An EHR-Based Population Assessment of Chronic Kidney Disease in Rural Communities of Northern Michigan

PRESENTED BY
Abigail Christmas MS3
Authors and Affiliations

Abigail Christmas MS3 [1] ;
John Stanifer MD [2]
1. Michigan State University College of Human Medicine
2. Munson Healthcare Kidney & Hypertension Specialists
Conflicts of Interest

No conflicts of interest
Background

Incidence Rate (per million/year) for ESRD in the United States, 2011-2015

Background

Percentage of Population Living in Poverty by City/Township

Age-adjusted Prevalence and of Chronic Kidney Disease by Family Income-to-Poverty Ratio


Background

- Leveraging existing EHR data by developing computable CKD phenotypes may be a novel way to characterize and begin to address rural CKD disparities.
- Conducted a proof of concept study by developing a CKD phenotype and implementing it in a rural health system to characterize CKD burdens.

**Table: Prognosis of CKD by GFR and albuminuria categories: KDIGO 2012**

<table>
<thead>
<tr>
<th>A1</th>
<th>A2</th>
<th>A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal to mildly increased</td>
<td>Moderately increased</td>
<td>Severely increased</td>
</tr>
<tr>
<td>&lt;30 mg/g</td>
<td>30–300 mg/g</td>
<td>&gt;300 mg/g</td>
</tr>
<tr>
<td>&lt;5 mg/mmol</td>
<td>3–30 mg/mmol</td>
<td>&gt;30 mg/mmol</td>
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</tr>
</tbody>
</table>

**Figure: GFR categories (mL/min per 1.73 m²)**

- G1: Normal or high: ≥90
- G2: Mildly decreased: 60–89
- G3a: Mildly to moderately decreased: 45–99
- G3b: Moderately to severely decreased: 30–44
- G4: Severely decreased: 15–29
- G5: Kidney failure: <15

Green: low risk (if no other markers of kidney disease, no CKD); yellow: moderately increased risk; orange: high risk; red, very high risk.

Study Design and Population:
Retrospective analysis of EHR data at Munson Health System, a rural community health system in Northern Michigan, comprising a network of primary care and specialty clinics and acute care hospitals.

Step 1 - Define patient population
All patients having at least one laboratory encounter between Jan 1st, 2018 and Dec 31st, 2020.

Step 2 - Identify clinical variables
- Age, Sex, Race, Zip Code
- Serum Creatinine
- Urine albumin-to-creatinine ratio
- Urine protein-to-creatinine ratio

Step 3 - Apply phenotype definitions
Applied a distinct CKD computable phenotype definition based on KDOQI guidelines.
Results

Munson Healthcare Encounters 2018 (n=116,295)

- Unique Individuals (≥18 years old) (n=74,885)
  - No laboratory data available for assessment of CKD (n=8,232)
    - Encounters (n=22,090)
      - Patients (n=12,055)
        - CKD Prevalence= 16.1%
  - Laboratory data available for complete or partial assessment of CKD status (n=66,653)
    - Identified CKD patients (G3a-G5 and/or A2-A3)
      - Encounters (n=46,310)
        - Patients (n=19,216)
          - CKD Prevalence= 16.4%

Munson Healthcare Encounters 2019 (n=235,916)

- Unique Individuals (≥18 years old) (n=117,220)
  - No laboratory data available for assessment of CKD (n=15,058)
    - Encounters (n=11,602)
      - Patients (n=86,034)
        - CKD Prevalence= 17.4%
  - Laboratory data available for complete or partial assessment of CKD status (n=102,162)
    - Identified CKD patients (G3a-G5 and/or A2-A3)
      - Encounters (n=46,310)
        - Patients (n=19,216)
          - CKD Prevalence= 16.4%

Munson Healthcare Encounters 2020 (n=178,949)

- Unique Individuals (≥18 years old) (n=97,636)
  - No laboratory data available for assessment of CKD (n=11,602)
    - Encounters (n=36,989)
      - Patients (n=17,027)
        - CKD Prevalence= 17.4%
Health Care Seeking Population Trends

**2018**
- CKD Prevalence: 16.1% (95% CI: 15.8%-16.4%)
- Mean Age: 73.5 ± 12.3
- Female: 55.4%

**2019**
- CKD Prevalence: 16.4% (95% CI: 16.2%-16.6%)
- Mean Age: 73.5 ± 12.0
- Female: 53.4%

**2020**
- CKD Prevalence: 17.4% (95% CI: 17.2%-17.6%)
- Mean Age: 73.5 ± 12.0
- Female: 53.5%
<table>
<thead>
<tr>
<th>Stage</th>
<th>Category</th>
<th>GFR range (ml/min per 1.73 m²)</th>
<th>Number of Encounters</th>
<th>Percentage of Encounters (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>Normal or high</td>
<td>&gt;90</td>
<td>62471</td>
<td>35.0</td>
</tr>
<tr>
<td>G2</td>
<td>Mildly decreased</td>
<td>60-89</td>
<td>64840</td>
<td>36.2</td>
</tr>
<tr>
<td>G3a</td>
<td>Mildly to moderately decreased</td>
<td>45-59</td>
<td>18248</td>
<td>10.2</td>
</tr>
<tr>
<td>G3b</td>
<td>Moderately to severely decreased</td>
<td>30-44</td>
<td>9521</td>
<td>5.3</td>
</tr>
<tr>
<td>G4</td>
<td>Severely decreased</td>
<td>15-29</td>
<td>4012</td>
<td>2.2</td>
</tr>
<tr>
<td>G5</td>
<td>Kidney failure</td>
<td>&lt;15</td>
<td>2767</td>
<td>1.5</td>
</tr>
<tr>
<td>GFR Not listed</td>
<td></td>
<td>-</td>
<td>17090</td>
<td>9.6</td>
</tr>
</tbody>
</table>
## 2020 Staging Proteinuria

<table>
<thead>
<tr>
<th>Stage</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>Albuminuria/Proteinuria Not Listed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Normal to midly increased</td>
<td>Moderately increased</td>
<td>Severely increased</td>
<td>-</td>
</tr>
<tr>
<td>Albuminuria range (mg/g)</td>
<td>&lt;30</td>
<td>30-300</td>
<td>&gt;300</td>
<td>-</td>
</tr>
<tr>
<td>Proteinuria range (mg/g)</td>
<td>&lt;150</td>
<td>150-500</td>
<td>&gt;500</td>
<td>-</td>
</tr>
<tr>
<td>Number of Encounters</td>
<td>10723</td>
<td>4221</td>
<td>2046</td>
<td>161959</td>
</tr>
<tr>
<td>Percentage of Encounters (%)</td>
<td>6.0</td>
<td>2.4</td>
<td>1.1</td>
<td>90.5</td>
</tr>
</tbody>
</table>
Identified CKD Cases in Northern Michigan, by ZIP Code

Prevalence

Munson Affiliated Hospital Facility
Discussion

- Leveraged EHR and phenotypic CKD definitions to identify large rural CKD burden
- Largest number of cases identified in Traverse City and Cadillac area
  - Proximity to hospital appearing to be a key factor
- Data are limited based on Munson Healthcare facility data
  - EHR should support exchange of CKD-related information across health care settings
Discussion

- In 2020, 11.9% of patients did not have appropriate laboratory data to identify CKD risk
- Only 18.9% of individual patients identified with CKD risk by GFR staging alone had a corresponding documented albuminuria
  - Inadequate screening
  - Lacking appropriate data to accurately assess overall CKD risk
  - Obstacles to implement goal directed therapy
- Proper surveillance is warranted to identify patients at risk for CKD

Discussion

- Use of EHR and phenotypic definitions of CKD proved successful for characterizing CKD burden in part of rural Northern Michigan
  - Vital for detect high risk populations
  - Crucial for rural areas with pre-existing health disparities and barriers
- Consider integration of phenotypic definitions into EHR
  - Surveillance or registry program
  - Engage patient with goal directed therapies
  - Proactive recognition and intervention
  - Improve public health and health care planning
Conclusion

- Further studies needed to characterize geographic disparities
- Consider including data across multiple hospital systems to better understand population statistics of Northern Michigan
- Identify patient risk factors, resource utilization, previous interventions, socioeconomic status, and possible environmental exposures
- Consider implementation of phenotypic CKD definitions into EHR to more readily identified high risk patients
References

1. United States Renal Data System. 2017 USRDS annual data report: Epidemiology of kidney disease in the United States. NIH. Bethesda, MD
Questions?