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ORIGINAL ARTICLE

Socioeconomic and patient-related factors for the management of male urethral stricture disease

Ryan A. Dornbier[1] · Eric J. Kirshenbaum[1] · Marc H. Nelson[1] · Robert H. Blackwell[2] · Gopal N. Gupta[1] · Ahmer V. Farooq[1] · Christopher M. Gonzalez[1]

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Abstract

Purpose We sought to determine the socioeconomic and patient factors that influence the utilization of urethroplasty and location of management in the treatment of male urethral stricture disease.

Methods A retrospective review using the Healthcare Cost and Utilization Project State Inpatient and Ambulatory Surgery and Services Databases for California and Florida was performed. Adult men with a diagnosis of urethral stricture who underwent treatment with urethroplasty or endoscopic dilation/urethrotomy between 2007 and 2011 in California and 2009 and 2014 in Florida were identified by ICD-9 or CPT codes. Patients were categorized based on whether they had a urethroplasty or serial dilations/urethrotomies. Patients were assessed for age, insurance provider, median household income by zip code, Charlson Comorbidity Index, race, prior stricture management, and location of the index procedure. A multivariable logistic regression model was fit to assess factors influencing treatment modality (urethroplasty vs endoscopic management) and location (teaching hospital vs non-teaching hospital).

Results Twenty seven thousand, five hundred and sixty-eight patients were identified that underwent treatment for USD. 25,864 (93.8%) treated via endoscopic approaches and 1704 (6.2%) treated with urethroplasty. Factors favoring utilization of urethroplasty include younger age, lower Charlson Comorbidity score, higher zip code median income quartile, private insurance, prior endoscopic treatment, and management at a teaching hospital.

Conclusion Socioeconomic predictors of urethroplasty utilization include higher income status and private insurance. Patient-specific factors influencing urethroplasty were younger age and fewer medical comorbidities. A primary driver of urethroplasty utilization was treatment at a teaching hospital. Older and Hispanic patients were less likely to seek care at these facilities.

Keywords Urethral stricture disease · Urethroplasty · Socioeconomics · Specialized centers

Introduction

Male urethral stricture disease (USD) is a commonly encountered urological condition affecting 0.6% of the male population [1]. Endoscopic management with direct vision internal urethrotomy (DVIU) or urethral dilation is a well-established method for initial treatment of USD [2]. However, failure rates are high, approaching 50%, and increase with long-term follow-up [3]. Alternatively, urethroplasty offers a more definitive treatment option with recurrence free rates approaching 85% over 5-year follow-up [4]. As a result, the American Urological Association (AUA) guideline on USD recommends patients be offered urethroplasty for recurrent strictures, as opposed to repeat endoscopic management [5]. Despite this recommendation, many urologists perform repeat DVIU or urethral dilation rather than definitive urethroplasty [6]. There is a paucity of information regarding factors that may predispose a patient to endoscopic management versus urethroplasty.

Socioeconomic barriers have been increasingly scrutinized across the health-care industry. Urologic conditions are not immune to these disparities with well-documented

✉ Ryan A. Dornbier
Ryan.Dornbier@lumc.edu

[1] Department of Urology, Loyola University Medical Center, 2160 S 1st Avenue, Fahey #54, Rm 239A, Maywood, IL 60153, USA

[2] Division of Urology, Southern Illinois University School of Medicine, Springfield, IL, USA

differences in prostate-specific antigen screening [7], prostate [8] and bladder [9] cancer outcomes. Provider-level barriers in USD include poor access to a trained reconstructive surgeon, concerns regarding complications, and geographic disparities in care [10]. Patient-related factors also play a role in dictating management of USD. Age and comorbidities have long been implicated as patient-related factors which limit access to urethroplasty [11]. Whether socioeconomic factors such as insurance provider, income status and race affect location of USD treatment and utilization of urethroplasty remains unknown. In our study, we seek to determine socioeconomic factors predicting the utilization of urethroplasty and location of care in the treatment of USD. We hypothesized that socioeconomic disparities exist in the management of USD.

Methods

Database

The Healthcare Cost and Utilization Project (HCUP) State Inpatient Database (SID) and State Ambulatory Surgery and Services Database (SASD) for the state of California from 2007 to 2011 and Florida from 2009 to 2014 were utilized. The HCUP SID includes patient discharge records for all payers within an individual state, while the HCUP SASD includes data from ambulatory surgeries and outpatient services. Patient data is de-identified and includes greater than 100 clinical and non-clinical variables [12]. The dataset has unique linkage variables that allow patients to be followed longitudinally over time and across outpatient and inpatient encounters [13]. This study was institutional review board exempt given the low risk for patient identification using a large, de-identified dataset.

Patients

All male patients with an International Classification of Disease, Ninth Revision (ICD-9) diagnostic code of urethral stricture and an ICD-9 procedural code or Current Procedural Terminology (CPT) code for intervention with urethral dilation, DVIU or urethroplasty were included. ICD-9 diagnostic and procedural codes and CPT codes utilized are similar to previous studies investigating the HCUP databases regarding USD (see Table 1 for ICD-9 and CPT codes utilized) [14, 15]. Patients were categorized based on whether they underwent endoscopic management alone versus urethroplasty (with/without a history of endoscopic intervention). In patients with a history of urethroplasty, the most recent urethroplasty was considered the index encounter. In all other patients, the most recent endoscopic intervention was considered the index encounter. Patients were excluded if they had a concomitant fistula repair, history of cystectomy or prostatectomy (see Fig. 1 for study design).

Outcomes

Baseline patient characteristics were assessed including age, insurance provider, median household income by zip code, Charlson Comorbidity Index (CCI), race, and year of index procedure. CCI was calculated using baseline patient comorbidities as a measure of overall patient health. We assessed prior endoscopic urethral stricture management preceding the index procedure, labeling patients as treatment naïve or having undergone prior endoscopic treatments. The location of the index procedure was assigned as a teaching hospital or non-teaching hospital based on the American Hospital Association Council of Teaching Hospitals data element in HCUP. Additionally, year of index procedure was evaluated for years in which the datasets overlapped (2009–2011). Patients were assessed for factors that may impact the likelihood of undergoing endoscopic management versus urethroplasty, as well as treatment at a teaching hospital.

Statistical analysis

Descriptive statistical analysis was performed on the baseline patient cohort. Continuous variables were reported as means with standard deviations, with significance determined using a Student's t test. For categorical variables, χ^2 tests were utilized. Patients categorized as treatment naïve or having undergone prior endoscopic treatment were analyzed with separate multivariable regression models to assess patient factors increasing the odds of undergoing urethroplasty. Additionally, a multivariable regression was performed to assess factors influencing USD management at teaching hospitals. Stata 14 (StataCorp, College Station, TX, USA) was used for all statistical analyses, with a $p < 0.05$ threshold for statistical significance.

Results

Twenty seven thousand, five hundred and sixty-eight patients were identified who underwent treatment for USD. Of those, 25,864 (93.8%) underwent endoscopic management, while 1704 (6.2%) underwent urethroplasty (Table 2). The mean age in the endoscopic cohort was 63.7 (SD: 17.1) compared to 48.9 (SD 16.3) for the urethroplasty cohort, $p < 0.001$. Categorizing patients based on CCI, we demonstrated higher rates of urethroplasty in patients with a CCI of 0 (8.3%) compared to patients with a CCI of 1 (5.6%), 2 (3.0%) and ≥ 3 (1.1%) ($p < 0.001$). Patients with private insurance had the highest rate of urethroplasty at 10.3% compared to Medicare (2.8%), Medicaid (5.9%) and self-pay

Table 1 ICD-9 and CPT codes utilized in identification of patients with urethral stricture disease

Diagnosis	ICD-9
Urethral stricture diagnosis	
Urethral stricture	598, 598.9
Urethral stricture due to infection	598.0, 598.01
Traumatic urethral stricture	598.1
Post-operative urethral stricture	598.2
Urethral stricture, other	598.8
Urethral stricture, unspecified	598.9
Procedure	**ICD-9 and CPT codes**
Endoscopic management	
Urethrotomy	58.0
Release of urethral stricture	58.5
Dilation of urethra	58.6
Cystourethroscopy with internal urethrotomy	52275, 52276
Cystourethroscopy with dilation/calibration	52281, 53600, 53601, 53605, 53620, 53621
Urethroplasty	
Repair of urethra	58.4
Closure of urethrostomy	58.42
Reanastomosis of urethra	58.44
Repair of hypospadias	58.45
Reconstruction of urethra, other	58.46
Urethral meatoplasty	58.47
Other repair of urethra	58.49
Urethroplasty, first stage	53400
Urethroplasty, second stage	53405
Urethroplasty, 1-stage (anterior/posterior)	53410, 53415
Urethroplasty, 2-stage	53420, 53425
Urethromeatoplasty with mucosal advancement	53450
Urethromeatoplasty, excision of distal urethral segment	53460

(6.1%) patients ($p < 0.001$). Patients in zip codes with higher median incomes were more likely to undergo urethroplasty compared to lower income quartiles (8.1% vs 6.5% vs 5.2% vs 5.1%). The rate of urethroplasty was highest for African Americans (6.4%), followed by Caucasians (6.2%), Hispanic (5.6%), and Asian and Pacific Islander (3.8%) ($p = 0.002$). Patients managed at teaching hospitals had higher rates of urethroplasty (25.7%) than those managed at non-teaching facilities (2.9%) ($p < 0.001$). Treatment-naïve patients had a rate of urethroplasty at 5.5%, which was lower than patients with prior endoscopic procedures (11.9%) ($p < 0.001$). There was no difference in the rate of urethroplasty by year, though the analysis was limited to years in which the California and Florida datasets overlapped (2009–2011).

A multivariable logistic regression model was fit utilizing all variables significant on univariable analysis, stratifying by treatment-naïve patients and patients with prior endoscopic management. When controlling for these variables, patients with prior endoscopic management were more likely to undergo urethroplasty compared to treatment-naïve patients (OR 2.42, 95% CI 2.10–2.82, $p < 0.001$). In both the treatment-naïve and previously managed cohorts, younger patients (18–29 years old) were more likely to undergo urethroplasty (OR 2.15 and 2.56, respectively) with decreasing odds with older decades of life (Table 3). Additionally, healthier patients (CCI = 0) were more likely to undergo urethroplasty compared to their more medically comorbid counterparts. Patients from higher median income zip code quartiles had a higher likelihood of undergoing urethroplasty compared to patients from lower income areas. Furthermore, in both cohorts, there was an increased likelihood of urethroplasty at teaching hospitals compared to non-teaching hospitals (OR 10.96 and 7.73). When looking at primary insurance provider, the two cohorts had different results. In the treatment-naïve cohort, Medicare (OR 0.78, $p = 0.015$), Medicaid (OR 0.67, $p = 0.001$), and self-pay/uninsured (OR 0.52, $p = 0.001$) patients had decreased likelihood of urethroplasty compared to patients with private insurance. However,

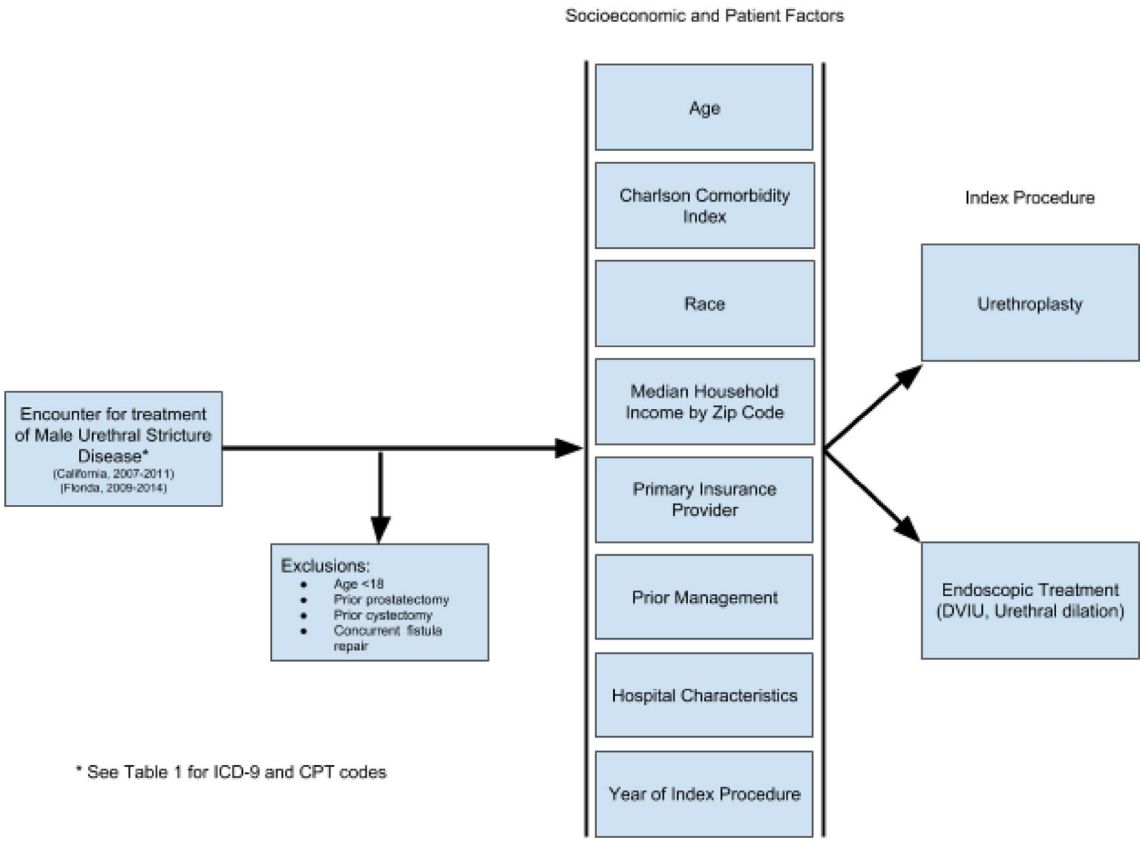

Fig. 1 Study design

in patients with prior endoscopic treatment, there was no significant difference in urethroplasty utilization among all insurance types.

As a significant driver of urethroplasty utilization, a subsequent multivariable logistic regression model was fit assessing factors that influence USD management at teaching hospitals (Tables 4, 5). Younger patients were more likely to receive care at teaching hospitals, with decreasing likelihood with each increased decade of life. Patients with prior endoscopic management attempts were more likely to be referred to a teaching hospital compared to treatment-naïve patients (OR 1.62, 95% CI 1.47–1.78, $p < 0.001$). There was no difference between patient comorbid status and insurance provider with regard to treatment location. Compared to Caucasian patients, Hispanic patients were less likely to receive care at a teaching facility compared to Caucasian patients (OR 0.84, 95% CI 0.76–0.93, $p = 0.001$). Conversely, African Americans were more likely to receive care at teaching hospitals than Caucasians (OR 1.52, 95% CI 1.35–1.72, $p < 0.001$). Though income level did not appear to influence access to a teaching hospital, the second quartile had slightly diminished treatment at these facilities.

Discussion

The management of USD has evolved over the last several decades. This evolution trends toward the increased utilization of urethroplasty, especially in the setting of failed endoscopic management. The AUA guidelines clearly recommend the utilization of urethroplasty after a prior endoscopic failure and promote urethroplasty as an upfront option that should be offered to men with USD [5]. Our data support this evolution. Upfront urethroplasty occurred at a rate of 5.5% with increased odds of urethroplasty in patients with previous endoscopic treatment, consistent with guidelines. Despite this trend, the proportion of study patients undergoing repeat endoscopic management remains high at 88.1%. Previously, a great deal of scrutiny had been placed on providers for overutilization of ineffective endoscopic procedures [7, 16]. However, there has been an increased trend toward urethroplasty utilization nationally [15] with newly certifying urologists performing urethroplasty more frequently than their predecessors, suggesting a future relief in provider limitations [17].

In our study, patient and socioeconomic factors showed significant impact on treatment modality for USD. The primary factors driving disparities included age, comorbid

Table 2 Patient demographic and comorbidity characteristics at the time of the index procedure

Demographics and comorbidity status at the time of the index procedure	Endoscopic treatment $N=25\,864$	Urethroplasty $N=1704$	p value
Age (years), mean (SD)	63.7 (17.1)	48.9 (16.3)	<0.001
Charlson Comorbidity Index, *n* (%, row)			
0	14 488 (91.7)	1313 (8.3)	<0.001
1	4103 (94.4)	242 (5.6)	
2	3316 (97.0)	103 (3.0)	
≥3	3957 (98.9)	46 (1.1)	
Race, *n* (%, row)			
Caucasian	14 608 (93.8)	965 (6.2)	0.002
Black	1972 (93.6)	134 (6.4)	
Hispanic	4284 (94.4)	256 (5.6)	
Asian/Pacific Islander	857 (96.2)	34 (3.8)	
Other	4143 (92.9)	315 (7.1)	
Zip code median household income quartile, *n* (%, row)			
1	6407 (94.9)	345 (5.1)	<0.001
2	6676 (94.8)	368 (5.2)	
3	6241 (93.5)	432 (6.5)	
4	5932 (91.9)	520 (8.1)	
Primary insurance provider, *n* (%, row)			
Medicare	13 813 (97.2)	400 (2.8)	<0.001
Medicaid	1991 (94.1)	125 (5.9)	
Private	8145 (89.7)	934 (10.3)	
Self-pay	664 (93.9)	43 (6.1)	
Unknown	1251 (86.1)	202 (13.9)	
Prior management, *n* (%, row)			
Treatment naïve	23 130 (94.5)	1335 (5.5)	<0.001
Prior endoscopic procedure	2734 (88.1)	369 (11.9)	
Hospital characteristics, *n* (%, row)			
Teaching hospital	3097 (74.3)	1074 (25.7)	<0.001
Non-teaching hospital	19 976 (97.1)	602 (2.9)	
Year of index procedure, *n* (%, row)*			
2009	4725 (94.2)	289 (5.8)	0.432
2010	4486 (93.8)	296 (6.2)	
2011	4856 (93.6)	330 (6.7	

*Analysis limited to overlapping years between California and Florida HCUP databases

status, zip code median income, insurance provider, and management at teaching hospitals. Irrespective of prior treatment status, older, medically comorbid, and poorer patients were significantly less likely to undergo urethroplasty. Insurance provider played a role in urethroplasty utilization among treatment-naïve patients; however, in patients with prior endoscopic management, insurance status was no longer a driver of treatment approach. This suggests that as USD management becomes more complex, there are fewer limitations to accessing urethroplasty.

A concerning notion of our data is that certain socioeconomic factors, namely insurance status and income level, influence the treatment modality for USD. Nonetheless, these socioeconomic disparities are not unique to the management of USD. In a review of 763,884 cases across a variety of malignancies, Parikh-Patel et al. [18] found that publicly insured patients had lower odds of receiving recommended cancer treatment after diagnosis. When investigating surgical approach, reports have shown a decreased utilization in minimally invasive surgical techniques for prostatectomy [19] and hysterectomy [20] among low income earners. From a reconstructive perspective, low income and publicly insured women have a lower probability of immediate breast reconstruction following mastectomy for breast cancer [21]. Reasons for these disparities are likely multifactorial; however, the primary concern among our study population is access to specialized care. Outside of urologic care, patients with lower socioeconomic status are less likely to receive

Table 3 Multivariable logistic regression of undergoing urethroplasty versus endoscopic management stratified by prior treatment status

	Treatment naïve			Prior endoscopic treatment		
	Odds ratio	95% CI	*p* value	Odds ratio	95% CI	*p* value
Age						
18–29	**2.15**	**1.72–2.69**	**< 0.001**	**2.56**	**1.44–4.54**	**0.001**
30–39	**1.81**	**1.46–2.25**	**< 0.001**	**1.87**	**1.13–3.09**	**0.014**
40–49	**1.41**	**1.16–1.71**	**0.001**	**1.72**	**1.15–2.58**	**0.008**
50–59 (Ref)	1	NA	NA	1	NA	NA
60–69	**0.57**	**0.46–0.71**	**< 0.001**	**0.78**	**0.52–1.15**	**0.21**
70–79	**0.4**	**0.30–0.53**	**< 0.001**	**0.3**	**0.18–0.51**	**< 0.001**
80–89	**0.19**	**0.13–0.29**	**< 0.001**	**0.14**	**0.07–0.28**	**< 0.001**
≥ 90	**0.18**	**0.06–0.57**	**0.004**	No Patients		
CCI						
0 (Ref)	1	NA	NA	1	NA	NA
1	0.89	0.73–1.07	0.203	0.93	0.65–1.33	0.692
2	**0.48**	**0.37–0.62**	**< 0.001**	**0.55**	**0.34–0.86**	**0.01**
3	**0.23**	**0.16–0.33**	**< 0.001**	**0.2**	**0.10–0.39**	**< 0.001**
Race						
Caucasian (Ref)	1	NA	NA	1	NA	NA
Black	0.85	0.66–1.08	0.187	0.85	0.52–1.38	0.51
Hispanic	0.92	0.77–1.11	0.415	0.97	0.66–1.43	0.885
Asian/Pacific Islander	0.95	0.64–1.42	0.801	0.33	0.09–1.15	0.082
Other	0.91	0.77–1.09	0.306	**0.61**	**0.41–0.91**	**0.014**
Zip code median household income quartile						
1 (Ref)	1	NA	NA	1	NA	NA
2	**1.21**	**1.01–1.48**	**0.047**	1.256	0.86–1.85	0.241
3	**1.25**	**0.37–0.62**	**< 0.001**	**1.59**	**1.09–2.33**	**0.016**
4	**1.71**	**1.41–2.07**	**< 0.001**	**1.58**	**1.08–2.32**	**0.02**
Primary insurance provider						
Medicare	**0.78**	**0.63–0.95**	**0.015**	1.05	0.74–1.50	0.778
Medicaid	**0.67**	**0.52–0.86**	**0.001**	0.83	0.50–1.39	0.479
Private (Ref)	1	NA	NA	1	NA	NA
Self-pay/uninsured	**0.52**	**0.35–0.77**	**0.001**	0.36	0.10–1.29	0.115
Unknown	**1.25**	**1.01–1.55**	**0.045**	1.64	0.99–2.74	0.056
Hospital characteristics						
Non-teaching (Ref)	1	NA	NA	1	NA	NA
Teaching	**10.96**	**9.64–12.45**	**< 0.001**	**7.73**	**5.95–10.03**	**< 0.001**

Bold indicates statistical significance on multivariable logistic regression

care at specialized centers for multiple surgical conditions [22]. Our study demonstrates that urethroplasty utilization was significantly higher when treatment occurred at a member hospital of the Council of Teaching Hospitals. This suggests that lack of referral to specialized centers limits access to urethroplasty.

Hispanic men were significantly less likely to be treated at specialized centers. Hispanics are the largest and fastest growing ethnic minority population in the USA and have experienced health-care disparities across a variety of metrics [23]. Historically, limited access to health services for Hispanic patients was thought to be an extension of economic conditions, as Hispanic patients are more likely to be uninsured and live below the poverty line [24]. Additionally, language and cultural barriers affect Hispanic patient access and utilization of health-care resources [25]. These barriers may result in Hispanic patients seeking care locally, with decreased presentation to tertiary care centers. Moreover, Hispanic men have an incidence of USD at 1011 per 100,000, higher than Caucasian and other minority groups [26]. This higher incidence and limited access point toward a particularly vulnerable population in which inequity of care may have more consequential outcomes.

In addition to socioeconomic factors, non-modifiable patient factors, including age and comorbidity status, impact management of USD. There was a significant

Table 4 Baseline demographic characteristics stratified by teaching and non-teaching hospital

Demographics and comorbidity status at the time of the index procedure	Non-teaching hospital $N=20\,581$	Teaching hospital $N=4173$	p value
Age (years), mean	64.0	58.0	< 0.005
Charlson Comorbidity Index, *n* (%, column)			
0	10,885 (52.9)	2496 (59.9)	< 0.005
1	3581 (17.4)	626 (15.0)	
2	2749 (13.4)	503 (12.1)	
≥ 3	3365 (16.4)	548 (13.1)	
Race, *n* (%, column)			
Caucasian	12,178 (59.2)	2332 (55.9)	< 0.005
Black	1572 (7.6)	487 (11.7)	
Hispanic	3515 (17.1)	602 (14.4)	
Asian/Pacific Islander	731 (3.6)	112 (2.7)	
Other	2585 (12.6)	640 (15.3)	
Zip code median household income quartile, *n* (%, column)			
1	5226 (25.4)	1117 (26.8)	< 0.005
2	5497 (26.7)	883 (21.2)	
3	5088 (24.7)	1113 (26.7)	
4	4771 (23.2)	1060 (25.4)	
Primary insurance provider, *n* (%, column)			
Medicare	11 161 (54.2)	1737 (41.6)	< 0.005
Medicaid	1496 (7.3)	378 (9.1)	
Private	6436 (31.3)	1587 (38.1)	
Self-Pay	552 (2.7)	123 (3.0)	
Unknown	936 (4.6)	348 (8.3)	
Prior management, *n* (%, column)			
Treatment naïve	18 371 (89.3)	3523 (84.4)	< 0.001
Prior endoscopic procedure	2210 (10.7)	650 (15.6)	

correlation between decade of life, likelihood of undergoing urethroplasty and receiving care at a teaching hospital. Older patients were less likely to undergo urethroplasty and less likely to seek care at teaching hospitals compared to younger patients. This suggests that a barrier to urethroplasty, for older patients, is referral to specialized centers. This finding may be related to patient decision making, as older patients may prefer temporizing measures, in lieu of more invasive procedures. Providers have cited concerns regarding complications as a limitation to referral for urethroplasty [7]. However, it has become increasingly clear that age alone should not limit use of urethroplasty. In a recent study, the Trauma and Urologic Reconstructive Network of Surgeons showed no difference in functional and anatomic success rates between men age ≥ 60 compared to men < 60 at the 1-year follow-up [27]. Similarly, Viers and colleagues reported on their success rate in older men undergoing urethroplasty. In their cohort of 450 men without prior radiation exposure, success rates for men ≥ 60 were similar to younger men at the 5-year follow-up [28]. Overall, urethroplasty is a safe and efficacious procedure for older patients; therefore, age alone should not be a contraindication to urethroplasty nor limit referral to a reconstructive urologist.

Though not a limitation of referral to a teaching hospital, increased CCI was associated with decreased utilization of urethroplasty. This likely stems from a concern regarding increased complication rates among the medically comorbid. Recent reports have shown increased odds of urethroplasty complications in older, medically comorbid and African American patients [15]. Moreover, higher CCI has been independently associated with urethroplasty failure [29]. The proposed mechanisms of this failure result from many of these comorbidities (diabetes, coronary artery disease, chronic obstructive pulmonary disease, hypertension) resulting in underlying peripheral vascular disease, which limits oxygenation of repaired tissue [28]. These concerns should be sufficiently communicated to the patient. Though patient selection remains a priority for the surgeon, the option of urethroplasty should be an option offered to comorbid men. Efforts should be made to optimize these medical comorbidities prior to surgical intervention.

Our study is not without limitations. Foremost, this is a retrospective review of a large database; as such, the

Table 5 Multivariable logistic regression of urethral stricture disease management at a teaching hospital versus non-teaching hospital

	Odds ratio	95% CI	*p* value
Age			
18–29	**1.64**	**1.40–1.91**	**<0.001**
30–39	**1.23**	**1.06–1.43**	**0.005**
40–49	**1.23**	**1.09–1.39**	**0.001**
50–59 (Ref)	1	NA	NA
60–69	0.94	0.84–1.06	0.333
70–79	**0.74**	**0.65–0.85**	**<0.001**
80–89	**0.57**	**0.49–0.66**	**<0.001**
≥90	**0.39**	**0.28–0.55**	**<0.001**
CCI			
0 (Ref)	1	NA	NA
1	0.91	0.82–1.00	0.066
2	0.97	0.87–1.09	0.634
3	0.92	0.82–1.03	0.131
Race			
Caucasian (Ref)	1	NA	NA
Black	**1.52**	**1.35–1.71**	**<0.001**
Hispanic	**0.84**	**0.76–0.93**	**0.001**
Asian/Pacific Islander	0.85	0.69–1.05	0.124
Other	1.05	0.94–1.16	0.399
Zip code median household income quartile			
1 (Ref)	1	NA	NA
2	**0.78**	**0.71–0.87**	**<0.001**
3	1.07	0.97–1.18	0.171
4	1.07	0.97–1.19	0.176
Primary insurance provider			
Medicare	0.93	0.84–1.03	0.162
Medicaid	1.06	0.93–1.12	0.376
Private (Ref)	1	NA	1
Self-pay/uninsured	0.89	0.72–1.11	0.305
Unknown	**1.53**	**1.33–1.77**	**<0.001**
Prior management			
Treatment naïve (Ref)	1	NA	NA
Prior endoscopic	**1.62**	**1.47–1.78**	**<0.001**

Bold indicates statistical significance on multivariable logistic regression

accuracy of the analysis is only as reliable as the dataset itself. The HCUP database is reliant on accurate billing and coding from inpatient and outpatient encounters. This concern mainly factors into identifying the appropriate patient population. The use of ICD-9 and CPT coding to identify patients with urethral stricture disease assumes all patients in the population were accurately identified using these metrics. Patients incorrectly coded would not be identified for analysis. Furthermore, patients with multiple responses are classified as "other" or "unknown", as in the racial and insurance provider categories above. This may underestimate the true occurence of individuals in overlapping categories. Patient median income is based on zip code medians and may not be a true reflection of patient economic status. Additional metrics such as distance to a specialized center and rural–urban continuum codes were not available for this dataset, limiting analysis. Additionally, our analysis is limited by a lack of clinical information regarding stricture characteristics, etiology, and location. The rationale for a particular treatment option cannot be explained with the dataset alone. USD is a heterogeneous condition and other similar conditions (bladder neck contracture, vesicourethral anastomotic strictures) are often miscoded as urethral strictures. Efforts were made to eliminate this overlap by excluding patients with a history of prior invasive procedures (prostatectomy, cystectomy, and concomitant fistula repair). Our study assumes that patients received all of their care within the states of California and Florida between the years of 2007 and 2014. We are unable to control for patients that received care outside our region or dates of interest. This mainly would result in overestimation of upfront urethroplasty, as patients may have received prior endoscopic management outside of the frame of interest. Lastly, given the limitation of the dataset to California and Florida, this data may not reflect on the USA as a whole, nor a more global population.

Conclusion

The management of USD is influenced by both socioeconomic and non-modifiable patient factors. Though the utilization of urethroplasty appears to be on the rise, patients undergoing urethroplasty tend to be younger, less comorbid, privately insured, and wealthier. Moreover, patients seeking care at specialized centers are more likely to undergo urethroplasty than those treated at community hospitals. Older and Hispanic patients are less likely to seek care at these specialized centers, suggesting diminished access to a reconstructive urologist, and thus urethroplasty. It is incumbent upon urologists to identify patients at risk of suboptimal care and work to reduce disparities to ensure appropriate management of USD.

Author contributions RA Dornbier: project development, data collection and analysis, manuscript writing. EJ Kirshenbaum: project development, data collection and analysis, manuscript editing. MH Nelson: data collection and analysis. RH Blackwell: project development, manuscript editing. GN Gupta: data analysis, manuscript editing. AV Farooq: project development, data analysis, manuscript editing. CM Gonzalez: data analysis, manuscript editing

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Compliance with ethical standards

Conflict of interest CM Gonzalez: fellowship support from Boston Scientific and Coloplast. AV Farooq: fellowship support from Boston Scientific and Coloplast. All other authors declare that they have no conflicts of interest.

Statement of human rights For this type of study formal consent is not required. This study was institutional review board exempt given the low risk of patient identification using a large, de-identified database. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee nd with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was not obtained for this study, given its retrospective nature and use of a large, de-identified database. The risk of patient identification was low.

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