reproducible test
  - Quantitative (vs. semi-quantitative) test
  - Urine albumin assay being standardized, urine protein not standardizeable
  - Allows for early detection/monitoring of CKD (unlike tests that can't distinguish normal from microalbuminuria)
- Done on spot specimen any time of day
  - No need for timed specimens (e.g. 24 hr, 4 hr, overnight, first morning specimens, etc)
- Accounts for urine concentration using ratio to creatinine
  - Unlike albumin-only tests

What about POC albumin-to-creatinine ratio test strips?

- Per Clinitek's product information:

"This product provides **semi-quantitative** results and can be used for **screening** samples for microalbuminuria; **positive results should be confirmed with quantitative methods for albumin.**"

  - Accuracy of 85% compared with UACR

- Whether to use Clinitek-type strips:
  - For screening (vs. monitoring CKD)
  - In remote clinical settings
  - Cost?

Urine Albumin Testing - IHS Cost

- **In-house UACR** $2.30- $9.10

  Mean $3.50

  Siemens Dimension, DCA 2000, Coulter DxC 600

  POC option?: Yes (e.g. DCA)

  CLIA-waived?: No

- **Send-out UACR** $6.31- $10.00

  Mean $8.00

  Quest, LabCorps, RML—but may **require a contract to get affordable prices**

Bert Tallant, Santa Fe Indian Hospital

UACR results prognostic and should guide therapy

- Rate of rise as well as absolute value
  - Continuous variable ("micro" and "macro" arbitrary)
    - Extra credit: where did the 300mg cut-off come from?
- If intervene and decrease urine albumin, this is a real reduction in risk of progression
  - Most recent UACR is prognostic, even if previous test results were higher

Am J Kidney Dis 2008;51:759-766

UACR works in diabetic kids too

- Pima Indian Youth
  - Cross-sectional and prospective study of youth +/- diabetes from 1982 to 2007
  - Elevated urine albumin in nondiabetic youth: infrequent and largely transient
    - Diabetic youth: frequent and largely persistent
  - "Microalbuminuria in youth with type 2 diabetes strongly predicts progression to macroalbuminuria, which supports annual screening for albuminuria."

Pediatrics 2010;125:e844-e851

Urine Albumin Testing: What to do?

- Sit down with lab manager, CAC: figure out which tests are being done and how they're named
- Be sure that lab performing (or sending out) UACR, ensure that it is clearly named in EHR and that results are in correct units (mg/g)
- Educate staff about UACR and make it the standard test at your facility for urine protein testing in patients with diabetes

Urine Albumin Screening and Monitoring in Type 2 DM

Albuminuria describes a condition in which urine contains an abnormal (high) amount of albumin. In people with Type 2 Diabetes, albumin is the primary protein excreted by the kidneys. Albuminuria is usually a marker of nephropathy and CVD. High levels and/or a rapid rise in urine albumin may be a sign of serious kidney disease. Not all kidney disease in people with diabetes is diabetic nephropathy; consider other causes of kidney damage.

The "gold standard" for kidney testing in people with diabetes = UACR and eGFR

Assessing Urine Albumin in Type 2 DM

1. **Screen:** Check UACR at diagnosis of Type 2 DM and yearly
2. **Diagnosis:** positive diagnosis albuminuria if UACR is greater than 30mg/g on 2 separate occasions
3. **Monitor:** Recheck UACR every year

   More frequent monitoring may be needed in patients with changing clinical status or after therapeutic interventions.

   (Do not monitor urine albumin in dialysis patients)

When you should NOT screen for proteinuria:

Do not screen if symptoms of UTI or a UA that is positive for leukocytes, nitrite, or RBC. Address these issues first, then screen for urine protein once resolved

Causes of false positives include: strenuous exercise within 24 hours, infection, fever, CHF, marked hyperglycemia, pregnancy, marked hypertension, UTI, and hematuria.

Management of Albuminuria

The following strategies should be implemented to reduce albuminuria, prevent/slow nephropathy progression, and lower the risk of CVD:

Maximize ACE Inhibitor/ARB	BP Control
Stop smoking	Lipid Control
Protein restriction (later stages)	Glucose Control

Repeat UACR to monitor effectiveness of intervention; a decrease in urine albumin is therapeutically significant

Urine Albumin Tests

1. Urine Albumin: Creatinine Ratio (UACR)

- UACR measures Albumin excretion in: mg albumin/g creatinine
- Run on a spot urine sample; timed samples not necessary. This test accounts for variation in urine concentration
- Good at assessing any level of proteinuria
- Values can be used for screening, diagnosing, and monitoring interventions, for guiding therapy
- Requires lab analysis; Currently no CLIA waived POC test

The "gold standard" for urine albumin testing = UACR

Other urine protein tests

These tests are not recommended for assessing albuminuria

2. Urine Protein: Creatinine Ratio (UPCR)

- Not sensitive for early detection; not standardized

3. 24 hour urine collection for protein

- Labor intensive for patients and is difficult to get a complete and accurate sample; no more effective than simpler tests such as UACR for DM nephropathy

4. Microalbumin:Creatinine strips (e.g. Clinitek)

- Results may look like UACR (mg alb /g creatinine) but less accurate
- Local lab test names vary widely; Talk with *your* lab on how to order a UACR (and not a test strip).

5. Microalbumin strips (e.g. Micral)

- Less accurate; resulted as mg alb/L

6. UA dipstick

- Only detects higher levels of proteinuria (>300mg/g)
- Not precise and cannot be used to assess or monitor albuminuria in Type 2 Diabetes

This year's Diabetes Audit will still count any type of urine protein screening, but UACR is preferred

Albuminuria is a continuous variable, the terms "microalbuminuria" and "macroalbuminuria" are going out of use.

Since these terms are still used for ICD9 Coding:

Normal = < 30mg/g
Microalbuminuria = 30 - 300mg/g
Macroalbuminura = > 300mg/g

Monitoring and Treatment of CKD Complications

Nephrology Referral

- No predefined threshold
  - Depends on primary care provider and setting
- Situations to consider referral:
  - Unsure as to etiology of CKD (e.g. need a biopsy)
    - Not all CKD in diabetes is diabetic nephropathy!
  - Rapid progression/significantly elevated urine albumin (e.g. >1000mg/g)
  - Difficulty controlling complications
  - Usually by eGFR <30
    - Goal: educated pt who has chosen renal replacement option (including transplant) in advance and begins dialysis with mature fistula/graft (or ready for PD) calmly in the light of day with CKD complications controlled
      - Quality of care indicator

Current Controversy: Treating CKD Anemia with ESAs

- Erythropoiesis-stimulating agents (ESAs)
  - TREAT: ↑risk of stroke, thromboembolism, cancer?
    - No benefit in mortality, CV or renal outcomes

      NEJM 2009;361(21):2019-2932
  - "…with the latest clinical trials and meta-analyses, these therapies seem not only expensive but also very much a clinical tradeoff (increased risk of adverse effects versus a small gain in fatigue scores)."

    Clin J Am Soc Nephrol 2010;5:929-935
  - "…the best evidence we have so far supports holding off on ESA treatment for the majority of nondialysis patients who have CKD with anemia unless there are extenuating circumstances."
    - Hb 9-11 g/dl: Fe (PO or IV), r/o occult bleeding
    - Hb< 9 mg/dl with sx: blood transfusion, short course of ESA, long-term ESA (lowest dose to achieve Hb 9-11 mg/dl, but <5,000 U per week)

      J Am Soc Nephrol 2010;21:2-6

Type 2 Diabetes - Chronic Kidney Disease

Type 2 Diabetes - Chronic Kidney Disease

CKD is eGFR < 60ml/min **or** kidney damage for ≥ 3 months (e.g. urine sediment, abnormal imaging, or albuminuria (UACR < 30mg/g = nl, 30-300 = micro, >300 = macro))

Stages of Chronic Kidney Disease (CKD)

	1	2	3	4	5
eGFR	> 60	> 60	30-59	15-29	< 15 ml/min/1.73m^2

Markers of progression: decreasing eGFR, increasing albuminuria, poor BP control

Workup of CKD and to r/o non-diabetes causes

CMP, UA, UACR, Uric Acid, Phos, CBC, ANA, RF, C3, C4, HepB sAg, HepC Ab, dilated retinal exam, and renal U/S; if pat >40 yrs & UACR is pos then check SPEP and UPEP

Referrals

Nephrologist: When eGFR < 30 or sooner if unsure of etiology or problems
Nutrition: Refer to RD for consult (protein, Na+, K+, PO4, fluids, saturated fat)

Managing Complications of CKD – Stages 3-5

Acidosis

If CO2 < 22mmol/L	Start sodium bicarbonate 325-650mg (1-2 tabs) TID-QID	Goal: CO2 ≥ 22mmol/L

Anemia

Check Hb at least yearly: Anemia = Hb <13.5 g/dL adult men, <12 g/dL adult women; r/o B12/folate deficiency, GI blood loss, other causes
Baseline Labs: Ferritin, transferrin % sat, iron studies (Fe, % Sat, TIBC), CBC+diff
Start oral iron therapy if ferritin/iron studies low
Ferrous Sulfate (FeSO4) 325mg daily to TID
Consider docusate 100mg BID to reduce constipation
Monitor ferritin to avoid iron overload
Consider IV iron or blood transfusion if needed
Safety of erythropoiesis stimulating agents (ESA) unclear; reserve for patients on dialysis, pending renal transplant, or Hb < 9 with symptoms unresponsive to treatment above

Blood Pressure

Most effective CKD intervention: **BP goal <130/80**; continue ACEI/ARB (watch K+)

Cardiovascular Disease (CVD)

CVD: CKD increases CVD risk – patients on aspirin (if no contraindications)
Achieve lipid targets, encourage tobacco cessation

Diabetes

Blood sugar control—as renal fxn declines pts' BGs often improve—titrate meds down as needed; Caution setting an A1c target <7% if advanced CKD or CVD
D/C metformin when Creatinine >1.5 men or >1.4 women
Peripheral Neuropathy: Foot ulcers common, check feet each visit, refer to shoe clinic
Retinopathy: Ophth/retinal visits regularly
Autonomic Neuropathy: Frequent BP fluctuations, including orthostatic symptoms.

Edema/Fluid Overload

Establish patient's dry wt; Titrate furosemide 20-240mg BID (diuresis lasts 6 hours-give AM & mid-day)

Metabolic Bone Disease

Evidence Based **Phosphorus (PO_4)**: if >4.6 mg/dL, start binder (calcium); Refer to RD for dietary PO_4 restriction
Calcium (Ca): If <8.4, start/increase calcium supplementation; target: 8.4-9.5 mg/dL
If >10.2, correct causes (often 2° meds), need to hold Ca and/or Vit D/calcitriol
Consensus Opinion: If iPTH elevated, measure 25(OH) Vitamin D; If 25(OH)D >=30mg/mL, start calcitriol
If 25(OH) Vitamin D <30mg/mL, start ergocalciferol (Vitamin D2)

Follow Ca, PO_4, iPTH, and 25(OH)D (Vitamin D): if Ca or PO_4 above target or if iPTH below target, hold calcitriol and/or calcium

CKD Stage	eGFR	iPTH goal	PO_4 Goal	Ca Goal	Ca goal Ca x PO_4
3	30-59	35-70	2.7-4.6	8.4-9.5	< 55
4	15-29	70-110	2.7-4.6	8.4-9.5	< 55
5	< 15	150-300	3.5-5.4	8.4-9.5	< 55

Medication*	iPTH efect	PO_4 effect	Ca effect	Comments
Phosphate Binders				
$CaCO_3$ (Oyst-Cal or TUMS) 500-2000mg with meals	–	↓	↑	Use if Ca < 8.4; No more than 7g/d
Ca Acetate 1334-2868mg with meals	–	↓↓	↑	Use if Ca < 8.4 & PO_4 > 5
Sevelamer (Renagel) 800-1600mg TID	–	↓↓		Decrease PO_4, no effect on Ca; cost
Lanthanum 1500-3750mg/day w/ meals	–	↓↓	↓	Decrease PO4 and Ca; cost
Aluminum 600-1200mg TID between meals & HS	–	↓↓	–	ONLY if PO_4 > 7 and Ca x PO_4 > 55; not more than 30 days (toxicity)
Vitamin D and Analogs				
Vit D2 (Ergocalciferol) 1.25-5mg daily	↓	–	↑↑	Use if Vit D < 30 mg/mL
Calcitriol 0.25-1mcg daily or 0.5-3mcg TIW	↓	–	↑↑	Use only if Ca & PO_4 in normal range
Doxercalciferol 1-3mcg daily or 10-20mcg TIW	↓	–	↑	Hold if Ca x PO_4 > 55
Other				
Cinacalcet 30-180mg daily	↓	↓	↓↓	Do not use if Ca < 8.4

*Always include dietary phosphorous restriction
Drugs in italics are not on the IHS National Core Formulary

Lab Monitoring

Parameter	GFR > 60	GFR 30-59	GFR 15-29	GFR<15 not on Dialysis
Creatinine and eGFR	Annual	Each visit	Each visit	Each visit
UACR	Annual	Q3-6mos*	Each visit*	Each visit*
Hb	Annual	Q3mos	Q3mos	Q3mos
Fe, Transferrin Sat, Ferritin		Q3mos	Q3mos	Q3mos
Ca, PO_4, and iPTH		At least annually	Q3mos	Q3mos

Monitor more often if values are worsening or on medications that affect these labs
***Frequency of checking depends on rate of rise of urine albumin**

Ref: KDOQI/NKF and UK Renal Assoc 4th Ed. Clinical Practice Guidelines for Complications of CKD
ADA Clinical Practice Recommendations 2010. J Am Soc Nephrol 2010; 21:2-6.

CKD Tools

And where to get them

NKDEP

- National Kidney Disease Education Program (NKDEP)
  - Many excellent tools, videos, handouts, referral form
  - NKDEP Director: Dr. Andy Narva
  - Website: nkdep.nih.gov

NKDEP
National Kidney Disease Education Program

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Chronic Kidney Disease (CKD) Overview

CKD is a growing epidemic. However, economical and effective testing and treatment exist.

- **Definition:** What is CKD?
- **Risk Factors:** Who is at risk for CKD?
- **Prevention:** How can I help my patients slow chronic kidney disease and prevent kidney failure?
- **Diagnosis:** How do I test my patients for CKD?
- **Treatment:** What can I offer my patients with CKD?

Educating Patients about CKD

Short videos demonstrating patient- provider interactions.

Watch now.

Tools & Resources

NKDEP assists practitioners by providing an array of resources and tools.

- *CKD and Drug Dosing: Information for Providers*
- Explaining Your Kidney Test Results: A Tear-off Pad for Clinical Use | Adobe PDF (407K) **(New)**
- Explaining GFR: A Tear-off Pad for Clinical Use (Spanish) | Adobe PDF (384K)
- Continuing Medical Education
- GFR Calculators - for adults (Original MDRD and IDMS-Traceable MDRD) and children
- Selecting the Correct Child Calculator
- Frequently Asked Questions About Estimated GFR Values
- Quick Reference on UACR and GFR | Adobe PDF (173K)
- Consult Letter Template - for nephrologists to facilitate communication with PCPs
- CKD Quick Reference Card | Adobe PDF (137K)
- Body Mass Index (BMI) Calculator

Clinical Practice Guidelines

NKDEP provides practical guidance for optimal patient care in the treatment of cholesterol, chronic kidney disease, diabetic nephropathy, hypertension, and nutrition.

Educating Patients

Patient education is an effective and important, yet often underutilized, component in CKD treatment. NKDEP offers a variety of tools and resources to help health professionals educate their patients. These include:

- **Short Web Videos** demonstrating sample patient-provider interactions around common CKD questions. Topics include CKD and risk, treatment, testing and diagnosis, and dialysis and transplantation.
- **Patient Education Concepts** for providing diabetes self-management education to patients. Includes talking points to help answer common questions patients may have.
- **Explaining Your Kidney Test Results: A Tear-off Pad for Clinical Use** to help providers discuss urine albumin and GFR results with their patients. The tear-off pad includes 50 easy-to-read patient education sheets with basic information about CKD and tips to keep the kidneys healthy.

View a complete listing of free NKDEP materials and resources for patients, families, health professionals, and laboratory professionals.

Statistics

NKDEP provides sources for statistics on the incidence and prevalence of kidney disease.

Related Links

- National Kidney and Urologic Diseases Information Clearinghouse - public inquiry response, publications, referrals to health information resources, and more
- Directory of Kidney and Urologic Diseases Organizations - voluntary, governmental, and private organizations providing services related to kidney disease

PDF files require Adobe Acrobat

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Last Reviewed: May 21, 2010

NKDEP is an initiative of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), National Institutes of Health (NIH), U.S. Department of Health & Human Services (DHHS).

U.S. Department of Health & Human Services | National Institutes of Health | NIDDK | USA.gov

NKDEP
National Kidney Disease Education Program

Urine Albumin-to-Creatinine Ratio (UACR)

In Evaluating Patients with Diabetes for Kidney Disease

The two key markers for kidney disease are urine albumin and estimated glomerular filtration rate (eGFR).

For patients with type 1 diabetes for 5 years or more or with type 2 diabetes, the American Diabetes Association and the National Kidney Disease Education Program (NKDEP) recommend that health care professionals:

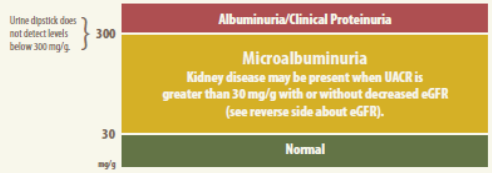
- Assess urine albumin excretion yearly to diagnose and monitor kidney damage. More frequent monitoring may be indicated in patients with changing clinical status or after therapeutic interventions.
- Screen using a spot UACR. UACR estimates 24-hour urine albumin excretion. 24-hour collection and timed specimens are not necessary.

Reducing urine albumin to the normal or near-normal range may improve renal and cardiovascular prognoses.

$$\frac{\text{Urine albumin (mg/dL)}}{\text{Urine creatinine (g/dL)}} = \text{UACR in mg/g} \approx \text{Albumin excretion in mg/day}$$

UACR is a ratio between two measured substances. Unlike a dipstick test for albumin, it is unaffected by variation in urine concentration.

Interpreting UACR Results



If kidney disease is detected, it should be addressed as part of a comprehensive approach to the treatment of diabetes.

For more information on UACR and kidney disease, go to *www.nkdep.nih.gov*.

NKDEP, a program of the National Institutes of Health, aims to improve early detection of kidney disease, help identify patients at risk for progression to kidney failure, and promote interventions to slow progression of kidney disease.

NIH Publication No. 08-6286 • May 2008

U.S. Department of Health and Human Services
National Institutes of Health

NKDEP
National Kidney Disease Education Program

Estimated Glomerular Filtration Rate (eGFR)

In Evaluating Patients with Diabetes for Kidney Disease

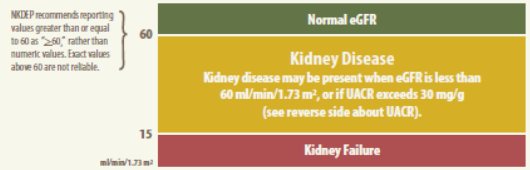
The two key markers for kidney disease are eGFR and urine albumin.

The American Diabetes Association and the National Kidney Disease Education Program (NKDEP) recommend that health care professionals:

- Calculate eGFR from stable serum creatinine levels at least once a year in all patients with diabetes.
  - eGFR is more accurate than serum creatinine alone. Serum creatinine is affected by muscle mass, and related factors of age, sex, and race.
  - eGFR is not reliable for patients with normal kidney function, rapidly changing creatinine levels, or extremes in muscle mass and diet, e.g., very muscular or large people, cachectic people, and vegans.

See if your lab reports eGFR routinely or if you need to request it. GFR calculators are available on NKDEP's website at *www.nkdep.nih.gov*.

Interpreting eGFR Results



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U.S. Department of Health and Human Services
National Institutes of Health

IHS Division of Diabetes

- Website: www.ihs.gov/MedicalPrograms/Diabetes
- CKD Quick Guide cards
- "Advancements in Diabetes" web seminars
  - Recordings available on website: 2 CKD sessions
- Algorithm cards:
    - Urine Protein
    - CKD Complications
    - Also: Glucose Control, HTN, Lipids, Foot Care, Insulin
    - Very soon: Neuropathic Pain treatment
- Advances in Indian Health Conference
  - May 3-6, 2011 in Albuquerque
  - Diabetes track including CKD

Division of Diabetes Treatment and Prevention

Leading the effort to treat and prevent diabetes in American Indians and Alaska Natives

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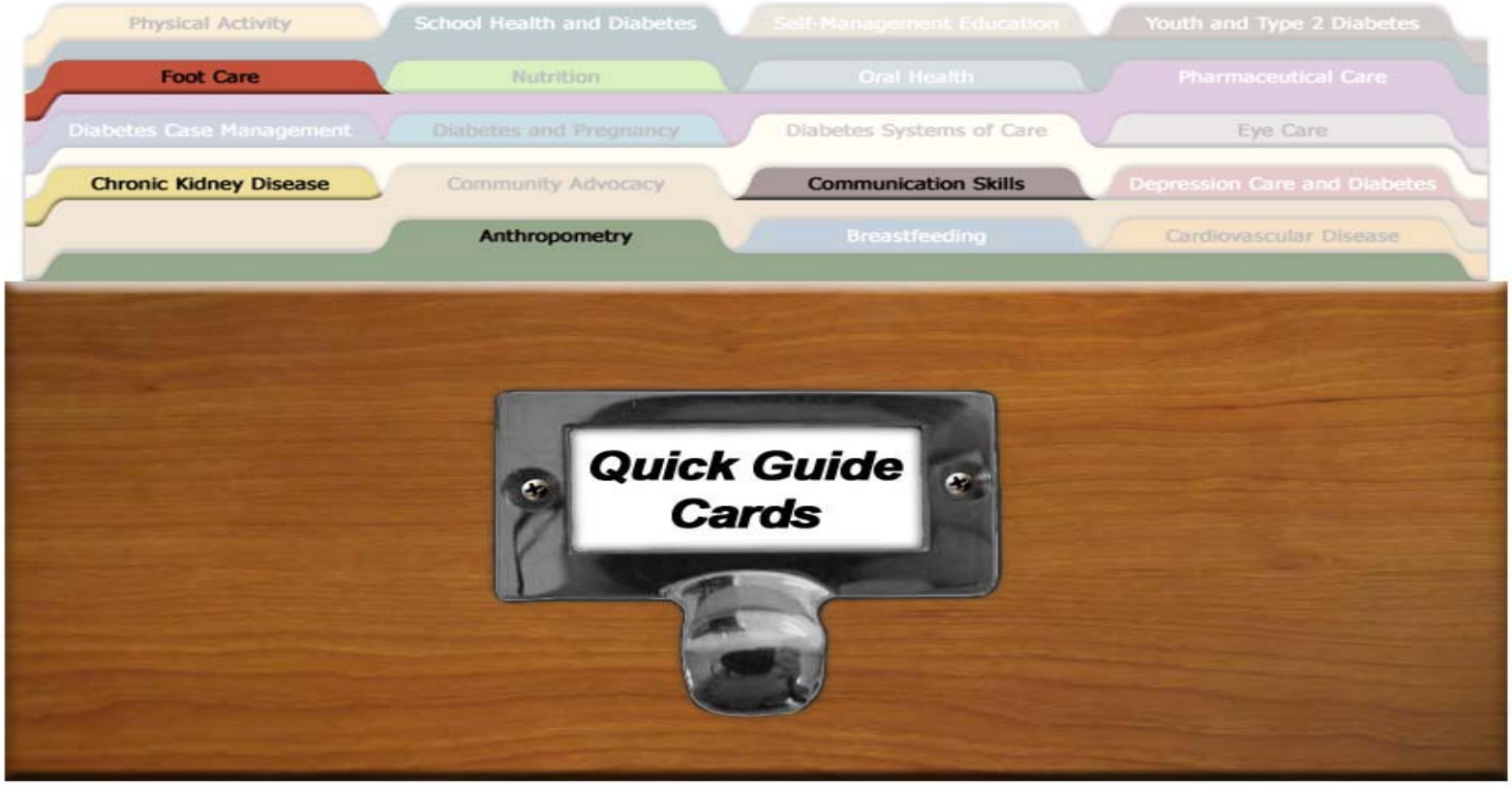
Quick Guides

Under each tab you will find a set of cards on various diabetes related topics. Each set includes an overview, resources and several 'how to' short video tutorials. Check back as new cards will be added.



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Quick Guides

Algorithm Cards (1 of 2) (PDF, 33KB / DOC, 328KB) | Best Practice (PDF, 167KB) | Standards of Care (PDF, 234KB)

Why is this important?

- Early CKD detection/treatment ↓'s development of kidney failure 30-70%.
- Screen, diagnose, monitor, treat CKD complications.
- Early preparation for kidney replacement therapy (transplant, dialysis) improves outcomes.

Quick Facts

- Screen all DM pts yearly:
  - Creatinine/eGFR (estimated Glomerular Filtration Rate).
  - UACR (Urine Albumin to Creatinine Ratio).
- Dx CKD: ≥ 3 mos duration of either:
  - **decreased function** - eGFR < 60 mL/min/1.73 m^2 or
  - **evidence of damage** - UACR ≥ 30 mg/g or other.
- BG & BP control (ACE inhibitor/ARB) ↓'s CKD progression.
- R/O non-DM potential causes of CKD.
- eGFR < 60 mL/min/1.73 m^2: monitor/treat CKD complications:
  - Acidosis
  - Anemia
  - CVD
  - Edema/Fluid Overload
  - Metabolic Bone Disease
  - Uremia
- Monitor pts more closely if:
  - Amount of albuminuria is high (e.g. UACR >1000 mg/g) or
  - Rate of albuminuria increases rapidly.
  - Nephrology referral:
    - If unsure of cause of CKD (e.g. renal biopsy needed).
    - Difficulty controlling complications of CKD.
    - Usually once eGFR < 30 mL/min/1.73 m^2.
    - Rapid progression of CKD.

Important Resources

- Quick Reference on UACR and eGFR – Describes the two key markers for kidney disease, urine albumin and estimated glomerular filtration rate (eGFR).
- Patient Education Videos - Short videos demonstrating patient-provider interactions around common CKD questions. Topics include CKD and risk, treatment, testing and diagnosis, and dialysis and transplantation.

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Quick Guides

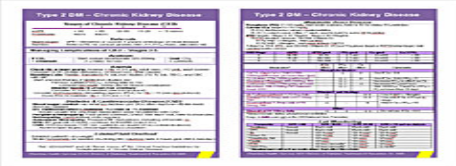
Return to Cards

CKD
Overview | How To | Other Resources
Screening and Diagnosis | Treating Complications

Algorithm Card (DOC, 328KB) | Best Practice (PDF, 167KB) | Standards of Care (PDF, 234KB)

Treating Complications

- Nephrology Referral:
  - If unsure of cause of CKD (e.g. renal biopsy needed).
  - Difficulty controlling complications of CKD.
  - Usually once eGFR < 30 mL/min/1.73 m^2.
  - Rapid progression of CKD.
  - Plan for kidney replacement (transplant, dialysis).
    - Goal: start dialysis using mature fistula or graft.
- Nutrition Referral: protein, phosphorus, sodium, potassium.
- Educate patient/family about CKD:
  - Progressive nature of CKD
  - Eventual need for renal replacement therapy
  - Protecting arm designated for fistula placement
  - Dialysis options (hemo, peritoneal)
- When eGFR < 60 mL/min/1.73 m^2: monitor/treat CKD complications (Type 2 DM and CKD Algorithm):
  - Acidosis: Bicarbonate goal ≥ 22mmol/L
  - Anemia:
    - Monitor Hb.
    - Treat with Fe (PO or IV if needed) as appropriate.
    - Consider blood transfusion for significant anemia with Sx.
    - If Hb < 9 g/dL with Sx, not responding to above, consider Erythropoiesis-Stimulating Agent (ESA).
      - safety in nondialysis patients not clear, so restrict use:
        - Consider short term "rescue" ESA course.
        - If use ESA long-term to ↓ Sx, use low dose and aim to slowly ↑ Hb.
  - CVD: CKD further increases CVD risk:
    - Anti-platelet agent (e.g. ASA) if no contraindications
    - Achieve lipid targets
    - Tobacco cessation
  - Fluid Overload – diuretics as needed:
    - Thiazides while eGFR >30 ml/min.
    - Loop diuretics (e.g. furosemide) when eGFR < 30 ml/min.
  - Metabolic Bone Disease:
    - See Type 2 DM and CKD Algorithm for goals.
      - Control phosphorus, replace calcium.
      - Monitor iPTH, 25 (OH) Vitamin D; consider treatment.
  - Other issues:
    - Foot ulcers common in CKD pts: check feet each visit, refer to foot clinic.
    - Hypertension – goal still < 130/80, continue ACE Inhibitor/ARB (watch potassium).



Important Resources

- CKD and Drug Dosing: Information for Providers – Estimation of Kidney Function for Prescription Medication Dosage in Adults.
- Consult Letter Template – for nephrologists to facilitate communication with PCPs.
- Patient Education Videos – Short videos demonstrating patient-provider interactions around common CKD questions. Topics include dialysis and transplantation.

Bottom Line…

- eGFR and UACR are important tests for screening, diagnosing and monitoring CKD in DM
  - Order at DM dx, then yearly
  - More often if changing rapidly, assessing interventions, and once CKD advanced
- CKD Dx= eGFR<60 *or* UACR ≥30 mg/g for at least 3 months
  - Microalbuminuria= 30-300 mg/g, macro >300 mg/g
- Just as important as testing is **treating**!
  - **Blood Pressure** (goal <130/80)
    - Maximize ACEi/ARB
  - Glucose control
  - CVD risk: lipids, ASA as indicated, smoking cessation
  - Nephrology referral once eGFR <30 or sooner if:
    - CKD etiology unclear
    - Rapid decline in eGFR and/or increase in UACR
    - Difficulty managing any CKD issue

CKD Case Study #1

- 76 y/o man with DM x 20 years
- eGFR 58 mL/min/ 1.73 m2, UACR 178 mg/g
- iPTH, Calcium, Phosphorus, Hgb normal
- A1c 6.6%
- Lipids: Total 139,LDL 62, HDL 49, TG 140
- BP 150/80—had orthostatic sx requiring reduction in BP meds 6 mos ago
- No edema, no known CVD
- Meds: statin, ASA, ARB, gabapentin, insulin

CKD Case Study #2

- 39 y/o female, Type 2 DM dx'd at age 16
- eGFR 20 mL/min/ 1.73 m2, UACR 800 mg/g
- Hgb 9.4, 25(OH)D 11, iPTH 208, CO2 19, PO4 5.86 (2.5-4.5), Ca 8.0 (8.4-10.2),T.Pro 5.7 (6.4-8.2),Alb 2.62 (3.9-5), LDL 157
- Pt is s/p amputation of 3 toes, retinal hemorrhage. Father died of DM complications at age 51
- Multiple caregiving responsibilities so she seldom comes to clinic for medical care
- Affect: angry and sad; notes h/o poor sleep