Update in Delaying Progression of Chronic Kidney Disease

การประชุมวิชาการสัญจร ครั้งที่ 21
ราชวิทยาลัยอายุรแพทย์แห่งประเทศไทย ร่วมกับ โรงพยาบาลบุญริม

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13 พ.ย. 2555
Scope of Presentation

1. ESRD: epidemiology
2. CKD - definition & classification
   - prevalence
3. Serum creatinine and GFR equation
4. Risk factors for CKD
5. Intervention to delay CKD progression
Yearly prevalence trend of renal replacement therapy patients, Thailand 1997-2010

USRDS report 2011
Taiwan = 2,447 pmp
Japan  = 2,205 pmp
Korea  = 1,114 pmp

*Missing data in 2002
## Etiology of RRT cases in 2007-2010

<table>
<thead>
<tr>
<th>Etiology</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic nephropathy</td>
<td>4,965 (34.6%)</td>
<td>7000 (36.9%)</td>
<td>9,487 (47.6%)</td>
<td><strong>11,148 (30.8%)</strong></td>
</tr>
<tr>
<td>Hypertensive nephropathy</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>2,795 (7.71%)</td>
</tr>
<tr>
<td>Obstructive nephropathy</td>
<td>626 (4.4%)</td>
<td>1020 (5.4%)</td>
<td>1,036 (5.2%)</td>
<td>1,449 (4.0%)</td>
</tr>
<tr>
<td>Presumed glomerulonephritis (No biopsy)</td>
<td>712 (5.0%)</td>
<td>743 (3.9%)</td>
<td>563 (2.8%)</td>
<td>827 (2.3%)</td>
</tr>
<tr>
<td>Chronic urate nephropathy</td>
<td>373 (2.6%)</td>
<td>437 (2.3%)</td>
<td>295 (1.5%)</td>
<td>549 (1.5%)</td>
</tr>
<tr>
<td>Polycystic kidney disease</td>
<td>229 (1.6%)</td>
<td>298 (1.6%)</td>
<td>257 (1.3%)</td>
<td>406 (1.1%)</td>
</tr>
</tbody>
</table>

* In 2007-2009 Hypertensive nephropathy were classified as unknown

*Thailand Renal Replacement Report 2010, Nephrology Society of Thailand*
Unique causes of CKD in Thailand

1. RTA (Nephrocalcinosis, renal stone)
2. Nephrolithiasis (obstruction infection, CKD)
3. Cadmium (แมสอด) B2G’ uria, RTA, CKD
4. Lead poisoning (คลีดี้, กาญจนบุรี)
5. Fluorosis
6. Herbal medicine (Aristolochic acid, etc.)
Measurement of glomerular function (GFR)

1. **Creatinine clearance**
   - 24h urine coll\(\text{\textsuperscript{n}}\): \(\text{Ccr} = \frac{\text{Ucr.V}}{\text{Pcr}}\)
   - Cockroft & Gault: \(\text{Ccr} = \frac{(140 - \text{Age}) \cdot \text{BW}}{72 \cdot \text{S.cr}}\) (x 0.85 if female)

2. **Isotope clearance**
   - Plasma clearance: Iothalamate, DTPA-plasma clearance
   - Estimated from serum creatinine [eGFR]
Abbreviated MDRD-GFR equations

Re-expressed IDMS – traceable \(^1\)

\[= 175 \times S.c\text{r}^{-1.154} \times \text{Age}^{-0.203} \times 0.742 \ (\text{female})\]

MDRD\(^2\) \[= 186 \times S.c\text{r}^{-1.154} \times \text{Age}^{-0.203} \times 0.742 \ (\text{female}) \times 1.212 \ (\text{black})\]

Japanese \(^3\) \[= 168 \times S.c\text{r}^{-1.044} \times \text{Age}^{-0.274} \times 0.775 \ (\text{female})\]

Chinese \(^4\) \[= 175 \times S.c\text{r}^{-1.234} \times \text{Age}^{-0.179} \times 0.79 \ (\text{female})\]

Thai \(^5\) re-expressed IDMS traceable MDRD equation.

\[= 175 \times \text{Cr}_{\text{Enz}}^{-1.154} \times \text{Age}^{-0.203} \times 0.742 \ (\text{female}) \times 1.129 \ (\text{Thai})\]

or \[= 375.5 \times \text{Cr}_{\text{Enz}}^{-0.848} \times \text{Age}^{-0.364} \times 0.712 \ (\text{female})\]

4. JASN 2006; 17: 2937-44.
Serum Creatinine measurement

- Modified Jaffe’s method
  (10 – 20% over estimation)

- Enzymatic method

Urgent need of S.Cr calibration
A New Equation to Estimate Glomerular Filtration Rate

Table 2. The CKD-EPI Equation for Estimating GFR on the Natural Scale*

<table>
<thead>
<tr>
<th></th>
<th>Black</th>
<th>White or other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>≤62 (≤0.7)</td>
<td>≤62 (≤0.7)</td>
</tr>
<tr>
<td></td>
<td>GFR = 166 \times \left(\frac{Scr}{0.7}\right)^{-0.329} \times (0.993)^{Age}</td>
<td>GFR = 144 \times \left(\frac{Scr}{0.7}\right)^{-0.329} \times (0.993)^{Age}</td>
</tr>
<tr>
<td></td>
<td>&gt;62 (&gt;0.7)</td>
<td>&gt;62 (&gt;0.7)</td>
</tr>
<tr>
<td></td>
<td>GFR = 166 \times \left(\frac{Scr}{0.7}\right)^{-1.209} \times (0.993)^{Age}</td>
<td>GFR = 144 \times \left(\frac{Scr}{0.7}\right)^{-1.209} \times (0.993)^{Age}</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>≤80 (≤0.9)</td>
<td>≤80 (≤0.9)</td>
</tr>
<tr>
<td></td>
<td>GFR = 163 \times \left(\frac{Scr}{0.9}\right)^{-0.411} \times (0.993)^{Age}</td>
<td>GFR = 141 \times \left(\frac{Scr}{0.9}\right)^{-0.411} \times (0.993)^{Age}</td>
</tr>
<tr>
<td></td>
<td>&gt;80 (&gt;0.9)</td>
<td>&gt;80 (&gt;0.9)</td>
</tr>
<tr>
<td></td>
<td>GFR = 163 \times \left(\frac{Scr}{0.9}\right)^{-1.209} \times (0.993)^{Age}</td>
<td>GFR = 141 \times \left(\frac{Scr}{0.9}\right)^{-1.209} \times (0.993)^{Age}</td>
</tr>
</tbody>
</table>

CKD-EPI = Chronic Kidney Disease Epidemiology Collaboration; GFR = glomerular filtration rate.

NORMAL KIDNEY FUNCTION

Presence of risk factor

Primary prevention

Renal Damage (Nephropathy)

Microalbuminuria / proteinuria

GFR

Secondary prevention

Progressive Renal Damage (CKD progression)

ESRD (pre-dialysis) → RRT (HD, PD, KTx)
KDIGO CLINICAL PRACTICE GUIDELINE
FOR EVALUATION AND MANAGEMENT OF CKD

1.1 Definition of CKD

1.1.1: CKD is defined as abnormalities of kidney structure or function, present for ≥3 months, with implications for health (see below). (Not Graded)

<table>
<thead>
<tr>
<th>Criteria for CKD (either of the following present for ≥3 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markers of Kidney Damage</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>✓ Abnormalities detected by histology</td>
</tr>
<tr>
<td>✓ Structural abnormalities detected by imaging</td>
</tr>
<tr>
<td>History of kidney transplantation</td>
</tr>
<tr>
<td>Decreased GFR</td>
</tr>
</tbody>
</table>
Stages of Chronic Kidney Disease

<table>
<thead>
<tr>
<th>Stage</th>
<th>Prevalence *</th>
<th>Glomerular Filtration Rate ml / min / 1.73 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64%</td>
<td>&gt; 90</td>
</tr>
<tr>
<td>2</td>
<td>31%</td>
<td>60 – 89</td>
</tr>
<tr>
<td>3</td>
<td>4.3%</td>
<td>30 – 59</td>
</tr>
<tr>
<td>4</td>
<td>0.2%</td>
<td>15 – 29</td>
</tr>
<tr>
<td>5</td>
<td>0.2%</td>
<td>&lt; 15</td>
</tr>
</tbody>
</table>

> Stage 3 = 4,700 PMP

* Prevalence per adult population age > 20

AJKD 2002; 39 (Suppl 1) : S49.
## Prevalence studies in Thailand

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Subject</th>
<th>Number</th>
<th>CKD stage (%)</th>
<th>MDRD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domrongkitchaiporn S et al, 1997</td>
<td>EGAT Age 55(5.1) Male 75.9%</td>
<td>2,967</td>
<td>NA</td>
<td>6.4</td>
</tr>
<tr>
<td>Chittinandana A et al, 2002</td>
<td>RTAF Age 45.7(8) Male 82%</td>
<td>15,612</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>InterASIA, 2000</td>
<td>General population Age 50.5(1.5) Male 48%</td>
<td>5,146</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Thai SEEK project, Ingsathit A, et al, 2009</td>
<td>General population Age 45.3 (15.4) Male 45.3%</td>
<td>3,459</td>
<td>3.3</td>
<td>5.6</td>
</tr>
</tbody>
</table>

**CKD awareness = 1.9% among stages 1 - 4**
1.4.2 Evaluation of Cause

1.4.2.1: Evaluate the clinical context, including history, physical examination, laboratory measures, imaging and pathologic diagnosis to determine the causes of kidney disease. (Not Graded)
Treatment of primary cause

- Glycemic control in DM
- Blood pressure control in hypertensive pts.

- Relieving obstruction
- $R_x$ of glomerulonephritis
  - Immunologic damage
    - Proteinuria
- $R_x$ of infection
2.1 Definition and Identification of CKD Progression

2.1.3: Define CKD progression based on one of more of the following (Not Graded):

• Decline in GFR category (≥90, 60-89, 45-59, 30-44, 15-29, <15). Confirmed progression is defined as a drop in GFR category accompanied by a 25% or greater drop in eGFR from baseline.

• Rapid progression is defined as a sustained decline in eGFR of more than -5 mL/min / 1.73 m² / year.

• The confidence in assessing progression is increased with increasing number of serum creatinine measurements and duration of follow-up.
Overall Risk Factors for CKD Progression

1. Poor glycemic control
2. Albuminuria & Proteinuria
3. BP control & RAAS inhibition
4. Baseline kidney function
5. Drugs (ASA, NSAID) & radio-contrast,
6. Metabolic acidosis
7. Acute kidney injury
8. Diet
9. Infection (local & systemic)
10. Kidney stones
11. Genetics & Races
DCCT / EDIC Group  1441 T1DM  F/U 17 yrs.
HbA1C  :  Intensive = 7.4%
          Conventional = 9.1%
### Table 1. Clinical Characteristics of the DCCT/EDIC Cohort.*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intensive Treatment (N=711)</td>
<td>Conventional Treatment (N=730)</td>
<td>Intensive Treatment (N=698)</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>27±7</td>
<td>27±7</td>
<td>34±7</td>
</tr>
<tr>
<td>Female sex (%)</td>
<td>49</td>
<td>46</td>
<td>49</td>
</tr>
<tr>
<td>Retinopathy at baseline (%)</td>
<td>51</td>
<td>48</td>
<td>—</td>
</tr>
<tr>
<td>Duration of diabetes (yr)</td>
<td>6±4</td>
<td>5±4</td>
<td>12±5</td>
</tr>
<tr>
<td>Current cigarette smoker (%)</td>
<td>19</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Albumin excretion rate (mg/24 hr)</td>
<td>16.4±19.6</td>
<td>15.5±17.9</td>
<td>29.8±197.6</td>
</tr>
<tr>
<td>Albumin excretion rate (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥40 mg/24 hr</td>
<td>5</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>≥300 mg/24 hr</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Serum creatinine ≥2 mg/dl (177 μmol/liter) (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dialysis or transplantation ever (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
11,140 T2DM: intensive vs. std. BS control, HbA1C 6.5 vs. 7.3%, F/U 5 yrs.
# Trials of glucose control on renal outcome in DM

<table>
<thead>
<tr>
<th></th>
<th>DM duration</th>
<th>Archived duration</th>
<th>Microalb. (MA)</th>
<th>eGFR or S.cr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T₁DM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCCT</td>
<td>1-5 yr</td>
<td>7.2 vs. 9.1%</td>
<td>↓ risk in IC</td>
<td>No. diff.</td>
</tr>
<tr>
<td>AER &lt; 40 mg/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **T₂DM**      |             |                   |                |              |
| Advance       | 8           | 6.5 vs. 7.3%      |                |              |
| Accord        | 10          | 6.4 vs. 7.5%      | ↓ risk of MA & Mac. A. | No. diff. |
| VADT          | 11.5        | 6.9 vs. 8.4%      |                |              |

IC = Intensive blood sugar control

〇 = Early termination of the study due to inc. MR in the arm
**Glycemic Control**

3.1.8: We recommend a target HbA1c of ~7.0% (53 mmol/mol) to delay progression of the microvascular complications of diabetes, including DKD. *(1A)*

3.1.10: We suggest that target HbA1c be extended above 7.0% (53 mmol/mol) in individuals with co-morbidities or limited life expectancy and risk of hypoglycemia. *(2C)*

3.1.11: Glycemic control should be part of a multifactorial intervention strategy addressing blood pressure control and cardiovascular risk, promoting the use of angiotensin converting enzyme inhibition and/or angiotensin receptor blockade, statins and antiplatelet therapy. *(Not Graded)*
Overall Risk Factors for CKD Progression

1. Poor glycemic control
2. Albuminuria & Proteinuria
3. BP control & RAAS inhibition
4. Baseline kidney function
5. Drugs (ASA, NSAID) & radio-contrast,
6. Metabolic acidosis
7. Acute kidney injury
8. Diet
9. Infection (local & systemic)
10. Kidney stones
11. Genetics & Races
1.4.4 Evaluation of albuminuria and proteinuria

1.4.4.1: We suggest using the following measurements for initial testing of proteinuria (in descending order of preference) (2B):

1) urine albumin-to-creatinine ratio (ACR)
2) urine protein-to-creatinine ratio (PCR)
3) reagent strip urinalysis for total protein with automated reading
4) reagent strip urinalysis for total protein with manual reading.

1.4.4.2: We recommend that lab. reports ACR and PCR in untimed urine samples rather than just alb. or prot. Concentration alone. (1B)
Cumulative incidence of ESKD in CKD patients

Lower estimated GFR and higher albuminuria are associated with adverse kidney outcomes. A collaborative meta-analysis of general and high-risk population cohorts

Ron T. Gansevoort¹, Kunihiro Matsushita², Marije van der Velde¹, Brad C. Astor², Mark Woodward³, Andrew S. Levey⁴, Paul E. de Jong¹, Josef Coresh² and the Chronic Kidney Disease Prognosis Consortium

General pop (GP) = 845,125  High risk (HR) = 173,892
Proteinuria in diabetic kidney disease: A mechanistic viewpoint

Schematic summary of some of the pathways and mediators that are believed to be involved in proteinuria-induced tubulointerstitial injury.

### Prognosis of CKD by GFR and Albuminuria Categories: KDIGO 2012

#### GFR Categories, Description and Range (mL/min/1.73 m²)

<table>
<thead>
<tr>
<th>GFR Category</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>normal or high</td>
<td>&gt;90</td>
</tr>
<tr>
<td>G2</td>
<td>mildly decreased</td>
<td>60-89</td>
</tr>
<tr>
<td>G3a</td>
<td>mildly to moderately decreased</td>
<td>45-59</td>
</tr>
<tr>
<td>G3b</td>
<td>moderately to severely decreased</td>
<td>30-44</td>
</tr>
<tr>
<td>G4</td>
<td>severely decreased</td>
<td>15-29</td>
</tr>
<tr>
<td>G5</td>
<td>kidney failure</td>
<td>&lt;15</td>
</tr>
</tbody>
</table>

#### Albuminuria Categories, Description and Range

<table>
<thead>
<tr>
<th>Albuminuria Category</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>normal to mildly</td>
<td>moderately</td>
<td>severely</td>
</tr>
<tr>
<td></td>
<td>increased</td>
<td>increased</td>
<td>increased</td>
</tr>
<tr>
<td></td>
<td>&lt;30 mg/g</td>
<td>30-299 mg/g</td>
<td>≥300 mg/g</td>
</tr>
<tr>
<td></td>
<td>&lt;3 mg/mmol</td>
<td>3-29 mg/mmol</td>
<td>&gt;30 mg/mmol</td>
</tr>
</tbody>
</table>
Overall Risk Factors for CKD Progression

1. Poor glycemic control
2. Albuminuria & Proteinuria
3. BP control & RAAS inhibition
4. Baseline kidney function
5. Drugs (ASA, NSAID) & radio-contrast,
6. Metabolic acidosis
7. Acute kidney injury
8. Diet
9. Infection (local & systemic)
10. Kidney stones
11. Genetics & Races
Intensive Blood-Pressure Control in Hypertensive Chronic Kidney Disease

Standard control  BP = 140/90  MAP = 105
Intensive control  BP = <125/75  MAP = 92

Metabolic derangement in diabetic nephropathy

Podocytes:
- effacement
- apoptosis
- ↓ HSPG
- loss of −ve charge at GBM
- ↓ α3β1 integrin
- loss of nephrin
- Detachment

Angiotensinogen
↓
All - synthesis
@ podocytes
↓
TGF-β

ACEI / ARB

T-I fibrosis

Glomerular sclerosis

Proteinuria

GBM thickening & adhesion to Bowman’s capsule
Slit diaphragm widening

Mesang. Matrix deposition

The impact of renin-angiotensin-aldosterone system inhibitors on Type 1 and Type 2 diabetic patients with and without early diabetic nephropathy

Jennifer A. Hirst\textsuperscript{1,2}, Kathryn S. Taylor\textsuperscript{1,2}, Richard J. Stevens\textsuperscript{1,2}, Claire L. Blacklock\textsuperscript{1,2}, Nia W. Roberts\textsuperscript{2,3}, Christopher W. Pugh\textsuperscript{4} and Andrew J. Farmer\textsuperscript{1,2}

\textbf{Ratio of U.alb restitution : control}

\textbf{Type 1 Diabetes}

\begin{center}
\begin{tabular}{|c|c|c|c|c|}
\hline
Trial & ACE/ARB & N & Comparator & Ratio of means (95\% CI) \\
\hline
Normoalbuminuria & Tuominen (1998) & ACE & 24 & Placebo & 0.83 (0.42, 1.64) \\
& Kweon (2001) & ACE & 75 & Placebo & 0.33 (0.21, 0.53) \\
& Mauer 2009 ACE & ACE & 142 & Placebo & 1.30 (0.56, 1.78) \\
& Mauer 2009 ARB & ARB & 145 & Placebo & 2.06 (1.52, 2.64) \\
& EUCLID (1997) & ACE & 384 & Placebo & 0.87 (0.74, 1.03) \\
& Direct 2009 prevent 1 & ARB & 1421 & Placebo & 0.97 (0.94, 1.00) \\
& Direct 2009 protect 1 & ARB & 1905 & Placebo & 0.93 (0.84, 1.03) \\
& IV subtotal (P = 85.2\%, P = 0.000) & & & & 0.96 (0.94, 0.99) \\
& DVI subtotal & & & & 0.94 (0.79, 1.12) \\
\hline
Microalbuminuria & Garg (1998) & ACE & 11 & Placebo & 0.54 (0.12, 2.49) \\
& Chase (1993) & ACE & 15 & Placebo & 0.91 (0.39, 2.10) \\
& Bakris (1994) & ACE & 15 & Placebo & 0.08 (0.04, 0.17) \\
& Poulsen (2001) & ACE & 21 & Placebo & 0.48 (0.36, 0.67) \\
& Jerums (2001) & ACE & 23 & Placebo & 0.20 (0.14, 0.27) \\
& Parving (2001a) & ACE & 32 & Placebo & 0.49 (0.42, 0.57) \\
& Bojeselig (2001) & ACE & 34 & Placebo & 0.84 (0.31, 2.47) \\
& Mathiesen (1999) & ACE & 44 & Placebo & 0.16 (0.07, 0.34) \\
& Crespaldi (1998) & ACE & 68 & Placebo & 0.24 (0.03, 1.90) \\
& Atlanta (2000) & ACE & 65 & Placebo & 0.48 (0.40, 0.58) \\
& Ahmad (2003) & ACE & 73 & Placebo & 0.15 (0.10, 0.24) \\
& EUCLID (1997) & ACE & 85 & Placebo & 0.51 (0.32, 1.15) \\
& Viberti (1994) & ACE & 92 & Placebo & 0.34 (0.10, 1.09) \\
& Lafrel (1995) & ACE & 137 & Placebo & 0.51 (0.27, 0.97) \\
& IV subtotal (P = 82.8\%, P = 0.000) & & & & 0.46 (0.26, 0.84) \\
& DVI subtotal & & & & 0.33 (0.23, 0.46) \\
\hline
\end{tabular}
\end{center}
The impact of renin-angiotensin-aldosterone system inhibitors on Type 1 and Type 2 diabetic patients with and without early diabetic nephropathy

Jennifer A. Hirst\textsuperscript{1,2}, Kathryn S. Taylor\textsuperscript{1,2}, Richard J. Stevens\textsuperscript{1,2}, Claire L. Blacklock\textsuperscript{1,2}, Nia W. Roberts\textsuperscript{2,3}, Christopher W. Pugh\textsuperscript{4} and Andrew J. Farmer\textsuperscript{1,2}

Ratio of U. alb
Intervention : control

Type 2 Diabetes

<table>
<thead>
<tr>
<th>Trial</th>
<th>ACE/ARB</th>
<th>N</th>
<th>Comparator</th>
<th>Ratio of means (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normoalbuminuria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawaki (2008)</td>
<td>ARB</td>
<td>20</td>
<td>nt</td>
<td>0.81 (0.51, 1.27)</td>
</tr>
<tr>
<td>Bara (2001)</td>
<td>ACE</td>
<td>135</td>
<td>ccb</td>
<td>0.64 (0.39, 1.05)</td>
</tr>
<tr>
<td>Revic (1999)</td>
<td>ACE</td>
<td>156</td>
<td>Placebo</td>
<td>0.60 (0.39, 0.93)</td>
</tr>
<tr>
<td>BENEDICT (2004)</td>
<td>ACE</td>
<td>334</td>
<td>ccb</td>
<td>0.65 (0.49, 0.86)</td>
</tr>
<tr>
<td>Direct 2009 P2 NT</td>
<td>ARB</td>
<td>725</td>
<td>Placebo</td>
<td>0.93 (0.88, 0.99)</td>
</tr>
<tr>
<td>Direct 2009 P3 HT</td>
<td>ARB</td>
<td>1160</td>
<td>Placebo</td>
<td>0.95 (0.85, 1.06)</td>
</tr>
<tr>
<td>Advance (2009)</td>
<td>ACE</td>
<td>0827</td>
<td>Placebo</td>
<td>0.85 (0.80, 1.03)</td>
</tr>
<tr>
<td>(\gamma) subtotals ((P = 0.000))</td>
<td></td>
<td></td>
<td></td>
<td>0.86 (0.84, 0.89)</td>
</tr>
<tr>
<td>D,L subtral</td>
<td></td>
<td></td>
<td></td>
<td>0.78 (0.68, 0.89)</td>
</tr>
</tbody>
</table>

**Microalbuminuria**

<table>
<thead>
<tr>
<th>Trial</th>
<th>ACE/ARB</th>
<th>N</th>
<th>Comparator</th>
<th>Ratio of means (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawaki (2008)</td>
<td>ARB</td>
<td>21</td>
<td>Placebo</td>
<td>1.45 (1.18, 1.79)</td>
</tr>
<tr>
<td>Tong (2000)</td>
<td>ACE</td>
<td>26</td>
<td>Placebo</td>
<td>0.67 (0.51, 0.89)</td>
</tr>
<tr>
<td>Nomura (2000)</td>
<td>ACE</td>
<td>21</td>
<td>Placebo</td>
<td>0.47 (0.35, 0.63)</td>
</tr>
<tr>
<td>Dial (2006)</td>
<td>ACE</td>
<td>15</td>
<td>Placebo</td>
<td>0.37 (0.26, 0.51)</td>
</tr>
<tr>
<td>Chan (2000)</td>
<td>ACE</td>
<td>24</td>
<td>Placebo</td>
<td>0.38 (0.29, 0.50)</td>
</tr>
<tr>
<td>Ogawa 2007 ACE</td>
<td>ACE</td>
<td>43</td>
<td>ccb</td>
<td>0.33 (0.24, 0.46)</td>
</tr>
<tr>
<td>Muller 1999 ACE</td>
<td>ACE</td>
<td>43</td>
<td>Placebo</td>
<td>0.40 (0.30, 0.52)</td>
</tr>
<tr>
<td>Muller 1999 ARB</td>
<td>ARB</td>
<td>46</td>
<td>Placebo</td>
<td>0.61 (0.51, 0.73)</td>
</tr>
<tr>
<td>Ogawa 2007 ARB</td>
<td>ARB</td>
<td>49</td>
<td>ccb</td>
<td>0.61 (0.51, 0.73)</td>
</tr>
<tr>
<td>Sano (1990)</td>
<td>ACE</td>
<td>56</td>
<td>nt</td>
<td>0.50 (0.40, 0.63)</td>
</tr>
<tr>
<td>Sato (1990)</td>
<td>ACE</td>
<td>70</td>
<td>Placebo</td>
<td>1.30 (0.75, 2.25)</td>
</tr>
<tr>
<td>Tan (2002)</td>
<td>ARB</td>
<td>60</td>
<td>Placebo</td>
<td>0.70 (0.49, 1.02)</td>
</tr>
<tr>
<td>Revic (1999)</td>
<td>ACE</td>
<td>84</td>
<td>Placebo</td>
<td>0.46 (0.33, 0.64)</td>
</tr>
<tr>
<td>Ahmed (1997)</td>
<td>ACE</td>
<td>103</td>
<td>Placebo</td>
<td>0.25 (0.10, 0.62)</td>
</tr>
<tr>
<td>Tewton (1995)</td>
<td>ACE</td>
<td>105</td>
<td>Placebo</td>
<td>0.64 (0.43, 0.94)</td>
</tr>
<tr>
<td>Rodriguez-woman (2002)</td>
<td>ACE</td>
<td>123</td>
<td>Placebo</td>
<td>1.02 (0.96, 1.10)</td>
</tr>
<tr>
<td>Sings (2007)</td>
<td>ARB</td>
<td>150</td>
<td>ccb</td>
<td>0.58 (0.52, 0.64)</td>
</tr>
<tr>
<td>Pug (2007)</td>
<td>ARB</td>
<td>167</td>
<td>Placebo</td>
<td>0.65 (0.60, 0.71)</td>
</tr>
<tr>
<td>Parving (2008b)</td>
<td>ARB</td>
<td>396</td>
<td>Placebo</td>
<td>0.88 (0.84, 0.93)</td>
</tr>
<tr>
<td>REINAL (2001)</td>
<td>ARB</td>
<td>877</td>
<td>Placebo</td>
<td>0.79 (0.74, 0.85)</td>
</tr>
<tr>
<td>Advance (2009)</td>
<td>ACE</td>
<td>2548</td>
<td>Placebo</td>
<td>0.79 (0.74, 0.85)</td>
</tr>
</tbody>
</table>

\(\gamma\) subtotals (\(P = 0.000\)) : Favors intervention

\(\gamma\) subtotals (\(P = 0.000\)) : Favors comparator
The impact of renin–angiotensin–aldosterone system inhibitors on Type 1 and Type 2 diabetic patients with and without early diabetic nephropathy

Jennifer A. Hirst1,2, Kathryn S. Taylor1,2, Richard J. Stevens1,2, Claire L. Blacklock1,2, Nia W. Roberts2,3, Christopher W. Pugh4 and Andrew J. Farmer1,2

Relative risk of progression from N.alb-uria to Mic.alb-uria

**Type 1 Diabetes**

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuominen</td>
<td>24</td>
<td>0.23 (0.01, 4.40)</td>
</tr>
<tr>
<td>Kvetny</td>
<td>75</td>
<td>0.08 (0.00, 1.28)</td>
</tr>
<tr>
<td>Mauer ACE</td>
<td>142</td>
<td>0.68 (0.16, 2.92)</td>
</tr>
<tr>
<td>Mauer ARB</td>
<td>143</td>
<td>2.61 (0.80, 8.52)</td>
</tr>
<tr>
<td>EUCLID</td>
<td>364</td>
<td>0.73 (0.37, 1.45)</td>
</tr>
<tr>
<td>Direct Protect 1</td>
<td>1905</td>
<td>1.02 (0.74, 1.39)</td>
</tr>
<tr>
<td>M-H overall (I^2 = 23.9%, P = 0.246)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D+L overall</td>
<td></td>
<td>0.96 (0.76, 1.23)</td>
</tr>
</tbody>
</table>

Favors intervention

**Type 2 Diabetes**

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lebovitz</td>
<td>37</td>
<td>0.35 (0.08, 1.52)</td>
</tr>
<tr>
<td>Chan</td>
<td>43</td>
<td>0.79 (0.27, 2.31)</td>
</tr>
<tr>
<td>Bucher</td>
<td>135</td>
<td>0.73 (0.40, 1.31)</td>
</tr>
<tr>
<td>UKPDS</td>
<td>299</td>
<td>1.21 (0.84, 1.73)</td>
</tr>
<tr>
<td>DIRECT P2</td>
<td>725</td>
<td>0.93 (0.73, 1.19)</td>
</tr>
<tr>
<td>BENEDICT</td>
<td>788</td>
<td>0.58 (0.36, 0.93)</td>
</tr>
<tr>
<td>ROADMAP</td>
<td>4440</td>
<td>0.85 (0.70, 1.03)</td>
</tr>
<tr>
<td>ADVANCE</td>
<td>6827</td>
<td>0.83 (0.78, 0.89)</td>
</tr>
<tr>
<td>M-H overall (I^2 = 19.2%, P = 0.278)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D+L overall</td>
<td></td>
<td>0.84 (0.79, 0.89)</td>
</tr>
</tbody>
</table>

Favors intervention
The impact of renin–angiotensin–aldosterone system inhibitors on Type 1 and Type 2 diabetic patients with and without early diabetic nephropathy

Jennifer A. Hirst¹,², Kathryn S. Taylor¹,², Richard J. Stevens¹,², Claire L. Blacklock¹,², Nia W. Roberts²,³, Christopher W. Pugh³ and Andrew J. Farmer¹,²

KI 2012; 81: 674.

Relative risk of progression from Mic.alb-uria to Mac.alb-uria

Type 1 Diabetes

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chase</td>
<td>15</td>
<td>2.57 (0.29, 22.93)</td>
</tr>
<tr>
<td>Jerums</td>
<td>23</td>
<td>0.26 (0.03, 2.11)</td>
</tr>
<tr>
<td>Mathiesen</td>
<td>44</td>
<td>0.24 (0.06, 1.00)</td>
</tr>
<tr>
<td>Atlantis</td>
<td>65</td>
<td>0.85 (0.24, 2.98)</td>
</tr>
<tr>
<td>Crespaldi</td>
<td>66</td>
<td>0.30 (0.07, 1.35)</td>
</tr>
<tr>
<td>Ahmad</td>
<td>73</td>
<td>0.27 (0.08, 0.87)</td>
</tr>
<tr>
<td>Viberti</td>
<td>92</td>
<td>0.33 (0.12, 0.96)</td>
</tr>
</tbody>
</table>

M-H overall ($I^2 = 0.0\%, P = 0.477$)

Favors intervention

Type 2 Diabetes

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chan</td>
<td>34</td>
<td>0.84 (0.23, 3.06)</td>
</tr>
<tr>
<td>Ogawa ACE</td>
<td>43</td>
<td>0.79 (0.19, 3.29)</td>
</tr>
<tr>
<td>Ogawa ARB</td>
<td>49</td>
<td>0.45 (0.10, 2.09)</td>
</tr>
<tr>
<td>Baba</td>
<td>76</td>
<td>0.88 (0.21, 3.66)</td>
</tr>
<tr>
<td>Ahmad</td>
<td>103</td>
<td>0.33 (0.11, 0.95)</td>
</tr>
<tr>
<td>Makino</td>
<td>342</td>
<td>0.33 (0.23, 0.48)</td>
</tr>
<tr>
<td>Parving</td>
<td>395</td>
<td>0.55 (0.17, 0.99)</td>
</tr>
<tr>
<td>ADVANCE</td>
<td>2548</td>
<td>0.69 (0.53, 0.89)</td>
</tr>
</tbody>
</table>

M-H overall ($I^2 = 47.8\%, P = 0.062$)

Favors intervention

Favors comparator
Renal outcomes with telmisartan, ramipril, or both, in people at high vascular risk (the ONTARGET study): a multicentre, randomised, double-blind, controlled trial

3.1 Prevention of CKD Progression

We suggest that ARBs or ACE inhibitors be used as first-line therapy in adults with diabetes and CKD with urine albumin excretion 30-300 mg/24 h. (2D) and recommend that in adults with urine albumin excretion >300 mg/24 h (or equivalent). (1B)

There is insufficient evidence to combine an ACEi and ARB to prevent progression of CKD.
3.1 Prevention of CKD Progression

**Blood pressure and renin angiotensin system interruption**

3.1.1: Treat people with CKD with antihypertensive agents to blood pressure levels determined by the presence or absence of diabetes and by albuminuria category, as described in the KDIGO 2012 Blood Pressure Guidelines (Not Graded):

<table>
<thead>
<tr>
<th>Albuminuria</th>
<th>A 1 (ACR &lt;30 mg/g)</th>
<th>A 2 (ACR 30-300 mg/g)</th>
<th>A 3 (ACR &gt;300 mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>&lt;140/90 (1B)</td>
<td>&lt;130/80 (2D)</td>
<td>&lt;130/80 (2D)</td>
</tr>
<tr>
<td>Non diabetes</td>
<td>&lt;140/90 (1B)</td>
<td>&lt;130/80 (2D)</td>
<td>&lt;130/80 (2C)</td>
</tr>
</tbody>
</table>

Levels of recommendation and quality of evidence are indicated in parentheses for each group.
Overall Risk Factors for CKD Progression

1. Poor glycemic control
2. Albuminuria & Proteinuria
3. BP control & RAAS inhibition
4. Baseline kidney function
5. Drugs (ASA, NSAID) & radio-contrast,
6. Metabolic acidosis
7. Acute kidney injury
8. Diet
9. Infection (local & systemic)
10. Kidney stones
11. Genetics & Races
Lower estimated GFR and higher albuminuria are associated with adverse kidney outcomes. A collaborative meta-analysis of general and high-risk population cohorts

Ron T. Gansevoort¹, Kunihiro Matsushita², Marije van der Velde¹, Brad C. Astor², Mark Woodward³, Andrew S. Levey⁴, Paul E. de Jong¹, Josef Coresh² and the Chronic Kidney Disease Prognosis Consortium

General pop (GP) = 845,125  High risk (HR) = 173,892
Figure 2. Kaplan–Meier Estimates of the Percentage of Patients Not Reaching the Primary Composite End Point of a Doubling of the Serum Creatinine Level, End-Stage Renal Disease, or Death.

Group 1 had a serum creatinine level of 1.5 to 3.0 mg per deciliter, and group 2 had a serum creatinine level of 3.1 to 5.0 mg per deciliter at baseline.
Overall Risk Factors for CKD Progression

1. Poor glycemic control
2. Albuminuria & Proteinuria
3. BP control & RAAS inhibition
4. Baseline kidney function
5. Drugs (ASA, NSAID) & radio-contrast,
6. Metabolic acidosis
7. Acute kidney injury
8. Diet
9. Infection (local & systemic)
10. Kidney stones
11. Genetics & Races
Daily oral sodium bicarbonate preserves glomerular filtration rate by slowing its decline in early hypertensive nephropathy

Serum Bicarbonate and Mortality in Stage 3 and Stage 4 Chronic Kidney Disease

3.4 Acidosis

3.4.1: We suggest that in people with CKD and serum bicarbonate concentrations <22 mmol/L treatment with oral bicarbonate supplementation be given to maintain serum bicarbonate >22 (but <30) mmol/L, unless contraindicated. (2B)
Overall Risk Factors for CKD Progression

1. Poor glycemic control
2. Albuminuria & Proteinuria
3. BP control & RAAS inhibition
4. Baseline kidney function
5. Drugs (ASA, NSAID) & radio-contrast,
6. Metabolic acidosis
7. Acute kidney injury
8. Diet
9. Infection (local & systemic)
10. Kidney stones
11. Genetics & Races
Acute kidney injury predicts CKD progression
4.4 Medication Management and Patient Safety in CKD

4.4.2: We recommend discontinuation of nephrotoxic and renally excreted drugs in people with a GFR < 60 mL/min/1.73 m². These agents include: RAAS blockers (including ACE i?, angiotensin receptor blockers ?, aldosterone inhibitors, direct renin inhibitors), diuretics?, NSAIDS, lithium, digoxin, and over the counter and herbal remedies (1C)

? = not totally agree with
Bowel preparation recommendation
4.5.5: We recommend NOT to use oral phosphate-containing bowel preparations in people with a GFR <60 mL/min/1.73 m² or in those known to be at risk of phosphate nephropathy. (1A)
4.5 Imaging Studies

*Radiocontrast recommendation*

4.5.2: We recommend that all people with GFR <60 mL/min/1.73 m² undergoing elective investigation involving the intravascular administration of iodinated radio contrast media should be managed according to the KDIGO Clinical Practice Guideline for AKI including:

- **Avoidance of high osmolar agents** *(1B)*;
- **Use lowest possible dose** *(Not Graded)*;
- **Withdrawal of potentially nephrotoxic agents** before and after procedure *(1C)*;
  - before, during and after procedure *(1A)*; Adequate **hydration** with **saline**
- **Measurement of GFR at 48–96 hours after the procedure** *(1C)*.
Gadolinium recommendations

4.5.3: We recommend not using gadolinium containing contrast media in people with GFR <15 mL/min/1.73 m² unless there is no alternative appropriate test. (1B)

4.5.4: We suggest that people with a GFR <30 mL/min/1.73 m² who require gadolinium are preferentially offered a macrocyclic chelate preparation. (2B)
Overall Risk Factors for CKD Progression

1. Poor glycemic control
2. Albuminuria & Proteinuria
3. BP control & RAAS inhibition
4. Baseline kidney function
5. Drugs (ASA, NSAID) & radio-contrast,
6. Metabolic acidosis
7. Acute kidney injury
8. Diet (protein, salt, phosphate)
9. Infection (local & systemic)
10. Kidney stones
11. Genetics & Races
Cumulative incidence of Renal failure or Death

Diet Protein Intake

- \( \geq 0.75 \text{ g/Kg/d} \)
- \(< 0.62 \)
- \(0.62 - 0.68 \)
- \(0.68 - 0.75 \)

Fig 3. Relationship of achieved protein intake to the risk of renal failure or death. Each curve is the cumulative incidence of renal failure or death for subgroups of patients with different values for follow-up total protein intake.
### Low protein diets for chronic kidney disease in non diabetic adults (Review)

**Fouque D, Laville M, Boissel JP**

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Low protein (n/N)</th>
<th>Higher protein (n/N)</th>
<th>Risk Ratio M-H,Random,95% CI</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 g/kg/d versus higher protein diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locatelli 1991</td>
<td>21/230</td>
<td>32/236</td>
<td>15.7 % 0.67 [0.40, 1.13]</td>
<td></td>
</tr>
<tr>
<td>MDRD 1994</td>
<td>18/291</td>
<td>27/294</td>
<td>12.9 % 0.67 [0.38, 1.20]</td>
<td></td>
</tr>
<tr>
<td>Williams 1991</td>
<td>12/33</td>
<td>11/32</td>
<td>9.8 % 1.06 [0.55, 2.04]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>554</strong></td>
<td><strong>562</strong></td>
<td>38.3 % 0.76 [0.54, 1.05]</td>
<td></td>
</tr>
<tr>
<td>0.3-0.6 g/kg/d versus higher/protein diets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chang 2000</td>
<td>9/212</td>
<td>13/211</td>
<td>6.2 % 0.69 [0.30, 1.56]</td>
<td></td>
</tr>
<tr>
<td>di Iorio 2003</td>
<td>2/10</td>
<td>7/10</td>
<td>2.5 % 0.29 [0.08, 1.05]</td>
<td></td>
</tr>
<tr>
<td>Ihle 1989</td>
<td>4/34</td>
<td>13/38</td>
<td>4.1 % 0.34 [0.12, 0.95]</td>
<td></td>
</tr>
<tr>
<td>Jungers 1987</td>
<td>5/10</td>
<td>7/9</td>
<td>8.4 % 0.64 [0.32, 1.31]</td>
<td></td>
</tr>
<tr>
<td>Maky 1999</td>
<td>11/25</td>
<td>17/25</td>
<td>15.8 % 0.65 [0.39, 1.09]</td>
<td></td>
</tr>
<tr>
<td>Mirescu 2007</td>
<td>1/27</td>
<td>7/26</td>
<td>1.0 % 0.14 [0.02, 1.04]</td>
<td></td>
</tr>
<tr>
<td>Rosman 1989</td>
<td>30/130</td>
<td>34/117</td>
<td>23.7 % 0.79 [0.52, 1.21]</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>448</strong></td>
<td><strong>436</strong></td>
<td>61.7 % 0.63 [0.48, 0.83]</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 62 (low protein), 98 (higher protein)
Heterogeneity: Tau² = 0.0; Chi² = 6.27, df = 6 (P = 0.39); I² = 4%
Test for overall effect: Z = 3.31 (P = 0.00092)

Total (95% CI) 1002 998

Total events: 113 (low protein), 168 (higher protein)
Heterogeneity: Tau² = 0.0; Chi² = 8.20, df = 9 (P = 0.51); I² = 0.0%
Test for overall effect: Z = 3.68 (P = 0.00024)

Less renal death on low protein

Less deaths on low
Protein Intake

3.1.6: We suggest lowering protein intake to 0.8 g/kg/day in adults with GFR <30 ( ? < 50 ) mL/min/ 1.73 m2, with appropriate education to avoid the risk of malnutrition.

We recommend lowering salt intake to <100 mmol (<2.4 g ) per day of sodium (corresponding to 6 g of sodium chloride), unless contraindicated. (1C)
Lifestyle

3.1.14: We recommend that people with CKD be encouraged to …

- take exercise (aiming for at least 30 minutes 5 times per week),
- achieve a healthy weight (BMI 20-25, according to country-specific demographics),
- and stop smoking. (1B)
Recommend lifestyle modifications

1. ↓ Salt intake 6 g / day
2. ↑ Vegetables & fruits
3. ↓ Cholesterol & saturated fatty acid
4. BMI < 25
5. Exercise
6. ↓ Alcohol
7. No smoking

Lower estimated glomerular filtration rate and higher albuminuria are associated with all-cause and cardiovascular mortality. A collaborative meta-analysis of high-risk population cohorts

Marije van der Velde¹, Kunihiro Matsushita², Josef Coresh², Brad C. Astor², Mark Woodward³, Andrew S. Levey⁴, Paul E. de Jong¹, Ron T. Gansevoort¹ and the Chronic Kidney Disease Prognosis Consortium

Effect of calcium supplements on risk of myocardial infarction and cardiovascular events: meta-analysis

3.3 CKD Metabolic Bone Disease Including Laboratory Abnormalities

3.3.1: We recommend measuring serum levels of calcium, phosphate, PTH, and alkaline phosphatase activity at least once in adults with GFR < 45 mL/min/1.73 m² in order to determine baseline values and inform prediction equations if used. (1C)

3.3.2: We suggest not to perform bone mineral density testing routinely in those with eGFR < 60 mL/min/1.73 m², as information may be misleading or unhelpful. (2B)
Vitamin D supplementation and bisphosphonates in people with CKD

3.3.5: We suggest to NOT routinely prescribe vitamin D supplements, in the absence of documented deficiency, to suppress elevated PTH concentrations in people with CKD not on dialysis. (2B)

3.3.6: We suggest NOT to prescribe bisphosphonate treatment in people with GFR <30 mL/min/1.73 m². (2B)
4.3 CKD and Peripheral Arterial Disease

4.3.1: We recommend that people with CKD be regularly examined for signs of peripheral arterial disease and be considered for revascularization procedures. (1A)
4.6 CKD and Risks for Infections, AKI, Hospitalizations and Mortality

**CKD and risk of infections**

4.6.1: We recommend that all people with CKD are offered annual vaccination with influenza vaccine, unless contraindicated. (1B)

4.6.2: We recommend that all people with eGFR <30 mL/min/1.73 m² and those at high risk of pneumococcal infection (nephrotic syndrome, or diabetes or receiving immunosuppression) receive vaccination with polyvalent pneumococcal vaccine unless contraindicated. (1B)

4.6.4: We recommend that all people who are at high risk of progression of CKD, and have GFR <30 mL/min/1.73 m² be immunized against hepatitis B and the response confirmed by appropriate serological testing. (1B)
Will power
Knowledge
IT
Budget
Personnel

CKD Team

- Awareness
- Screening
- Counseling
- Direct care
- Research

รพ.สต.

Home care

Home care

Home care
5.2 Care of the Patient with Progressive CKD

5.2.1: We suggest that people with progressive CKD should be managed in a multidisciplinary care setting. (2B)

5.2.2: The multidisciplinary team should include or have access to dietary counseling, education and counseling about different RRT modalities, transplant options, vascular access surgery, ethical, psychological and social care. (Not Graded)
Slower Decline of Glomerular Filtration Rate in the Japanese General Population: A Longitudinal 10-Year Follow-Up Study

Enyu IMAI, Masaru HORIO, Kunihiro YAMAGATA, Kunitoshi ISEKI, Shigeko HARA, Nobuyuki URA, Yutaka KIYOHARA, Hirofumi MAKINO, Akira HISHIDA, and Seiichi MATSUO

5.1 Referral to Specialist Services

5.1.1: We recommend referral to specialist kidney care services for people with CKD in the following circumstances (1B):

- acute kidney injury or abrupt sustained fall in GFR;
- GFR <30 mL/min/1.73 m²;
- persistent significant albuminuria (ACR ≥30 mg/mmol, approximately equivalent to PCR ≥50 mg/mmol, or urinary protein excretion ≥500 mg/24 hours);
- progression of CKD (see section 2.1.3 for definition);
- urinary red cell casts, RBC >20 per high power field sustained and not readily explained;
- CKD and hypertension refractory to treatment (≥4 anti-hypertensive agents);
- persistent abnormalities of serum potassium;
- recurrent or extensive nephrolithiasis;
- hereditary kidney disease.
5.3 Timing the Initiation of RRT

5.3.1: We suggest that dialysis be initiated in the GFR range between 5 and 10 mL/min/1.73 m² or when one or more of the following are present: symptoms or signs attributable to kidney failure (serositis, acid-base or electrolyte abnormalities), inability to control volume status or blood pressure or a progressive deterioration in nutritional status refractory to dietary intervention, or cognitive impairment). (2B)
5.1 Referral to Specialist Services

5.1.2: We recommend timely referral for planning RRT in people with progressive CKD in whom the risk of kidney failure within 1 year is 10-20% or greater. (1A)