Patient-Centered Care in CKD

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Objectives

• Overview of burden of CKD/ESRD

• Implementation programs:
  – Hypertension management in CKD
  – CKD complications – Anemia/BMD
  – Pre-ESRD care
  – AKI - CKD
Incident & prevalent patient counts (USRDS), by modality

Incident

- Hemodialysis (2010: 105,923)
- Peritoneal dialysis (7,703)
- Total dialysis (114,083)
- Transplant (2,863)

Prevalent

- Hemodialysis (2010: 383,992)
- Peritoneal dialysis (29,733)
- Transplant (179,361)
- OPTN transplant wait list (87,932)

> 100,000 start Dialysis/yr

> 625,000 with Dialysis/Transplant

Incident & December 31 point prevalent patients.
Incident counts & adjusted rates of ESRD, by primary diagnosis

Adjusted all-cause mortality in the ESRD & general populations, by age, 2010

Point prevalent distribution & annual costs of Medicare (fee-for-service) patients, age 65 & older, with diagnosed diabetes, CHF, & CKD

Population:
(n = 24,184,440; mean age 76.2)

Costs:
(total: $212,769,005,961)

DM 22.8%
CHF 9.6%
CKD 7.6%

DM 32.4%
CHF 15.9%
CKD 22.3%
CKD: CV events and Death

Death Rate:
- Age-standardized rate of death from any cause (per 100 person-years)
- Estimated GFR (ml/min/1.73 m²)

CV Events Rate:
- Age-standardized rate of cardiovascular events (per 100 person-years)
- Estimated GFR (ml/min/1.73 m²)

Go et al, NEJM, 2004
Chronic Kidney Disease

• Curbing the progression to ESRD
• Cost-effective management of morbidity
• Improving quality of life
## Chronic Kidney Disease Staging
### National Kidney Foundation

<table>
<thead>
<tr>
<th>Stage of CKD</th>
<th>GFR (ml/min/1.73m²)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>&gt; 90</td>
<td>Risk of progression</td>
</tr>
<tr>
<td>Stage II</td>
<td>60 - 89</td>
<td>Mild kidney damage</td>
</tr>
<tr>
<td>Stage III</td>
<td>30 – 59</td>
<td>Moderate kidney damage</td>
</tr>
<tr>
<td>Stage IV</td>
<td>15 - 29</td>
<td>Severe kidney damage</td>
</tr>
<tr>
<td>Stage V</td>
<td>&lt; 15</td>
<td>Pre-ESRD</td>
</tr>
<tr>
<td>ESRD</td>
<td>Dialysis or Transplant</td>
<td>Dialysis status</td>
</tr>
</tbody>
</table>

CKD is defined as either an absolute reduction in GFR to < 60 ml/min/1.73m², or markers of persistent kidney damage (proteinuria, or hematuria) for three months, or sonographic evidence of kidney damage.
Reforming Paradigm of Care

- Patient with a Problem
- Practitioner(s) with knowledge
- Technology (investigative, therapeutic information)
- Infrastructure
- Resources
- Revenue
- Health Outcome
Reforming Paradigm of Care

Provider team with knowledge

Patient with a Problem

Design Process Control

Technology (investigative, therapeutic information)

Organizational context

Health Outcome

M. Bohmer, MHCD, HBS
• To study the implementation of evidence based guidelines for kidney disease management

• To identify factors that would bridge the “Second Translation Gap”

• To assess the impact of practice on patient outcomes
CKD QI Program – Cincinnati VAMC
Impact Sites and Broad Goals

- Impact Sites
  - Specialty Care
  - Primary Care
  - Pharmacy
  - IT
PARAMETERS:
• Definition of variables
• Weekly/Monthly Data Reports
• Data Validation

TARGET EVALUATION:
• Quarterly and Semi-annual Evaluation of All Targets
• Annual Assessment and Improvement Plan
• Identifying Barriers to Reaching Targets
• Feedback Between Clinical Workforce, Patients, Researchers

OUTCOME PARAMETERS:
• Clinical Outcomes: ESRD; All Cause Mortality; CV Mortality
• Resource-Utilization: Hospitalization, ER Visits, Clinic Visits
To assess burden of CKD

(NEEDS ASSESSMENT):
- Definition & classification
- Assess prevalence of co-morbid conditions

To assess the implementation of EBM

(IDENTIFY BEST PRACTICES)
- Screening and follow-up
- Hypertension, Diabetes, Bone-mineral metabolism
- Pre-ESRD care (vascular access)

To identify barriers in adherence to EBM

(FIND WAYS TO IMPLEMENT THEM AND ASSESS IMPACT)
- Patient related factors
- Processes of care factors
Implementation

- Evidence-to-Practice Gap
- Practice replenish evidence
CKD QI Program – Cincinnati VAMC

EBM Targets

- Clinical Practice Guidelines
- Outcome based re-imbursement/Performance Measures
Drugs don’t work if you don’t take them
C. Everett Koop, US Surgeon General
CKD QI Program – Cincinnati VAMC
Needs Assessment

• Multidisciplinary program to study
  – Patient Adherence to Anti-hypertensives
  – Conformity to guidelines

Funding – ASHP Foundation 2008 – 2010
CKD defined as GFR <60ml/min/1.73m²

Serum creatinine (SrCr), estimated glomerular filtration rate (eGFR), modification of diet in renal disease equation (MDRD), prescription (Rx)
# CKD QI Program – Cincinnati VAMC

**KDOQI Target – Hypertension Control**

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>DBP 0-80mmHg</th>
<th>DBP 81-90mmHg</th>
<th>DBP ≥ 90mmHg</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP 0-130mmHg</td>
<td>2,486 (35%)</td>
<td>170 (2%)</td>
<td>6 (0.1%)</td>
<td>2,662 (37.1%)</td>
</tr>
<tr>
<td>SBP 131-140mmHg</td>
<td>1,748 (25%)</td>
<td>393 (5%)</td>
<td>27 (0.4%)</td>
<td>2,168 (30.4%)</td>
</tr>
<tr>
<td>SBP ≥140mmHg</td>
<td>1,411 (20%)</td>
<td>668 (9%)</td>
<td>191 (2.7%)</td>
<td>2,270 (31.7%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5,645 (80%)</td>
<td>1,231 (17%)</td>
<td>224 (3.2%)</td>
<td>7,100 (100.0%)</td>
</tr>
</tbody>
</table>

Medication Adherence (MA) was derived from medication possession ratio (MPR)

- **MPR** = Actual Treatment Days / Total Possible Treatment Days
- Possible treatment days truncated for study period and deaths
- **Good MA** = MPR ≥ 0.8; **Poor MA** = MPR < 0.8

Medication available from 4/10 to 7/1 (81 days)
Patient refilled 2nd fill late, missed 15 days of medication.
Patient had medication for 66 of 81 possible days.
**MPR** = 66/81 = 0.81
CKD QI Program – Cincinnati VAMC
KDOQI Target – Hypertension Control


(MPR: medication possession ratio)
Poor MA Patients are 23% More Likely to Have Suboptimal Blood Pressure Control

<table>
<thead>
<tr>
<th>Adherence</th>
<th>Unadjusted</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor MA</td>
<td>2.1</td>
<td>1.24</td>
<td>1.23</td>
<td>1.23</td>
</tr>
<tr>
<td>(MPR&lt; 0.80)</td>
<td>(1.93 – 2.23)</td>
<td>(1.11 – 1.37)</td>
<td>(1.11 – 1.37)</td>
<td>(1.10 – 1.36)</td>
</tr>
</tbody>
</table>

(MPI – medication possession ratio; Model I - adjusted for age; Model II – adjusted for age, GFR; Model III – adjusted for age, GFR and the co-morbidities of diabetes, hyperlipidemia, obesity, hepatitis C, and HIV)

Implementation

• Education of providers about adherence

• Feedback of adherence to providers
  – Real-time adherence assessment
  – Adherence assessment report

• Increase interaction with subspecialty

Funding: OhioPACE Foundation – 2012 - 2013
Adherence to Meds

Gaps in Therapy === Non-adherence

- Clonidine 0.1mg/24hr Patch
- Clonidine 0.3mg/24hr Patch
Adherence to Meds

PTH levels remain High

Recommendation – Increase Cincalcet from 60 to 90 mg
Adherence assessment tool

Teams
- Primary care teamlet or
- Subspecialty provider team

Patients
- All patients on at least one antihypertensive
- More than 1 BP reading >140/90 mm Hg

MPR
- Calculate & report medication possession ratio
- For each drug class & overall antihypertensives
<table>
<thead>
<tr>
<th>Patient Name</th>
<th>Last 4</th>
<th>BP Date</th>
<th>BP Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Care Provider</td>
<td></td>
<td>3/8/2011</td>
<td>170/96</td>
</tr>
<tr>
<td>Drug Name With Adherence</td>
<td></td>
<td></td>
<td>LISINOPRIL 40MG TAB 100%</td>
</tr>
<tr>
<td>Drug Name With Adherence</td>
<td></td>
<td></td>
<td>HYDROCHLOROTHIAZIDE 25MG TAB 100%</td>
</tr>
<tr>
<td>Drug Name With Adherence</td>
<td></td>
<td></td>
<td>AMLODIPINE BESYLATE 5MG TAB 73%</td>
</tr>
</tbody>
</table>
• Multidisciplinary program to study
  – Patient Adherence to Anti-hypertensives
  – Conformity to guidelines

Funding – ASHP Foundation 2008 – 2010
RASi Use in Diabetes with CKD

Laflam et al, JCH, 2011
RASi Use: By GFR and Specialty Clinics

Renal/Cardiac/Endocrine/Pharmacy

No Subspecialty Clinics

Laflam et al, JCH, 2011
Implementation

- Evidence-to-Practice Gap
- Practice replenish evidence
RASi Use in CKD with Diabetes

<table>
<thead>
<tr>
<th>Cohort</th>
<th>&lt; 71 Years</th>
<th>71 or Older</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pooled RCT</td>
<td>97.5%</td>
<td>2.5%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>VA Cohort</td>
<td>47.5%</td>
<td>52.5%</td>
<td></td>
</tr>
</tbody>
</table>

Specific Strata/Interactions:
- Age Strata
- Diabetes Status
- Proteinuria
- Blood Pressure

CV and Renal End-point

Covariates:
- Demographics
- Co-morbidities
- Lab variables

Propensity Adjusted
• Clinical Practice Guidelines
• Outcome based re-imbursement/Performance Measures
Reforming Paradigm of Care

Patient With Problem

Renal/Specialty

Lab Visits

Primary Care

Pharmacy

Provider

Patient

Pharmacy

I.T. Lab/Sites

Outcome/Safety
Anemia Mgmt in CKD: Patient Safety

Hb levels

- 64% Within Target 9.0-10.0 (21/33 patients)
- 18% Above Target >10 (6/33 patients)
- 15% Below Target <9 (5/33 patients incident)
- 3% Below Target < 9 (1/33 patients prevalent)

Actionable Threshold (Hb > 10)

- Dose changed or held (78%)
- Frequent monitoring (17%)
- Results not recognized/acted upon at time of collection (5%)

Mersch, S et al, NKF, 2013
CKD QI Program – Cincinnati VAMC

EBM Targets

- Clinical Practice Guidelines
- Outcome based re-imbursement/Performance Measures
## Pre-ESRD Care: Needs Assessment

<table>
<thead>
<tr>
<th>Specialty Care</th>
<th>GFR &gt; 60</th>
<th>GFR 30 – 60</th>
<th>GFR &lt; 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal Clinic YES</td>
<td>3%</td>
<td>14%</td>
<td>48%</td>
</tr>
<tr>
<td>Renal Clinic NO</td>
<td>97%</td>
<td>86%</td>
<td>52%</td>
</tr>
<tr>
<td>Total N</td>
<td>34,222</td>
<td>8,021</td>
<td>700</td>
</tr>
</tbody>
</table>

### Average appointments per patient:
- Renal Clinic
- Nutrition Clinic/Social Work Assessment
- Vascular access surgery clinic
- Nurse education

3 - 5

### Incident Vascular Access

<table>
<thead>
<tr>
<th>Incident Vascular Access</th>
<th>VA</th>
<th>National Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functioning AVF</td>
<td>25%</td>
<td>18%</td>
</tr>
<tr>
<td>Catheter with AVF Maturing</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>Catheter only</td>
<td>45%</td>
<td>62%</td>
</tr>
</tbody>
</table>

(Lee et al, ASN, 2011)
Pre-ESRD Care: Implementation

- CKD Surveillance Program
- Weekly Report of Outpatient eGFR < 30
- Not Established in Renal Clinic

- Encourage Specialty Referral
  - 48% ----> 75%

- Consider Home BP Monitoring (Telehealth)
  - 9% ----> 50%

- Recognize need for Pre-ESRD Care
PC Approach: Pre-ESRD Care

- Patient: GFR < 20
- Vascular Access
- Dialysis and Transplant Education
- Social Work
- Nutrition Assessment
- Feedback

- Team led by NP – NOT MD
- Venue for family members to discuss impact of ESRD
- KDQOL Assessment
- Protein and Salt Intake Assessment
PC Approach: Vascular Access

- Interdisciplinary Clinic
- Avoids 2/3 appointments
- Saves space and admin staff
- Streamlined Pre- and Post-op Care
- Integrated with overall CKD care
Implementation

- Evidence-to-Practice Gap
- Practice replenish evidence
Desai et al, ASN, 2012
### Outcome Events

<table>
<thead>
<tr>
<th>Outcome Event</th>
<th>Rate (Case-mix adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted Rate of Dialysis</td>
<td>6.7% (95% CI, 1.4 – 8.6)</td>
</tr>
<tr>
<td>Adjusted Rate of Death</td>
<td>64.4% (95% CI, 59.4 – 69.3)</td>
</tr>
</tbody>
</table>

**Patients Alive and not on Dialysis:** 135 (33.7%)

- **Median time to dialysis initiation:** 1.7 years (q1, 1.1, q3, 2.1)
- **Median time to death:** 1.3 years (q1, 0.4, q3, 2.3)
- **Median time to death after dialysis:** 13 months (q1, 3, q3, 45)

Desai et al, ASN, 2012
AKI → CKD

CKD QI Program – Cincinnati VAMC

EBM Targets

- Novel Targets
- Hypertension/CVD
- Bone-Mineral Metabolism
- Anemia
- Pre-ESRD Care
- Diabetes Control

- Clinical Practice Guidelines
- Outcome based re-imbursement/Performance Measures
### Hospital Care

<table>
<thead>
<tr>
<th>Category</th>
<th>US Population</th>
<th>&gt; 65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Discharges</td>
<td>35.5 Million</td>
<td>38% of Total</td>
</tr>
<tr>
<td>Average LOS</td>
<td>4.8</td>
<td>5.6</td>
</tr>
<tr>
<td>Annual procedures</td>
<td>52 Million (10% are Cardiovascular)</td>
<td></td>
</tr>
</tbody>
</table>

### ICU Admissions

<table>
<thead>
<tr>
<th>Co-morbid Conditions</th>
<th>No AKI</th>
<th>AKI I</th>
<th>AKI II</th>
<th>AKI III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: &lt; 40 to 59</td>
<td>35</td>
<td>26</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>60 to 79</td>
<td>51</td>
<td>57</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>&gt; 80</td>
<td>14</td>
<td>17</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>GFR &lt; 60 on Admission</td>
<td>35</td>
<td>49</td>
<td>34</td>
<td>52</td>
</tr>
<tr>
<td>Hypertension</td>
<td>34</td>
<td>25</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Diabetes</td>
<td>25</td>
<td>26</td>
<td>21</td>
<td>17</td>
</tr>
</tbody>
</table>

Thakar et al, Crit Care Med, 2009
Adjusted Hazard of an AKI Hospitalization:

USRDS Vol 1, CKD, Ch 5
AKI Episode

Susceptibility:
- Co-morbidity
- Age
- Drugs/toxins

Pro-inflammatory State

Tissue Fibrosis

Albuminuria

Increased Blood Pressure

Progressive decline in renal function
CKD in Diabetes: Proteinuria -- AKI

### Table 2. Association between AKI and stage 4 CKD in diabetes mellitus

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Hazard Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>1.01</td>
<td>0.99, 1.02</td>
</tr>
<tr>
<td>Sex (female <em>versus</em> male)</td>
<td>2.65</td>
<td>1.40, 5.03</td>
</tr>
<tr>
<td>Race (black <em>versus</em> non-black)</td>
<td>0.91</td>
<td>0.71, 1.24</td>
</tr>
<tr>
<td>Baseline creatinine (per unit increase)</td>
<td>8.59</td>
<td>6.07, 12.15</td>
</tr>
<tr>
<td>Obesity</td>
<td>0.72</td>
<td>0.52, 0.98</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.82</td>
<td>1.41, 2.37</td>
</tr>
<tr>
<td><strong>Proteinuria</strong></td>
<td><strong>3.54</strong></td>
<td><strong>2.47, 5.08</strong></td>
</tr>
<tr>
<td><strong>AKI</strong></td>
<td><strong>3.56</strong></td>
<td><strong>2.76, 4.61</strong></td>
</tr>
<tr>
<td><strong>Number of episodes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AKI (each episode, up to three)</td>
<td>2.02</td>
<td>1.78, 2.30</td>
</tr>
</tbody>
</table>

Final models included covariates. The table shows multivariable Cox regression models in hospitalized patients predicting stage 4 CKD, including time-dependent comorbid conditions occurring up to the last eligible creatinine or end point. AKI, acute kidney injury; CKD, chronic kidney disease.

### Table 3. Association between AKI and primary end point stratified by baseline GFR

<table>
<thead>
<tr>
<th>GFR Categories</th>
<th>n</th>
<th>Hazard Ratio for AKI Episodes</th>
<th>95% Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFR &lt;60</td>
<td>306</td>
<td>1.61</td>
<td>1.28, 2.03</td>
</tr>
<tr>
<td>GFR 60 to 90</td>
<td>841</td>
<td>2.33</td>
<td>1.93, 2.81</td>
</tr>
<tr>
<td>GFR &gt;90</td>
<td>675</td>
<td>2.27</td>
<td>1.69, 3.06</td>
</tr>
</tbody>
</table>

*aBaseline GFR estimated by four variable Modification of Diet in Renal Disease equation (ml/min per 1.73 m²) at the beginning of the study period.

*bMultivariate Cox regression model in hospitalized patients, counting up to three AKI (acute kidney injury) episodes, and adjusted for demographics and comorbid conditions.
Serum Creatinine within 1-Year of Discharge from AKI

50% at 2 months
Urine Albumin within 1-Year after AKI Discharge

Vol 1, CKD, Ch 5
Chronic Kidney Disease

• Curbing the progression to ESRD
• Cost-effective management of morbidity
• Improving quality of life