

UCSF

UC San Francisco Previously Published Works

Title

Trends, Utilization, and Immediate Perioperative Complications of Urethroplasty in the United States: Data From the National Inpatient Sample 2000-2010

Permalink

<https://escholarship.org/uc/item/7dm6z7k7>

Journal

Urology, 85(5)

ISSN

0090-4295

Authors

Blaschko, Sarah D

Harris, Catherine R

Zaid, Uwais B

et al.

Publication Date

2015-05-01

DOI

10.1016/j.jurology.2015.01.008

Peer reviewed

Trends, Utilization, and Immediate Perioperative Complications of Urethroplasty in the United States: Data From the National Inpatient Sample 2000-2010

Sarah D. Blaschko, Catherine R. Harris, Uwais B. Zaid, Tom Gaither, Carissa Chu, Amjad Alwaal, Jack W. McAninch, Charles E. McCulloch, and Benjamin N. Breyer

OBJECTIVE	To determine national urethroplasty trends based on type of surgery and patient and hospital characteristics. We hypothesized that the number of complex urethroplasty procedures performed has increased over time and may be associated with increased periprocedure complications.
METHODS	The National Inpatient Sample from years 2000 to 2010 was queried for patients with urethroplasty-associated <i>International Classification of Diseases, Ninth Revision, Clinical Modification</i> codes. We analyzed trends in urethroplasty procedures, patient demographics, comorbidities, and hospital characteristics. We evaluated the relationship between patient demographics and comorbid disease, length of hospital stay, hospital charges, and inpatient complications.
RESULTS	During the study period, an estimated 13,700 men (95% confidence interval, 9507-17,894) underwent urethroplasty nationally. Excision with primary anastomosis, buccal graft, and other graft or flap urethroplasty comprised 80.3%, 14.3%, and 5.4%, respectively. Buccal mucosa graft procedures increased over time ($P = .03$). Only 1.6% of hospitals have ≥ 20 urethroplasties performed annually. Urethroplasty type and urethroplasty volume were not associated with immediate complication rates. Hypertension, diabetes, chronic pulmonary disease, and obesity were the most common comorbidities in urethroplasty patients. Complications during urethroplasty hospitalization occurred in 6.6% of men, with surgical or wound complications being the most common (5.2%). Postoperative mortality was exceedingly rare. Older patients, African Americans, and patients with increased comorbidities were more likely to have complications.
CONCLUSION	An increasing number of buccal mucosa graft urethroplasties occurred over time. Urethroplasty patients have low immediate perioperative morbidity (6.6%) and mortality (0.07%). Patients who are older, African American, or have more comorbid conditions have greater risk for complications. UROLOGY 85: 1190–1194, 2015. © 2015 Elsevier Inc.

Urethral stricture disease can cause men to experience a host of problems including lower urinary tract symptoms, pain, and ejaculatory and bladder dysfunction.¹⁻³ Urethral stricture disease is common and accounted for an estimated 1.2 million office

visits in the United States between 2002 and 2007.^{1,4} Urethroplasty remains the gold standard treatment for urethral strictures. Because most published outcomes on urethroplasty is derived from individual surgeon case series,^{2,5-12} there is a lack of national level data reporting trends in the type of urethroplasty performed, patient and hospital characteristics, and perioperative outcomes and complications of urethroplasty.¹³

A recent review of >1200 cases spanning 3 decades showed that excision primary anastomosis (EPA) urethroplasty is associated with success rates of >90% and complication rates of <5%.¹⁴ EPA procedures are typically performed for short strictures, whereas longer and more complex strictures require graft techniques. Although surgical experience with graft procedures has

Financial Disclosure: Benjamin N. Breyer was supported by K12DK083021, California Urologic Foundation, Clinical and Translational Science Institute grant #UL1 TR000004. The remaining authors declare that they have no relevant financial interests.

From the Department of Urology, University of California, San Francisco, San Francisco, CA; and the Department of Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, CA

Address correspondence to: Benjamin N. Breyer, M.D., M.A.S., Department of Urology, University of California, San Francisco, San Francisco General Hospital, 1001 Potrero Avenue, Suite 3A20, San Francisco, CA 94117. E-mail: bbreyer@urology.ucsf.edu

Submitted: November 4, 2014, accepted (with revisions): January 9, 2015

increased with success rates reported at >77%,^{15,16} graft procedures may be associated with higher rates of post-operative complications, possibly due to increased stricture length and the need for graft harvesting.¹⁷

Our objective was to determine national trends of types of urethroplasties performed and to examine patient and hospital factors affecting perioperative morbidity and mortality using the National Inpatient Sample (NIS). NIS is the largest data set for all-payer inpatient care. We hypothesized that the number of more complex urethroplasties, which we define as using buccal mucosa and other graft or flap urethroplasty procedures, had increased over time and that EPA procedures would have fewer immediate complications than buccal mucosa or other graft or flap urethroplasty procedures.

METHODS

Data Source

We queried the NIS to obtain data on urethroplasty procedures between 2000 and 2010. Approximately 1000 hospitals from 37 states and 8 million inpatient hospital admissions per year are included in this data set, which is designed as an approximate 20% sample of hospital admissions in the United States.¹⁸

Inclusion Criteria

All male patients from 2000 to 2010 were included for evaluation, if they had both an *International Classification of Diseases, Ninth Revision* (ICD-9), code of urethral stricture disease and an ICD-9 procedural code indicating that a urethroplasty was performed. ICD-9 diagnosis codes for urethral stricture were 598, 598.0, 598.01, 598.1, 598.2, 598.8, and 598.9. ICD-9 procedural codes for urethroplasty included 58.4 (repair of urethra), 58.42 (closure of urethrostomy), 58.44 (reanastomosis of urethra), 58.45 (repair of hypospadias), 58.46 (reconstruction of urethra), 58.47 (urethral meatoplasty), and 58.49 (other repair of urethra). Two urologists (S.D.B. and B.N.B.) evaluated lists for each year to ensure patients included for analysis actually had urethroplasty surgery performed and not a different urethral procedure, such as urethral dilation. We excluded urethral fistula patients and those with an additional major surgical procedure such as cystectomy for which urethral reconstruction was sometimes also coded.

We categorized patients based on type of urethroplasty performed: those with buccal mucosa graft urethroplasties, patients with other graft or flap urethroplasties, and patients with no procedural codes for grafts or flaps. ICD-9 procedural codes for buccal mucosa graft harvest included 27.49, 27.99, and 27.56. ICD-9 procedural codes for all other types of grafts and flaps were 83.43, 83.82, 86.63, 86.66, 86.69, 86.70, 86.71, 86.72, 86.74, and 86.91. The patients without any procedural code for a graft or flap were categorized as EPA procedures.

Patient and Hospital Characteristics

We evaluated patient age (18-44, 45-64, and ≥65 years), race (Caucasian, African American, or other), number of comorbidities (0, 1, 2, or ≥3; as defined by NIS and listed in Table 2), hospital size (previously validated NIS classification of small, medium, or large³), and urethroplasty volume per year (1, 2-9, or ≥10). We examined length of hospital stay, hospital charges,

the year the urethroplasty was performed, and type of urethroplasty procedure.

Outcome Variables

Primary outcome variables were complications and mortality. The ICD-9 codes included for abstraction of complications from the NIS data set were categorized as neurologic, cardiovascular, respiratory, gastrointestinal, genitourinary, musculoskeletal, surgical, wound, or medical (Supplementary Table 1).¹⁹

Statistical Analysis

Data analysis was performed using SAS (version 9.2; SAS Institute Inc, Cary, NC). All analyses accounted for the complex survey design and the sampling weights of the NIS. We performed statistical tests for trend with year for total number of urethroplasties performed and for each subtype. We examined the association of demographic factors and urethroplasty type with complication rates using a chi-square test. We performed univariate analysis to measure the association between specific comorbid conditions and complication types. We also fit a multivariate model with the outcome of complication (yes or no) with predictors of age, race, hospital case volume, number of comorbidity, and urethroplasty type.

RESULTS

National Urethroplasty Trends

In the United States, an estimated total of 13,700 (95% confidence interval [CI], 9507-17,894) urethroplasty procedures were performed from 2000 to 2010. Between 800 and >2000 patients underwent urethroplasty each year, with more urethroplasties performed from 2007 through 2010. The estimated percentage of patients who underwent buccal mucosa graft urethroplasty procedures increased significantly over the study period, from 7.9% to 21.6% of total urethroplasties ($P = .03$). There was also a trend toward increasing use of buccal mucosa graft compared with EPA urethroplasties each year from 2000 to 2010 with an odds ratio (OR) of 1.10 (95% CI, 1.01-1.20). Use of a graft or flap other than buccal mucosa ranged from 1.7% to 7.7% between the years 2000 and 2010, with no statistically significant trend in use (Fig. 1).

Patient characteristics of age, race, comorbidity index, hospital size, and urethroplasty volume per year are presented in Table 1 along with complication rates. In the sample, 31.7% of hospitals had no urethroplasty procedures performed annually. An estimated 12% of hospitals had only 1 urethroplasty performed annually. An average of ≤8 urethroplasties are performed annually in 95.8% of hospitals. Only 1.6% of hospitals have ≥20 urethroplasties performed annually.

Patient Comorbidity

The most common comorbidity in urethroplasty patients was hypertension, diagnosed in over one-quarter of patients. Diabetes, chronic lung disease, and obesity were the next most common comorbidities occurring in 9.4%, 6.8%, and 6.7% of patients, respectively.

Weighted Number of Urethroplasty Procedures for Each Year

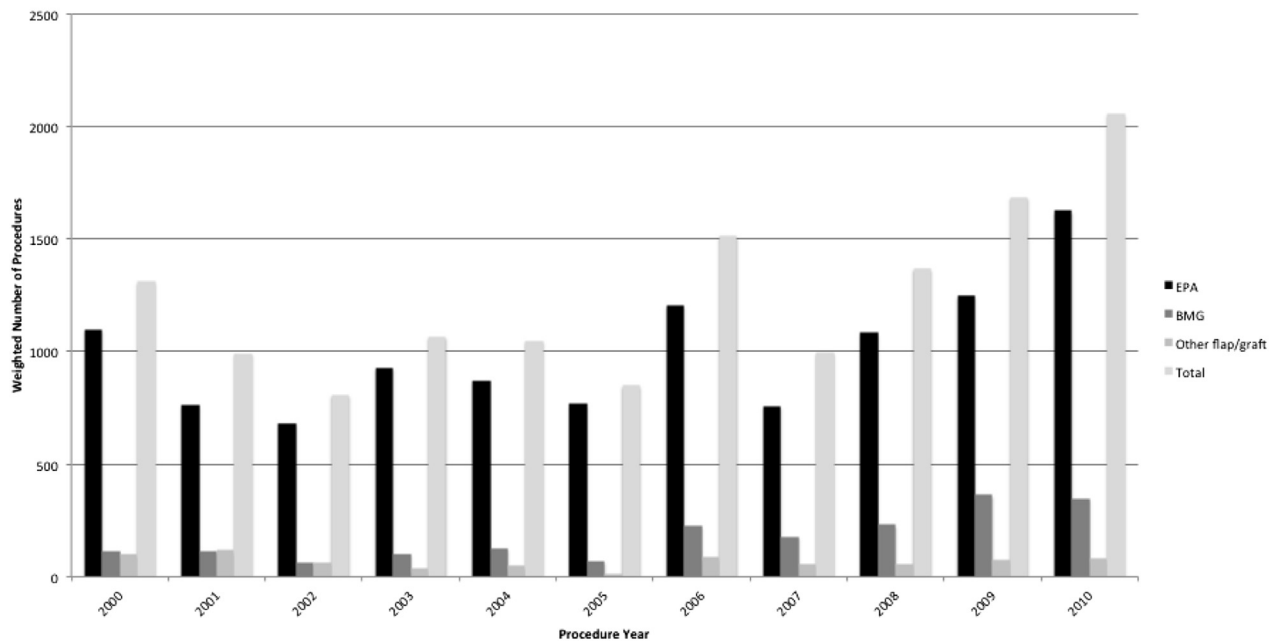


Figure 1. Number of urethroplasty procedures per year from 2000 to 2010, categorized as excision primary anastomosis, buccal mucosa graft, or other flap or graft ($P = .03$). BMG, buccal mucosa graft; EPA, excision primary anastomosis.

Table 1. Patient and hospital characteristics and complication rates

Characteristic	Category	Number of Patients (%)	Complication Rate (%)	P Value
Age (y)	18-45	6757 (49)	3.9	<.0001
	45-64	5083 (37)	8.3	
	≥65	1860 (14)	11.6	
Race	White	7411 (70)	5.8	.013
	Black	1546 (15)	9.5	
	Other	1590 (15)	8.4	
Comorbidity index	0	8096 (59)	4.8	<.0001
	1	3378 (25)	8.6	
	2	1640 (12)	8.1	
	≥3	586 (4)	15.1	
Hospital size	Small	591 (4)	9.4	.29
	Medium	1816 (13)	6.8	
	Large	11,161 (82)	6.5	
Volume (urethroplasty cases/y)	1:1	3120 (23)	7.8	.17
	2-9	4546 (33)	5.5	
	≥10	6034 (44)	6.7	

Perioperative Complications

The overall complication rate for urethroplasty procedures from 2000 to 2010 was 6.6%, with complication rates ranging from 4.6% to 10% per year. Genitourinary complications were the most common and accounted for 2.8% of all complications, with urinary tract surgical complications and complication of a genitourinary device or graft being the most common complications. Surgical and wound complications were the next most common and accounted for 1.2% and 1.1% of complications, respectively. Urethral fistula and accidental operative laceration were the most common surgical complications. Hemorrhage, hematoma, and post-operative infection were the most common wound complications. Musculoskeletal complications were

entirely composed of rhabdomyolysis and were least common at 0.11% of complications. There was no difference in specific type of urethroplasty complications based on type of urethroplasty.

The percentage of patients with a complication increased with age. Men aged >65 years had an 11.6% complication rate compared with a 3.9% complication rate in men aged 18-45 years ($P < .0001$). African American men were more likely than Caucasian men to have a complication with 9.5% and 5.8% complication rates, respectively ($P = .013$). Smaller hospitals and hospitals that performed fewer urethroplasty procedures each year had a trend of increased likelihood of complications compared with larger and higher urethroplasty volume hospitals, but this was not statistically significant.

Table 2. Multivariate analysis* of risk factors for any complication

Risk Factor	OR (95% CI)
Age (10-year increase)	1.24 (1.11-1.39)
Race	
Caucasian	1.00 (ref)
African American	1.73 (1.04-2.89)
Other	1.64 (0.99-2.73)
Volume (cases/y)	
1	1.00 (ref)
2-9	0.82 (0.52-1.30)
≥10	0.81 (0.51-1.32)
Comorbidities (number)	
0	1.00 (ref)
1	1.59 (1.07-2.34)
2	1.28 (0.78-2.09)
≥3	2.31 (1.16-4.60)
Type of urethroplasty	
EPA	1.00 (ref)
Buccal mucosa	1.07 (0.68-1.67)
Other graft/flap	0.89 (0.31-2.56)

CI, confidence interval; EPA, excision primary anastomosis; OR, odds ratio; ref, reference.

* Adjusted for age, race, hospital case volume, number of comorbidity, and urethroplasty type.

There was no difference in complication rates based on urethroplasty type. There was no statistically significant complication rate trend for urethroplasty procedures from 2000 to 2010.

Patients with ≥3 comorbidities had an almost 2- to 4-fold increase in complication rate compared with men with 0-2 comorbid conditions ($P \leq .0001$). Certain comorbid conditions were associated with specific categories of complications. In univariate analysis, genitourinary complications were associated with chronic hypertension (OR, 2.58; 95% CI, 1.60-4.15), diabetes (OR, 2.30; 95% CI, 1.33-3.99), and diabetes with chronic complications (OR, 8.16; 95% CI, 2.79-23.82). Wound complications were associated with liver disease (OR, 5.82; 95% CI, 1.33-25.45). Surgical complications were not statistically significantly associated with any comorbidities.

In multivariate analysis, African American race and comorbidities were associated with increased odds of having a complication (Table 2). There was a statistically significant trend for increasing number of comorbidities being associated with increased complications (OR, 1.24; CI, 1.03-1.50).

As the number of urethroplasty complications increased, the mean length of stay ($P \leq .0001$) and mean total charges ($P = .001$) increased. Mean total hospital charges were >3-fold higher for patients with ≥3 complications compared with those with no complications (Table 3). Increased urethroplasty volume was not associated with a decrease in complications, decreased length of hospital stay, or decreased hospital charges.

COMMENT

This analysis presents a unique look at urethroplasty complications across the United States in a variety of

Table 3. Urethroplasty length of stay and cost stratified by patient complication number

Number of Complications	Mean Length of Stay; $P < .0001$ (d)	Mean Hospitalization Cost; $P = .001$ (\$)
0	2.49	24,853
1	3.91	31,058
2	7.64	35,854
≥3	7.83	77,059

hospital settings. This study also allows for analysis of comorbid conditions and their relation to urethroplasty complications, which has been discussed sparingly in prior analysis of urethroplasty outcomes case series.² From 2000 to 2010, urethroplasty procedures in the United States increased over time with an increasing number of buccal mucosa graft compared with EPA urethroplasties, confirming our hypothesis. Because almost 96% of hospitals had ≤8 urethroplasty procedures performed annually, the increased complexity of urethroplasties may reflect an increase in fellowship-trained reconstructive urologists over time. Comparing the few high-volume urethroplasty centers with lower volume hospitals in the NIS data set, no difference was demonstrated in the number of immediate complications during hospitalization. Increasing number of comorbidities was associated with an increased risk of immediate complications after urethroplasty. Additionally, we demonstrated that specific comorbidities were associated with specific complications. For example, patients with liver disease had an almost 6-fold increase in immediate wound complications.

The NIS data set demonstrated a 6.6% complication rate during hospitalization for urethroplasty procedures. This rate compares to a <5% complication rate in a meta-analysis of primary anastomosis urethroplasty procedures and complication rates ranging from 3.1% to 40% in several case series of multiple urethroplasty techniques.^{8,14,20} The wide range of complication rates in retrospective studies is attributed to variance in what is included as a complication. Minor complications are not uniformly recorded and reported. For example, scrotal swelling and spraying of urine are reported in some studies but not in others.^{8,14,20-22} Most of the complications in retrospective studies were minor and include urinary tract infections, local wound infection, hematoma, and orchialgia. Major complications previously reported include rectal injury, urosepsis, and fistula.^{8,20-22} NIS will under capture overall complication rates because the data contain no events that occur after discharge.

Although intuitive, patients with increased comorbidities should be counseled regarding their modestly increased risk of complications during their hospitalization. Conversely, patients with no comorbid conditions may be counseled they are likely to have a lower complication rate.

We found similar immediate inpatient complication rates in hospitals of different sizes and urethroplasty

volume. We initially anticipated lower complication rates in higher volume centers, reflecting improved outcomes in high-volume centers of excellence. Although it is possible that complication rates are equivalent when controlled for patient risk factors, it is more likely that there is referral of more complex urethroplasty cases to higher volume tertiary care centers, which may increase the complication rates at these centers.

Study limitations should be considered. Urethroplasty procedure type, complexity, and stricture length are not accounted for with ICD-9 coding, and long-term stricture complications and failures are not accounted for in the NIS data set. The study only assessed inpatient complications during the initial perioperative hospital admission, and patients who were readmitted with complications were not included. Most patients with urethroplasties performed in inpatient centers were included in analysis even if they were discharged the same day. However, patients with urethroplasties performed in outpatient surgical centers and some 23-hour stay patients might not be included based on coding differences across hospitals, and therefore this population of patients is not represented.²³ Analysis of complications is limited by medical documentation and ICD-9 coding with categories like “surgical complication—urinary tract” (ICD-9 code 997.5) without providing detailed information.

CONCLUSION

An increasing number of buccal mucosa graft urethroplasties occurred over time. Urethroplasty patients have low perioperative morbidity (6.6%) and mortality (0.07%). Patients who are older, African American, or have more comorbid conditions have greater risk for complications. These data can be used to counsel urethroplasty patients regarding perioperative risk.

References

1. Santucci RA, Joyce GF, Wise M. Male urethral stricture disease. *J Urol*. 2007;177:1667-1674.
2. Breyer BN, McAninch JW, Whitson JM, et al. Multivariate analysis of risk factors for long-term urethroplasty outcome. *J Urol*. 2010;183:613-617.
3. Lubahn JD, Zhao LC, Scott JF, et al. Poor quality of life in patients with urethral stricture treated with intermittent self-dilation. *J Urol*. 2014;191:143-147.
4. Litwin MS and Saigal CS, eds. *Urologic Diseases in America*. Washington, D.C.: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Q6 Digestive and Kidney Diseases, 2007.
5. Cooperberg MR, McAninch JW, Alsikafi NF, Elliott SP. Urethral reconstruction for traumatic posterior urethral disruption: outcomes of a 25-year experience. *J Urol*. 2007;178:2006-2010; discussion 2010.
6. Elliott DS, Barrett DM. Long-term followup and evaluation of primary realignment of posterior urethral disruptions. *J Urol*. 1997;157:814-816.

7. Barbagli G, De Angelis M, Romano G, Lazzeri M. Long-term followup of bulbar end-to-end anastomosis: a retrospective analysis of 153 patients in a single center experience. *J Urol*. 2007;178:2470-2473.
8. Andrich DE, Dunglison N, Greenwell TJ, Mundy AR. The long-term results of urethroplasty. *J Urol*. 2003;170:90-92.
9. Das SK, Kumar A, Sharma GK, et al. Lingual mucosal graft urethroplasty for anterior urethral strictures. *J Urol*. 2009;173:105-108.
10. Lumen N, Hoebeke P, Troyer BD, et al. Perineal anastomotic urethroplasty for posttraumatic urethral stricture with or without previous urethral manipulations: a review of 61 cases with long-term followup. *J Urol*. 2009;181:1196-1200.
11. Koraitim MM. The lessons of 145 posttraumatic posterior urethral strictures treated in 17 years. *J Urol*. 1995;153:63-66.
12. Navai N, Erickson BA, Zhao LC, et al. Complications following urethral reconstructive surgery: a six year experience. *Int Braz J Urol*. 2008;34:594-600; discussion 601.
13. Wong S, Aboumarzouk OM, Narahari R. Blind stretching or telescopic cutting versus open surgery for urethral narrowing in men. *Cochrane Summ*, <http://summaries.cochrane.org/CD006934/blind-stretching-or-telescopic-cutting-versus-open-surgery-for-urethral-narrowing-in-men>, 2012.
14. Morey AF, Watkin N, Shenfeld O, et al. Anterior urethra—primary anastomosis. *Urology*. 2014;83(3 suppl):S23-S26.
15. Gelman J, Siegel JA. Ventral and dorsal buccal grafting for 1-stage repair of complex anterior urethral strictures. *Urology*. 2014;83:1418-1422.
16. Wang K, Miao X, Wang L, Li H. Dorsal onlay versus ventral onlay urethroplasty for anterior urethral stricture: a meta-analysis. *Urol Int*. 2009;83:342-348.
17. Terlecki RP, Steele MC, Valadez C, Morey AF. Grafts are unnecessary for proximal bulbar reconstruction. *J Urol*. 2010;184:2395-2399.
18. Houchens R, Elixhauser A. *Final Report on Calculating Nationwide Inpatient Sample (NIS) Variances, 2001*. HCUP Methods Series Report #2003-2. Agency for Healthcare Research and Quality; June 2005, <http://www.hcup-us.ahrq.gov/reports/CalculatingNISVariances200106092005.pdf>, June 2005.
19. Sharma M, Sonig A, Ambekar S, Nanda A. Discharge dispositions, complications, and costs of hospitalization in spinal cord tumor surgery: analysis of data from the United States Nationwide Inpatient Sample, 2003-2010. *J Neurosurg Spine*. 2014;20:125-141.
20. O'Riordan A, Narahari R, Kumar V, Pickard R. Outcome of dorsal buccal graft urethroplasty for recurrent bulbar urethral strictures. *BJU Int*. 2008;102:1148-1151.
21. Hoy NY, Kinnaird A, Rourke KF. Expanded use of a dorsal onlay augmented anastomotic urethroplasty with buccal mucosa for long segment bulbar urethral strictures: analysis of outcomes and complications. *Urology*. 2013;81:1357-1361.
22. Al-Qudah HS, Santucci RA. Extended complications of urethroplasty. *Int Braz J Urol*. 2005;31:315-323; discussion 324-325.
23. HCUP Nationwide Inpatient Sample (NIS). *Healthcare Cost and Utilization Project (HCUP)*. Rockville, MD: Agency for Healthcare Research and Quality; 2011, www.hcup-us.ahrq.gov/nisoverview.jsp, 2011.

APPENDIX

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.urology.2015.01.008>.