

Identifying opportunities to improve evaluation for hematuria in a large health system

Alexander R. Chang,¹ Thomas H. Jones,¹ Yirui Hu,¹ Briana C. Ndice,² Carolina A. Aldworth²

¹Geisinger Health System, Danville, Pennsylvania, USA; ²Novartis Pharmaceuticals Corporation, East Hanover, New Jersey, USA

KEY FINDINGS & CONCLUSIONS

- In a large US regional health system, nephrology and urology referral rates were low following hematuria diagnosis, highlighting substantial opportunities to improve the evaluation of hematuria
- Follow-up microscopy testing occurred in only 41.6% of patients despite guidelines recommending repeat microscopic evaluation^{5,6}
- Referral to nephrology was minimal, even in patients with more severe concomitant proteinuria
- Overall, patients with appointments or referrals were more likely to be male, of White race, have hypertension, and have worse urinalysis proteinuria or hematuria categories
- Based on the findings presented here, subsequent analyses are being planned to help determine strategies to improve first-line management and follow-up of hematuria in primary care



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INTRODUCTION

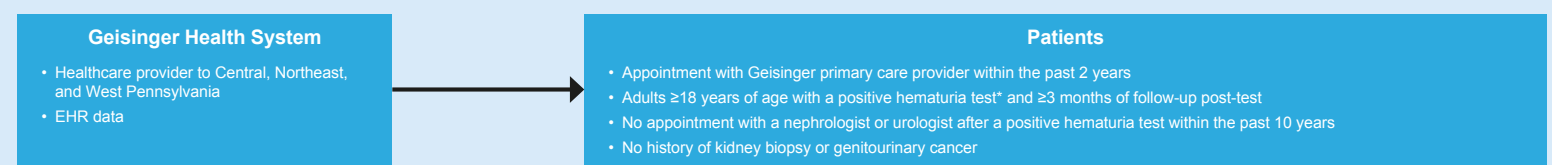
- Hematuria is commonly encountered in primary care and presents in 1–18% of patients, depending on age, gender, frequency of testing, and the presence of risk factors¹
- As hematuria can be an initial sign of conditions such as glomerulonephritis and urologic cancer, adherence to medical society guidelines is key for timely diagnosis and patient management^{1–6}
- There is currently limited evidence describing referral patterns and management of patients with hematuria to nephrology or urology by primary care physicians
- This study aimed to examine opportunities to improve hematuria management in the primary care setting for the early diagnosis of serious hematuria-associated conditions

METHODS

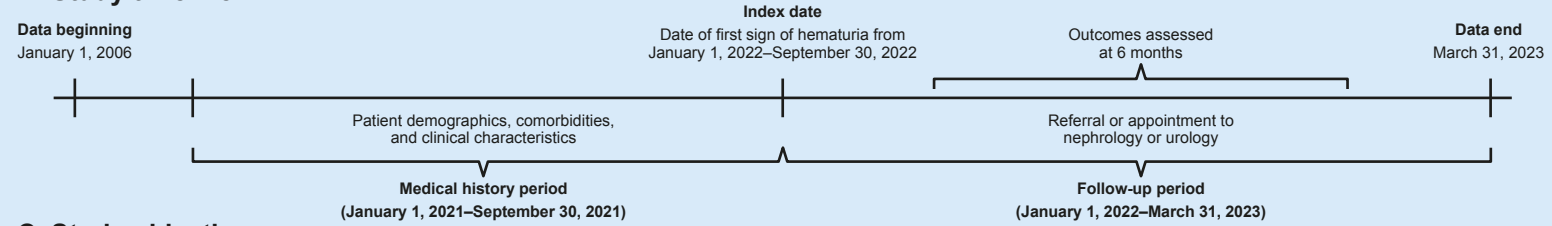
- This was a retrospective cohort study of adults with EHR data in the US Geisinger Health System, who tested positive for hematuria (defined as a positive dipstick test with blood 1+ or greater) between January 1, 2022, and September 30, 2022 (Figure 1)
- Descriptive statistics were used to compare characteristics of patients who were referred vs not referred and to summarize patients who underwent follow-up testing or presented with concomitant proteinuria
 - For the univariate analysis, continuous variables were analyzed using a t-test, and categorical variables were analyzed using the Chi-square test

Figure 1. Study design

A. Study cohort



B. Study timeline



C. Study objectives

Primary objectives	Secondary objectives
To evaluate the proportion of patients with hematuria who had a referral to, or appointment with, a nephrologist or urologist within 6 months of the index date	To evaluate the proportion of patients with the following: <ul style="list-style-type: none"> Confirmation of hematuria by repeat urinalysis or urine microscopy within 3 months of the index date Patients with concomitant proteinuria* at presentation Patients with concomitant proteinuria who underwent quantitative ACR or PCR testing within 3 months of the index date

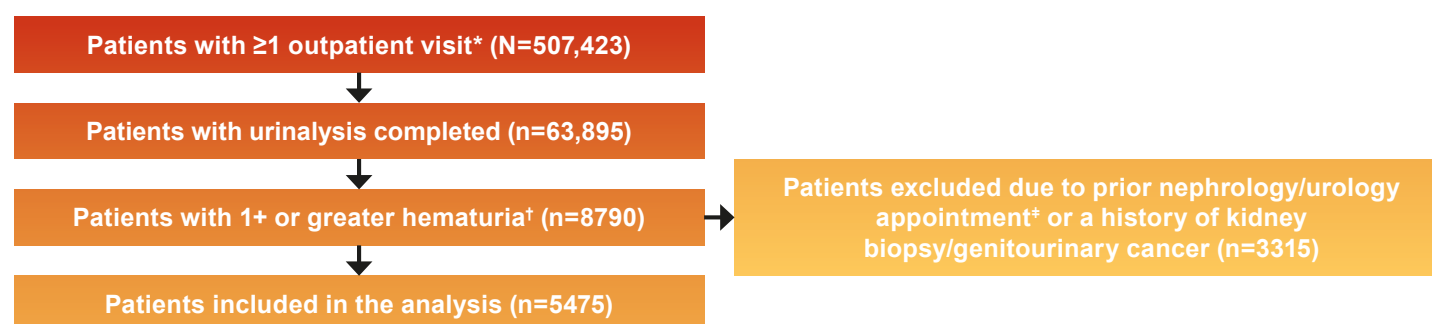
*Defined as dipstick with blood 1+ or greater; †Defined as dipstick with protein 1+ or greater. ACR, albumin/creatinine ratio; EHR, electronic health record; PCR, protein/creatinine ratio.

RESULTS

Patient selection

- Of 507,423 patients with ≥1 outpatient visit to a Geisinger primary care provider, 5475 patients were included in the analysis (Figure 2)

Figure 2. Selection of patients in the 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.

Demographics and clinical characteristics

- The majority of patients were female (78.0%), White (92.1%), and not Hispanic or Latino (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 CKD (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 urology (12.9%) or nephrology (1.8%) within 6 months of hematuria assessment
- In a univariate analysis, appointment or referral was higher for patients with greater hematuria (1+: 11.7% vs 2+: 18.0%; $P<0.001$) and patients with concomitant proteinuria (negative: 11.9%, trace: 15.6%, 1+: 15.8%, 2+: 14.9%, 3+: 17.5%; $P=0.001$) (Table 2)
- Other factors associated with higher appointment or referral rates included a tendency to receive primary care at Geisinger Health System ($P<0.001$), male sex ($P<0.001$), White race ($P=0.019$), and hypertension ($P=0.001$) (Tables 1 and 2)

Patients with concomitant hematuria and proteinuria

- A total of 4952 patients had concurrent urinalysis protein and blood data available, of whom 2375 (48.0%) had 1+ or greater protein (Figure 3)
- Of these 2375 patients, 348 (14.7%) had quantitative ACR and/or PCR testing performed within 3 months of the index date
 - This included 252 patients (72.4%) who had ACR testing and 197 patients (56.6%) who had PCR testing
 - ACR and PCR levels by urinalysis proteinuria category are shown in Table 3
- Appointment or referral with nephrology or urology within 6 months of the index date was observed in 373 out of 2375 patients (15.7%) with concomitant proteinuria
 - Of those with more severe proteinuria, 1.9% with 2+ and 5.1% with 3+ urinalysis proteinuria categories had an appointment or were referred to nephrology

Confirmation of hematuria by repeat urinalysis and urine microscopy

- Of the 4187 patients with urine microscopy data available at the index date, 2905 (69.4%) had ≥3 RBCs/HPF (Figure 4)
 - Among 1743 patients (41.6%) who had ≥1 repeat microscopy conducted, 1010 (57.9%) had ≥3 RBCs/HPF
- Overall, 1582 of 5475 patients (28.9%) had ≥1 repeat urinalysis test (Figure 5)
 - Of the 1582 patients, 1086 (68.6%) had 1+ or greater hematuria

Figure 3. Index urinalysis proteinuria results (n=4952)

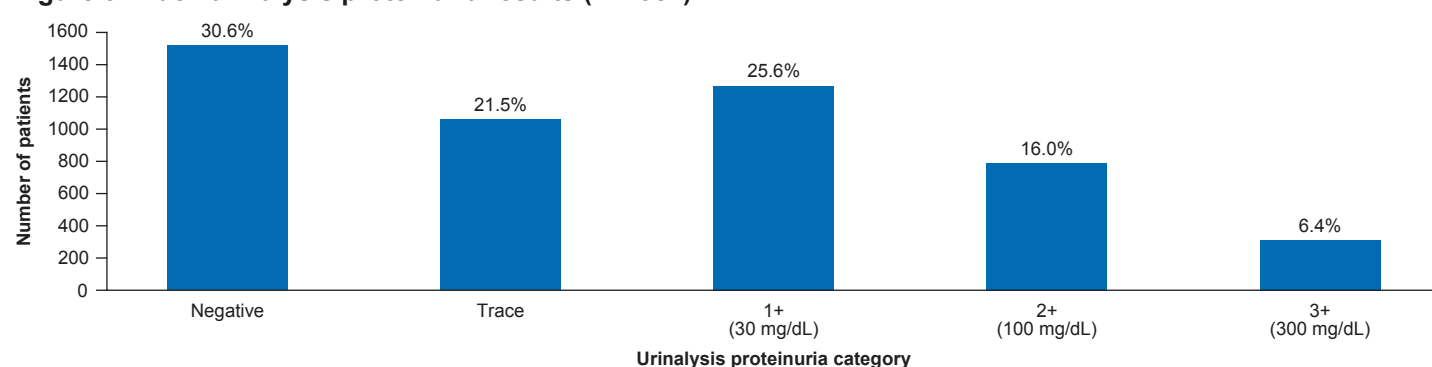
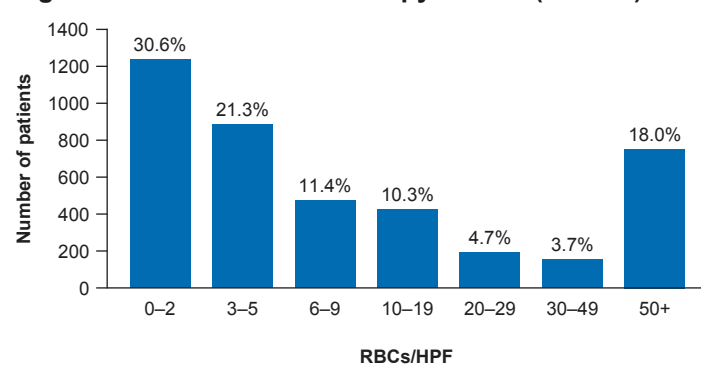


Figure 4. Index urine microscopy results (n=4187)



HPF, high power field; RBC, red blood cell.

Figure 5. Repeat urinalysis hematuria results (n=1582)

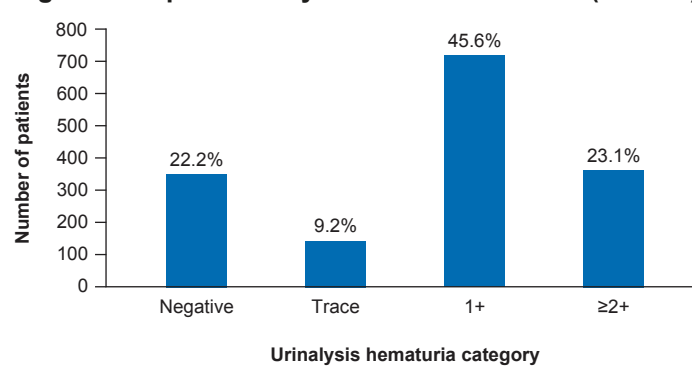


Table 1. Demographics of patients with hematuria

Category	Overall N=5475	No appointment or referral within 6 months n=4701	Appointment or referral within 6 months n=774	P-value*
Receives Geisinger primary care, n (%)				
Yes	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)	
Not 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

*Continuous variables were analyzed using a t-test, and categorical variables were analyzed using the 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 within 6 months n=4701	Appointment or referral within 6 months n=774	P-value*
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
CKD	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
Urinalysis hematuria category, n (%)				
1+	3342 (61.0)	2952 (62.8)	390 (50.4)	
2+	2133 (39.0)	1749 (37.2)	384 (49.6)	<0.001
Urinalysis proteinuria category, n (%)				
Negative	1514 (27.7)	1334 (28.4)	180 (23.3)	
Trace	1063 (19.4)	897 (19.1)	166 (21.5)	
1+ (30 mg/dL)	1267 (23.1)	1067 (22.7)	200 (25.8)	
2+ (100 mg/dL)	793 (14.5)	675 (14.4)	118 (15.3)	0.001
3+ (300 mg/dL)	315 (5.8)	260 (5.5)	55 (7.1)	
Missing	523 (9.6)	468 (10.0)	55 (7.1)	

*Continuous variables were analyzed using a t-test, and categorical variables were analyzed using the Chi-square test. †Comorbidities were identified using separate ICD-10 diagnostic codes during the 12 months prior to index date. CKD, chronic kidney disease.

Table 3. Quantification of proteinuria in patients with hematuria

Urinalysis proteinuria category	ACR levels, mg/g			PCR levels, mg/g		
	n	Mean (±SD)	Median (IQR)	n	Mean (±SD)	Median (IQR)
1+ (30 mg/dL)	91	188 (355)	94 (33–215)	47	492 (403)	333 (145–750)
2+ (100 mg/dL)	61	595 (598)	383 (195–793)	53	1403 (1116)	1193 (475–2053)
3+ (300 mg/dL)	39	3131 (2791)	2262 (981–4203)	42	5509 (4405)	4558 (2726–6581)

ACR, albumin/creatinine ratio; IQR, interquartile range; PCR, protein/creatinine ratio; SD, standard deviation.

LIMITATIONS

- Data recorded in the database may be subject to human or technical error or data omission
 - Laboratory values, appointments, and/or referrals may be incomplete for patients who received care outside of Geisinger Health System
 - Ascertainment of clinical characteristics relied on ICD-10 diagnosis codes
- Patients who received more care due to illness are more likely to be represented in the database
- The Geisinger Health System database only includes individuals who have interacted with the medical system and may not be representative of populations beyond those identified in the database, such as patients with undiagnosed hematuria who did not receive initial urinalysis

Abbreviations

ACR, albumin/creatinine ratio; CKD, chronic kidney disease; EHR, electronic health record; HPF, high power field; ICD-10, International Classification of Diseases, 10th Revision; IQR, interquartile range; KDIGO, Kidney Disease Improving Global Outcomes; PCR, protein/creatinine ratio; RBC, red blood cell; SD, standard deviation; US, United States.

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Disclosures

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