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Variation in the diagnostic evaluation among persons with hematuria: influence of gender, race, and risk factors for bladder cancer

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Abstract

Purpose—To determine whether race, gender, and number of bladder cancer risk factors are significant predictors of hematuria evaluation.

Methods—We used self-reported data from the Southern Community Cohort Study linked to Medicare claims data. Evaluation of subjects diagnosed with incident hematuria was considered complete if both imaging and cystoscopy were performed within 180 days of diagnosis. Exposures of interest were race, gender, and risk factors for bladder cancer.

Results—Among 1412 patients, evaluation was complete in 261 (18%). In our adjusted analyses, black patients were less likely than white patients to undergo any aspect of evaluation: urology referral (OR 0.72; 95%CI 0.56, 0.93), cystoscopy (OR 0.67; 95%CI 0.50, 0.89) and imaging (OR 0.75; 95%CI 0.59, 0.95). Women were less likely than men to be referred to a urologist (OR 0.59; 95%CI 0.46, 0.76). And although all patients with 2-3 risk factors had 31% higher odds of urology referral (OR 1.31; 95%CI 1.02, 1.69), adjusted analyses indicated that effect was only apparent among men.

Conclusions—Only 18% of incident hematuria diagnoses had a complete hematuria evaluation. Gender had a substantial effect on referral to urology when controlling for socioeconomic factors but otherwise had an unclear role on quality of evaluation. Black patients had markedly lower rates of thorough evaluation than white patients. Number of risk factors predicted referral to urology among men but was otherwise a poor predictor of evaluation. There is opportunity for improvement by increasing the completion of hematuria evaluations, particularly in high-risk and vulnerable patients.

Keywords

Urinary bladder neoplasm; hematuria; cystoscopy; outcome and process assessment (healthcare); urinary bladder

INTRODUCTION

Although bladder cancer has a higher prevalence in whites compared to blacks (22.8 vs. 12.8 per 100,000) and a higher incidence in males compared to females (36.6 vs. 8.9 per 100,000), five-year relative survival is worse for blacks and females (82% white male vs. 76% white female vs. 69% black male vs. 54% black female).¹ Multiple factors may contribute to this disparity, including tumor characteristics as well as the access to, and quality of, healthcare.^{2,3} Inadequate or delayed completion of hematuria evaluation may result in delayed diagnosis of bladder cancer and portend the observed inferior survival outcomes. Between 2.3% and 25.8% of hematuria workups result in the diagnosis of malignancy; however, population-based studies indicate only 9–36% of patients diagnosed with hematuria are adequately evaluated, including those considered high-risk.^{4–9}

We have recently demonstrated that women who present with hematuria over the age of 65 more commonly have an incomplete or absent hematuria workup.⁹ We now repeat the analysis using a novel data source: the Southern Community Cohort Study (SCCS). This cohort was designed for the purpose of studying disparities in cancer risk and care. Our aim was to determine whether race and gender are significant predictors of hematuria evaluation, even when controlling for patient-specific socioeconomic status and risk factors. We also wanted to determine how risk factors for bladder cancer relate to the completeness of hematuria evaluation, and whether they are weighted differently among the race/gender groups.

METHODS

Database & Study Sample

This is an IRB approved study of medical procedures applied within 180 days of a hematuria diagnosis among participants in a prospectively accrued cohort, the SCCS. The cohort comprises about 85,000 generally low-income individuals, two-thirds African American, three-fifths female, all of whom completed a baseline questionnaire highlighting socioeconomic and cancer risk factors, such as smoking history and occupational exposures.¹⁰ Details regarding the SCCS can be reviewed at their website (<http://www.southerncommunitystudy.org/>). The SCCS is linked to data from Center for Medicare and Medicaid Services (CMS), allowing for studies of association between baseline characteristics and downstream diagnoses, procedures, and imaging. We utilized data collected from patients accrued between 2001 and 2009.

Inclusion criteria for the study included individuals aged 40 years or older who had SCCS enrollment with continuous Medicare coverage for parts A & B without HMO for 360 days prior to a diagnosis of incident hematuria as well as coverage for 180 days after. Subjects were included if a primary care provider (**PCP**; Appendix) diagnosed them with hematuria based on ICD-9 codes in the outpatient setting during the study period. For patients diagnosed with hematuria more than once, their first diagnosis was determined to be the time of “incident hematuria.”

Exclusion criteria included end stage renal disease as candidacy for Medicare coverage, any diagnosis of hematuria, genitourinary neoplasm, or stone at any point prior to incident hematuria based on ICD-9 codes (360 days minimum), any genitourinary procedure within 360 days of incident hematuria based on ICD-9 codes, or any genitourinary infection within 30 days of incident hematuria based on ICD-9 codes (Appendix).

Outcomes/Endpoints

The primary outcome of the study was receipt of a timely and complete hematuria evaluation. A hematuria evaluation was determined to be ‘complete’ if a cystoscopy and abdomino-pelvic imaging (ultrasound, CT, MRI, or retrograde pyelogram) were performed within 180 days of the incident hematuria event. ‘Incomplete’ and ‘absent’ evaluations were reported if one or both aspects of the evaluation was incomplete, respectively.

Once the date of incident hematuria was established, determination of receipt of evaluation was based on ICD-9 or Healthcare Common Procedure Coding System procedure codes (Appendix).

The secondary endpoints of the study were 1) referral to a urologist (a prerequisite for cystoscopy in most cases) and 2) diagnosis of a genitourinary malignancy. Diagnosis of genitourinary malignancy (bladder cancer, kidney cancer, or prostate cancer) was determined using the same ICD-9 codes utilized for exclusion criteria.

Exposures of Interest

We were interested in gender and race variation in evaluation for hematuria. We also studied the association between risk factors for bladder cancer and receipt of hematuria evaluation. Included factors were tobacco use, occupational exposure (Appendix), and age >50 years. Male gender and white race are known risk factors, but were not included in the tally of risk factors so that we could illuminate gender and race differences in completeness of evaluation. Thus, patients were characterized as low-risk (0–1 factors) and high-risk (2–3 factors) for urologic malignancy based on the three remaining risk factors being evaluated. Although the magnitude of risk may vary among each factor (e.g. smoking harbors more risk than occupational exposure), an inability to account for the varying magnitude within each risk factor (e.g. two pack year smoking history harbors lower risk than fifty pack years) resulted in our assignment of equal weight to each factor with regard to risk.

Covariates

Models controlled for sociodemographic variables from the SCCS questionnaire including household income, highest level of education, and marital status. Long-term, current use of antiplatelets or anticoagulants was per ICD-9 codes (V58.61, V58.63, V58.66). We quantified patient comorbidity using the Klabunde adaptation of the Charlson Comorbidity Index from CMS data.¹¹

In order to quantify local healthcare resources, we linked the SCCS-CMS data with the Area Health Resources File to determine the density of PCP per 100,000 persons, and density of urologists per 100,000 persons within the county of patient residence.

Statistical Analysis

Standard descriptive statistics were used to describe the cohort. Pearson chi-squared tests were used to evaluate bivariate associations between race, gender, and the primary and secondary endpoints.

We fit logistic regression models for each component of the evaluation (referral to urologist, receipt of imaging, procedure) and for complete evaluation (both imaging and procedure). For the evaluation completeness model, we used proportional odds logistic regression to model the log odds of receiving one category vs. any category comprising the more thorough evaluation hierarchy of absent, incomplete, or complete evaluation. In all of these models, we allowed for interaction effects between number of risk factors and race, and between number of risk factors and gender. Age was modeled using a restricted cubic spline, which allows for a polynomial relationship between age and the log odds of the outcome.

All analyses were performed using R Version 3.0.2 (R Core Team).

RESULTS

A cohort of 1412 patients met inclusion criteria. Baseline characteristics of the cohort are presented in Table 1.

Imaging and cystoscopy were performed on 44% (625/1412) and 20% (288/1412) of patients, respectively. A total of 261 (18%) patients met the definition for having had a complete hematuria evaluation. Incomplete evaluations were observed in 391 (28%) patients while 760 (54%) evaluations were absent. PCPs referred 35% (493/1412) of patients to urologists after diagnosing incident hematuria. Of those referred to urologists, 58% (287/493) of patients underwent cystoscopy.

Effect of race

On univariate analyses (Table 2), black patients were less likely than white patients to undergo any part of the evaluation (urology referral 31% vs. 40%, $p<0.001$; imaging 41% vs. 47%, $p=0.029$; cystoscopy 18% vs 25%, $p=0.010$). These differences were also apparent after adjusting for risk factors and other covariates. Odds ratios comparing blacks to whites were 0.72 (95%CI 0.56, 0.93) for urology referral, 0.67 (95% CI 0.50, 0.89) for cystoscopy, and 0.75 (95% CI 0.59, 0.95) for imaging (Table 3).

Effect of gender

Overall, women were less likely than men to be referred to a urologist (Table 2; 29% vs, 45%, $p<0.001$) or undergo cystoscopy (19% vs 23%, $p=0.042$). Adjusted analysis (Table 3) also showed large differences between men and women in urology referral. Women were much less likely to be referred to a urologist than men (OR 0.59 95% CI 0.46, 0.76). However, the extent of gender differences were less clear in use of imaging and cystoscopy in adjusted analyses.

Effect of cancer risk factors

Patients with 2 or 3 risk factors were more likely to be referred to a urologist than those with 0 or 1 risk factors (38% vs 31%, $p = 0.004$), but there were no differences in the proportions who received imaging or cystoscopy between these risk groups. After adjusting for other factors, but averaged over race-sex strata, patients with 2-3 risk factors had 31% higher odds of urology referral (Table 3; OR 1.31; 95% CI 1.02, 1.69). However, our adjusted analyses indicate that effect was only apparent among men (Figure 1).

Diagnosis of malignancy

Genitourinary malignancy was diagnosed in 2.2% (31/1412) of cases (Table 4). Malignancy was diagnosed in 8.8% of patients who underwent a complete hematuria evaluation, whereas malignancy was only diagnosed in 1.3% and 0.4% of those receiving an incomplete, and absent evaluation, respectively. 3.0% of patients with 2 or more risk factors were diagnosed with genitourinary malignancy compared to 1.4% of patients with 0–1 risk factors.

DISCUSSION

In this study, only 18% of patients with an incident diagnosis of hematuria underwent a complete hematuria evaluation, with 54% having no imaging or procedure performed. On unadjusted analyses, the likelihood of undergoing any part of the evaluation was lower for black patients compared to whites. These differences remained significant on adjusted analyses when controlling for socioeconomic factors, availability of medical care, and risk factors for bladder cancer. With regard to the effect of gender, women were less likely to be referred to a urologist or undergo cystoscopy on unadjusted analyses, and continued to be less likely referred to a urologist on adjusted analyses. Risk factors for bladder cancer were more likely to result in a referral to a urologist, but this effect was only apparent for men in adjusted analyses.

The bladder cancer survival disparity seen in female and black patients has been largely attributed to late presentation and higher-stage malignancy at the time of diagnosis.^{12,13} In black patients, this discrepancy has been hypothesized to be secondary to receipt of incomplete or delayed hematuria evaluations.¹⁴ However, many factors could underlie observed gender and race disparities in health outcomes, including economic and other barriers to healthcare (e.g., density of PCPs and urologists). Social factors, particularly smoking and occupation, also vary between gender and race. These differences are difficult to account for in large retrospective cohort studies. Using the SCCS enabled us to derive a cohort that is a majority of both black and female patients and contains granular information regarding socioeconomic factors and individual risk factors for bladder cancer. Even when controlling for these patient-specific and healthcare environment factors, however, effects of race and gender on the quality of hematuria evaluation persisted.

In addition to race and gender, we focused on the influence of risk factors for bladder cancer on the likelihood of hematuria evaluation. We found that a higher number of bladder cancer risk factors was associated with a higher rate of urologist referral in men. However, we failed to detect other statistically significant associations between the presence of risk factors

for bladder cancer and the likelihood of receiving a hematuria evaluation. This could mean that physicians do not account sufficiently for an individual's risk of harboring malignancy in deciding whether to evaluate a patient with hematuria, although lack of sufficient statistical power could also explain the absence of statistical association. In this study, 8.8% of those with a complete evaluation were found to have a malignancy compared with 1.3% with an incomplete evaluation, and 0.4% of those who had no evaluation. If, indeed, hematuria evaluation decisions are not based on risk of malignancy, a substantial number of occult malignancies could remain unidentified in patients who were not completely evaluated.

Our study has limitations inherent to its design. Our cohort was both localized to the southeast United States and consisted of a majority of black and female individuals whose associated factors may not be generalizable to the national population, but are representative of an important underserved and high-risk population. Strict inclusion criteria also inhibit generalizability as many real-world patients with hematuria have had prior history of urologic malignancy, recent operations, or infections. Diagnoses and procedures are based on coding, which has inherent limitations. For example, the potential for incorrectly coding hematuria based on a dipstick may certainly explain the low referral numbers and meager 18% complete hematuria. These misdiagnoses of hematuria may also result in a urologist screening out patients who do not truly have hematuria which may explain, in part, why only 58% of patients referred to a urologist underwent cystoscopy. Even in the event that hematuria was properly coded, we also cannot easily quantify the severity of hematuria (i.e. gross vs. microscopic or number of red blood cells per high powered field).

Despite these limitations, this study provides a novel perspective into evaluating hematuria evaluation discrepancy in two groups often under-represented in bladder cancer outcomes studies: female and black patients. The baseline SCCS questionnaire allows for determination of social risk factors for urologic malignancy as well as socioeconomic factors. The linkage to Medicare allows determination of diagnosis and receipt of care – details that are also often lacking in large retrospective outcomes studies. Finally, the linkage to area health resources enabled us to control, to an extent, for availability of healthcare services.

Although this study helps to highlight discrepancies in hematuria evaluation among different race/gender groups, it also accentuates an overall poor adherence to guidelines for adults with microscopic hematuria in that only 18% of patients in our study received a complete evaluation based on American Urological Association guidelines.¹⁵ Urinary malignancies discovered during microscopic hematuria evaluation are relatively uncommon, reported between 0.4% and 13% for patients evaluated by a urologist, with more recent studies supporting 5% or less.^{16–19} In light of this, some have made efforts to target evaluating those at higher risk for urologic malignancy and avoid unnecessary evaluation in very low risk patients. In a prospective cohort study, Loo et al created a 'Hematuria Risk Index' using age > 50, history of gross hematuria, degree of current microhematuria, smoking history, and male gender as factors to determine which microscopic hematuria patients should undergo a complete evaluation.¹⁶ Though the results lack external validation, the authors demonstrated the potential to risk-stratify patients into groups and more efficiently identify most

malignancies while performing far fewer evaluations. While this stratification may have merit, one must be mindful that, not surprisingly, urinary malignancy is discovered in higher rates of microscopic hematuria referred to a urologist compared to microscopic hematuria in the general population.^{7,20} Given that only 35% of patients with hematuria in our study were referred to a urologist, it is reasonable to maintain a broad net for urology referral of microscopic hematuria and reserve risk-stratification for urologic consultation.

CONCLUSION

Using a novel cohort, we demonstrated that race/gender differences in hematuria evaluation persisted even when accounting for socioeconomic and healthcare environmental factors. Furthermore, we did not find a statistically significant association between an individual's risk factors for malignancy and one's receipt of a complete hematuria evaluation in any race/gender group. Overall, only 18% of patients with incident hematuria received a complete evaluation. The current approach to hematuria evaluation leaves a large proportion of socially vulnerable and high-risk patients unevaluated, which could have deleterious consequences in those harboring occult malignancy.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

1. Howlander, N., Noone, AM., Krapcho, M., et al. SEER Cancer Statistics Review, 1975 – 2010. 2013. p. 1-109.seer.cancer.gov
2. DeGraff DJ, Matusik RJ. Gender specific differences in bladder cancer. JURO. 2012; 188:10–11.
3. Barocas DA, Alvarez J, Koyama T, et al. Racial variation in the quality of surgical care for bladder cancer. Cancer. 2014; 120:1018–1025. [PubMed: 24339051]
4. Buteau A, Seideman CA, Svatek RS, et al. What is evaluation of hematuria by primary care physicians? Use of electronic medical records to assess practice patterns with intermediate follow-up. Urol. Oncol. 2014; 32:128–134. [PubMed: 23153858]
5. Friedlander DF, Resnick MJ, You C, et al. Variation in the Intensity of Hematuria Evaluation: A Target for Primary Care Quality Improvement. Am. J. Med. 2014
6. Elias K, Svatek RS, Gupta S, et al. High-risk patients with hematuria are not evaluated according to guideline recommendations. Cancer. 2010; 116:2954–2959. [PubMed: 20564400]
7. Mohr DN, Offord KP, Owen RA, et al. Asymptomatic microhematuria and urologic disease. A population-based study. JAMA. 1986; 256:224–229. [PubMed: 3723707]
8. Khadra MH, Pickard RS, Charlton M, et al. A prospective analysis of 1,930 patients with hematuria to evaluate current diagnostic practice. JURO. 2000; 163:524–527.
9. Bassett JC, Alvarez J, Koyama T, et al. Gender, Race, and Variation in the Evaluation of Microscopic Hematuria Among Medicare Beneficiaries. J Gen Intern Med. 2014; 30:440–447. [PubMed: 25451992]
10. Signorello LB, Hargreaves MK, Steinwandel MD, et al. Southern community cohort study: establishing a cohort to investigate health disparities. J Natl Med Assoc. 2005; 97:972–979. [PubMed: 16080667]
11. Klabunde CN, Potosky AL, Legler JM, et al. Development of a comorbidity index using physician claims data. J Clin Epidemiol. 2000; 53:1258–1267. [PubMed: 11146273]
12. Prout GR, Wesley MN, McCarron PG, et al. Survival experience of black patients and white patients with bladder carcinoma. Cancer. 2004; 100:621–630. [PubMed: 14745881]

13. Lee CT, Dunn RL, Williams C, et al. Racial disparity in bladder cancer: trends in tumor presentation at diagnosis. *JURO*. 2006; 176:927–33. discussion 933–4.
14. Virnig BA, Baxter NN, Habermann EB, et al. A matter of race: early-versus late-stage cancer diagnosis. *Health Aff (Millwood)*. 2009; 28:160–168. [PubMed: 19124866]
15. Davis R, Jones JS, Barocas DA, et al. Diagnosis, Evaluation and Follow-Up of Asymptomatic Microhematuria (AMH) in Adults: AUA Guideline. *JURO*. 2012; 188:2473–2481.
16. Loo RK, Lieberman SF, Slezak JM, et al. Stratifying risk of urinary tract malignant tumors in patients with asymptomatic microscopic hematuria. *Mayo Clin. Proc.* 2013; 88:129–138. [PubMed: 23312369]
17. Carson CC, Segura JW, Greene LF. Clinical importance of microhematuria. *JAMA*. 1979; 241:149–150. [PubMed: 758513]
18. Fracchia JA, Motta J, Miller LS, et al. Evaluation of asymptomatic microhematuria. *UROL*. 1995; 46:484–489. [PubMed: 7571215]
19. Kiragu D, Cifu AS. Evaluation of Patients With Asymptomatic Microhematuria. *JAMA*. 2015; 314:1865–1866. [PubMed: 26529165]
20. Sutton JM. Evaluation of hematuria in adults. *JAMA*. 1990; 263:2475–2480. [PubMed: 2184261]

Figure 1.

Estimated expected probability of evaluation outcomes by race-gender strata. Expected probabilities of referral to a urologist, receiving a component of hematuria evaluation (i.e., procedure or imaging), and both components (i.e., complete evaluation). Expected probabilities computed from multivariable models with baseline demographic, clinical, socioeconomic, and environmental characteristics set to medians/modes.

Baseline characteristics of SCCS patients with incident hematuria and Medicaid or Medicare. a [b, c] represent the median [lower quartile, upper quartile].

Table 1

	Cohort		Male, n (%)		Female, n (%)	
	n = 1412		Black, 309 (22%)	White, 323 (23%)	Black, 535 (38%)	Other, 36 (2%)
Age at time of hematuria diagnosis (years)	59 [51, 67]		56 [48, 65]	63 [54, 68]	59 [51, 67]	56 [51, 65]
30 – 50	291 (21%)		87 (28%)	9 (41%)	105 (20%)	7 (19%)
50–60	425 (30%)		100 (32%)	10 (45%)	169 (32%)	16 (44%)
60–70	475 (34%)		90 (29%)	3 (14%)	182 (34%)	7 (19%)
70–81	221 (16%)		32 (10%)	0 (0%)	79 (15%)	6 (17%)
Smoking status						
Current	387 (28%)		126 (42%)	12 (57%)	110 (21%)	4 (11%)
Former	453 (33%)		112 (37%)	6 (29%)	130 (25%)	15 (42%)
Never	535 (39%)		64 (21%)	3 (14%)	281 (54%)	17 (47%)
Occupational risk						
No	1149 (83%)		237 (78%)	15 (68%)	458 (88%)	31 (86%)
Number of risk factors						
0	83 (6%)		18 (6%)	1 (5%)	43 (8%)	3 (8%)
1	545 (40%)		90 (30%)	8 (38%)	257 (50%)	15 (42%)
2	613 (45%)		150 (50%)	7 (33%)	193 (37%)	16 (44%)
3	128 (9%)		43 (14%)	5 (24%)	25 (5%)	2 (6%)
Charlson comorbidity						
0	413 (29%)		87 (28%)	6 (27%)	145 (27%)	9 (25%)
1	381 (27%)		81 (26%)	7 (32%)	134 (25%)	11 (31%)
2–3	434 (31%)		90 (29%)	5 (23%)	189 (35%)	11 (31%)
4–5	107 (8%)		23 (7%)	3 (14%)	43 (8%)	2 (6%)
6 or more	77 (5%)		28 (9%)	1 (5%)	24 (4%)	3 (8%)
Anticoagulation use						
No	856 (63%)		213 (71%)	13 (59%)	326 (63%)	26 (74%)
Household income						
Less than \$15,000	911 (67%)		207 (68%)	12 (57%)	372 (72%)	21 (60%)
\$15,000 – \$25,000	262 (19%)		63 (21%)	5 (24%)	98 (19%)	7 (20%)

	Cohort n = 1412	Male, n (%)			Female, n (%)		
		White, 176 (12%)	Black, 309 (22%)	Other, 22 (2%)	White, 323 (23%)	Black, 535 (38%)	Other, 36 (2%)
\$25,000 or more	189 (14%)	48 (29%)	33 (11%)	4 (19%)	47 (15%)	46 (9%)	7 (20%)
Education							
Did not graduate high school	530 (38%)	64 (37%)	143 (47%)	9 (41%)	106 (33%)	202 (39%)	6 (17%)
High school graduate or more	852 (62%)	108 (63%)	162 (53%)	13 (59%)	216 (67%)	322 (61%)	30 (83%)
Marital status							
Unmarried	918 (67%)	73 (44%)	179 (59%)	13 (65%)	209 (66%)	414 (79%)	26 (72%)
Percent urban population	79 [46, 90]	69 [46, 89]	80 [52, 91]	82 [58, 96]	69 [42, 89]	80 [48, 90]	87 [50, 96]
County-level PCP per 100k	65 [45, 93]	65 [42, 93]	60 [47, 90]	67 [49, 94]	61 [41, 92]	71 [47, 93]	65 [44, 90]
County-level urologists per 100k	3 [1, 5]	4 [0, 5]	4 [2, 5]	3 [0, 5]	3 [0, 4]	3 [2, 5]	3 [2, 5]

Table 2

Referral for hematuria and evaluation and completion of components to the hematuria evaluation in the cohort population. Findings represented from univariate analysis.

	Saw Urologist		Procedure		Imaging		Complete	
	N = 493	p-value	N = 288	p-value	N = 625	p-value	N = 261	p-value
Race - no. (%)		<0.001 *		0.01 *		0.029 *		0.018 *
White	202 (40%)		123 (25%)		235 (47%)		111 (22%)	
Black	260 (31%)		150 (18%)		350 (41%)		136 (16%)	
Other	25 (43%)		13 (22%)		32 (55%)		12 (21%)	
Age - no. (%)		0.015 *		0.3		0.524		0.516
<50	84 (29%)		53 (18%)		124 (43%)		47 (16%)	
50	409 (36%)		235 (21%)		501 (45%)		214 (19%)	
Ever smoker - no. (%)		0.309		0.257		0.188		0.245
No	178 (33%)		118 (22%)		248 (46%)		111 (21%)	
Yes	302 (36%)		164 (20%)		359 (43%)		144 (17%)	
Occupational exposure - no. (%)		0.149		0.672		0.004 *		<0.001 *
No	395 (34%)		240 (21%)		490 (43%)		219 (19%)	
Yes	92 (39%)		46 (20%)		124 (53%)		40 (17%)	
Gender - no. (%)		<0.001 *		0.042 *		0.153		0.106
Female	263 (29%)		169 (19%)		386 (43%)		158 (18%)	
Male	230 (45%)		119 (23%)		239 (47%)		103 (20%)	
Number of risk factors - no. (%)		0.044 *		0.895		0.063		0.031 *
0	25 (32%)		17 (20%)		40 (48%)		17 (20%)	
1	169 (31%)		114 (21%)		237 (43%)		104 (19%)	
2	235 (38%)		128 (21%)		259 (42%)		114 (19%)	
3	51 (40%)		23 (18%)		70 (55%)		20 (16%)	

* Significant at the $\alpha = 0.05$ level

** p values correspond to a test for a difference among the three categories (Absent, Incomplete, and Complete)

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hematuria evaluation was determined to be 'complete' if a cystoscopy and abdomino-pelvic imaging (ultrasound, CT, MRI, or retrograde pyelogram) were performed within 180 days of the of the incident hematuria event. An evaluation was determined to be 'incomplete' if only cystoscopy or imaging were completed within 180 days, and the evaluation was considered to be 'absent' if neither imaging nor procedure were completed.

Table 3

Adjusted odds ratios showing effect of gender, race, and risk on likelihood of evaluation outcome.

	Female vs. Male		Black vs. White		2-3 vs. 0-1 Risk Factors	
	OR	95% CI	OR	95% CI	OR	95% CI
Saw Urologist	0.59	[0.46, 0.76]	0.72	[0.56, 0.93]	1.31	[1.02, 1.69]
Procedure	0.79	[0.59, 1.06]	0.67	[0.50, 0.89]	0.96	[0.72, 1.29]
Imaging	0.84	[0.66, 1.07]	0.75	[0.59, 0.95]	0.94	[0.74, 1.18]
Complete Evaluation	0.87	[0.64, 1.18]	0.66	[0.49, 0.90]	0.91	[0.68, 1.24]

Table 4

Factors associated with diagnosis of urologic malignancy. a [b, c] represent the median [lower quartile, upper quartile].

	Percentage (n) with urologic malignancy
Intensity of evaluation *	
Absent	0.4% (3)
Incomplete	1.3% (5)
Complete	8.8% (23)
Saw urologist after hematuria diagnosis	
Yes	5.7% (28)
No	0.3% (3)
Age at time of hematuria diagnosis (years)	68 [60, 72]
30–50	1.0% (3)
50–60	0.5% (2)
60–70	3.2% (15)
70–81	5.0% (11)
Race	
Black	2.0% (17)
White	2.6% (13)
Other	1.7% (1)
Gender	
Male	4.5% (23)
Female	0.9% (8)
Smoking status	
Current	1.3% (5)
Former	4.2% (19)
Never	1.3% (7)
Occupational risk	
No	2.3% (27)
Yes	1.7% (4)
Number of risk factors	
0	0% (0)
1	1.7% (9)
2	3.1% (19)
3	2.3% (3)

* A hematuria evaluation was determined to be ‘complete’ if a cystoscopy and abdomino-pelvic imaging (ultrasound, CT, MRI, or retrograde pyelogram) were performed within 180 days of the incident hematuria event. An evaluation was determined to be ‘incomplete’ if only cystoscopy or imaging were completed within 180 days, and the evaluation was considered to be ‘absent’ if neither imaging nor procedure were completed