Diabetic Nephropathy: CKD Screening, Monitoring, and Treatment

Ann Bullock, MD
IHS Division of Diabetes Treatment and Prevention
(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
Kidney Disease
1996-2007

- Urinalysis
- Proteinuria
- ACE inhibitor

What is Chronic Kidney Disease?

CKD is at least 3 months ("chronic") of either:

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

  or

- 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*

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<td>5</td>
<td>Kidney Failure</td>
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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](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**

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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:

- normoalbuminuria < 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
- 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
- Macroalbuminuria = > 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).”
  - “…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)
Type 2 Diabetes - Chronic Kidney Disease

**Stages of Chronic Kidney Disease (CKD)**

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<td>30-59</td>
<td>2</td>
</tr>
<tr>
<td>15-29</td>
<td>3</td>
</tr>
<tr>
<td>&lt; 15</td>
<td>4</td>
</tr>
<tr>
<td>&lt; 15</td>
<td>5</td>
</tr>
</tbody>
</table>

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

**Workup of CKD and to rule non-diabetes causes**
- CMP, UA, UACR, Uric Acid, Phos, CSC, ANA, RF, C3, C4, HEP B & Ag, HEP C Ab, dilated retinal exam, and renal US. If ptt >40 yrs & UACR is pos then check SLEP 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; rif B12/folate deficiency, GI bleed 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 decosasate 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 ACE/ARB (watch K+);

**Cardiovascular Disease (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/IC metformin when Creatinine >1.5 men or >1.4 women

**Peripheral Neuropathy:** Foot ulcer common, check feet each visit, refer to shoe clinic

**Retinopathy:** Ophth/retinal visits regularly

**Autonomic Neuropathy:** Frequent BP fluctuations, including orthostatic symptoms

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**Type 2 Diabetes - Chronic Kidney Disease**

**Edema/Fluid Overload**

- Establish patient’s dry wt; Titrate furosemide 20-240mg BID (diuretics last 6 hours give AM & mid-day)

**Metabolic Bone Disease**

- Intestinal Absorption: Phosphate (PO4), if >4.5 mmol/L, start binder (calcium). Refer to RD for dietary PO4 restriction
- Calcium (Ca): if <9.4, intravenous calcium supplementation: target 8.4-9.5 mmol/L
- If >10.2, consider dialysis (often 2X/week need to hold Ca and vitamin D intake)

**Concentration/Output:** If PTTH elevated, measure 25(OH)D, Vitamin D; if 25(OH)D <30ng/mL, start calcitriol
- If 25(OH)D <30ng/mL, start calcitriol (Vitamin D2)

**Follow Ca, PO4, PTH, and 25(OH)D (Vitamin D):** If Ca or PO4 above target or if PTTH below target, hydroxide and/or calcium

<table>
<thead>
<tr>
<th>CKD Stage</th>
<th>eGFR</th>
<th>iPTH effect</th>
<th>PO4 effect</th>
<th>Ca effect</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30-59</td>
<td>30-70</td>
<td>2.7-8.4</td>
<td>8.4-9.5</td>
<td>&lt; 65</td>
</tr>
<tr>
<td>2</td>
<td>15-29</td>
<td>70-110</td>
<td>2.7-8.4</td>
<td>8.4-9.5</td>
<td>&lt; 65</td>
</tr>
<tr>
<td>3</td>
<td>&lt; 15</td>
<td>150-300</td>
<td>3.5-8.4</td>
<td>8.4-9.5</td>
<td>&lt; 65</td>
</tr>
</tbody>
</table>

**Best Practice for Anemia**

- Epoetin: 40mg SQ weekly

**Vitamin D and Analogs**

- Vit D2 (Ergocalciferol): 1,250 IU daily
- Vit D3 (Cholecalciferol): 400 IU daily

**Other**

- Ciclosporin 300-1000mg daily

**Lab Monitoring**

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

**Parameter**

<table>
<thead>
<tr>
<th>Creatinine &amp; GFR</th>
<th>GFR &gt; 60</th>
<th>GFR 30-59</th>
<th>GFR 15-29</th>
<th>GFR &lt; 15 not on Dialysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine &amp; GFR</td>
<td>Annual</td>
<td>Each visit</td>
<td>Each visit</td>
<td>Each visit</td>
</tr>
<tr>
<td>UACR</td>
<td>Annual</td>
<td>G3-6mos*</td>
<td>Each visit*</td>
<td>Each visit*</td>
</tr>
<tr>
<td>Hb</td>
<td>Annual</td>
<td>Gm/mos</td>
<td>Gm/mos</td>
<td>Gm/mos</td>
</tr>
<tr>
<td>Fe, Transferrin Sat, Ferritin</td>
<td>Gm/mos</td>
<td>Gm/mos</td>
<td>Gm/mos</td>
<td></td>
</tr>
<tr>
<td>Ca, PO4, PTH</td>
<td>At least annually</td>
<td>Gm/mos</td>
<td>Gm/mos</td>
<td></td>
</tr>
</tbody>
</table>

**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: KDQI/K/UKRDA, National Clinical Practice Guidelines for Complications of CKD

IHS Division of Diabetes Treatment and Prevention, 2010
CKD Tools

And where to get them
National Kidney Disease Education Program (NKDEP)

- Many excellent tools, videos, handouts, referral form
- NKDEP Director: Dr. Andy Narva
- Website: nkdep.nih.gov
Urine Albumin-to-Creatinine Ratio (UACR)

The two key markers for kidney disease are urine albumin and estimated glomerular filtration rate (eGFR). For patients with type 2 diabetes for 5 years or more with type 2 diabetes, the American Diabetes Association and the National Kidney Disease Education Program (NKEP) recommend that healthcare providers:

- Assess urine albumin levels annually to identify and Management kidney damage. More frequent monitoring may be indicated in patients with changing albumin status or other chronic comorbidities.
- Monitor using a spot UACR. UACR estimates 24-hour urine albumin excretion. 11-microalbuminuria and abnormal UACR are an option.

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

Interpreting UACR Results

<table>
<thead>
<tr>
<th>Albuminuria/Clinical Proteinuria</th>
<th>Microalbuminuria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Kidney disease may be present when UACR is greater than 30 mg/g with or without decreased eGFR (see reverse side about eGFR).</td>
</tr>
</tbody>
</table>

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.kidney.org.gov.

Estimated Glomerular Filtration Rate (eGFR)

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

The American Diabetes Association and the National Kidney Disease Education Program (NKEP) recommend that healthcare providers:

- Calculate eGFR from creatinine levels at least once a year in all patients with diabetes.
- eGFR is more accurate than serum creatinine. Serum creatinine is affected by muscle mass, and normal values of age, sex, and race.
- eGFR is also reliable for patients with normal kidney function, rapidly changing creatinine, or patients who are elderly, very muscular, or have other disorders, and ages.

If your lab reports eGFR routinely or if you need to request it, eGFR calculations are available on NKEP’s website at www.kidney.org.gov.

Interpreting eGFR Results

| Kidney Disease | 60 ml/min/1.73 m² or eGFR < 60 ml/min/1.73 m² or if UACR is greater than 30 mg/g (see reverse side about UACR). |

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

For more information on eGFR and kidney disease, go to www.kidney.org.gov.
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
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.
Quick Guides

Why is this important?
- Early CKD detection/treatment is key to prevention 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: >2 mos duration of either:
  - Decreased function: eGFR < 60 mL/min/1.73 m² or evidence of damage: UACR > 30 mg/g or other.
- BG & BP control (ACE inhibitor/ARB) is CKD progression.
- R/O non-ON potential cause of CKD.
- eGFR < 60 mL/min/1.73 m² 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 m²
    - 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.
Treating Complications

- Nephropathy/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 m².
  - Rapid progression of CKD.
  - Plan for kidney replacement (transplant, dialysis).
- Goal: start dialysis using mature fistula or graft.
  - Educate patient/family about CKD:
    - Progressive nature of CKD.
    - Eventual need for renal replacement therapy.
    - Protecting arm designated for fistula placement.
    - Dialysis options (home, peritoneal).
  - When eGFR < 60 mL/min/1.73 m², monitor/track CKD complications (Type 2 DM and CKD Algorithm):
    - Acidosis.
    - Sarcopenia.
    - Aorta.
  - Anemia:
    - Monitor Hb.
    - Treat with Fe (PO or IV if needed) as appropriate.
    - Consider blood transfusion for significant anemia with Gx.
    - If Hb < 6 g/dL with Gx, not responding to above, consider Erythropoiesis-Stimulating Agent (ESA).
    - Safety in nondonor patients not clear, so restrict use.
    - Consider short term ‘rescue’ ESA course.
    - If use ESA long-term to > 6x, use low dose and aim to slowly 1 Hb.
  - Heart: 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 weekly, treat to stop ulcers.
    - Hypertension—goal still < 130/80. Continue ACE inhibitor/ARB (watch potassium).
**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