Laboratory Diagnosis in Primary Care

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Disclosure

- No real or potential conflict of interest to disclose.
- No off-label, experimental or investigational use of drugs or devices will be presented.

Objectives

- Upon completion of the learning activity the participant will be able to:
  - Describe factors influencing the choice of laboratory testing in acute and chronic renal failure, select hematology and chemistries.
  - Identify factors influencing select laboratory parameters in the clinical care process.
Renal Anatomy and Physiology
Urine Formation

- Impairment of any of these processes = Azotemia
  - Increase in urea nitrogen and creatinine

Factors Influencing Nephron Destruction and Renal Failure

True or false?

- In reference for number of nephrons, the number present in the kidney at birth is what a person has for life.
- Risk factors of low nephron number include female gender, short adult stature, small kidney size, and low birth weight.
True or false?

• In reference for number of nephrons, the number present in the kidney at birth is what a person has for life. **TRUE**

• Risk factors of low nephron number include female gender, short adult stature, small kidney size, and low birth weight. **TRUE**

True or false?

• Nephrons in the fetal kidney are formed up to the 36th week of gestation. **TRUE**

• The range of nephrons in individuals within a given healthy populations can range from 200,000 to more than 2 million per kidney. **TRUE**
True or false?

• Nephrons in the fetal kidney are formed up to the 36th week of gestation. **TRUE**
• The range of nephrons in individuals within a given healthy populations can range from 200,000 to more than 2 million per kidney. **TRUE**

Risk Factors That You Probably Did Not Consider...

• Increase HTN risk=Potential risk for CRF
  – Low birth weight
  – Gestational age at birth
  – Maternal HTN during pregnancy
  – Low maternal calcium intake during pregnancy
  – Low nephron number

Source: [http://www.rmmj.org.il/userimages/83/1/PublishFiles/125Article.pdf](http://www.rmmj.org.il/userimages/83/1/PublishFiles/125Article.pdf)
Impact of Aging on the Kidney

- Glomeruli changes
  - Sclerotic glomeruli: 1 to 2% age 30 to 40 y to >12% age >70 y
- Renal blood flow
  - Decreases related to reduction in cardiac output
- Result
  - Less reserve, increased risk of drug-induced nephrotoxicity


Defining the Terms

- BUN to creatinine ratio (BUN:Cr)
  - Usually ≤20:1 in the presence of appropriate hydration
    - Reduced in overhydration
  - Often elevated in renal disease
    - In absence of renal disease, can be transiently elevated in dehydration, ingestion of extreme amounts of protein, upper, lower GI bleed

Altered BUN:Cr Ratio in Absence of Significant Renal Disease

- 45 yo otherwise well woman of European ancestry with severe dehydration due to gastroenteritis
  - BUN=55 mg/dL (19.6 mmol/L)
  - Cr=0.8 mg/dL (70.7 µmol/L)
  - BUN:Cr ratio>20:1=68.75
  - GFR=89 mL/min/1.73 m²
Altered BUN:Cr Ratio in Absence of Significant Renal Disease (continued)

• Upper GI bleed in 50 yo AA man
  - Appropriate hydration
  - Hemoglobin=11.2 g/dL (112 g/L), hematocrit=33% (0.33 proportion)
  - BUN=36 mg/dL (12.85 mmol/L), Cr=0.9 mg/dL (79.6 µmol/L)
  - BUN:Cr ratio>20:1=36
  - GFR=115 mL/min/1.73 m²


• Lower GI bleed in a 50 yo male
  - Appropriate hydration
  - Hemoglobin=10.2 g/dL (102 g/L), hematocrit=30.5% (0.305 proportion)
  - BUN=24 mg/dL (8.6 mmol/L), Cr=0.9 mg/dL (79.6 µmol/L)
  - BUN:Cr ratio>24

BUN, Cr in Late Pregnancy

• 28 yo woman, 34-weeks pregnant, normotensive, healthy
  - Normative up to 50% or greater increase in blood volume
  - Hemoglobin=12.5 g/dL (125 g/L), HCT=34% (0.34 proportion)
  - BUN=9 mg/dL (3.2 mmol/L), Cr=0.5 mg/dL (44.2 µmol/L)

Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4089195/
Defining the Terms

- **Proteinuria**
  - Presence of abnormal amount of protein in the urine
    - Adult urinary protein excretion in health ≤150 mg/day
    - "Negative" dip UA for protein accounts for this level

Defining the Terms (continued)

- **Proteinuria (cont.)**
  - Most commonly wasted protein = Albumin
  - Most common type = Glomerular proteinuria
    - Due to increased filtration of macromolecules including albumin across glomerular capillary wall
    - Seen in DM nephropathy, other glomerular disease
    - Also in absence of renal disease such as exercise-induced or orthostatic proteinuria

Defining the Terms (continued)

- **Microalbuminuria**
  - Excretion of small amount albumin that would escape detection by standard urine dip test
    - Normal albumin excretion rate <30 mg/day (20 mcg/min)
    - Microalbuminuria = Persistent albumin excretion = 30–300 mg/day (20 to 200 mcg/min)
Defining the Terms (continued)

- Microalbuminuria (cont.)
  - Intervention = Improved control of all of the following
    - Glucose
    - Lipids
    - Blood pressure
      - CV risk factor reduction in general to enhance endothelial dysfunction

Defining the Terms (continued)

- Glomerular filtration rate (GFR)
  - Volume of fluid filtered from the renal glomerular capillaries into Bowman's capsule per unit time

Defining the Terms (continued)

- Creatinine clearance
  - A comparison of the level of urine creatinine in with blood creatinine. Because creatinine is found in stable plasma concentrations, is freely filtered and not reabsorbed, and is minimally secreted by the kidneys, creatinine clearance is used to estimate the glomerular filtration rate (GFR).
Cr Cl vs. GFR

- Cr Cl approximates GFR but might overestimate due to
  - Creatinine secreted by proximal tubule
  - Filtered by the glomerulus

GFR>60 mL/min/1.73 m² vs. <60 mL/min/1.73 m²?

- Equation less accurate at GFR estimates greater than 60 mL/min/1.73 m²
  - Most labs with NL or near normal Cr simply report GFR>60 mL/min/1.73 m²
- W/estimated GFR<60 mL/min/1.73 m²
  - Equation accurate for most of average body size and muscle mass
  - Source: [https://www.kidney.org/professionals/KDOQI/gfr](https://www.kidney.org/professionals/KDOQI/gfr)

Factors Affecting Serum Creatinine Concentration

- Muscular bulk
  - Increased muscle generation due to increased muscle mass ± increased protein intake
- Malnutrition, muscle wasting, amputation
  - Reduced creatinine generation due to reduced muscle mass ± reduced protein intake
Factors Affecting Serum Creatinine Concentration (continued)

- Vegetarian diet
  - Decrease in creatinine generation
- Ingestion of cooked meats
  - Transient increase in creatinine generation; however, might be blunted by transient increase in GFR

Factors Affecting Serum Creatinine Concentration (continued)

- Older age
  - Reduction in creatinine generation due to age-related decline in muscle mass
- Female sex
  - Reduced creatinine generation due to reduced muscle mass

Factors Affecting Serum Creatinine Concentration (continued)

- Obesity
  - No change, excess mass is fat, not muscle mass and does not contribute to increased creatinine generation
Does age, gender, race or lifestyle influence serum Cr?

- **Aging**
  - Less muscle mass = Lower creatinine produced

- **Male vs. female**
  - Men with greater muscle mass = High creatinine

Source: https://www.kidney.org/professionals/KDOQI/gfr

(continued)

- **African ancestry**
  - ~15% higher AST
  - ~10% higher Cr
  - Due to greater muscle mass

- Possible influence of increased physical activity

GFR: True or false?

- The normal mean GFR in young adults is approximately 120 to 130 (20 to 25) mL/min/1.73 m².
- Children reach adult values for mean GFR by approximately age 2 years.
GFR: True or false?

- The normal mean GFR in young adults is approximately 120 to 130 (20 to 25) mL/min/1.73 m². **TRUE**
- Children reach adult values for mean GFR by approximately age 2 years. **TRUE**

Two Patients

- 70 yo man who weighs 75 kg and is at ideal body weight
  - Cr=1.4 mg/dL (123.76 µmol/L)
- 70 yo woman who weighs 75 kg and is at ideal body weight
  - Cr=1.4 mg/dL (123.76 µmol/L)
Cockcroft-Gault Equation  
Use IBW

- To calculate Cr Cl in men
  \[(140 - \text{age}) \times \text{wt in kg} / (72 \times \text{sCr})\]
  - 70 yo man, weighs 75 kg, sCr=1.4 mg/dL (123.76 µmol/L)
  \[(140 - 70=70) \times 75 / (72 \times 1.4=100.8)=70 \times 0.744=52.08 \text{ mL/min}\]

Another Formula  
Modification of Diet in Renal Disease Formula

- Needed patient information
  - Age
  - Gender
  - Serum creatinine
  - Ethnicity
  - Black vs. non black
    - Source: www.kidney.org/professionals/kdoqi/gfr_calculator.cfm

With Identical Parameters, Calculated GFR

- GFR=51 mL/min/1.73 m², non African American male
- GFR=58 mL/min/1.73 m², African American male
  - Source: http://www.kidney.org/professionals/kdoqi/gfr_calculator.rfm
**Cockcroft-Gault Equation**

Use IBW

**To calculate Cr Cl in women**

- 70 yo, weighs 75 kg, sCr=1.4 mg/dL (123.76 µmol/L)

\[
(140-\text{age}) \times \frac{\text{wt in kg}}{(72 \times \text{sCr})} \times 0.85
\]

\[
(140-70=70) \times \frac{75}{(72 \times 1.4=100.8)}=70 \times 0.744=52.08 \times 0.85=44.26 \text{ mL/min}
\]

**With Identical Parameters, Calculated GFR**

- GFR=38 mL/min/1.73 m², non African American female
- GFR=44 mL/min/1.73 m², African American female


**What is the significance in clinical practice?**

- 70 yo woman
  - Cr Cl=44 mL/min (0.74 mL/s)
  - Lisinopril= 50–75% of typical dose
- 70 yo man
  - Cr Cl=52 mL/min (0.87 mL/s)
  - No dose adjustment for lisinopril at current Cr Cl
Hematologic Changes in CKD

- Erythropoietin supply
  - Diminished in advancing renal failure
  - Usually beginning when glomerular filtration rate (GFR)<49 mL/min/1.73 m²
- Resulting anemia of chronic disease (ACD)
  - Treatment- Treat underlying cause, erythropoietin replacement

Stages of Chronic Renal Failure
Please see information at the end of the handout.

The National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF KDOQITM)
Available at http://www.renal.org/information-resources/the-uk-ckd-guide/ckd-stages#sthash.a27QOiVt.7BnpoGJK.dpbs
Anaizi, N, The Drug Monitor- Review Renal Pharmacology
Available at http://www.thedrugmonitor.com/RIT97.html

52 YO Woman with Stage 3 CKD

- Hg=10.1 g/dL (12–14)
  (101 g/L [120–140])
- Hct=32% (36–43)
  (0.32 proportion [0.36–0.43])
- RBC=3.2 million/mm³ (4.2–5.4)
52 YO Woman with Stage 3 CKD (continued)

- MCV=82 fl (81–96) NL
- MCHC=34.8 g/dL (31–37) NL (348 g/L [310–370])
- RDW=12.1% (11.5–15) NL (0.121 proportion [0.115–0.15 proportion])

Michael
58 YO Man w/o Complaint

- Known to be hypertensive>18 y
- No therapy>3 years, feeling well
  - Gr II HTN retinopathy
  - S4, Gr II/VI systolic murmur
  - PMI @ 6th ICS, MCL
  - BP=170/110 mm Hg
- Renal issues likely acute or chronic?
Michael

- FPG=180 mg/dL – 9.99 mmol/L
- HgA1c=8% – 0.08 proportion
- HDL=32 mg/dL – 0.83 mmol/L
- LDL=170 mg/dL – 4.4 mmol/L
- TG=280 mg/dL – 3.16 mmol/L
- Cr=1.6 mg/dL – 122 µmol/L
- UA=Protein 30 mg/dL – 300 g/L

GFR per NKF Calculator
African Ancestry or Otherwise

- If Michael has African ancestry – GFR=54 per mL/min/1.73 m²
- If any other ethnic group – GFR=45 per mL/min/1.73 m²
- If female and African ancestry – GFR=45 per mL/min/1.73 m²
- If female and other ethnic group – GFR=33 per mL/min/1.73 m²

Intervention in Proteinuria/Albuminuria with T2DM

- Is adding an ACEI/ARB enough?
  - Improved glycemic control
  - Improved lipid control
  - Improved HTN control
What type of renal failure?

• Prerenal?
• Intrarenal?
• Post renal?

True or false?

• If the prescribing information about a given medication includes a warning about the need for dose adjustment in the presence of renal impairment, then that product is likely nephrotoxic.

TRUE

True or false?

• If the prescribing information about a given medication includes a warning about the need for dose adjustment in the presence of renal impairment, then that product is likely nephrotoxic.

FALSE
Metformin Use in Renal Impairment

• Rational for possible metformin in renal impairment
  - Decrease lactic acidosis risk
    • 90% renally eliminated
  - National Institute for Health – Discontinue at eGFR below 45 mL/min per 1.73 m², absolute metformin discontinuation at eGFR<30 mL/min per 1.73 m².

24 YO Man

• Seen by a colleague for first visit to the practice
  - No CC, no abnormalities noted on examination
  - Strong family Hx HTN, NL BMI but on ACEI for primary HTN
• Now seen due to “critical lab”

24 YO Man (continued)

• WBC=2.9K (4.8–10.8K)
  - N=38% (ANC=1100 mm³)
  - B=2% (ABC=58 mm³)
  - L=45% (ALC=1300 mm³)
    • Atypical or reactive lymphs=3%
  - M=10% (AMC=290 mm³)
Ethnic and Benign Familial (Constitutional) Neutropenia

- **Suggested neutropenia mechanism**
  - Defect in release of mature WBC from bone marrow to peripheral circulation

- **At-risk ethnic group**
  - African, Middle Eastern


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**24 YO Man**

- **Hg**=11.6 g/dL (14–16)
  - (116 g/L [140–160])
- **Hct**=36.7% (42–48) ↓
  - (0.367 proportion [0.42–0.48])
- **RBC**=6.38 million/mm³ (4.7–6.10) ↑
- **MCV**=69.5 fl (81–99) ↓
- **MCH**=22 pg (27–33) ↓
- **RDW**=13.8% (11.5–15) NL
  - (0.138 proportion[0.115–0.15])

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**Hemoglobin Electrophoresis**

<table>
<thead>
<tr>
<th>Hemoglobin</th>
<th>Patient’s value</th>
<th>Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93.2%</td>
<td>96–98.5%</td>
</tr>
<tr>
<td>A₂</td>
<td>5.7%</td>
<td>1.5–3.5%</td>
</tr>
<tr>
<td>S</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>F</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Hemoglobin Electrophoresis

- Test to identify variant and abnormal hemoglobins, including
  - Hemoglobin A1 (HbA1), hemoglobin A2 (HbA2), hemoglobin F (HbF; fetal hemoglobin), hemoglobin C (HbC), and hemoglobin S (HbS).
- Increased HbA2
  - Beta-thalassemia minor

1 in 4 Risk with Each Pregnancy

Another Example

- Hg=10.6 g/dL (12–14)
- Hct=32% (36–42)
- RBC=5.2 million/mm³ (3.2–4.3)
- MCV=71 fL (80–96)
- MCHC=25.2 g/dL (31–37)
- RDW=12% (<15)
**Versus This**

- **Hg** = 10.1 g/dL (12–14)
  - (101 g/L [120–140])
- **Hct** = 32% (36–43%)
  - (0.32 proportion [0.36–0.43])
- **RBC** = 3.2 million/mm$^3$ (4.2–5.4)
- **MCV** = 72 fL (81–96)
- **MCHC** = 26.8 g/dL (31–37)
  - (268 g/L [310–370])
- **RDW** = 18.1% (11.5–15%)
  - (0.181 proportion [0.115–0.15])

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**Maritza**

68-year-old with New-onset Confusion

- Presents with a 4-d Hx increasing headache, nausea and vomiting, “feels warm,” “new skin rash” per family member report who came to Maritza’s home today as she did not answer the phone
- Other health problems
  - HTN, on ACEI and thiazide diuretic with mild renal insufficiency

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**Maritza**

PE Findings

- **T** = 101.8°F (38.78°C), **P** = 120, **RR** = 24, **BP** = 92/78 mm Hg
- Can be roused by speaking to her but does not respond coherently
- Negative Kernig and Brudzinski signs
  - Early or later finding in meningitis?
Maritza PE Findings (continued)

- Chest clear, tachypnea consistent with elevated body temperature, no apparent dyspnea
- Cardiac exam=No S3, S4, a Gr 2/6 systolic crescendo-decrescendo murmur heard over the precordium, no radiation, both heart sounds intact

Maritza PE Findings (continued)

- Scattered, non blanching, raised purpura skin lesions (similar to those shown here)

Maritza 68-year-old with New-onset Confusion

- Hemoglobin=11 g/dL (12–14 g/dL) \{110 g/L (120–140 g/L)\}
- Hct=37% (36–43%) \{0.37 proportion (0.36–0.43 proportion)\}
  - Hb:Hct ratio >1:3
- RBC=3.2 million (4.2–5.4 mil)
Maritza
68-year-old with New-onset Confusion
(continued)
• MCV=84 fL (81–96 fL)
  – Normal size
• MCHC=33.8 g/dL (31–37 g/dL)
  {338 g/L (310–370 g/L)}
  – Normal color
• RDW=14.1% (11.5–15%) {0.141 proportion (0.115–0.15 proportion)}
  – All around the same size

Maritza
68-year-old with New-onset Confusion
(continued)
• BUN=55 mg/dL (19.64 mmol/L)
• Cr=2.1 mg/dL (185.64 µmol/L)
  – BUN:Cr ratio ≥20, C/W volume depletion
• GFR per NKF calculator=23 mL/min/1.73 m²
• Previous Cr 2 months ago
  – Cr=1.1 mg/dL (97.24 µmol/L)
• GFR per NKF calculator=49 mL/min/1.73 m²
  – Stage 3 chronic kidney disease

What type of renal failure?
• Prerenal?
• Intrarenal?
• Post renal?
### White Blood Cell Lines

<table>
<thead>
<tr>
<th>WBC</th>
<th>Point of action</th>
<th>In health, % of differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophil</td>
<td>Bacteria</td>
<td>~60%</td>
</tr>
<tr>
<td>Lymphocyte</td>
<td>Virus</td>
<td>~30%</td>
</tr>
<tr>
<td>Monocyte</td>
<td>Debris</td>
<td>~6%</td>
</tr>
<tr>
<td>Eosinophil</td>
<td>Allergens, parasites</td>
<td>~3%</td>
</tr>
<tr>
<td>Basophils</td>
<td>Unknown</td>
<td>~1%</td>
</tr>
</tbody>
</table>

### Maritza’s WBC with Differential Results

**Day Prior to Admission**
- WBC=13,550 mm$^3$ (6,000–10,000 mm$^3$)
- Neutrophils=75% (50–70%)
  - ANC=10,012, toxic granulation
- Bands=7% (0–4%)
  - ABC=934
- Lymphs=11% (30–40%)
  - ALC=1485

**Day of Admission**
- WBC=5,800 mm$^3$
- Neuts=22% (AMNC=1232)
- Bands=42% (ABC=2436)
- Lymphs=34% (ALC=2204)
- Monos=2% (AMC=116)
- Platelets=600,000 mm$^3$
Degenerative Left Shift

- When available more mature neutrophil forms are exhausted.
  - Less mature forms accessed
    - Total number of cells lower
    - General supply is less

Regenerative Left Shift

- Rise in total WBC
- Drop in immature forms
- Rise in monocytes
  - Predictor of recovery

Maritza

- After initiation of antimicrobial therapy and parenteral hydration
  - WBC=6,200 mm$^3$
  - Neuts=57%
  - Bands=12%
  - Monos=9% (>5%)
Maritza's CSF Results

- Appearance = Cloudy, white
- WBC = 1660 mm$^3$
- Neuts = 93%
- Glucose = 33 mg/dL (1.83 mmol/L)
  - NL = ~60% plasma glucose
- Protein = 150 mg/dL (1500 g/L)
  - NL 40–50 mg/dL (400–500 g/L)

Diff Dx Pleocytosis
WBC (CSF) > 5 Cells/mm$^3$

- Infection
  - Bacterial, viral, tubercular, fungal, protozoan

(continued)

- Intracranial lesion near subarachnoid space
  - Malignancy, abscess, demyelination, infarct, hemorrhage
Diff Dx Pleocytosis
WBC (CSF)>5 Cells/mm³
(continued)

- Miscellaneous
  - Recent seizure, vasculitis, radiation therapy, injection of drug into intrathecal space

CSF in Bacterial Meningitis

- Typical response
  - Neutrophilia
    - WBC=Median 1,200 cells/mm³
    - 90–95% neutrophils

- Atypical response
  - Lymphocytosis
    - In up to 10% Gram-neg infection
    - In up to 30% L. monocytogenes

CSF in Viral Meningitis

- Colorless, clear
  - WBC=100 mm³
    - 0–10
  - Lymph=75%
    - 0–10
  - Neut=15%
    - 0

- Gluc=63 mg/dL (3.50 mmol/L)
  - 40–80 mg/dL (2.22–4.44 mmol/L)
- Pro-T=53 mg/dL (530 g/L)
  - 15–45 mg/dL (150–450 g/L)
37 YO Woman with Asthma Flare
6-hours after First Dose Prednisone

- Total WBC=8,100 mm$^3$
  - Neuts=86%
    - ANC=7,081
  - Bands=1%
- Lymphs=11%
  - ALC=840

Corticosteroid-induced Neutrophilia

- Peaks at 4−6 hours
  - Resolved in 24 hours
  - ANC increase by 1,700−7,500
- Lymphocyte
  - Decreased by 70%
- Monocyte
  - Decreased by 90%

Noninfectious Neutrophilia

- Lithium use
- Surgery
- Acute gouty arthritis
- Acute coronary syndrome
Joanne

- 56 yo woman
  - S/P head injury from MVA
  - In rehabilitation center
  - Difficulty with swallowing
  - Developed fever, decreased level of consciousness, vomiting today
    • Assessment- Aspiration pneumonia

(continued)

- WBC=22,100 mm$^3$
  - Neutrophils=60%
  - Bands=15%
    • WBC morphology=Toxic granulation
  - Lymph=12%
  - Monos=8%
- Platelets=892,000 mm$^3$

Reactive Thrombocytosis

- Precipitating event present
  - Acute blood loss
  - Infection
  - Inflammatory disease
  - IDA
  - Malignancy
- Interleukin-6 implicated
Implicated in Reactive Thrombocytosis

• Due to promotion of platelet production
  - Interleukin-6
  - Interleukin-1
  - Tumor necrosis factor


Fitzgerald Health Education Associates

Reactive Thrombocytosis

• Platelet count > 600,000 mm$^3$
  - Absent
    - Splenomegaly
  - Typically absent (until ≥1 million)
    - Clotting risk

Fitzgerald Health Education Associates

Reactive Thrombocytosis
True or false?

• Reactive thrombocytosis quickly resolves when the underlying cause is treated.
Reactive Thrombocytosis
True or false?

• Reactive thrombocytosis quickly resolves when the underlying cause is treated. TRUE

Conclusion

Additional References and Resources

Additional References and Resources (continued)


Select References

The National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF KDOQITM)
Available at http://www.renal.org/information-resources/the-uk-ckd-guide/ckd-stages#sthash.a27Q1v7rpoGJK.dpbs

Anaizi, N, The Drug Monitor- Review Renal Pharmacology
Available at http://www.thedrugmonitor.com/RIT97.html

End of Presentation
Thanks for your time and attention.

Margaret A. Fitzgerald,
DNP, FNP-BC, NP-C, FAANP, CSP, FAAN, DCC, FNAP
www.fhea.com     cs@fhea.com
<table>
<thead>
<tr>
<th>Stage</th>
<th>GFR*</th>
<th>Description</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90+</td>
<td>Normal kidney function but urine findings or structural abnormalities or</td>
<td>Observation, control of blood pressure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>genetic trait point to kidney disease.</td>
<td></td>
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<tr>
<td>2</td>
<td>60−89</td>
<td>Mildly reduced kidney function, and other findings (as for stage 1) point</td>
<td>Observation, control of blood pressure and risk factors.</td>
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<td></td>
<td></td>
<td>to kidney disease.</td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>45−59</td>
<td>Moderately reduced kidney function</td>
<td>Observation, control of blood pressure and risk factors.</td>
</tr>
<tr>
<td>3B</td>
<td>30−44</td>
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<tr>
<td>4</td>
<td>15−29</td>
<td>Severely reduced kidney function</td>
<td>Planning for endstage renal failure.</td>
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<tr>
<td>5</td>
<td>&lt;15 or on dialysis</td>
<td>Very severe, or endstage kidney failure (sometimes called established renal failure)</td>
<td>Treatment choices.</td>
</tr>
</tbody>
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