Chronic Kidney Disease: Definitions and Optimal Management

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Objectives

- Definition of CKD
- Prevalence and Scope of CKD
- Optimal management
  - Delaying progression
  - Treatment of Comorbidities
  - Transition to End Stage Renal Disease

Kidney Disease Outcomes Quality Initiative
K/DOQI
http://www.kidney.org/
Does she have CKD?

At what level of creatinine does a 65-year-old diabetic, hypertensive white woman weighing 50 kilograms have CKD?

1. 1.0 mg/dL
2. 1.3 mg/dL
3. 1.5 mg/dL
4. 1.7 mg/dL
Definitions and Stages of Chronic Kidney Disease

- Chronic >3 months

- Kidney Damage
  - Hematuria/Albuminuria
  - Biopsy
  - Abnormal imaging tests

- Glomerular Filtration Rate ≤ 60ml/min
Good news
NO MORE 24-HOUR URINES!
Spot urines are adequate.
## Quantification of Proteinuria (positive dipstick):

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Abnormal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>24 H Urine Protein</strong></td>
<td>&lt; 300mg/24h</td>
<td>&gt;300mg/24h</td>
</tr>
<tr>
<td><strong>Urine SPOT protein/ Creat. ratio (mg/gm)</strong></td>
<td>&lt; 200mg/g</td>
<td>&gt;200mg/g</td>
</tr>
</tbody>
</table>
Quantification of Proteinuria: (Negative Dipstick)

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>“Micro”-albuminuria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine AER (μg/min)</td>
<td>&lt; 20</td>
<td>20 - 200</td>
</tr>
<tr>
<td>Urine AER (mg/24h)</td>
<td>&lt; 30</td>
<td>30 - 300</td>
</tr>
<tr>
<td>Spot albumin/Cr# ratio (mg/gm)</td>
<td>&lt; 30</td>
<td>30 - 300</td>
</tr>
</tbody>
</table>
Methods of Estimating GFR

- Inulin/iothalamate clearance “GOLD STANDARD”
- Creatinine Clearance (24 h urine)
- Equations base on serum creatinine
  - Cockroft-Gault
  - MDRD
MDRD equation for predicting GFR

Estimated GFR (ml/min/1.73m²)

\[ = 186 \times (S_{cr})^{-1.154} \times (Age)^{-0.203} \times (0.742 \text{ if female}) \times (1.210 \text{ if African-American}) \]

\[ = \exp(5.228 - 1.154 \times \ln(S_{cr}) - 0.203 \times \ln(Age) - (0.299 \text{ if female}) + (0.192 \text{ if African-American})) \]
MDRD GFR Calculator (with SI Units)

Plasma creatinine
○ mg/dL ○ umol/L

Age

Race
○ Black ○ White*

Gender
○ Male ○ Female

GFR value:
(Age, Race, Gender, Plasma creatinine)

36 ml/min/1.73 m² in white females

*All ethnic groups other than black
K/DOQI CKD Staging

Requires 2 or more GFR, 3 or more months apart

<table>
<thead>
<tr>
<th>GFR</th>
<th>90</th>
<th>60</th>
<th>30</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Other markers kidney disease: proteinuria, hematuria, anatomic

Complications Possible

Complications Evident

Renal Replacement

Stage
Does she have CKD?

At what level of creatinine does a 65-year-old diabetic, hypertensive white woman weighing 50 kilograms have CKD?

1. 1.0 mg/dL
2. 1.3 mg/dL
3. 1.5 mg/dL
4. 1.7 mg/dL

Creatinine = 1.0 for GFR = 59 mL/min/1.73 m²
Objectives

- Definition of CKD
- Prevalence and Scope of CKD
- Optimal management
  - Delaying progression
  - Treatment of Comorbidities
  - Transition to End Stage Renal Disease
Incidence & Prevalence of ESRD

USRDS 2004
Prevalence of CKD: NHANES III

- Stage 5 (GFR <15 or ESRD): 0.3
- Stage 4 (GFR 15-29): 0.4
- Stage 3 (GFR 30-59): 7.6
- Stage 2 (GFR 60-89): 5.3
- Stage 1 (albuminuria): 5.9
- Total: 19.2

Median age by race/ethnicity

USRDS 2004
Etiology of ESRD

USRDS 1999
Objectives

- Definition of CKD
- Prevalence and Scope of CKD
- **Optimal management**
  - Delaying progression
  - Treatment of Comorbidities
  - Transition to End Stage Renal Disease

Kidney Disease Outcomes Quality Initiative
K/DOQI
http://www.kidney.org/
What can be done to slow progression of renal disease?

- Hypertension control
- ACE-Inhibitors/A2R-Blockers
- Blood sugar control
- Moderate protein restriction
Early Aggressive Antihypertensive Treatment in Diabetic Nephropathy (n=10)


metoprolol, hydralazine, and furosemide or thiazide
Meta Analysis: Lower Mean BP Results in Slower Rates of Decline in GFR in Diabetics and Non-Diabetics

\[ r = 0.69; \quad P < 0.05 \]


www.hypertensiononline.org
# Blood Pressure Targets

<table>
<thead>
<tr>
<th>Clinical Status</th>
<th>BP Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension (no diabetes or renal disease)</td>
<td>&lt;140/90 mmHg (JNC 7)</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>&lt;130/80 mmHg (ADA, JNC 7)</td>
</tr>
<tr>
<td>Renal Disease with proteinuria &gt;1 gram/24 hours, or diabetic kidney disease</td>
<td>&lt;130/80 mmHg (NKF) &lt;125/75 mmHg (NKF)</td>
</tr>
</tbody>
</table>

SCORECARD: Awareness, Treatment and Control of Blood Pressure 1976-2000 (JNC-VII)
# Clinical Practice Guidelines for Management of Hypertension in CKD

<table>
<thead>
<tr>
<th>Type of Kidney Disease</th>
<th>Blood Pressure Target (mm Hg)</th>
<th>Preferred Agents for CKD, with or without Hypertension</th>
<th>Other Agents to Reduce CVD Risk and Reach Blood Pressure Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic Kidney Disease</td>
<td>130/80</td>
<td>ACE inhibitor or ARB</td>
<td>Diuretic preferred, then BB or CCB</td>
</tr>
<tr>
<td>Nondiabetic Kidney Disease with Urine Total Protein-to-Creatinine Ratio $\geq 200$ mg/g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondiabetic Kidney Disease with Spot Urine Total Protein-to-Creatinine ratio $&lt;200$ mg/g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney Disease in Kidney Transplant Recipient</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: CVD = Cardiovascular Disease; BB = Beta Blocker; CCB = Calcium Channel Blocker; ACE inhibitor = Angiotensin-Converting Enzyme inhibitor; ARB = Angiotensin II Receptor Blocker.
SCORECARD: ACE-I/ARB Use in Proteinuric Patients

Diabetes Control and Complications Trial

- 1441 patients with IDDM
  - 726 without retinopathy at base line (the primary-prevention cohort)
  - 715 with mild retinopathy (secondary-intervention cohort)
- Conventional (2 insulin injections/day vs Intensive (insulin pump or ≥ 3 insulin injections/day)
- mean F/U = 6.5 yrs

Diabetes Control and Complications Trial

Prevention of Microalbuminuria

Microalbuminuria reduced by 39 percent (95 % C.I.=21 – 52 %)

**UKPDS: Microalbuminuria**

*Urine albumin >50 mg/L*

<table>
<thead>
<tr>
<th></th>
<th>RR</th>
<th>p</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.89</td>
<td>0.24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three years</td>
<td>0.83</td>
<td>0.043</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Six years</td>
<td>0.88</td>
<td>0.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nine years</td>
<td>0.76</td>
<td>0.00062</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twelve years</td>
<td>0.67</td>
<td>0.000054</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifteen years</td>
<td>0.70</td>
<td>0.033</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Relative Risk & 99% CI**

![Graph with Relative Risk and 99% CI](https://example.com/graph.png)

**Favours**

- Intensive
- Conventional

**UKPDS**

![UKPDS Logo](https://example.com/logo.png)
ACCORD Glycemic Trial
(Overarching trial)

10,000
Age-eligible, high risk people with type 2 diabetes

5,000 to Intensive Group
(A1c Target < 6.0%)

5,000 to Standard Group
(A1c Target 7.0 - 7.9%)

Treated and followed for > 4 years (mean 5.5 yrs)

MAJOR CVD EVENTS
## ACCORD: Deaths in Intensive vs Standard Glycemic Control Groups

<table>
<thead>
<tr>
<th>Deaths</th>
<th>Standard Glycemic Control</th>
<th>Intensive Glycemic Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>203 (11/1000/y)</td>
<td>257 (14/1000/y)</td>
</tr>
</tbody>
</table>

Despite 10% lowering of primary outcome (MI rates) there was a 20% higher death rate

http://www.nhlbi.nih.gov/health/prof/heart/other/accord/q_a.htm
CKD and Mortality

Salvador Dali - Premonition of Civil War
Chronic Kidney Disease and the Risks of Death, Cardiovascular Events, and Hospitalization

- **Graph A**: Shows the age-standardized rate of death from any cause per 100 person-years for different estimated GFR (ml/min/1.73 m²) categories. The number of events ranges from 11,569 to 18,420.

- **Graph B**: Displays the age-standardized rate of cardiovascular events per 100 person-years. The number of events varies from 73,108 to 3,824.

Go AS.. NEJM, 351:1296-1305, 2004
Rates of Death and Cardiovascular Events in Patients According to eGFR

- CV = cardiovascular.
- N = 1,120,295 adults.
- *Age-standardized rates per 100 person-years; †CV event defined as hospitalization for coronary heart disease, heart failure, ischemic stroke, and peripheral arterial disease per 100 person-years.
HOPE TRIAL: Predictive Variables for CV Death, MI, and Stroke

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microalbuminuria</td>
<td>1.59</td>
</tr>
<tr>
<td>Creatinine &gt; 1.4 mg/dL</td>
<td>1.40</td>
</tr>
<tr>
<td>CAD</td>
<td>1.51</td>
</tr>
<tr>
<td>PVD</td>
<td>1.49</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>1.42</td>
</tr>
<tr>
<td>Male</td>
<td>1.20</td>
</tr>
<tr>
<td>Age</td>
<td>1.03</td>
</tr>
<tr>
<td>Waist-Hip Ratio</td>
<td>1.13</td>
</tr>
</tbody>
</table>

CKD Patients Are More Likely to Die Than Progress to ESRD

RRT = renal replacement therapy

Risk Factors for CVD

**TRADITIONAL**
- Age
- Male gender
- Menopause
- Family history
- Hypertension
- Smoking
- Low HDL, high LDL
- Diabetes
- Inactivity, Obesity
- LVH

**NON TRADITIONAL**
- CaxPO4 product
- Anemia
- Inflammation
- Hypoalbuminemia

**“REVERSE” EPIDEMIOLOGY**
- Low cholesterol
- Low body weight
- Low blood pressure
Malnutrition, Inflammation and Atherosclerosis (MIA syndrome)

# Endothelial Cell Gene Expression

## ESRD Patients Vs. Controls: Increased Inflammation and Oxidative Stress

<table>
<thead>
<tr>
<th></th>
<th>ESRD Patients</th>
<th>Controls</th>
<th>Fold Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCP-1*</td>
<td>2.3±1.0x10⁻¹</td>
<td>1.4±0.8x10⁻⁵</td>
<td>&gt;15,000x</td>
</tr>
<tr>
<td>RAGE*</td>
<td>1.2±1.0x10⁻¹</td>
<td>1.6±0.3x10⁻⁵</td>
<td>7,000x</td>
</tr>
</tbody>
</table>

* mRNA Relative Copy Number via Real-Time PCR

Anjali Ganda, .. Jai Radhakrishnan.  
Submitted to American Society of Nephrology, November, 2008, Philadelphia, PA.
Endothelial Cell Protein Expression
ESRD Patients Vs. Controls:
Increased Nitrotyrosine (Oxidative Stress)

*Quantitative Immunofluorescence Analysis
4 Fold Reduction in Circulating Endothelial Progenitor Cells
ESRD Patients Vs. Controls
Endothelial Dysfunction: The Cardiovascular Disease Continuum

Cardiovascular Disease Progression

Endothelial Dysfunction $\rightarrow$ Vascular Dysfunction $\rightarrow$ Elevated BP $\rightarrow$ Target-Organ Damage

$\rightarrow$ LVH $\rightarrow$ Stroke $\rightarrow$ Angina Pectoris $\rightarrow$ Renal Damage

?
Management of Comorbidities

- Anemia
- Renal Osteodystrophy
- Hyperlipidemia
What is the prevalence of anemia in CKD? Is the pt’s GFR too good to explain anemia?

Am J Kidney Dis 34:125-134, 1999
Benefits of Correction of Hb

- Raising Hematocrit to 30-36% improves:
  - Brain and cognitive function
  - Quality of Life
  - Exercise capacity/muscle function
  - ?LVH
  - ?Survival
Principles of Anemia Treatment

- **Erythropoietin**
  - Epoetin alfa: Procrit®, Epogen®
  - Darbepoietin Alpha: ARANESP®

- **Targets**
  - Hgb=11g/dL (caution when intentionally maintaining Hb>13g/dL)
  - Sufficient iron should be administered to maintain
    - TSAT of >20%,
    - Serum ferritin level of >200 ng/mL
CHOIR Study
Primary Endpoint: MI, CVA, CHF, Death

High hemoglobin group

Low hemoglobin group

Renal Osteodystrophy
Metastatic Coronary Calcification
Relationship between Moderate to Severe Kidney Disease and Hip Fracture

Serum Phosphate Levels and Mortality Risk

Proportion surviving

Years of survival time
(number of persons at risk)

Phosphate level, relative to estimated creatinine clearance:

- Lowest quintile
- Average (middle quintiles)
- Highest quintile

J Am Soc Nephrol 16: 520-528, 2005
Oral Calcitriol with Improved Survival

![Graph showing cumulative incidence of death over time comparing control and calcitriol groups.]

No. at risk
Control 989 538 323 198 115
Calcitriol 429 305 185 79 42

Treatment of Calcium, Phosphate Levels and Osteodystrophy

- **AIM:** To Normalize-
  - Serum calcium
  - Serum Phosphorus
  - PTH levels

- **Methods:**
  - Oral Calcium
  - Vitamin D analogs
  - Phosphate binders (sevelamer-Renagel®)
  - Calcimimetics (cinacalcet-Sensipar®)
## Dyslipidemia in Renal Patients

<table>
<thead>
<tr>
<th></th>
<th>Total Chol &gt;240 mg/dL</th>
<th>LDL Chol &gt;130 mg/dL</th>
<th>HDL Chol &lt;35 mg/dL</th>
<th>Triglycerides &gt;200 mg/dL</th>
<th>Lp (a) &gt;30 mg/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population*</td>
<td>20</td>
<td>40</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>CRI with nephrotic syndrome (includes diabetic nephropathy)†</td>
<td>90</td>
<td>85</td>
<td>50</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>CRI without nephrotic syndrome†</td>
<td>30</td>
<td>10</td>
<td>35</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>ESRD treated by HD†</td>
<td>20</td>
<td>30</td>
<td>50</td>
<td>45</td>
<td>30</td>
</tr>
<tr>
<td>ESRD treated by PD†</td>
<td>25</td>
<td>45</td>
<td>20</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>RTR†</td>
<td>60</td>
<td>60</td>
<td>15</td>
<td>35</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>CKD Exclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Protection Study,\textsuperscript{34} 2002</td>
<td>20,536</td>
<td>&quot;Cr $\geq 2.26 \text{ mg/dL}&quot;&quot;</td>
</tr>
<tr>
<td>MIRACL Study,\textsuperscript{51} 2001</td>
<td>3,086</td>
<td>&quot;renal failure requiring dialysis&quot;</td>
</tr>
<tr>
<td>BIP,\textsuperscript{52,53}2000</td>
<td>3,090</td>
<td>&quot;Cr $\geq 1.5 \text{ mg/dL or NS}$&quot;</td>
</tr>
<tr>
<td>AVERT,\textsuperscript{54} 1999</td>
<td>341</td>
<td>&quot;Significant renal dysfunction&quot;</td>
</tr>
<tr>
<td>LIPID,\textsuperscript{55,56}1998</td>
<td>9,014</td>
<td>&quot;renal disease&quot;</td>
</tr>
<tr>
<td>AFCAPS/TexCAPS,\textsuperscript{57,58}1998</td>
<td>5,615</td>
<td>&quot;secondary hyperlipoproteinemia, NS&quot;</td>
</tr>
<tr>
<td>CARE,\textsuperscript{59,60}1996</td>
<td>1,283</td>
<td>&quot;NS or other renal disease&quot;</td>
</tr>
<tr>
<td>ALLHAT,\textsuperscript{35} 1996</td>
<td>20,000</td>
<td>&quot;Cr $\geq 2 \text{ mg/dL}$&quot;</td>
</tr>
<tr>
<td>LCAS,\textsuperscript{61}, 1996</td>
<td>572</td>
<td>&quot;Any kidney disease&quot;</td>
</tr>
<tr>
<td>WOSCOPS,\textsuperscript{62,63}1995</td>
<td>6,595</td>
<td>&quot;Cr $&gt;1.75 \text{ mg/dL}$&quot;</td>
</tr>
<tr>
<td>REGRESS,\textsuperscript{64} 1995</td>
<td>885</td>
<td>&quot;NS, Cr $\geq 2.5 \text{ mg/dL}$&quot;</td>
</tr>
<tr>
<td>PLAC-1,\textsuperscript{65}, 1995</td>
<td>480</td>
<td>&quot;Cr $\geq 2.5 \text{ mg/dL, urine protein } &gt; 2+$&quot;</td>
</tr>
<tr>
<td>4S,\textsuperscript{66,67}1994</td>
<td>4,444</td>
<td>Not reported, but only 72 had Cr $\geq 1.5 \text{ mg/dL}$</td>
</tr>
<tr>
<td>CCAIT,\textsuperscript{68} 1994</td>
<td>331</td>
<td>&quot;Impaired kidney function&quot;</td>
</tr>
</tbody>
</table>
| EXCEL,\textsuperscript{69,70}1991        | 8,245 | "NS" Baseline Cr = 1.1$\pm 0.2 \text{ mg/dL (mean } \pm \text{ SD)$}"
|                                          |       | "4% had elevated Cr"                                |
| Helsinki Heart Study,\textsuperscript{71-73} 1987 | 18,966| "Cr $\geq 1.3 \text{ mg/dL}$"                       |
TNT (Treating to New Targets) study
CKD substudy

Risk Reduction
-32% CKD
(n= 3,107)
-15% normal eGFR
(n= 9,656)

J Am Coll Cardiol. 2008 Apr 15;51(15):1448-54
TNT
eGFR at Last Study Visit

Mean increase from baseline (mL/min)

- Atorvastatin 10 mg (n=3977)
- Atorvastatin 80 mg (n=3988)

MDRD (mL/min/1.73 m²)

- (↑ 8.4%)

Cockcroft-Gault (mL/min)

- (↑ 3.3%)
- (↑ 1.2%)

P<0.0001

TNT eGFR at Last Study Visit
HDL-directed therapies?

My doctor said:
“Only 1 glass of alcohol a day.”
I can live with that!
Management of Dyslipidemia in CKD

NCEP guidelines recommended:
- Cholesterol <200
- LDL-C <100 (?<70)
- HDL-C >45 (M), 55(F)
- Triglycerides<150
Preparation for renal replacement

- Choice of renal replacement
- Timely access surgery
- Timely dialysis initiation
Preparation for Renal Replacement

When GFR <25ml/min
- Renal transplant is treatment of first choice
  - Workup living donors
- If no donors available
  - List patient on cadaver tx. list
  - Place Angioaccess if HD preferred
AV access (Target 50% Fistulæ)
Patient Survival vs Waiting Time

Event-free patient survival, %

Post-transplant time, months

By months of dialysis
0
0–6
6–12
12–24
24–36
36–48
48+

80
85
90
95
100

0 12 24 36 48 60 72 84 96
Effect of Preemptive Renal Transplant on Allograft Survival

Kidney Donors Recovered 1993-2002

7/15/2007: 72,355

7/15/2007: 72,355

# of Donors Recovered

Year

Deceased Donor

Living Donor
GIRL RAISED BY BARNYARD PIGS
11-year-old squeals, oinks and walks on all fours!

CUPID’S COMEBACK
Couple remarries — 44 years after they divorce

The most incredible lawsuit in history . . .

DONOR WANTS HER KIDNEY BACK

‘Saving my no-good brother’s life was a mistake,’ says woman
ORIGINAL INVESTIGATIONS

Pathogenesis and Treatment of Kidney Disease and Hypertension

Awareness of Kidney Disease in the US Population: Findings From the National Health and Nutrition Examination Survey (NHANES) 1999 to 2000

Thomas L. Nickolas, MD, MS, Gershon D. Frisch, MD, Alexander R. Opotowsky, MD, MPH, Raymond Arons, DrPH, MPH, and Jai Radhakrishnan, MD
Awareness/CKD Stage

![Bar graph showing percent prevalence by stage of kidney disease.](chart.png)
<table>
<thead>
<tr>
<th>Demographics</th>
<th>Aware Group</th>
<th>Unaware Group</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (y)</td>
<td>110/384</td>
<td>274/384</td>
<td>0.0002</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>52/110</td>
<td>149/274</td>
<td>0.1</td>
</tr>
<tr>
<td>Race-ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white (%)</td>
<td>43/110</td>
<td>91/274</td>
<td>0.6</td>
</tr>
<tr>
<td>Non-Hispanic black (%)</td>
<td>19/110</td>
<td>80/274</td>
<td>0.03</td>
</tr>
<tr>
<td>Mexican American (%)</td>
<td>37/110</td>
<td>80/274</td>
<td>0.2</td>
</tr>
<tr>
<td>Other Hispanic (%)</td>
<td>7/110</td>
<td>16/274</td>
<td>0.4</td>
</tr>
<tr>
<td>Other race and multirace (%)</td>
<td>4/110</td>
<td>7/274</td>
<td>0.4</td>
</tr>
<tr>
<td>Primary language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spanish (%)</td>
<td>27/43</td>
<td>58/95</td>
<td>0.07</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\leq) High school education (%)</td>
<td>82/110</td>
<td>228/272</td>
<td>0.09</td>
</tr>
<tr>
<td>Health care access</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined health care access variable‡ (%)</td>
<td>75/110</td>
<td>209/274</td>
<td>0.4</td>
</tr>
<tr>
<td>Comorbidities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>67/108</td>
<td>216/268</td>
<td>0.001</td>
</tr>
<tr>
<td>DM (%)</td>
<td>35/110</td>
<td>204/274</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>CVD (%)</td>
<td>24/110</td>
<td>79/272</td>
<td>0.08</td>
</tr>
<tr>
<td>Mean systolic blood pressure (mm Hg)</td>
<td>104/366</td>
<td>262/366</td>
<td>0.0001</td>
</tr>
<tr>
<td>Mean diastolic blood pressure (mm Hg)</td>
<td>104/366</td>
<td>262/366</td>
<td>0.8</td>
</tr>
<tr>
<td>Mean HbA1c</td>
<td>110/384</td>
<td>274/384</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mean UACR ((\mu)g/mg)</td>
<td>104/371</td>
<td>267/371</td>
<td>0.1</td>
</tr>
<tr>
<td>Mean serum creatinine (mg/dL)</td>
<td>110/384</td>
<td>274/384</td>
<td>0.1</td>
</tr>
<tr>
<td>Mean total cholesterol (mg/dL)</td>
<td>108/382</td>
<td>274/382</td>
<td>0.9</td>
</tr>
<tr>
<td>Mean serum albumin (g/dL)</td>
<td>110/384</td>
<td>274/384</td>
<td>0.4</td>
</tr>
<tr>
<td>Mean hemoglobin (g/dL)</td>
<td>110/383</td>
<td>273/383</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Timing Of Nephrology Referral

- Patients with chronic kidney disease should be referred to a specialist for consultation and co-management if:
  - the clinical action plan cannot be prepared
  - the prescribed evaluation of the patient cannot be carried out
  - the recommended treatment cannot be carried out.
- In general, patients with GFR <30 mL/min/1.73 m² should be referred to a nephrologist.
The timing of specialist evaluation in chronic kidney disease and mortality: Cumulative Mortality

- Early: > 12 months
- Intermediate: 4-12 months
- Late: <4 months

Kinchen KS....Ann Intern Med 2002 Sep 17;137(6):479-86
Early Treatment Should Make a Difference

![Graph showing the difference in GFR (glomerular filtration rate) over time for different treatment scenarios: No Treatment, Current Treatment, and Early Treatment. The graph illustrates that early treatment significantly delays the onset of Kidney Failure compared to no treatment or current treatment.]
PCP Must be Engaged

1) 7.6 million people with GFR 30-60 mL/min/1.73 m²
2) About 5,000 full-time nephrologists
3) Nearly 1,500 new patients per nephrologist

Therefore, 7 new patients per day per nephrologist.  
Obviously not possible.
Summary: Definition of CKD

- **“Spot”** urine albumin/microalbumin to creatinine ratio
- **Estimate GFR** from serum creatinine using the MDRD prediction equation

**Note:**

24 hour urine collections are NOT needed
Diabetics, HTN: should be tested once a year
Others at risk: less frequently as long as normal
Summary
Optimal Management of CKD

- **Delay Progression**
  - ACE-Inhibitors/ARB
  - BP control (130/85)
  - Blood sugar control
  - ?Protein restriction

- **Treat Comorbidities**
  - Anemia
  - Renal osteodystrophy
  - Hyperlipidemia
  - Cardiovascular disease
  - Nutrition, Acidosis

- **Preparation for renal replacement**
  - Choice of Renal Replacement
  - Timely access surgery
  - Timely dialysis initiation
www.columbianephrology.org