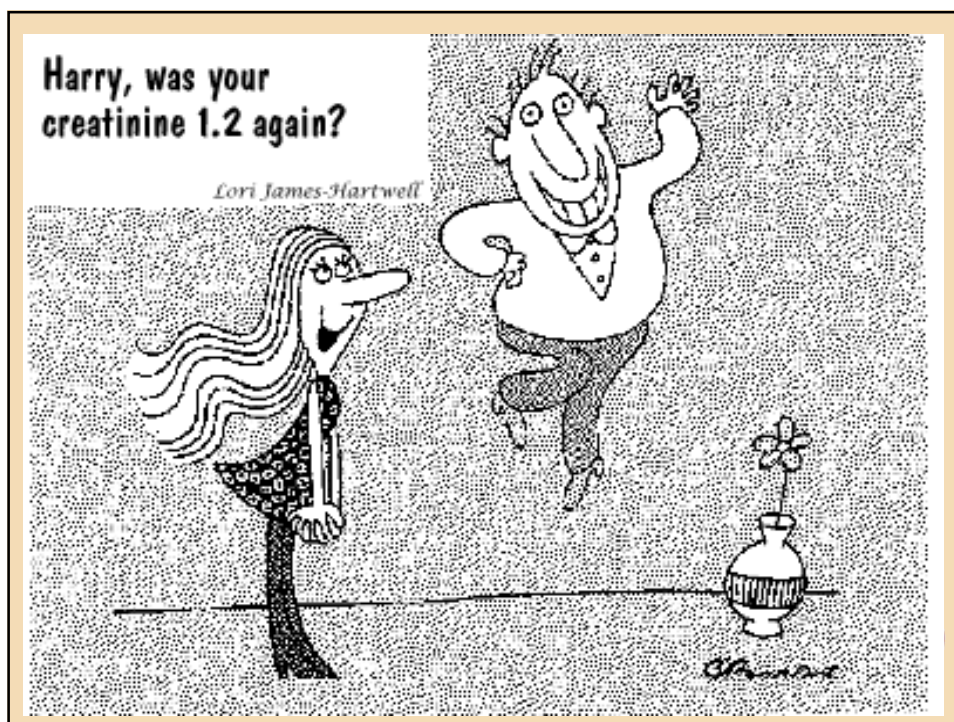
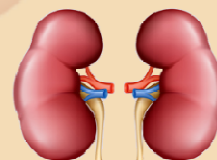


# Chronic Kidney Disease: *An Overview*

ANNA NC Statewide Symposium  
May 23, 2017

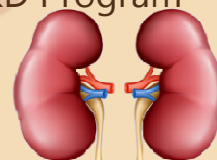
Leah Smith, MSN, APRN, FNP-BC, CNN-NP



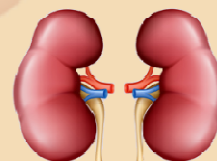
## Objectives




- Identify patients who have or are at risk for chronic kidney disease (CKD)
- Discuss the medical management of CKD patient
- Describe ways to utilize a CKD Program



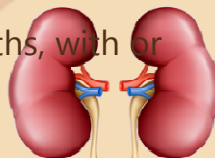
## OVERVIEW OF CKD






## What is CKD?

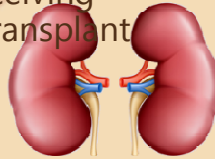
- **National Kidney Foundation (NKF) Definition**
  - Kidney damage/decreased function for  $\geq 3$  months
  - Defined by structural or functional abnormalities of the kidney, with or without decreased glomerular filtration rate (GFR), manifested by:
    - Pathological abnormalities
    - Markers of kidney damage, including abnormalities in the composition of the blood or urine, or abnormalities in imaging tests
  - GFR  $< 60$  mL/min/1.73 m for  $\geq 3$  months, with or without kidney damage

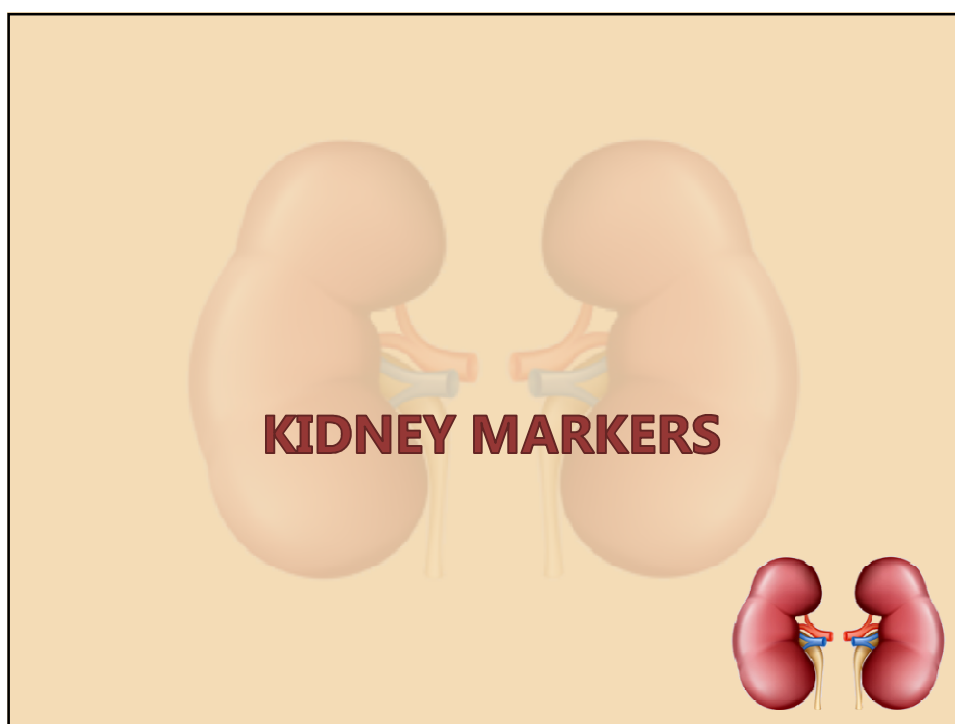
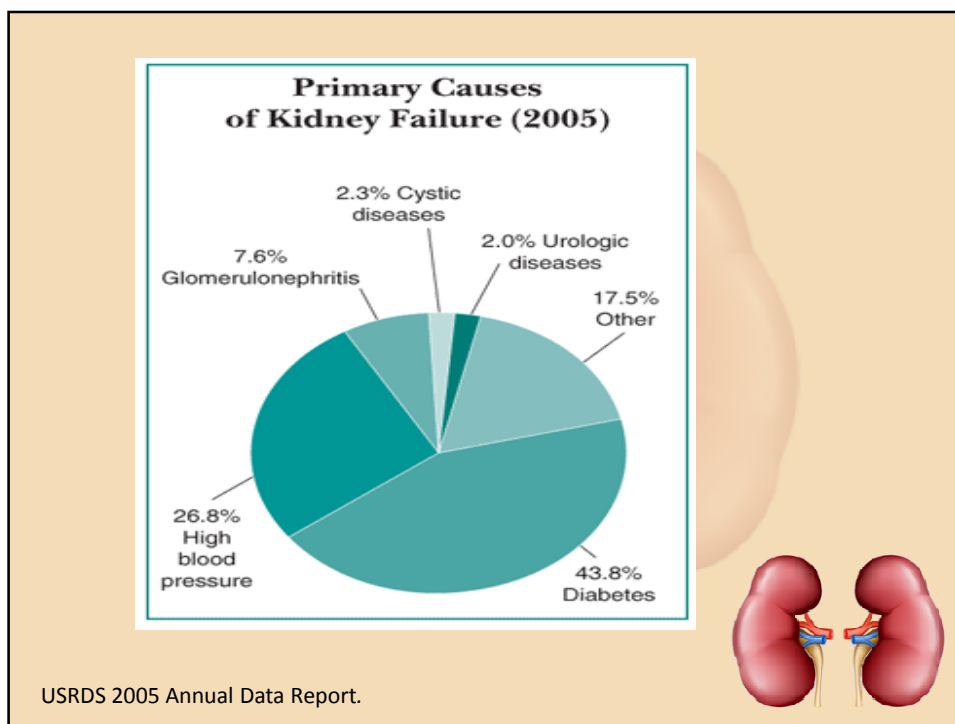


## CKD Statistics



- 1 in 9 American adults (age 20 & older) have CKD
- Estimated 26 million Americans
- 9<sup>th</sup> leading cause of death in America
- Each year kidney disease kills more than 14 out of 100,000 Americans
- The number of people diagnosed with CKD has **DOUBLED** each decade for the last 2 decades
- It is estimated that 800,000 patients in US have creatinine  $> 2$ mg/dL & 6.2 million have creatinine  $> 1.5$  mg/dL
- By 2030, new annual onset of ESRD will exceed 450,000 with  $> 2$  million receiving dialysis or transplant





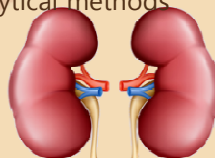


## Creatinine

- Creatinine is a metabolite from muscle
- It is secreted in the tubules
- Creatinine alone is NOT an accurate index of kidney dysfunction


– Affected by:

- Age
- Gender
- Race
- Body mass
- Muscle mass
- Body fat
- Metabolic state
- Pharmacologic agents
- Lab analytical methods



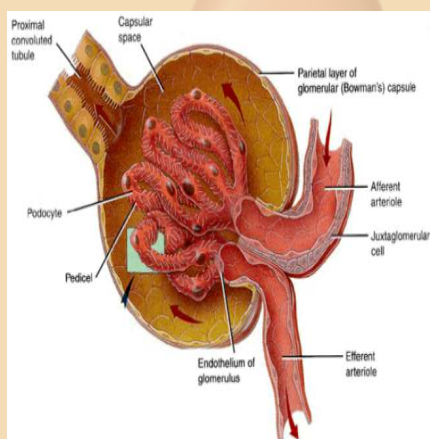
## Serum Creatinine vs. Creatinine Clearance

Renal Function	Serum Creatinine (mg/dL)	Creatinine Clearance Rate (mL/min/1.73 m <sup>2</sup> )
Normal		
Mild renal failure		
Moderate renal failure		
Severe renal failure		

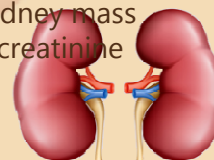


Kobrin & Aradhya 1997

# Glomerular Filtration Rate



- GFR is the BEST measure of kidney function
- Definition
  - The rate at which an ultrafiltrate of plasma is produced by the glomeruli per unit of time
  - Equal to the sum of filtration rates in each functioning nephron
- Provides a measure of the filtering capacity of the kidneys & an index of the functioning kidney mass
- Estimated by creatinine clearance



# CKD Prediction Equations

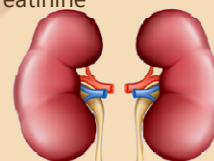
## Cockcroft-Gault Equation

- Used to estimate creatinine clearance (CCr)
- Takes into account:
  - Age, **weight**, gender & serum creatinine

## MDRD Equation

- Used to estimate GFR
  - Formula available on websites: ([www.kidney.org](http://www.kidney.org)) ([www.nkdep.nih.gov](http://www.nkdep.nih.gov))
  - Takes into account:
    - Age
    - Gender
    - **Race**
    - Serum Creatinine

Calculating CrCl with Cockcroft-Gault equation <sup>1</sup>	
<b>MALES</b>	<b>FEMALES</b>
$\frac{(140 - \text{age}) \times (\text{actual body weight in kg})}{72 \times (\text{serum creatinine})}$	$\frac{(140 - \text{age}) \times (\text{actual body weight in kg}) \times (0.85)}{72 \times (\text{serum creatinine})}$



## CKD-EPI eGFR Equation

- Original paper of the CKD-EPI equation was published in 2009 in the Annals of Internal Medicine
- In the Atherosclerosis Risk in Communities (ARIC) Study the CKD-EPI equation more appropriately categorized individuals with respect to long-term clinical risk compared with the MDRD equation
- Suggesting improved clinical usefulness in this middle-aged bi-ethnic population in the United States

$$\text{GFR} = 141 \times \min(\text{Scr}, 1)^{\alpha} \times \max(\text{Scr}, 1)^{-1.209} \times 0.993^{0.98} \times 1.018[\text{if female}] \times 1.159[\text{if black}]$$

$$k = 0.7 \text{ if female}$$

$$k = 0.9 \text{ if male}$$

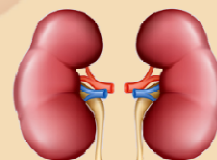
$$\alpha = -0.329 \text{ if female}$$

$$\alpha = -0.411 \text{ if male}$$

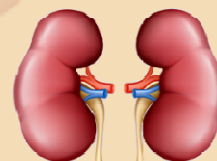
min = The minimum of Scr/k or 1

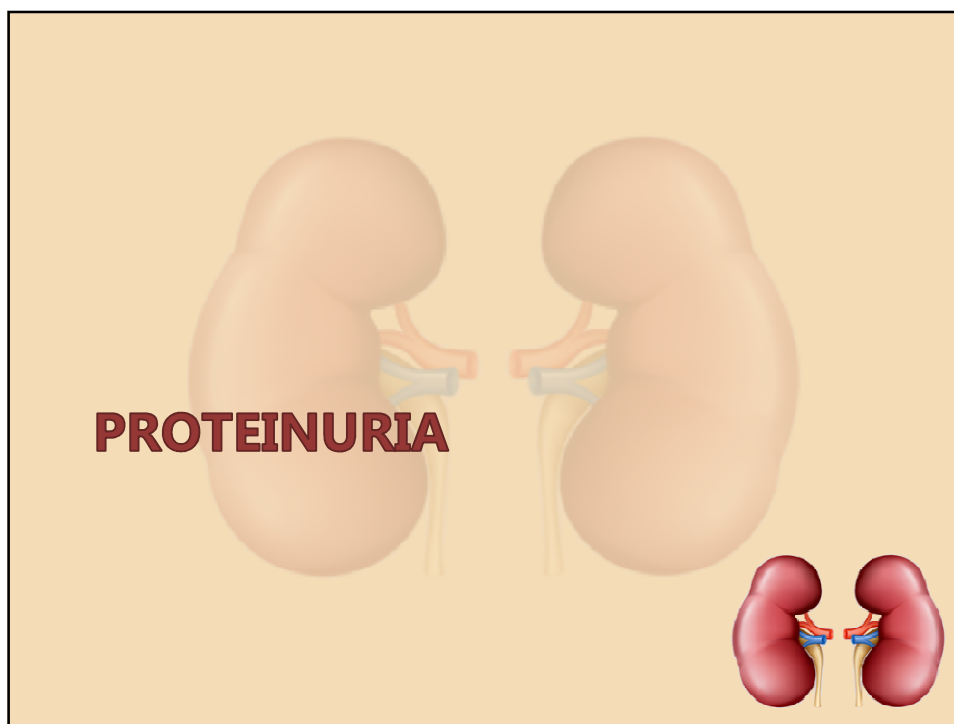
max = The maximum of Scr/k or 1

Scr = serum creatinine (mg/dL)



## MEDICAL MANAGEMENT OF THE CKD PATIENT

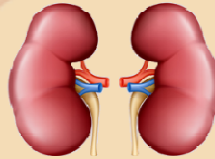




## Proteinuria

### Key Prognostic Finding in CKD

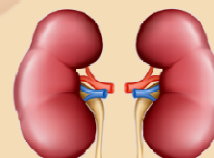
- In healthy kidneys, most proteins are too big to pass through the kidneys
- The glomerular basement membrane does NOT allow proteins to pass
- As the glomeruli are damaged from nephritis/glomerulonephritis, they release proteins esp. albumin into the urine ~ **"LEAKINESS"**
- Albumin's function in the blood includes retention of fluid in the blood
- Marker for declining kidney function



This slide contains a list of five bullet points explaining proteinuria. The text is in black, with the word "LEAKINESS" in bold red. The background features a faint, semi-transparent image of kidneys. In the bottom right corner, there is a smaller, more detailed illustration of two red kidneys with their respective ureters and blood vessels.

## Classifications of Proteinuria

- **KDIGO A1 < 30mg**
  - Normal to mildly increased
- **KDIGO A2 (30-300mg)**
  - **Microalbuminuria**
  - First evidence of kidney damage
    - Most common marker of kidney disease
    - Sensitive marker for diabetes, glomerular diseases, & HTN
- **KDIGO A3 > 300**
  - **Albuminuria/Macroalbuminuria (300-1000mg)**
    - Increased excretion of albumin
    - Preferred measurement until albumin in urine > 500mg/day
- **Proteinuria (1000-3000mg)**
  - Excretion of albumin & other proteins
  - Persistent proteinuria ≥ 3 months is an early marker of kidney disease
  - **> 3000 mg/day = Nephrotic - range proteinuria**
- **Nephrotic Syndrome (>3000mg)**
  - Edema
  - Hypoalbuminemia
  - Hyperlipidemia
  - May or may not have clotting abnormalities

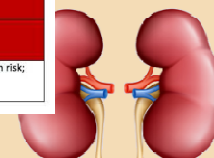


KDIGO 2012 CKD Guidelines

## Classification of CKD Based on GFR and Albuminuria Categories: "Heat Map"

Prognosis of CKD by GFR and Albuminuria Categories		Albuminuria categories Description and range		
GFR categories (ml/min/1.73 m <sup>2</sup> ) Description and range				

Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk; Orange: high risk; Red, very high risk.  
KDIGO 2012



Kidney Disease: Improving Global Outcomes (KDIGO)  
CKD Work Group. *Kidney Int Suppl.* 2013;3:1-150.



## Tests for Proteinuria

### • Urine Dipstick

- Used in screening CKD patients
- Colorimetric pH dye on pad of dipstick changes color to negatively charged serum proteins
- Detects total protein concentration of 10-20 mg/dL



### • Readings:

- Trace  $\approx$  5 to 20 mg/dL
- 1+  $\approx$  30 mg/dL
- 2+  $\approx$  100 mg/dL
- 3+  $\approx$  300 mg/dL
- 4+  $\approx$  > 2000 mg/dL

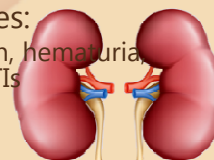
### • Positive reading 1+ or > should be re-measured in 3 months

### • False negatives:

- Excessive hydration

### • False positives:

- Dehydration, hematuria, exercise, UTIs



## Tests for Proteinuria

### 24-hour Urine Collection

- ✓ NO LONGER considered preferred treatment
- ✓ Collection errors include:
  - ✓ Improper timing, missed samples, & incomplete emptying of bladder

### In ESRD patients:

- ✓ 24 hour Urine for **CREATININE CLEARANCE** to evaluate 'true' kidney function NOT urea clearance
- ✓ Results: CrCL mL/min

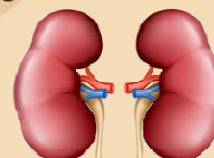


## Tests for Proteinuria



### Spot UP/C Ratio

- ✓ Preferred method for quantifying albumin or protein in the urine
- ✓ First morning specimens are preferred, but random samples are acceptable

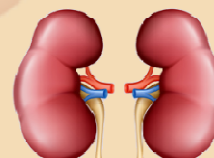


## How to Interpret Urine P/C Ratio

$$\frac{\text{Spot Urine Protein}}{\text{Spot Urine Creatinine}} = \text{UP/C Ratio}$$

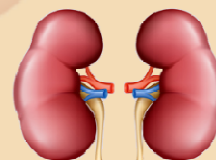
Convert milligrams to grams by moving decimal point over by 3

UP/C ratio of 0.45 = 450mg of Proteinuria



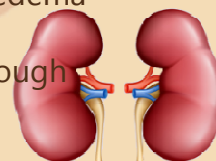
## Goals of Tx → Proteinuria

- ✓ Reduction in overall proteinuria
- ✓ UP/C Ratio < 500mg
- ✓ Watchful of **RETURN** of proteinuria especially in GN diseases = Exacerbation of disease



## ACE-I & ARBs: *First Line Therapy*

- ACE-I &/or ARBs are highly recommended with the presence of proteinuria
- Effects:
  - Renoprotective/Anti-proteinuric
    - Decrease intraglomerular pressure & improve glomerular barrier size selectivity
  - Decreasing arterial pressure leads to reduction in preload & afterload on the heart (*1<sup>st</sup> Line CHF*)
  - Initial decrease in GFR, mild increase in K<sup>+</sup>
  - Antihypertensive
    - Dilate arteries & veins thereby reducing arterial pressure
    - Promotes renal excretion of Na<sup>+</sup> & H<sub>2</sub>O
- Adverse Effects:
  - Hyperkalemia
    - Avoid other meds that ↑ K<sup>+</sup>: K<sup>+</sup> supplements, K<sup>+</sup> sparing diuretics, & COX 2 inhibitors
  - ACE-I
    - Cough (Dry & Persistent)
    - Angioedema
  - ARBs
    - Less Cough

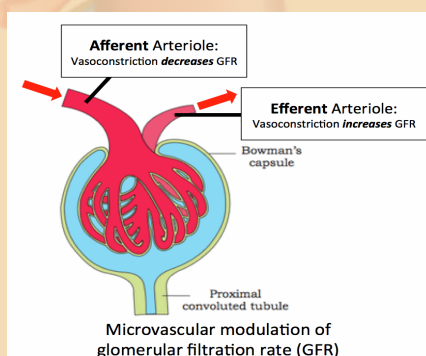


## ACE-I & ARBs: Contraindication → Bilateral RAS

- **Reason**
  - Elevated angiotensin II in RAS
  - Constricts the efferent arteriole more than the afferent arteriole within the kidney
  - This constriction helps to maintain glomerular capillary pressure and filtration
  - IF this constriction on the efferent arteriole is removed, it can cause an abrupt fall in glomerular filtration rate
  - Thus leading to ARF

- **Reminder**
  - *Efferent arteriole takes blood away from the glomerulus*
  - *Afferent arteriole brings blood from the body into the glomerulus*

- **Monitoring**
  - **Repeat Creatinine & K+ within 7 to 10 days**



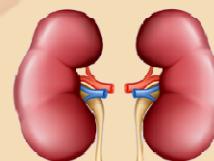
## RAAS Blockade

ACE Inhibitors	Angiotensin Receptor Blockers	Direct Renin Inhibitor

## Additional Treatments for Proteinuria

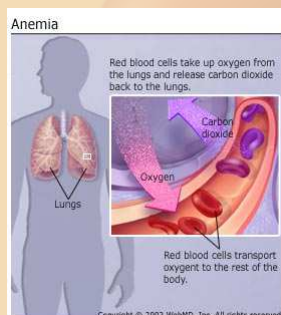
OTHER AGENTS	EFFECT

## ANEMIA OF CKD

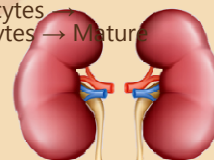




## Anemia of CKD

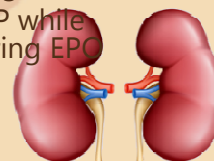


- **Causes of Anemia**
  - Erythropoietin (EPO) deficiency is main cause in CKD
  - Shortened RBC life span
  - Low iron intake/absorption
  - Folate or B12 deficiency
  - Inflammation
  - Hemolysis
- **EPO**
  - Exogenous hormone produced by kidney
  - Stimulates RBC production
    - Reticulocytes → Erythrocytes → Mature RBC



## Treatment of Anemia FDA on ESAs

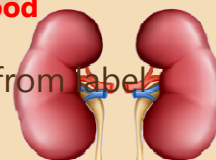
- **CHOIR Study (Correction of Hemoglobin & Outcomes in Renal Insufficiency) 11/16/06**
  - 1432 pts in US not on dialysis were randomly assigned to anemia correction with Procrit to target Hb levels fo 11.3-13.5.
  - Conclusion:
    - Use of a target Hb of 13.5 was associated with increased risk and no improvement in QOL
    - Demonstrated **serious & life threatening CV events** when targeted Hgb was 13.5 g/dL
    - Primary end points
      - Death, MI, CHF, & Stroke
  - **Rocked the world of the nephrology community**
- **FDA Black Box Warning Issued**
  - Target dose should NOT exceed 12 g/dL
- **KDOQI 8/30/07 – Update of 2006 Anemia Guidelines**
  - Target range should generally be 11-12 g/dL
  - Target should NOT exceed 13 g/dL
  - Monitor BP while administering EPO



## Treatment of *Anemia* FDA on ESAs

### FDA Update 6/24/11

- 'More Conservative Dosing in CKD'
- ESA Label
  - *Warn*
    - Greater risk of death, CV event & stroke when administered ESA to target Hgb above 11 g/dL
  - **Recommend**
    - **Start ESA when Hgb < 10 g/dL**
    - **Use lowest dose to reduce need for blood transfusions**
  - Target range of 10-12 g/dL removed from label



### FDA: **ESA APPRISE Oncology Program** February 26, 2010

- FDA now requires **all ESAs** to be prescribed and used under a risk management program, known as a risk evaluation and mitigation strategy (REMS)
- Goals of the REMS for the ESAs
  1. To support informed decisions between patients and their healthcare professionals who are considering treatment with an ESA by educating them on the risks of ESAs
  2. To mitigate the risk of decreased survival and/or poorer tumor outcomes in patients with cancer by implementing the part of the REMS called the **ESA APPRISE Oncology Program**
- This is to ensure the safe use of these drugs
  - Includes:
    - Epogen
    - Procrit
    - Aranesp
    - Mircera
  - Amgen required to develop the program by the FDA
  - Prescribers & Hospitals required to enroll to prescribe/dispense EPO to patients with cancer



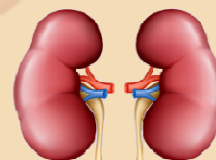
## FDA: ***ESA APPRISE Oncology Program***

- Studies show that ESAs can increase the risk of tumor growth and shorten survival in patients with cancer who use these products
  - Head & Neck Cancers
  - Metastatic Breast Cancers
  - Lymphoid Cancers
  - Non-Small Cell Lung Cancers who are not undergoing chemotherapy or radiation

FDA 2010

### APRN Role

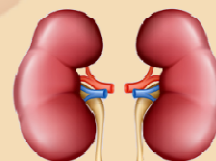
- **Review patient's history for history of cancer**
- **Consult with patient's oncologist re: use of ESAs for ESRD patient**
- **Document conversation/decision in patient chart**



## Sample Documentation

*Patient A is now being followed by Oncologist B for her newly diagnosed squamous carcinoma of the larynx. I spoke with Oncologist B today regarding use of ESAs in the outpatient HD setting for management of her anemia of ESRD/chronic disease. Oncologist B sees no contraindication for ESA therapy to continue at this time in the outpatient HD unit per our existing ESA protocols.*

*Signature*



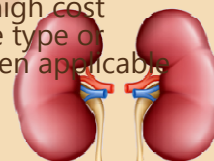
## Medicare Improvements for Patients and Providers Act (MIPPA)

- Medicare Improvements for Patients and Providers Act (MIPPA) enacted by Congress in 2008
- Passage of the Affordable Care Act in 2010 provided additional funding to support MIPPA activities



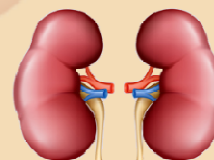
## ESRD PPS = 'Bundle'

- **Section 1881(b)(14) of the Social Security Act** requires a bundled PPS for renal dialysis services furnished to Medicare beneficiaries for the treatment of ESRD **effective January 1, 2011**
- ESRD PPS provides a patient-level and facility-level adjusted per treatment (dialysis) payment to ESRD facilities for renal dialysis services provided in an ESRD facility or in a beneficiary's home
- The bundled per treatment payment includes drugs, laboratory services, supplies and capital-related costs related to furnishing maintenance dialysis
- ESRD PPS provides a training add-on for home and self-dialysis modalities and additional payment for high cost outliers when there are unusual variations in the type or amount of specific medically necessary care, when applicable



## ESRD QIP

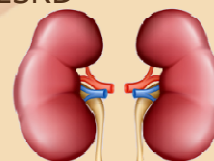
- **ESRD QIP is described in Section 1881(h) of the Social Security Act, as added by Section 153(c) of the MIPPA 2008**
- **Program intent**
  - Promote patient health by providing a financial incentive for renal dialysis facilities to deliver high-quality patient care
- **Section 1881(h)**
  - Authorizes payment reductions if a facility does not meet or exceed the minimum Total Performance Score (TPS) as set forth by CMS
  - Allows payment reductions of up to 2%



## ESRD Bundle Implications: *Treatment of Anemia*

### ESAs & Iron Therapy

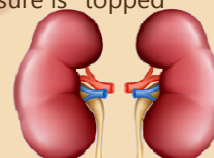
- Medications given with dialysis are no longer billed for separately by dialysis companies
- Injectable drugs and biologicals and their oral or other forms of administration that are for the treatment of ESRD
- Oral or other forms of non-injectable drugs and biologicals that are for the treatment of ESRD





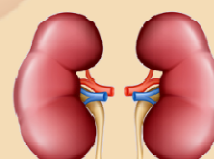
## Evolution of Anemia in the QIP Program

- **PY 2012**
  - First year of the program features three measures
    - **Hemoglobin (Hgb) > 12 g/dL** (anemia management)
    - **Hgb < 10 g/dL** (anemia management)
- **PY 2013**
  - **Hgb < 10** measure removed based on change in FDA labeling
- **PY 2015**
  - **Anemia Management** added as a reporting measure
- **PY 2017**
  - **Hemoglobin > 12 g/dL measure removed**
    - High level of overall achievement indicates the measure is “topped out”



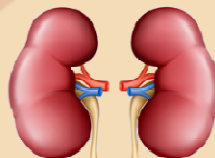
## Anemia of CKD: *Guideline Review*

General Target					
Hb level					
For CVD <sup>a</sup>					
For DM <sup>b</sup>					



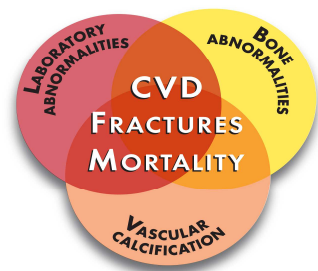
## Treatment of Anemia of CKD

- **KDOQI Iron Guidelines:**
  - Ferritin > 100 ng/mL in CKD 2-5
  - Ferritin > 200 ng/mL in ESRD on HD
  - Transferrin saturation (Tsat) > 20% & < 50%
- **KDIGO Iron Guidelines**
  - Treat if Tsat ≤ 30% or Ferr ≤ 500 ng/mL
  - Evaluate iron status every 3 months if on ESA
  - Avoid IV iron in patients with active infection
- **Iron Therapy**
  - Oral
    - At least 200 mg elemental iron/day
  - IV
    - Ferrlecit
    - Venofer
    - Feraheme
- **ESA Therapy**
  - Epogen
  - Procrit
  - Aranesp
  - Micera

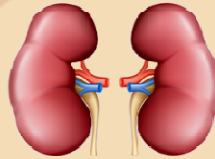


## CKD-MINERAL BONE DISORDER (MBD)

CHRONIC KIDNEY DISEASE—  
MINERAL AND BONE DISORDER

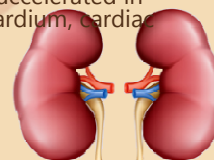


**CKD-MBD**



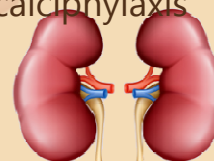
## CKD-MBD

- Other names:
  - Renal secondary hyperparathyroidism
  - Renal osteodystrophy (Need Bone Biospy for definitive diagnosis)
- Components/Abnormalities in:
  - Calcium
  - Phosphorus
  - PTH
  - Vitamin D metabolism
- Bone turnover
  - High: Osteitis fibrosa
  - Low: Adynamic bone disease
  - Accumulation of B12 microglobulin
  - Steroid-induced osteoporosis
  - Mineralization
- Vascular & soft tissue calcifications leading calciphylaxis – accelerated in CKD. Excess calcium is deposited into blood vessels, myocardium, cardiac vessels & valves.

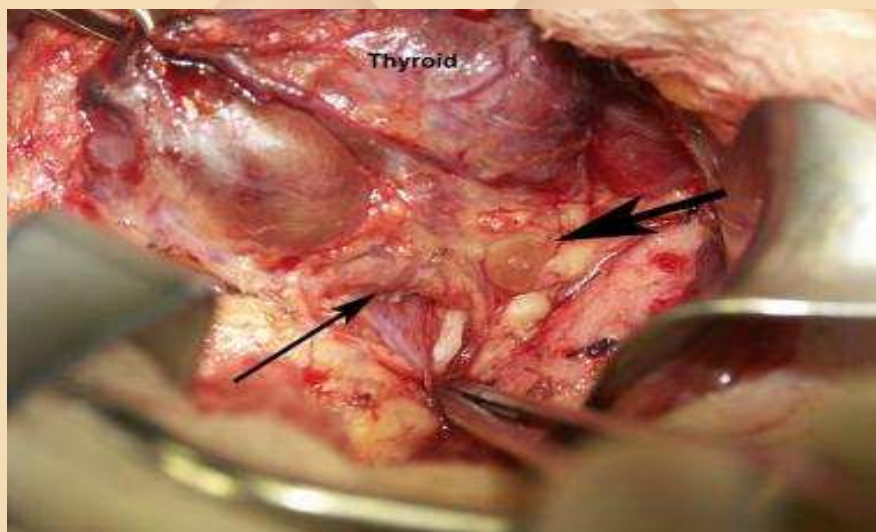


## Pathogenesis of CKD-MBD

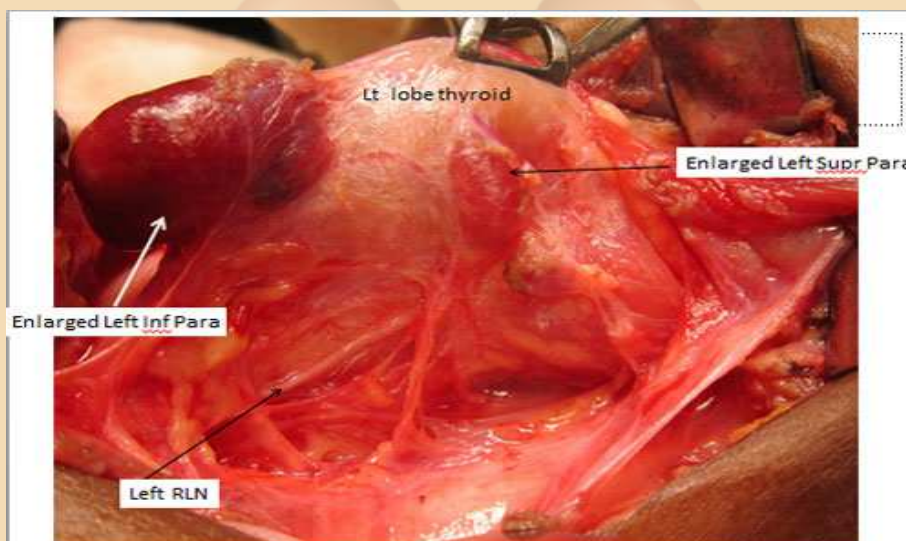
- Alterations in calcium & phosphorus metabolism begin as early as Stage 3 CKD
- Phosphorus suppresses Vitamin D production by the kidney leading to ↓ in calcium absorption.
- Parathyroid gland senses a low calcium level
- PTH ↑ in response
- The parathyroid gland hypertrophies as it attempts to compensate for the low calcium level
- Overtime Ca<sup>+</sup> & PO<sub>4</sub> levels increase in blood leading to CV complications including calciphylaxis & bone abnormalities



## Parathyroid Glands

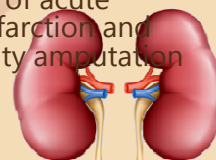


## Hyperplastic Parathyroid Glands



## CKD-MBD → FGF23

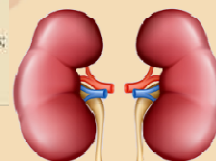
- **FGF23**, a member of the fibroblast growth factor family primarily involved in CKD-MBD
- Represents the earliest detected serum abnormality in patients with CKD-MBD
- FGF23 rises as GFR decreases
- FGF23 levels rise before any changes in PTH, 1,25(OH)<sub>2</sub> D<sub>3</sub>, or serum phosphate levels are detected
- Implicated in the regulation, growth, and differentiation of cardiac myocytes holding paracrine functions in the kidneys because of its phosphaturic properties
- Blocks vitamin D<sub>3</sub> synthesis and inhibits proximal nephron reabsorption
- In a post-hoc analysis of the HOST study, a strong relation between higher FGF23 levels and higher risks of cardiovascular events was found
- Elevated C-terminal FGF23 levels were also strongly associated with an increased risk of acute myocardial infarction and lower-extremity amputation



## Guidelines: *Bone Metabolism in CKD*

	KDOQI	KDIGO
Frequency of measurement of serum calcium and phosphorus		
Target serum calcium		
Target serum phosphorus		
Calcium intake		
Populations requiring specific types of binders		

KDOQI = Kidney Disease Outcomes Quality Initiative; KDIGO = Kidney Disease: Improving Global Outcomes; PTH = parathyroid hormone.  
Kovesdy CP. *Semin Dial*. 2011;24:35-36.



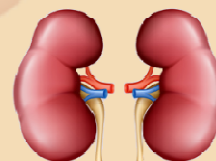


## Clinical Guideline: *Treatment of CKD-MBD*

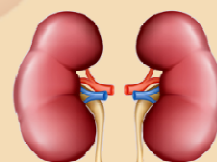
Diet	Phosphorus Binders	PTH Reduction

## Phosphorus Binders *Reminders*

- ❖ **Renagel/Renvela** – Contraindication in GI obstruction
- ❖ **Fosrenol** – Contraindication GI Obstruction; Caution Colon CA/IBD
- ❖ **Velphoro/Auryxia** – Dark Stools/Caution in elevated Ferritin levels



## Get To Know Your CKD-MBD Pharmaceutical Reps



## ESRD Bundle Implications: *CKD – MBD*

### 2011

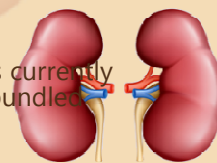
- Injectable drugs and biologicals and their oral or other forms of administration that are for the treatment of ESRD
- Oral or other forms of non-injectable drugs and biologicals that are for the treatment of ESRD

### July 1 2017

- Recent approval of an intravenous **calcimimetic (Amgen's etelcalcetide, Parsabiv™)**, as an intravenous equivalent of **Amgen's Sensipar**, means that both drugs will move into the "bundle" and the dialysis clinic will become responsible for the cost of the drugs regardless of whether they are administered in the clinic, or dispensed to the patients by a pharmacy
- **Effectively, oral calcimimetics will move from Part D Medicare (pharmacy benefit) to Part B (dialysis)**

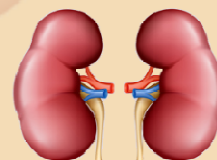
### 2024

- All other ESRD-related oral medications that patients currently receive from their pharmacy will be included in the bundle payment
- This includes **phosphorus binders**

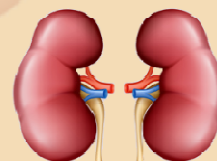


## Evolution of CKD-MBD in the QIP Program

- **PY 2014**
  - Mineral Metabolism as reporting measure
- **PY 2016**
  - **Hypercalcemia** added to list of clinical measures



## METABOLIC ACIDOSIS OF CKD



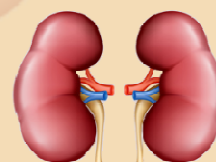
## Metabolic Acidosis in CKD

- **Mechanism of Action**

- Accumulation of organic acids in plasma
- Impairment of renal acidification
- Loss of nephron mass

➤ *Inadequate excretion of hydrogen & ammonium*

➤ *Inadequate production of bicarbonate*



## Metabolic Acidosis in CKD

- **Consequences:**

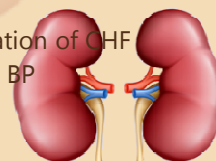
- Hyperkalemia
- Increased resorption of bone
- Increased muscle catabolism

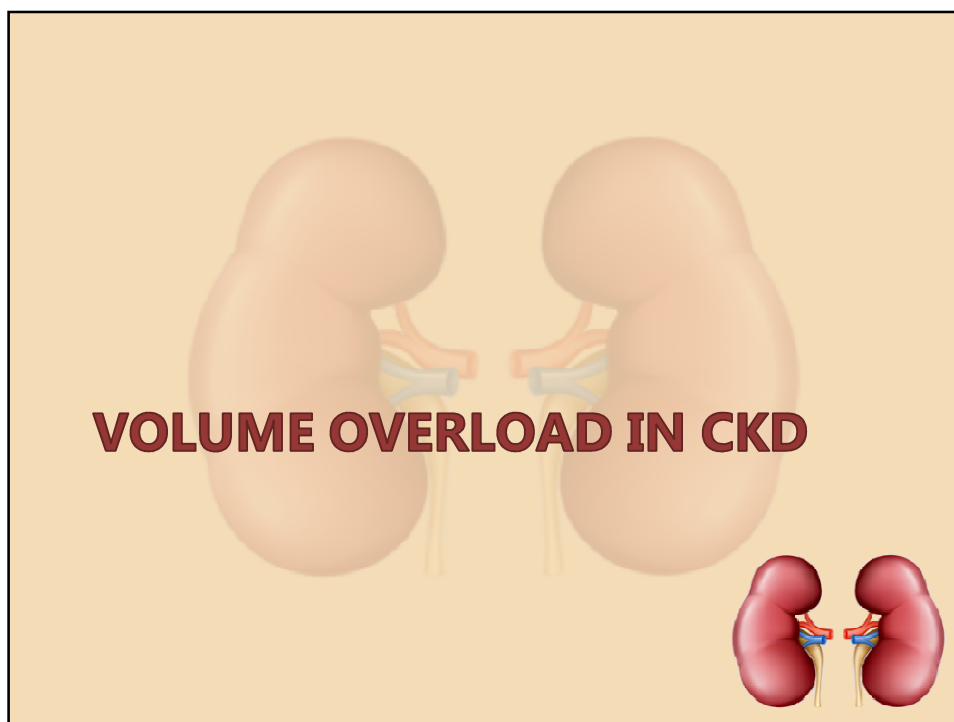
- **Complications**

- Chronic Bone Loss
- Muscle wasting
- Anorexia & weight loss
- Hypoalbuminemia
- Acceleration of renal failure
- Impaired cardiac function
- Resistance to insulin
- Abnormal function of growth hormone & thyroid hormone

- **Treatment**

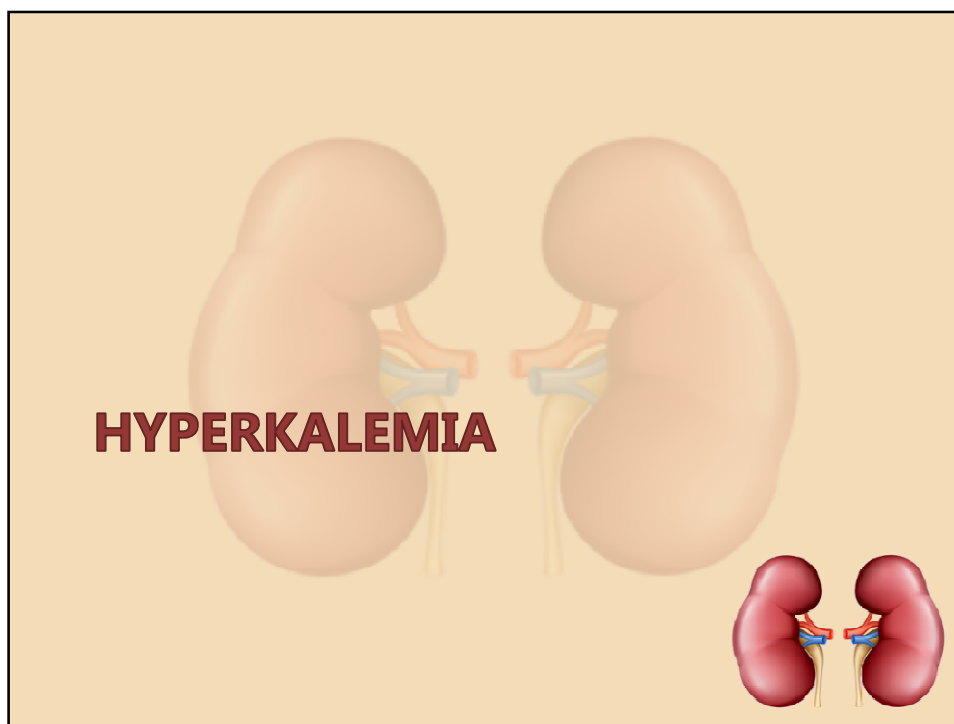
- Maintain serum bicarbonate level  $\geq 22$  mEq/L
- Oral  $\text{NaHCO}_3$  0.5 mEq/kg/day
- Adjustment of dialysis bath
- Side effects:
  - Fluid retention
  - Edema
  - Exacerbation of CHF
  - Elevated BP





## Volume Overload in CKD

- **Precipitating factors:**
  - ↑ Serum sodium
  - ↑ Extracellular fluid
- **Mechanism of Action:**
  - Inability to excrete sodium effectively
  - Increase in overactivity of the RAAS resulting in increase aldosterone production.
- **Assessment:**
  - Weight gain
  - ↑ BP
  - ↑ Heart rate
  - SOB/↑ RR
  - JVD
  - Peripheral edema
- **Treatment:**
  - Restriction of salt intake
  - Diuretics: Thiazides & Loops
    - Monitor for side effects: hypotension, dehydration, electrolyte imbalance
  - If no response to treatment, initiate dialysis
  - **Discontinue Thiazides GFR < 30 mL/min & switch to Loops**



## Hyperkalemia in CKD

- More prevalent with GFR < 15 mL/min
- **Physiologic changes:**
  - Impaired tubular secretion of K<sup>+</sup>
  - Renal Tubular Acidosis
  - Volume depletion
  - Starvation
- **Precipitating factors:**
  - Dietary indiscretions
  - Constipation
  - Protein catabolism
  - Hemolysis
  - Hemorrhage
  - Blood transfusion
  - Medications
  - Physiologic changes

**Treatment**

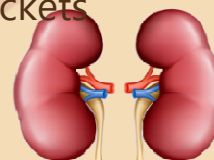
- Dietary consult for low K<sup>+</sup> diet
- D/C offending drugs
  - ACE-I
  - ARBs
  - Potassium-sparing diuretics
  - NSAIDs
- ↑ K<sup>+</sup> entry into cells
  - Insulin & glucose
  - NaHCO<sub>3</sub>
- Removal of K<sup>+</sup>
  - Diuretics
  - Kaexylate (Cation Exchange Resin)
  - Initiate dialysis



## Hyperkalemia Mgt

### VELTASSA

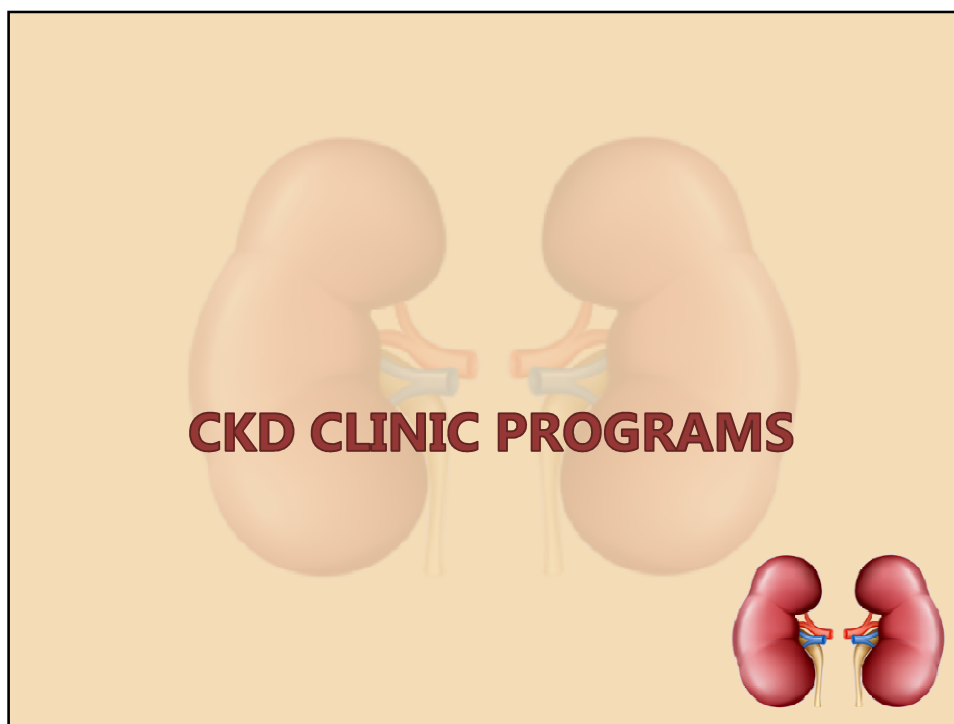
- Potassium Binder
- Recommended starting dose: 8.4 gm/day with food
- Adjust dose by 8.4 gm/day as needed at one week intervals to obtain desired serum potassium target range
- Max: 25.2 gm/day
- Powder: 8.4, 16.8 and 25.2 gram packets
- Warning: Low Mg & GI issues



## Indications for Renal Replacement Therapy (RRT)

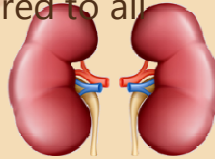
- Uncontrolled hyperkalemia
- Metabolic acidosis
- Fluid overload
- Fatigue
- Pruritis
- Gastrointestinal symptoms
  - Nausea, vomiting, anorexia, GI bleeding, diarrhea or constipation, & malnutrition
- Neurologic symptoms
  - Encephalopathy, peripheral neuropathy, sleep disorders, autonomic dysfunction, impaired memory, inability to concentrate, weakness
- Autonomic dysfunction
- BP variability in response to postural changes





### **CKD Program Goals**

- ❖ Ensure consistency of care among all patients with CKD in your practice
- ❖ Create a team approach to provide more frequent visits, efficiency of care & improve patient outcomes
- ❖ Provide a safety net to ensure important CKD milestones & program details are offered to all patients



This slide contains a list of three goals for a CKD program. The background features a large, faint illustration of two kidneys. A smaller, detailed illustration of two kidneys with blood vessels is positioned in the bottom right corner.

## Stages & Prevalence of CKD in the Adult US Population

STAGE	DESCRIPTION	GFR mL/min/1.73 m <sup>2</sup>	US PREVALENCE

NHIS 2002 & USRDS

## CKD Program Labs

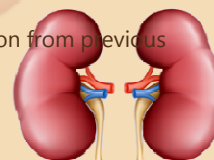
*Labs to be drawn one week prior to regular CKD visit*

CBC				
Renal Panel <i>(Creat, GFR, Ca, PO4)</i>				
Intact PTH				
25 (OH) Vitamin D				
Ferritin/Tsat <i>(Stage 4 &amp; 5)</i>				
Urinalysis				
Spot urine creatinine/protein <i>(If history of proteinuria)</i>				

## Regular CKD Program OFFICE Visits

All parameters related to the CKD Stage are reviewed with each patient at every visit when applicable to the patient and their medical history

- Interval History & Review of Systems
- Medication review
- Physical Examination with review blood pressure & fluid status
- Lab Review
  - Anemia
  - Electrolytes
  - Mineral Bone Metabolism
  - Acidosis
  - Urinalysis/Spot Urine Protein-Creatinine Ratio
- Review of related disorders:
  - Cardiovascular Risk Reduction
  - Hyperlipidemia
  - Diabetes
  - Smoking Cessation
- Nutrition Counseling with Referral to Dietician
- Access Referral or assessment if placed
- Transplant status review
- Immunization Review
- Continuation of CKD education from previous educational visits



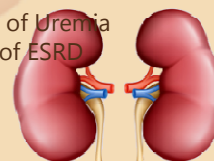
## CKD Program Education Visits

### CKD Education Visit

- Functions of the Kidney
- Understanding Lab Values
- Stages of CKD
- How to delay the progression of CKD & How to manage CKD
- Avoidance of Nephrotoxic Agents
- Anemia of CKD
- Mineral Bone Disorder of CKD
- Renal diet overview
- Immunizations in CKD

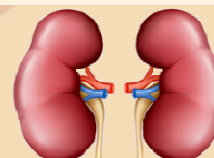
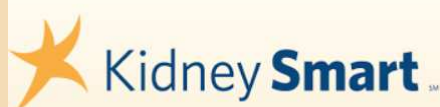
### Dialysis Education Visit

- Dialysis functions
- Hemodialysis:
  - Incenter
  - Home HD
  - NxStage
- Peritoneal Dialysis:
  - CAPD
  - CCPD
- Traveling on Dialysis
- Transplantation
- Vascular Access
- Signs/Symptoms of Uremia
- Financial Impact of ESRD



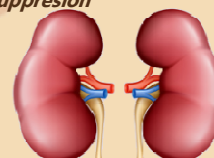
## Additional Modality Education Visits

- Free of charge to patient
- **In-House Visits**
  - Dialysis providers offer service in your office locations
- **Dialysis Unit Visits**
  - Patients go to dialysis unit for group education sessions &/or unit tour
  - FMC
    - TOPS Program
  - DaVita
    - Kidney Smart Program



## Avoidance of Nephrotoxic Agents in CKD

- **NSAIDs**
  - Ibuprofen
  - Naproxen
  - COX 2 inhibitors
- **Contrast dye**
  - Radiocontrast nephropathy
  - Hydrate with  $\text{NaHCO}_3$  more effective than  $\text{NaCl}$  in prevention (Merten et al. 2004)
- **Immunosuppressants**
  - Cyclosporin, Tacrolimus
- **Antibiotics**
  - Dosage adjustments for most antibiotics
  - Nephrotic: Aminoglycosides, amphotericin B
- **Other Medications**
  - Lithium
  - Cisplatin
  - Gold
- **Herbals**
  - Aristolochic acid → *Interstitial renal fibrosis*
  - Djenkol → *Severe tubular necrosis*
  - Licorice, rhubarb, cascara sagrada → *Hypokalemia*
  - Noni juice → *Hyperkalemia*
  - Dandelion, juniper berry, & golden rod → *Diuretic effect*
  - Echinacea & St. John's wort → *Decrease in Immunosuppression*



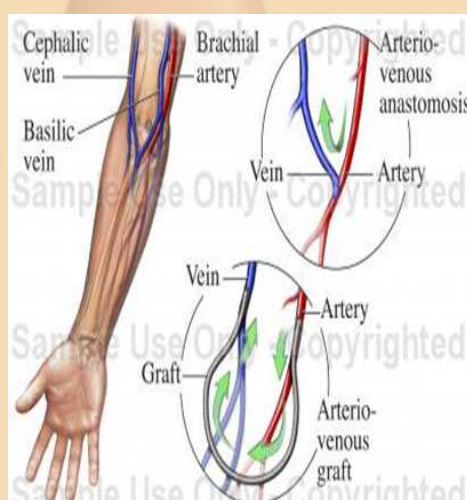
## CKD Program: Save the Vein

- Arm Preservation Education
- Initial Vein Mapping
- Patient Flyer
- Arm Band
- Wallet Card
- Label Patient Chart



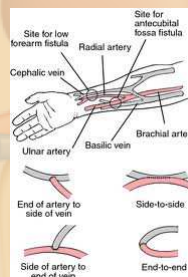
## CKD Program: *Vascular Access*

- **Arm Preservation**
  - GFR 30-40 mL/min
- **Early Access Referral**
  - GFR < 25 mL/min
- **Maturation Check Visit**
  - 6 to 8 weeks post surgery



## Vascular Surgeon Referral

- Goal:
  - Reduce the number of dialysis starts with permanent catheters & increase rate of patients with AVFs
- Early referral to vascular surgeon is KEY
  - **GFR 20-25 mL/min**
  - **Key: Watch GFR Trends**



## Maturation Check Visit

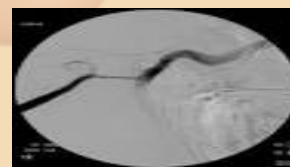
- Led by Interventional Nephrologist or APRN
- Visits scheduled 6 to 8 weeks after AVF placed
- Sonasite ultrasound used during visit
- Billed as Established Visit Level 2 (99212)





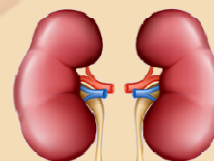
## Maturation Check Visit

- **PHYSICAL EXAM**
  - Visualization of Main Outflow Vein
  - Character of Access Thrill & Bruit
  - Chest Wall or Shoulder Collateral Veins
  - Evidence of Steal/Limb Ischemia
  - Ipsilateral Limb Edema
- **ULTRASONOGRAPHY**
  - Depth of outflow vein in anticipated cannulation area
  - Vessel diameters --
    - Feeding artery (> 2-3 mm)
    - Juxta-anastomosis
    - Centimeters from anastomosis
- **IMPRESSION/PLAN**
  - Continue to exercise
  - Ready for cannulation
  - Road map
  - Fistulogram/Angioplasty
  - Ligation of collaterals/Follow-up surgeon



## Transplant Evaluation Referral

- Goal: Early referral
  - Preemptive Transplant
  - Reduce time on dialysis
- Can be listed once GFR < 20 mL/min



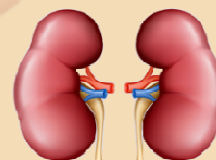
## Transplant Criteria

### Absolute Contraindications

- Untreated Malignancy
- Dementia
- Active Substance Abuse
  - Complete Rx Program
  - Documented Abstinence X 6 months
- Active Noncompliance
  - Complete 6 mo successful compliance contract

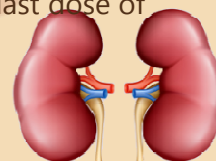
### Relative Contraindications

- BMI > 40
- Advanced cerebrovascular dz
- Advanced cardiac dz
  - EF < 20% and/or severe ischemic dz
- Advanced liver dz
- Advanced pulm dz
  - No eval if home oxygen
- Advanced PVD
  - No eval if amputation or revascularization procedure
- Active Tobacco Use
- Active, Untreated HIV



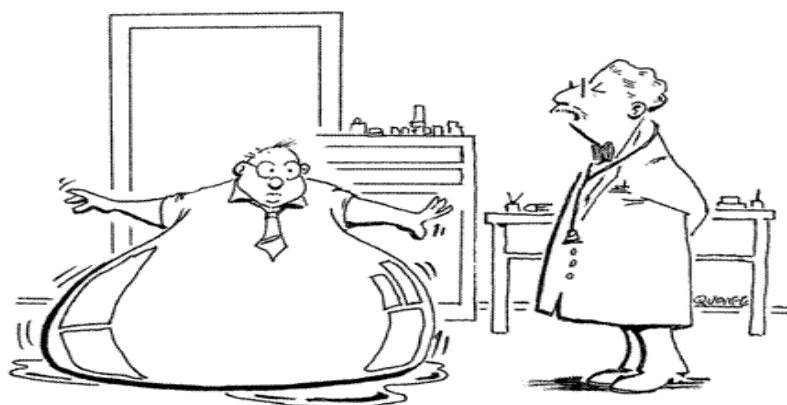
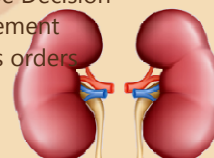
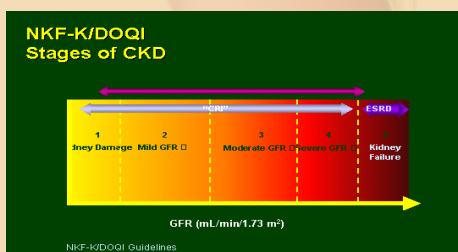
## Immunizations in CKD

- **Influenza Vaccine**
  - Annual recommendation by CDC
- **Pneumovax Vaccine (PPV23)**
  - Recommended every 5 years by CDC
- **Pevnar 13**
  - Recommended for both pneumococcal vaccine-naïve and PPSV23 – previously vaccinated adults aged 65 and older
- **Hepatitis B Vaccine (Recombivax/Energix)**
  - CDC recommends vaccines prior to dialysis for better seroconversion rates & higher antibody titers (Anti-HBs)
  - Monitor Anti-HBs levels 1 to 2 months after last dose of series
  - Repeat initial series if Anti-HBs < 10 mIU/mL



## CKD Program Milestones Recap

- **CKD Stage 3**
  - CKD Education
  - Nutritional Referral
  - Save The Vein Program Initiation
  - Immunizations (Flu + Pneumonia)
- **CKD Stage 4**
  - Dialysis Education
  - Access Surgeon Referral
  - Maturation Check Visit
  - Transplant Referral
  - Hepatitis B
- **CKD Stage 5**
  - History & Physical with dialysis labs within 30 days of dialysis start
  - Modality Type Decision
  - Dialysis placement
  - Initial dialysis orders completed



Your tests reveal that you are retaining fluids!

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<http://KidneyKorner.com/AK/Comics.html>

