Identifying Chronic Kidney Disease Using Claims Data: Agreement with Estimated GFR Using Two Different Estimating Equations

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Disclosure of Financial Relationships

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Introduction

• Identification of comorbidity using claims data is common.
• Accuracy of claims-based diagnoses unclear.
• We assessed the agreement of claims-identified CKD with estimated glomerular filtration rate (eGFR) using two different estimating equations:
  ▪ Modification of Diet in Renal Disease (MDRD) 4-variable equation, developed in CKD patients
Methods

• Data Source: Ingenix LabRX Database™

• Inclusion Criteria
  - Insurance coverage for all of 2006
  - At least one serum creatinine measured
  - Age 20 – 64

• Assessed comorbidity from claims, including presence of CKD, using a standard method requiring ≥ 1 inpatient or ≥ 2 outpatient claims with the appropriate diagnosis code

• Calculated eGFR using two equations:
  - MDRD, 4-variable
  - Mayo, combined CKD and healthy population equation
## Patient characteristics; Serum Creatinine Measured vs. Not Measured

<table>
<thead>
<tr>
<th>Gender</th>
<th>With &gt;= 1 Serum Creatinine (n=748,179)</th>
<th>Without Serum Creatinine (n=4,570,278)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Male</td>
<td>329,886</td>
<td>44.1%</td>
</tr>
<tr>
<td>Female</td>
<td>418,273</td>
<td>55.9%</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>20-35</td>
<td>136,863</td>
<td>18.3%</td>
</tr>
<tr>
<td>36-50</td>
<td>311,697</td>
<td>41.7%</td>
</tr>
<tr>
<td>51-64</td>
<td>299,619</td>
<td>40.0%</td>
</tr>
</tbody>
</table>
Patient Comorbidity; Serum Creatinine Measured vs. Not Measured

With >= 1 creatinine
With 0 creatinine

Percent

ASHD  Anemia  CHF  CKD  COPD  CVA  Cancer  DM  HTN  PVD

With >= 1 creatinine
With 0 creatinine
Distribution of Serum Creatinine

NHANES 2005-2006

Mean 0.87
Median 0.8
IQR 0.24

Ingenix I3 2006

Mean 0.92
Median 0.9
IQR 0.2
Distribution of eGFR; MDRD vs. Mayo
Distribution of eGFR; Last creatinine vs. Maximum creatinine

Proportion

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

0.0 0.005 0.010 0.015 0.020 0.025 0.030

MDRD

Mayo
Distribution of eGFR; Assuming Different Proportions African-American

- MDRD
- Mayo

- 0% Afr. Amer.
- 20% Afr. Amer.
- 40% Afr. Amer.
Percent with eGFR < 60 by MDRD vs. Mayo, and Percent with CKD from Claims
Sensitivity (or PPV) – Pr (CKD from claims | eGFR < X)
Specificity (or NPV) – Pr (no CKD from claims | eGFR > X)
Positive Predictive Value (or sensitivity) – $\Pr(eGFR < X \mid \text{CKD from claims})$
Negative Predictive Value (or specificity) – Pr (eGFR > X | no CKD from claims)
Kappa

![Graph showing the relationship between eGFR and Kappa with curves for MDRD and Mayo methods.](USRDS)
Of Patients with eGFR < 60 by MDRD and Mayo, Percent with Each Comorbidity

![Bar chart showing comorbidity percentages for patients with eGFR < 60 by MDRD and Mayo methods.](chart.png)
Hazard Ratios for Hospitalization by eGFR, MDRD vs. Mayo

Hazard Ratio
HR for CKD from Claims
eGFR

MDRD
Mayo

Hazard Ratio

HR for CKD from Claims

>= 90
60 - <90
Stage 3
Stage 4
Stage 5

eGFR

USRDS
Hazard Ratios for Hospitalization by eGFR, MDRD vs. Mayo
Summary

• Prevalence of eGFR<60 was considerably different for the two equations (10.6% - MDRD vs. 1.6% - Mayo)

• Sensitivity (PPV) (Pr (claims-CKD | eGFR < X))
  - Mayo higher

• Specificity (NPV) (Pr (no claims-CKD | eGFR > X))
  - Similar
• PPV (Sensitivity) (Pr (eGFR < X | claims-CKD)
  - MDRD higher

• NPV (Specificity) (Pr (eGFR > X | no claims-CKD)
  - Mayo higher

• Kappa
  - Similar (0.4), but at different eGFR (0.45 for MDRD, 0.55 for Mayo)

• More monotonic increasing relationship between decreasing eGFR and hazard ratio for hospitalization with Mayo equation
Limitations

• No gold standard
  - Neither estimated GFR nor CKD from claims is “truth”

• Lack of standardization of serum creatinine.

• Population with serum creatinine measured as opposed to random sample.
  - More often measured, higher creatinine, sicker patients
  - Probably does not represent the general population aged 20-64

• Race
  - Mayo equation – no adjustment for race
  - MDRD equation – race not in dataset
Conclusions

• Agreement between eGFR by either equation and claims is “fair to moderate” by Kappa (0.4), but at different levels of eGFR:
  - MDRD equation – 45 ml/min 1.73 m²
  - Mayo equation – 60 ml/min 1.73 m²

• Associations between decreasing eGFR and hospitalization using the Mayo equation are more consistent across the range of eGFR, suggesting the MDRD equation may be overestimating CKD prevalence, particularly in early stage 3
Distribution of eGFR; by Number of Creatinines Measured

- Last Creat
- > 1 Creat
- > 2 Creat

MDRD
Mayo

Distribution of eGFR; by Number of Creatinines Measured
Comparison of MDRD Stage vs. Mayo Stage

MDRD Eq. | Mayo Eq. | >90 | 60-90 | Stg 3 | Stg 4 | Stg 5 |
---------|----------|-----|-------|-------|-------|-------|
% Same Stage | 100 | 60-90 | 90 | 60-90 | 90 | 60-90 | 90 |
% Different Stage | 0 | 60-90 | 0 | 60-90 | 0 | 60-90 | 0 |

Same Stage
Different Stage