Predictors of Documented Chronic Kidney Disease using ICD Coding in an Integrated Health System Among Patients with Abnormal Clinical GFR and ACR

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Abstract

Introduction: Chronic kidney disease (CKD) is a common, long-term condition that is often asymptomatic in its early stages. When left untreated, it can lead to serious adverse outcomes. We aimed to evaluate how CKD is diagnosed at Henry Ford Health [HFH] patients and to identify key predictors associated with its diagnosis.

Methods: We conducted a retrospective cohort study of adult patients with clinical evidence of chronic kidney disease based on laboratory evidence of CKD defined as urine albumin-creatinine ration (uACR) ≥30 with a consecutive UACR of ≥30 between and GFR <60 with a consecutive GFR <60 between 3 months to 12 months who were initially seen at Henry Ford between January 1, 2021, to December 31, 2023. Multivariate logistic regression assessed variables associated with the Chronic kidney disease ICD diagnosis.

Results: A total of 62,670 patients had clinical evidence of CKD, only 39, 074 (62%) patients were clinically diagnosed with CKD. There were 46,100 missing urine albumin-creatinine ratio values. Younger age (p < 0.001), males (odds ratio [OR] OR 2.14; 95% CI 2.02-2.26; p < 0.001) comorbidities (specifically HTN OR 2.22; 95% CI 2.04-2.42, Diabetes OR 1.70; 95% CI 1.61-1.80) and more advanced renal dysfunction (CKD stage) correlated with increased odds of having a documented CKD diagnosis (p < 0.001).

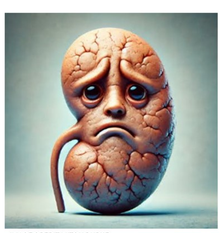
Conclusions: Chronic kidney disease appears to be underdiagnosed within our population. Notably, there is a low frequency of urine microalbuminuria testing. This gap likely contributes to reduced patient awareness and suboptimal management of CKD. Further evaluation is warranted to understand the underlying causes and improve identification and care.

Background

- **Definition:** Chronic kidney disease (CKD) is a common long-term condition where the kidneys become damaged over time (lasting at least three months).[1,2]
- **Epidemiology:** Prevalence of CKD
  - 8%–16% of the global population
  - 14% of the American population, around 35 million people, have CKD
    - Race:
      - highest in Black (18.8%)
      - lowest in Hispanic individuals (12.0%)
    - Insurance: twice as high for those with Medicare (31.5%-33.6%) compared to Medicaid (15.6%), private insurance (13.2%), other government insurance (14.3%), or no insurance (10.8%) from 2017 to March 2020
    - Income and Education: People with lower levels of income and educational achievement were more likely to have CKD.
- **Diagnosis for CKD:** involves two different tests: blood test known as the estimated glomerular filtration rate (eGFR) and a urine test known as the urine albumin-creatinine ratio. [3]
- **Importance of Early Detection and Treatment:**
  - Early diagnosis and management by primary care providers are crucial. Untreated progressive CKD can lead to adverse outcomes such as end-stage kidney disease (ESKD), cardiovascular disease, and increased mortality.
  - Most CKD patients are asymptomatic, making screening important for early detection.
  - A risk-based approach to screening is recommended, focusing on individuals:
    - Older than 60 years
    - With a history of diabetes or hypertension
    - With other risk factors such as autoimmune disease, obesity, kidney stones, recurrent urinary tract infections, reduced kidney mass, exposure to medications like NSAIDs or lithium, or previous acute kidney injury.
- CKD is frequently **underrecognized by both patients and clinicians**.[5]
  - The key findings from REVEAL-CKD study by Tangri et al. (2023), showed a high prevalence of undiagnosed Stage 3 CKD across countries: 61.6-64.3% in the U.S., 95.5% in France, 84.3% in Germany, 77.0% in Italy, and 92.1% in Japan. [6]
  - **9 in 10 Americans with CKD do not know they have it**

Aims

- How many patients in the Henry Ford Health meeting clinical criteria for CKD are without a documented diagnosis?
- What patient characteristics influence the likelihood of diagnosis of CKD in those meeting clinical criteria for CKD?



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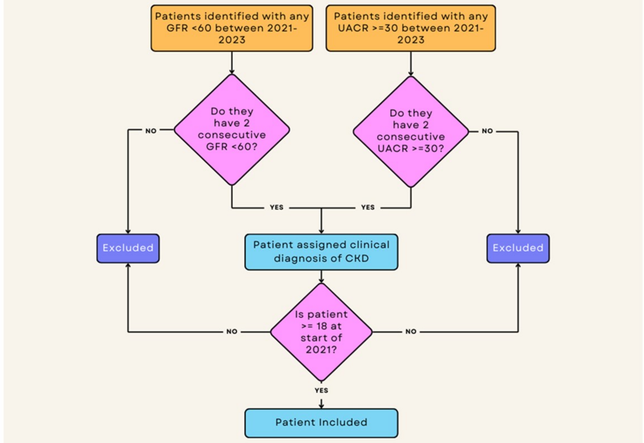
Methods

- Retrospective study between beginning January 1, 2021, to December 31, 2023 with CKD based on clinical laboratory evidence
- Data was extracted from linked electronic health records for the identified patients and subsequently analyzed
- Clinical laboratory evidence of CKD defined as
  - UACR ≥30 with a consecutive UACR of ≥30 between 3 months to 24 months
  - GFR <60 with a consecutive GFR <60 between 3 months to 24 months
- Logistic regression is used to analyze the relationship between population characteristics and having a documented CKD diagnosis using SAS and R statistical program
- The study was approved by the Institutional Review Board at Henry Ford Health.

Figure 1. Attrition Diagram



Results

Table 1. Study population characteristics

Characteristic	ICD10 CKD Diagnosis N = 39,074	No ICD 10 CKD Diagnosis N = 23,596	Overall N = 62,670
Gender			
Female	20,517 (53%)	14,355 (61%)	34,872 (56%)
Male	18,557 (47%)	9,241 (39%)	27,798 (44%)
Age			
18-35	488 (1.2%)	362 (1.5%)	850 (1.4%)
36-55	3,389 (8.7%)	2,860 (12%)	6,249 (10.0%)
56-75	18,406 (47%)	11,826 (50%)	30,232 (48%)
76+	16,791 (43%)	8,548 (36%)	25,339 (40%)
Race			
American Indian/Alaskan Native	173 (0.4%)	132 (0.6%)	305 (0.5%)
Asian	640 (1.6%)	557 (2.4%)	1,197 (1.9%)
Black/African American	13,238 (34%)	6,180 (26%)	19,418 (31%)
Native Hawaiian/Pacific Islander	39 (<0.1%)	29 (0.1%)	68 (0.1%)
Unknown	1,101 (2.8%)	1,035 (4.4%)	2,136 (3.4%)
White	23,132 (59%)	15,108 (64%)	38,240 (61%)
Other	749 (1.9%)	552 (2.3%)	1,301 (2.1%)
Multiple races	2 (<0.1%)	3 (<0.1%)	5 (<0.1%)
Ethnicity: Middle Eastern North African	545 (1.4%)	375 (1.6%)	920 (1.5%)
Ethnicity: Hispanic	857 (2.2%)	690 (2.9%)	1,547 (2.5%)
Median Household Income			
<$30K	3,089 (11%)	1,471 (9.3%)	4,560 (11%)
$30K-$49K	7,711 (28%)	4,281 (27%)	11,992 (28%)
$50K-$69K	7,597 (28%)	4,451 (28%)	12,048 (28%)
$70K-$89K	5,104 (19%)	3,218 (20%)	8,322 (19%)
$90K+	3,677 (14%)	2,389 (15%)	6,266 (15%)
Unknown	11,696	7,786	19,482
Detroit Zip Code	7,076 (26%)	3,351 (21%)	10,427 (24%)
Unknown	11,486	7,697	19,183
Any Insurance	15,237 (39%)	8,322 (35%)	23,559 (38%)
Hypertension	35,425 (91%)	18,393 (78%)	53,818 (86%)
Diabetes	22,047 (56%)	11,996 (51%)	34,043 (54%)
Type 1 Diabetes	1,488 (3.8%)	576 (2.4%)	2,064 (3.3%)
Type 2 Diabetes	21,667 (55%)	11,763 (50%)	33,430 (53%)
Obesity	15,678 (48%)	9,292 (51%)	24,970 (49%)
Unknown	6,614	5,259	11,873
BMI			
Normal (18.5-24.9)	6,260 (19%)	3,394 (19%)	9,654 (19%)
Underweight (<18.5)	453 (1.4%)	267 (1.5%)	720 (1.4%)
Overweight (25.0-29.9)	10,069 (31%)	5,384 (29%)	15,453 (30%)
Obese Class I (30.0-34.9)	7,899 (24%)	4,464 (24%)	12,363 (24%)
Obese Class II (35.0-39.9)	4,260 (13%)	2,587 (14%)	6,847 (13%)
Obese Class III (40.0+)	3,519 (11%)	2,241 (12%)	5,760 (11%)
Unknown	6,614	5,259	11,873
CCI			
None	4,931 (13%)	9,241 (39%)	14,172 (23%)
Mild (1-2)	10,410 (27%)	10,377 (44%)	20,787 (33%)
Moderate (3-4)	13,251 (34%)	3,051 (13%)	16,302 (26%)
Severe (5+)	10,482 (27%)	927 (3.9%)	11,409 (18%)

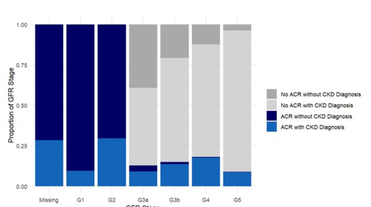
n(%)

Table 2. Study population CKD characteristics.

Characteristic	N = 62,670
ICD10 CKD Diagnosis	
ICD 10 CKD Diagnosis	39,074 (62%)
No ICD 10 CKD Diagnosis	23,596 (38%)
KDIGO GFR Stage	
G1: Normal/High	2,690 (4.5%)
G2: Mildly Decreased	3,597 (6.0%)
G3a: Mildly/Moderately Decreased	28,340 (47%)
G3b: Moderately/Severely Decreased	16,055 (27%)
G4: Severely Decreased	5,722 (9.6%)
G5: Kidney Failure	3,337 (5.6%)
Unknown	2,929
KDIGO ACR Stage	
A1: Normal/Mildly Increased	2,544 (15%)
A2: Moderately Increased	10,193 (62%)
A3: Severely Increased	3,833 (23%)
Unknown	46,100

n(%)

Figure 2.Urine albumin creatinine ratio

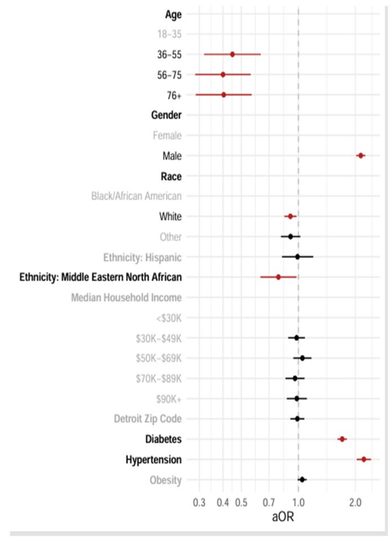


Results- logistic regression

Table 3: Logistic regression for ICD 10 CKD Diagnosis. Significant variables are indicated by a p-value less than 0.05 or a CI that does not contain 1. OR estimates less than 1 indicate smaller odds of receiving a diagnosis than the reference level. OR estimates more than 1 indicate greater odss of

Characteristic	OR	95% CI	p-value
CKD Stage			<0.001
Stage 1	—	—	
Stage 2	4.74	3.91, 5.79	
Stage 3a	27.2	22.7, 32.8	
Stage 3b	91.6	76.0, 111	
Stage 4	211	169, 266	
Stage 5	594	417, 868	
Age			<0.001
18-35	—	—	
36-55	0.45	0.32, 0.63	
56-75	0.40	0.29, 0.56	
76+	0.40	0.29, 0.57	
Gender			
Female	—	—	
Male	-2.14	-2.02, 2.26	<0.001
Race			
Black/African American	—	—	
White	-0.91	-0.84, 0.98	0.030
Other	0.91	0.81, 1.02	
Ethnicity: Hispanic	0.99	0.82, 1.20	>0.9
Ethnicity: Middle Eastern North African	0.78	0.63, 0.98	0.031
Median Household Income			0.15
<$30K	—	—	
$30K-$49K	0.98	0.89, 1.08	
$50K-$69K	1.05	0.94, 1.17	
$70K-$89K	0.96	0.86, 1.08	
$90K+	0.98	0.87, 1.11	
Detroit Zip Code	0.99	0.91, 1.07	0.8
Diabetes	1.70	1.61, 1.80	<0.001
Hypertension	2.22	2.04, 2.42	<0.001
Obesity	1.05	0.99, 1.11	0.095

Abbreviations: CI = ConfidenceInterval, eInterval, OR = Odds Ratio



Conclusions

- CKD is under-diagnosed in the Henry Ford Health population
- Lack of documented (missing/unknown) urine microalbuminuria in particular, as well as basic metabolic profile is noteworthy
- Younger age, males, comorbidities (specifically HTN, Diabetes) and more advanced renal dysfunction (CKD stage) correlated with increased odds of documented CKD diagnosis
- This likely leads to reduced patient awareness and consequently to suboptimal management of CKD
- This likely also leads to lost revenue generation given CKD is Hierarchical Condition Category code

Bibliography

1. Chronic kidney disease (Ckd) - Symptoms, causes, treatment | National Kidney Foundation. Accessed November 5, 2024. https://www.kidney.org/kidney-topics/chronic-kidney-disease-ckd
2. CDC. Chronic kidney disease in the united states, 2023. Chronic Kidney Disease. May 21, 2024. Accessed November 5, 2024. https://www.cdc.gov/kidney-disease/php/data-research/index.html
3. Home page: Kidney International. (n.d.-b). https://www.kidney-international.org/article/S0085-2538(20)30694-3/fulltext
4. Annual data report. USRDS. Accessed November 5, 2024. https://usrds-adr.niddk.nih.gov/
5. Chen, T. K., Knicely, D. H., & Grams, M. E. (2019). Chronic Kidney Disease Diagnosis and Management: A Review. JAMA, 322(13), 1294–1304. https://doi.org/10.1001/jama.2019.14745
6. Tangri, N., Peach, E. J., Franzén, S., Barone, S., & Kushner, P. R. (2023). Patient Management and Clinical Outcomes Associated with a Recorded Diagnosis of Stage 3 Chronic Kidney Disease: The REVEAL-CKD Study. Advances in therapy, 40(6), 2869–2885. https://doi.org/10.1007/s12325-023-02482-5

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