

Identifying opportunities to improve early referral for hematuria with concomitant proteinuria in a large health system

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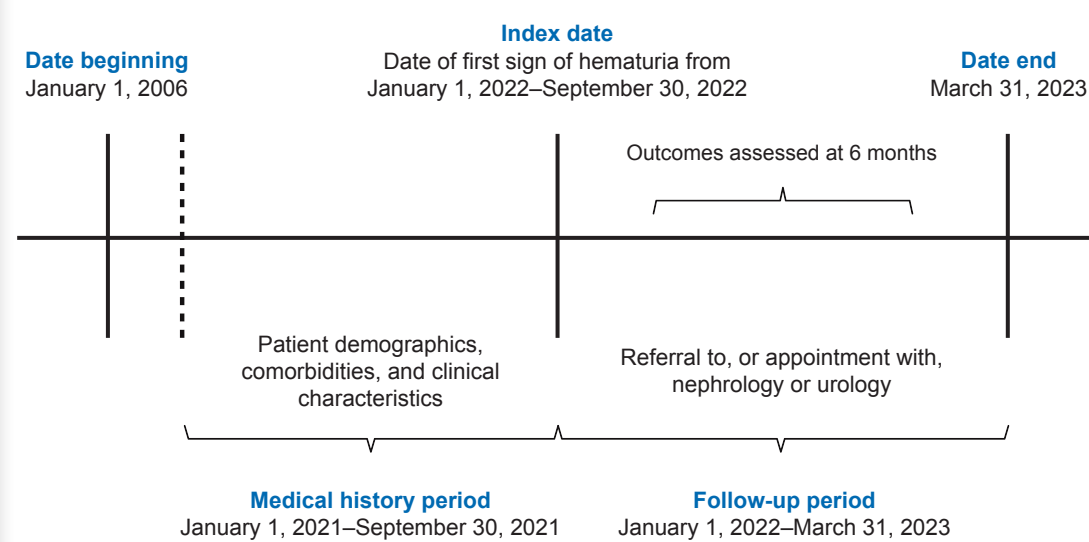
Introduction

- Hematuria is commonly encountered by PCPs, with 1–18% of patients presenting with hematuria depending on patient characteristics and the presence of risk factors¹
- Hematuria can indicate conditions such as glomerulonephritis and urologic cancer; adherence to medical society guidelines is key for timely diagnosis and patient management^{1–5}
- Current evidence describing hematuria management and referral patterns of patients with hematuria to nephrology or urology by PCPs are limited
- The objective of this study was to improve understanding of hematuria management in primary care and to identify opportunities to improve hematuria workup

Methods

- This was a retrospective cohort study using EHR data from Geisinger Health System, a large US regional health system in Central, Northeast, and West Pennsylvania, from January 1, 2006 to March 31, 2023 (Figure 1)
- Adult patients (≥18 years of age) who had ≥1 outpatient visit at Geisinger Health System, underwent urinalysis, and tested positive for hematuria between January 1, 2022 to September 30, 2022 were included
 - Hematuria was defined as a positive dipstick test with blood 1+ or greater
 - Excluded patients were any who had a previous appointment with a nephrologist or urologist after a prior positive hematuria test in the past 10 years and patients with a history of kidney biopsy or genitourinary cancer
- The proportion of patients with hematuria who were referred to, or had an appointment with, a nephrologist or urologist within 6 months of the index date (defined as the time of first sign of hematuria) was evaluated
- Characteristics of patients who were referred versus not referred were summarized by descriptive statistics and compared
 - For the univariate analysis, continuous variables were analyzed using t-test, and categorical variables were analyzed using Chi-square test
 - For the multivariable analysis, penalized logistic regression with L1 regularization was fitted to train the model by eliminating variables that were not important. Variables, including demographics, comorbidities, and clinical characteristics, were selected using LASSO regression

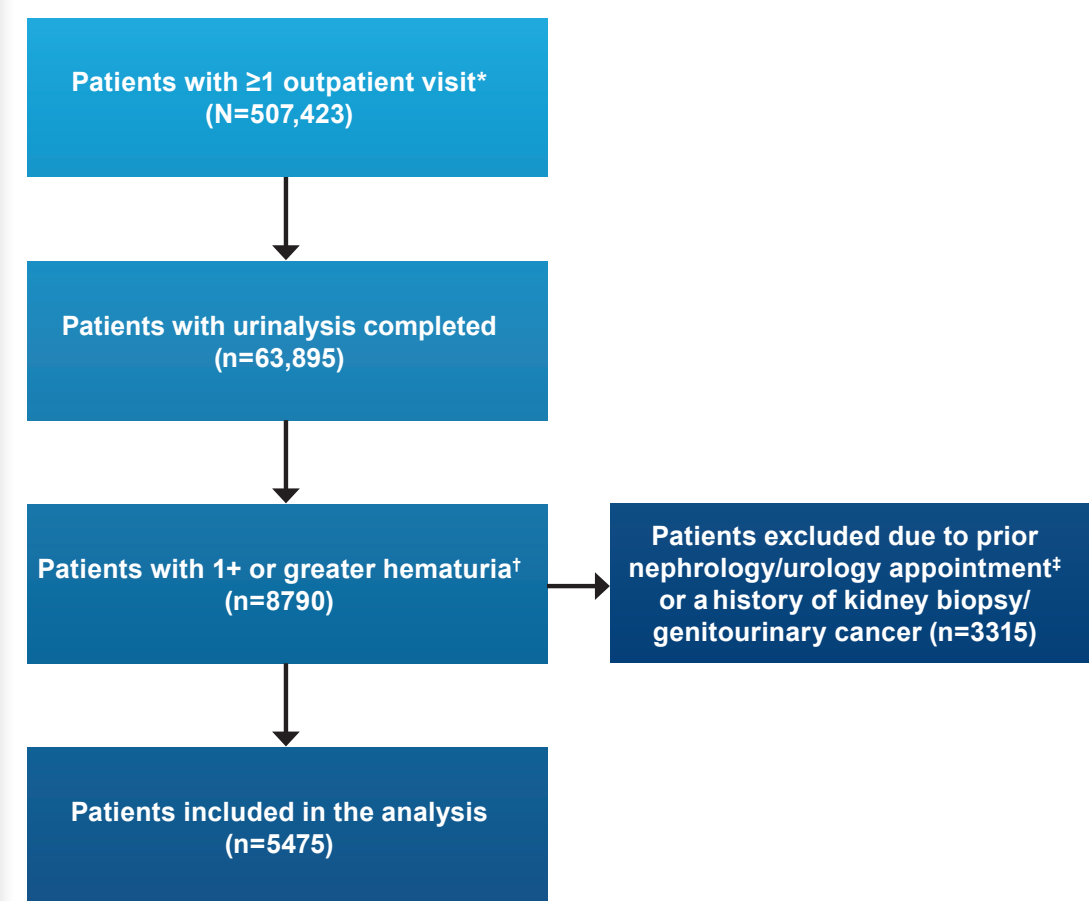
Figure 1. Study design



Results

- Among 507,423 patients with ≥1 outpatient visit at Geisinger Health System, 5475 patients were included in the analysis (Figure 2)

Figure 2. Selection of patients in Geisinger Health System



*Patients receiving care from Geisinger Health System between January 1, 2022 to September 30, 2022 (including patients receiving or not receiving primary care at Geisinger Health System); †Based on dipstick test; ‡Within the past 10 years.

Conclusions

- In a US regional health system, there were low referral rates to nephrology and urology after hematuria diagnosis, even among patients with concomitant proteinuria
- Further studies are required to determine optimal strategies to improve follow-up and management of hematuria

Demographics and clinical characteristics

- The majority of patients were female (78.0%), White (92.1%), and non-Hispanic (93.1%), with a mean age of 60.5 years (Table 1)
- Overall, the most frequent comorbidities included hypertension (33.4%), diabetes (15.3%), and chronic kidney disease (9.9%) (Table 2)

Characteristics associated with appointment or referral to urology or nephrology

- In total, 774 of 5475 patients (14.1%) had an appointment or referral to nephrology or urology within 6 months of hematuria assessment
 - This included 707 patients (12.9%) with an appointment or referral to urology and 97 patients (1.8%) with an appointment or referral to nephrology
- In a sensitivity analysis excluding patients with positive nitrite and leukocyte esterase (a surrogate for possible infection risk), nephrology and urology referrals or appointments were completed in 491 of 3234 patients (15.2%) within 6 months
- In the univariate analysis, appointment or referral to nephrology or urology within 6 months of hematuria assessment was higher for patients with greater hematuria (1+ : 11.7% vs 2+ : 18.0%; P<0.001) and for patients with concomitant proteinuria (no proteinuria: 11.9%, trace: 15.6%, 1+ : 15.8%, 2+ : 14.9%, 3+ : 17.5%; P=0.001)
 - Other factors associated with an appointment or referral to nephrology or urology included receiving Geisinger primary care (P<0.001), male sex (P<0.001), non-Hispanic White ethnicity (P=0.020), and more smoking pack-years (P=0.010) (Table 1)
 - Higher referral rates were also associated with the presence of hypertension (P=0.001), diabetes (P=0.030), or genitourinary infection (P=0.020), higher Charlson Comorbidity Index category (P=0.001), and receipt of albumin/creatinine ratio testing (P<0.001), but not UPCR testing (Table 2)
- In the multivariable analysis, variables significantly associated with increased odds of appointment or referral to nephrology or urology within 6 months of hematuria assessment are shown in Figure 3
 - These included receipt of Geisinger primary care, receipt of follow-up urinalysis, presence of neoplasm, and erythrocytes >30 per HPF

Table 1. Demographics of patients with hematuria

Category	Overall N=5475	No appointment or referral in 6 months n=4701	Appointment or referral in 6 months n=774	P-value*
Receives Geisinger primary care, n (%)	2058 (37.6)	1643 (35.0)	415 (53.6)	<0.001
Age, years				
Mean (SD)	60.5 (18.4)	60.5 (21.1)	60.9 (18.4)	0.600
Sex, n (%)				
Male	1204 (22.0)	937 (19.9)	267 (34.5)	<0.001
Race, n (%)				
White	5041 (92.1)	4312 (91.7)	729 (94.2)	
Black or African American	211 (3.9)	187 (4.0)	24 (3.1)	
Asian	75 (1.4)	67 (1.4)	8 (1.0)	0.200
Other†	58 (1.1)	51 (1.1)	7 (0.9)	
Unknown	90 (1.6)	84 (1.8)	6 (0.8)	
Ethnicity, n (%)				
Hispanic or Latino	239 (4.4)	212 (4.5)	27 (3.5)	
Non-Hispanic or Latino	5096 (93.1)	4362 (92.8)	734 (94.8)	0.100
Unknown	140 (2.6)	127 (2.7)	13 (1.7)	
Non-Hispanic White	4799 (87.7)	4101 (87.2)	698 (90.2)	0.020
Insurance type, n (%)				
Commercial (non-Geisinger)	1223 (22.3)	1049 (22.3)	174 (22.5)	
Commercial (Geisinger)	937 (17.1)	802 (17.1)	135 (17.4)	
Medicaid	363 (6.6)	320 (6.8)	43 (5.6)	0.100
Medicare	2618 (47.8)	2228 (47.4)	390 (50.4)	
Self-pay	156 (2.8)	140 (3.0)	16 (2.1)	
Other	178 (3.3)	162 (3.4)	16 (2.1)	
Smoking status				
Mean pack-years (SD)	6.8 (16.6)	6.5 (16.3)	8.4 (17.7)	
Missing, n (%)	1422 (26.0)	1271 (27.0)	151 (19.5)	0.010

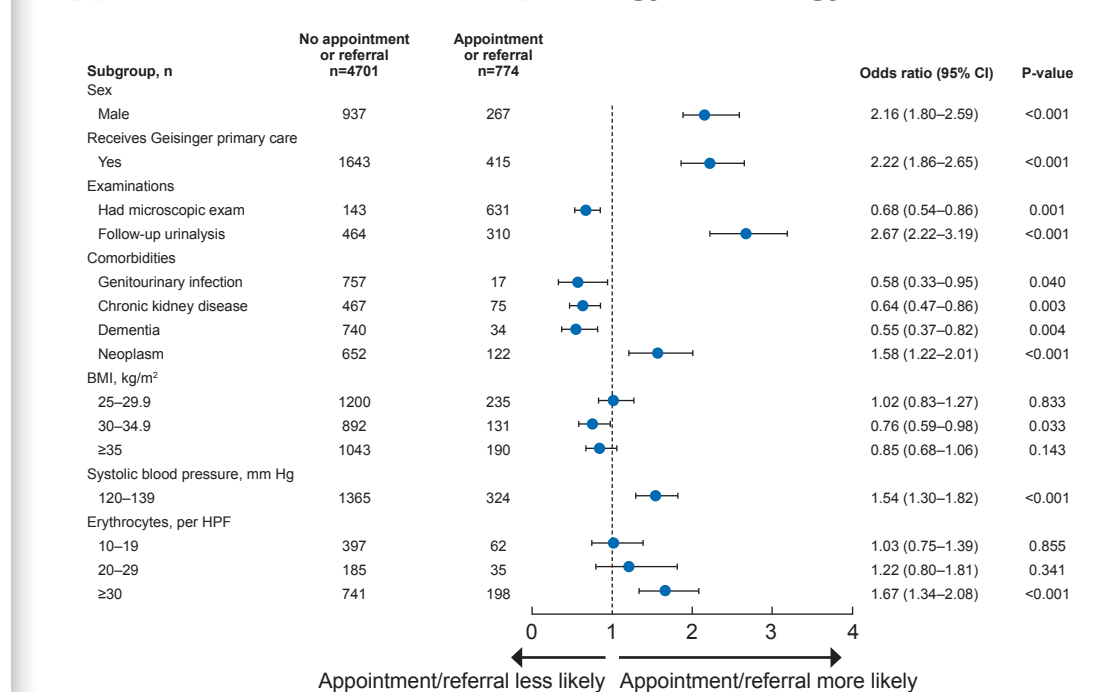
*Continuous variables were analyzed using t-test, and categorical variables were analyzed using Chi-square test; †Includes patients with racial groups defined as 'American Indian or Alaska Native', 'Native Hawaiian or other Pacific Islander', 'two or more', and 'other'. SD, standard deviation.

Table 2. Comorbidities and clinical characteristics of patients with hematuria

Category	Overall N=5475	No appointment or referral in 6 months n=4701	Appointment or referral in 6 months n=774	P-value*
BMI, kg/m ²				
Mean (SD)	30.3 (8.3)	30.3 (8.3)	30.3 (7.9)	1.000
Missing, n (%)	304 (5.6)	298 (6.3)	6 (0.8)	<0.001
Comorbidities, n (%)				
Hypertension	1829 (33.4)	1529 (32.5)	300 (38.8)	0.001
Diabetes	840 (15.3)	701 (14.9)	139 (18.0)	0.030
Genitourinary infection	201 (3.7)	184 (3.9)	17 (2.2)	0.020
Chronic kidney disease	542 (9.9)	467 (9.9)	75 (9.7)	0.800
Acute kidney injury	95 (1.7)	83 (1.8)	12 (1.6)	0.100
Glomerular disease	8 (0.1)	8 (0.2)	0	0.300
Charlson Comorbidity Index category, n (%)				
0–2	2478 (45.3)	2174 (46.2)	304 (39.3)	
3–4	1263 (23.1)	1070 (22.8)	193 (24.9)	0.050
5+	1734 (31.7)	1457 (31.0)	277 (35.8)	
Mean (SD)	3.5 (3.2)	3.5 (3.2)	3.9 (3.2)	0.001
Urinalysis hematuria category, n (%)				
1+	3342 (61.0)	2952 (62.8)	390 (50.4)	<0.001
2+	2133 (39.0)	1749 (37.2)	384 (49.6)	
Urinalysis proteinuria category, n (%)				
0	1514 (27.7)	1334 (28.4)	180 (23.3)	
Trace	1063 (19.4)	897 (19.1)	166 (21.4)	
1+	1267 (23.1)	1067 (22.7)	200 (25.8)	0.001
2+	793 (14.5)	675 (14.4)	118 (15.2)	
3+	315 (5.8)	260 (5.5)	55 (7.1)	
Missing	523 (9.6)	468 (10.0)	55 (7.1)	
eGFR, mL/min/1.73 m ²				
Mean (SD)	77.5 (27.1)	77.4 (27.5)	77.6 (24.7)	0.900
Albumin/creatinine ratio testing status, n (%)				
Completed	882 (16.1)	682 (14.5)	200 (25.8)	<0.001
Albumin/creatinine ratio category, n (%)				
<30 mg/g	445 (8.1)	344 (7.3)	101 (13.0)	
30–299 mg/g	292 (5.3)	224 (4.8)	68 (8.8)	0.900
≥300 mg/g	145 (2.6)	114 (2.4)	31 (4.0)	
UPCR testing status, n (%)				
Completed	342 (6.2)	286 (6.1)	56 (7.2)	0.200
UPCR category, n (%)				
<150 mg/g	110 (2.0)	89 (1.9)	21 (2.7)	
150–499 mg/g	87 (1.6)	74 (1.6)	13 (1.7)	0.600
≥500 mg/g	145 (2.6)	123 (2.6)	22 (2.8)	

*Continuous variables were analyzed using t-test, and categorical variables were analyzed using Chi-square test; †Laboratory data include most recent laboratory measurement using outpatient data back to 2019. BMI, body mass index; eGFR, estimated glomerular filtration rate; SD, standard deviation; UPCR, urine total protein to creatinine ratio.

Figure 3. Multivariable analysis of risk factors associated with appointment or referral to nephrology or urology in 6 months*



*Only statistically significant variables are shown; the following variables were selected by LASSO regression but did not reach statistical significance: hypertension, chronic heart disease, cardiovascular disease, chronic obstructive pulmonary disease, rheumatic disease, peptic ulcer, metastatic tumor, age (40–49, 50–59, or ≥60 years of age), eGFR stage, protein category of 'trace' or '1+', and smoking pack-years 1–9, 10–29, or ≥30. †The reference group was age <40 years, BMI >18.5 to <25 kg/m², erythrocytes <10 per HPF, and systolic blood pressure <120 mm Hg. BMI, body mass index; CI, confidence interval; eGFR, estimated glomerular filtration rate; HPF, high power field; LASSO, least absolute shrinkage and selection operator.

Limitations

- As with all EHR-based studies, the data recorded in the database may be subject to human or technical error or data omission
 - Laboratory values and/or referrals to nephrology or urology may be missing for patients who received care outside of Geisinger Health System
- Patients who received more care due to illness are more likely to be represented in the EHR database
- The results from this study may not be generalizable to populations beyond those identified in the database, such as patients with undiagnosed hematuria who did not receive initial urinalysis

References

1. Peterson LM, Reed HS. Prim Care. 2019;46:265–273.
2. Ingelfinger JR. N Engl J Med. 2021;385:153–163.
3. Kidney Disease: Improving Global Outcomes (KDIGO) Glomerular Diseases Working Group. Kidney Int. 2021;100:S1–S276.
4. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. Kidney Int Suppl. 2013;3:1–150. & Barocas DA et al. J Urol. 2020;204:778–786.

Abbreviations

BMI, body mass index; CI, confidence interval; eGFR, estimated glomerular filtration rate; EHR, electronic health record; HPF, high power field; LASSO, least absolute shrinkage and selection operator; PCP, primary care physician; SD, standard deviation; UPCR, urine total protein to creatinine ratio; US, United States.

Disclosures

AC, TH, YH, JL, and LO are employees of Geisinger Health, Danville, Pennsylvania, USA. JA, BN, and CA are employees of Novartis Pharmaceuticals Corporation, East Hanover, New Jersey, USA.

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