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# Male Urethral Stricture Disease

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**Purpose:** The incidence of urethral stricture disease in the United States is unknown. We estimated the impact of urethral stricture disease by determining its prevalence, costs and other measures of burden, including side effects and the need for surgical intervention.

**Materials and Methods:** Analyses of services for urethral stricture disease were performed in 10 public and private data sets by epidemiological, biostatistical and clinical experts.

**Results:** Male urethral stricture disease occurred at a rate as high as 0.6% in some susceptible populations and resulted in more than 5,000 inpatient visits yearly. Yearly office visits for urethral stricture numbered almost 1.5 million between 1992 and 2000. The total cost of urethral stricture diseases in 2000 was almost \$200 million, not including medication costs. A diagnosis of urethral stricture increased health care expenditures by more than \$6,000 per individual yearly in insured populations after controlling for comorbidities. Urethral stricture disease appeared to be more common in the elderly population and in black patients, as measured by health care use. In most data sets services provided for urethral stricture disease decreased with time. Patients with urethral stricture disease appeared to have a high rate of urinary tract infection (41%) and incontinence (11%).

**Conclusions:** Despite decreasing rates of urethral strictures with time the burden of urethral stricture disease is still significant, resulting in hundreds of millions of dollars spent and hundreds of thousands of caregiver visits yearly.

*Key Words:* urethra, urethral stricture, epidemiology, demography, health care costs

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The incidence of male urethral stricture disease is unknown, although urethral strictures have the potential for great negative impact on patients. The majority of patients with stricture experience moderate complications, such as bother from lower urinary tract voiding symptoms, recurrent urinary tract infection and the need for repeat urethral procedures such as dilation or urethrotomy.<sup>1,2</sup> A minority experience severe sequelae, such as acute urinary retention, renal failure, urethral carcinoma, Fournier's gangrene<sup>3</sup> and bladder failure from long-standing obstruction.<sup>2</sup>

In addition to the burden caused by the disease, sometimes therapy for strictures can be associated with complications that further add to the burden of disease. For example, urethrotomy can be associated with complications such as bleeding in 4% to 6% of cases, infection in 8% to 9%, incontinence in 1% and impotence in 1% with up to a 100% failure rate after repeat use.<sup>4,5</sup> Until they are definitively treated with urethroplasty strictures tend to recur after urethrotomy or dilation,<sup>6-8</sup> further adding to the impact of disease on patients. Even after definitive urethroplasty urethral strictures can cause problems for the patient. Rates of surgical complications range from 7% for anastomotic urethroplasty to 33% for fasciocutaneous urethroplasty after

open urethral surgery.<sup>9</sup> One study showed that the rate of erectile dysfunction after anastomotic urethroplasty could be as high as 27%.<sup>10</sup>

Despite emerging understanding of the individual burden of urethral stricture on each patient little is known about the burden of the disease on society as a whole. The Urologic Diseases in America Project has endeavored to understand the burden of urological disease on Americans in the largest analysis of urological epidemiology ever performed.<sup>11</sup> We used 10 sets of public and private health care databases to examine disease rates, treatments and costs of male urethral stricture disease in America.

## MATERIALS AND METHODS

The analytical methods used to generate these results were described previously.<sup>12</sup>

## RESULTS

### Incidence

**Overall.** Data from the Veteran's Hospital database showed that the raw rate of urethral stricture diagnosis was 274/100,000 VA patients (95% CI 268-279) for 1998, which decreased to 193/100,000 by 2003. This number increased to 627/100,000 patients (95% CI 618-636) among VA patients who were also Medicare patients and, thus, were usually older than 65 years for 1999. The rate of stricture diseases climbed sharply after age 55 years (see figure).

**Inpatient.** The HCUP data set showed that the rate of hospitalizations for urethral stricture was 3.8/100,000 pop-

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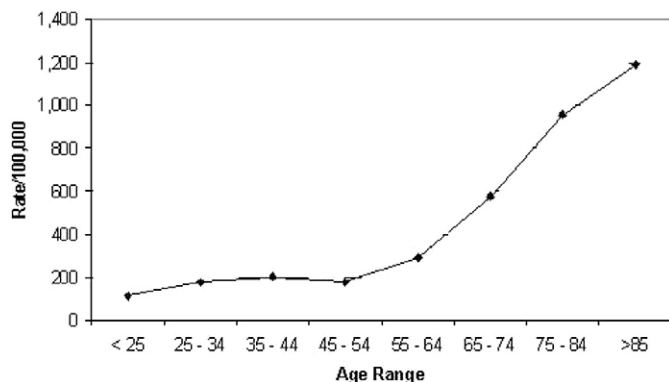


FIG 1. Age adjusted rate in male dual VA Medicare users with diagnosis of urethral stricture in 2002. Source: Inpatient and Outpatient Files, VA Information Resource Center, and Carrier and Outpatient and Medicare Provider Analysis and Review, Centers for Medicare and Medicaid Services.

ulation in 2000 (table 1). This had trended downward since 1994 from a rate of 5.7/100,000 population (a 50% decrease). This rate was considerably lower than that of other urological diseases, such as urolithiasis (71/100,000 population).<sup>13</sup> The incidence of stricture tended to peak at age 55 years and it appeared higher in urban and black patients.

Data from the Centers for Medicare and Medicaid Services showed a higher incidence of hospitalization for stricture disease at 9.0/100,000 population for 2001 (table 2). As in the HCUP database, a higher incidence of stricture diseases in older patients was confirmed, almost doubling from 5.8/100,000 to 9.0/100,000 in populations older than 65 years. The downward trend in incidence with time seen in

HCUP was confirmed with a 3-fold decrease from 1992 to 2001.

**Outpatient hospital visits.** Outpatient visits for Medicare patients (who, it should be noted, are usually older than 65 years) was 21/100,000 in 2001 (table 3). This rate was about half that of visits for urolithiasis.<sup>13</sup>

**Office visits.** Physician office visits for males with urethral stricture disease was determined by the National Ambulatory Medical Care Survey using pooled data from 1992 to 2000. The annualized adjusted rate was 229/100,000 population (table 4), which was actually far lower than that seen for urolithiasis.<sup>13</sup> Physician office visits by male Medicare beneficiaries, who tended to be older than the general population, was 312/100,000 for 2001 (95% CI 299-324).

**Emergency room visits.** Emergency room visits by male Medicare beneficiaries with urethral strictures occurred at a rate of 6.9/100,000 in 2001.

**Ambulatory surgery center visits.** As determined by the National Survey of Ambulatory Surgery, the annualized rate of ambulatory surgery center visits pooled from 1994 to 1996 was 60/100,000. There was a bimodal distribution in incidence with the first peak below age 10 years and the second peak steadily increasing in patients from age 35 years on (table 5).

**Procedures**

**Retrograde urethrogram.** The number of retrograde urethrograms performed in patients with a diagnosis of ure-

TABLE 1. Inpatient hospital stays for males with urethral stricture listed as primary diagnosis

|                 | 1994  |               |                   | 1996  |               |                   | 1998  |               |                   | 2000  |               |                   |
|-----------------|-------|---------------|-------------------|-------|---------------|-------------------|-------|---------------|-------------------|-------|---------------|-------------------|
|                 | Count | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate |
| Totals:         | 7,004 | 5.7 (5.4-6.3) | 5.7               | 5,235 | 4.1 (3.7-4.5) | 4.1               | 4,932 | 3.8 (3.4-4.1) | 3.8               | 5,035 | 3.8 (3.1-4.4) | 3.8               |
| Age:            |       |               |                   |       |               |                   |       |               |                   |       |               |                   |
| Younger than 18 | 408   | 1.2 (0.7-1.7) |                   | 227   | 0.6 (0.3-0.9) |                   | 239   | 0.6 (0.4-0.9) |                   | 145   | 0.4 (0.2-0.6) |                   |
| 18-24           | 241   | 2.0 (1.4-2.5) |                   | 171   | 1.4 (0.8-2.0) |                   | *     | *             |                   | 218   | 1.7 (0.8-2.5) |                   |
| 25-34           | 552   | 2.8 (2.1-3.4) |                   | 376   | 1.9 (1.4-2.4) |                   | 355   | 1.8 (1.4-2.3) |                   | 468   | 2.6 (1.6-3.5) |                   |
| 35-44           | 618   | 3.1 (2.4-3.8) |                   | 474   | 2.2 (1.7-2.8) |                   | 560   | 2.6 (2.0-3.2) |                   | 650   | 3.0 (2.1-3.9) |                   |
| 45-54           | 599   | 4.3 (3.3-5.2) |                   | 540   | 3.5 (2.7-4.3) |                   | 539   | 3.2 (2.6-4.0) |                   | 667   | 3.7 (2.8-4.7) |                   |
| 55-64           | 725   | 7.6 (6.0-9.1) |                   | 543   | 5.5 (4.2-6.7) |                   | 500   | 4.7 (3.6-5.8) |                   | 649   | 5.8 (4.3-7.3) |                   |
| 65-74           | 1,685 | 21 (18-25)    |                   | 1,293 | 16 (13-18)    |                   | 895   | 11 (9.2-13)   |                   | 877   | 11 (8.7-13)   |                   |
| 75-84           | 1,545 | 41 (34-48)    |                   | 1,159 | 27 (23-32)    |                   | 1,202 | 26 (22-31)    |                   | 905   | 19 (15-22)    |                   |
| 85 or Older     | 630   | 70 (56-84)    |                   | 452   | 52 (40-64)    |                   | 493   | 50 (39-61)    |                   | 457   | 45 (35-55)    |                   |
| Race/ethnicity: |       |               |                   |       |               |                   |       |               |                   |       |               |                   |
| White           | 3,945 | 4.3 (3.7-4.9) | 3.9               | 3,042 | 3.3 (2.9-3.6) | 2.9               | 2,617 | 2.8 (2.4-3.1) | 2.5               | 2,679 | 2.8 (2.2-3.5) | 2.6               |
| Black           | 1,078 | 7.3 (5.9-8.7) | 10                | 770   | 5.0 (4.1-5.9) | 6.9               | 833   | 5.3 (4.2-6.8) | 6.9               | 761   | 4.8 (3.8-5.8) | 6.1               |
| Hispanic        | 361   | 2.8 (2.0-3.6) | 5.0               | 349   | 2.4 (1.6-3.3) | 3.7               | 339   | 2.2 (1.3-3.0) | 4.3               | 398   | 2.4 (1.7-3.2) | 3.8               |
| Region:         |       |               |                   |       |               |                   |       |               |                   |       |               |                   |
| Midwest         | 1,560 | 5.3 (3.9-6.7) | 5.4               | 1,199 | 4.0 (3.1-4.9) | 4.0               | 1,144 | 3.7 (3.0-4.4) | 3.7               | 1,063 | 3.4 (2.5-4.3) | 3.5               |
| Northeast       | 2,427 | 9.8 (7.7-12)  | 9.3               | 1,546 | 6.2 (4.9-7.6) | 5.9               | 1,209 | 4.9 (3.9-5.9) | 4.7               | 1,178 | 4.8 (3.7-5.8) | 4.4               |
| South           | 2,115 | 5.1 (4.3-5.9) | 5.1               | 1,783 | 4.0 (3.4-4.6) | 4.0               | 1,716 | 3.8 (3.1-4.5) | 3.8               | 1,892 | 4.0 (2.7-5.4) | 4.0               |
| West            | 903   | 3.2 (2.4-4.1) | 3.4               | 707   | 2.4 (2.0-2.9) | 2.6               | 862   | 2.9 (2.2-3.5) | 3.0               | 902   | 3.0 (1.5-4.4) | 3.1               |
| MSA:            |       |               |                   |       |               |                   |       |               |                   |       |               |                   |
| Rural           | 876   | 2.8 (2.1-3.5) | 2.5               | 776   | 2.7 (2.1-3.3) | 2.5               | 578   | 2.0 (1.5-2.4) | 1.8               | 540   | 1.8 (1.4-2.3) | 1.7               |
| Urban           | 6,112 | 6.6 (5.8-7.5) | 6.9               | 4,430 | 4.5 (4.0-4.9) | 4.6               | 4,335 | 4.3 (3.8-4.7) | 4.4               | 4,495 | 4.3 (3.5-5.1) | 4.4               |

Rate per 100,000 is based on 1994, 1996, 1998 and 2000 population estimates from CPS, CPS Utilities, Unicon Research Corp. for relevant demographic categories of male civilian noninstitutionalized population in the United States, age adjusted rate adjusted to the United States Census derived age distribution of the year under analysis and individuals of other races, and with missing or unavailable race and ethnicity, and missing MSA included in the total (counts may not sum to total due to rounding) (source: HCUP Nationwide Inpatient Sample, 1994, 1996, 1998 and 2000).

\* Value does not meet reliability or precision standard.

TABLE 2. Inpatient stays by male Medicare beneficiaries with urethral stricture listed as primary diagnosis

|                       | 1992          |               |                   | 1995  |               |                   | 1998  |                |                   | 2001  |               |                   |
|-----------------------|---------------|---------------|-------------------|-------|---------------|-------------------|-------|----------------|-------------------|-------|---------------|-------------------|
|                       | Count         | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI)  | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate |
| Totals                | 3,760         | 25 (22-29)    |                   | 2,340 | 15 (13-18)    |                   | 2,020 | 14 (11-17)     |                   | 1,260 | 8.2 (6.2-10)  |                   |
| Younger than 65       | 320           | 10 (5.2-15)   |                   | 240   | 7.0 (3.0-11)  |                   | 320   | 9.3 (4.7-14)   |                   | 220   | 5.8 (2.4-9.2) |                   |
| 65 or Older           | 3,440         | 29 (25-34)    | 33                | 2,100 | 18 (14-21)    | 20                | 1,700 | 15 (12-19)     | 16                | 1,040 | 9.0 (6.5-11)  | 9.4               |
| Age:                  |               |               |                   |       |               |                   |       |                |                   |       |               |                   |
| 65-69                 | 660           | 16 (11-22)    |                   | 380   | 9.9 (5.4-14)  |                   | 280   | 8.3 (3.9-13)   |                   | 160   | 4.5 (1.4-7.7) |                   |
| 70-74                 | 640           | 20 (13-27)    |                   | 320   | 9.6 (4.9-14)  |                   | 340   | 11 (5.8-16)    |                   | 160   | 5.2 (1.6-8.8) |                   |
| 75-79                 | 800           | 35 (24-46)    |                   | 620   | 27 (18-37)    |                   | 420   | 18 (11-26)     |                   | 360   | 15 (7.9-21)   |                   |
| 80-84                 | 680           | 52 (34-69)    |                   | 380   | 27 (15-40)    |                   | 380   | 28 (15-40)     |                   | 180   | 12 (4.1-20)   |                   |
| 85-89                 | 420           | 70 (40-101)   |                   | 220   | 35 (14-55)    |                   | 220   | 34 (14-54)     |                   | 100   | 14 (1.7-26)   |                   |
| 90-94                 | 240           | 118 (51-186)  |                   | 160   | 76 (23-128)   |                   | 20    | 9.3 (0.0-27)   |                   | 80    | 35 (0.9-68)   |                   |
| 95-97                 | 0             | 0.0           |                   | 20    | 53 (0.0-156)  |                   | 40    | 101 (0.0-240)  |                   | 0     | 0.0           |                   |
| 98 or Older           | 0             | 0.0           |                   | 0     | 0.0           |                   | 0     | 0.0            |                   | 0     | 0.0           |                   |
| Race/ethnicity:       |               |               |                   |       |               |                   |       |                |                   |       |               |                   |
| White                 | 2,660         | 21 (18-25)    | 21                | 1,680 | 13 (10-16)    | 13                | 1,320 | 11 (8.2-13)    | 11                | 880   | 6.7 (4.7-8.7) | 6.3               |
| Black                 | 920           | 72 (51-93)    | 77                | 480   | 35 (21-49)    | 35                | 520   | 39 (24-54)     | 42                | 260   | 18 (8.1-27)   | 22                |
| Asian                 | Not available | Not available | Not available     | 0     | 0.0           | 0.0               | 0     | 0.0            | 0.0               | 20    | 9.8 (0.0-29)  | 9.8               |
| Hispanic              | Not available | Not available | Not available     | 80    | 40 (1.0-80)   | 30                | 80    | 24 (0.6-47)    | 24                | 40    | 11 (0.0-25)   | 11                |
| North American native | Not available | Not available | Not available     | 20    | 99 (0.0-293)  | 99                | 0     | 0.0            | 0.0               | 20    | 60 (0.0-177)  | 60                |
| Region:               |               |               |                   |       |               |                   |       |                |                   |       |               |                   |
| Midwest               | 760           | 20 (14-27)    | 23                | 520   | 13 (8.3-18.7) | 12                | 320   | 8.7 (4.4-12.9) | 8.1               | 200   | 5.3 (2.0-8.5) | 4.7               |
| Northeast             | 1,260         | 40 (30-50)    | 44                | 700   | 22 (15-29)    | 22                | 600   | 22 (14-29)     | 22                | 240   | 8.2 (3.6-13)  | 7.5               |
| South                 | 1,260         | 24 (18-30)    | 20                | 920   | 17 (12-22)    | 17                | 760   | 14 (9.7-19)    | 14                | 460   | 7.9 (4.7-11)  | 7.9               |
| West                  | 320           | 13 (6.7-20)   | 14                | 80    | 3.4 (0.1-6.8) | 4.3               | 280   | 13 (5.9-19)    | 13                | 280   | 11 (5.4-17)   | 11                |

Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 male Medicare beneficiaries in the same demographic stratum, age adjusted rate adjusted to the 2000 United States Census and individuals of other races, unknown race and ethnicity, and other region included in the total (counts less than 600 should be interpreted with caution) (source: Centers for Medicare and Medicaid Services, Medicare Provider Analysis and Review Files, 1992, 1995, 1998 and 2001).

TABLE 3. Hospital outpatient visits by male Medicare beneficiaries with urethral stricture listed as primary diagnosis

|                       | 1992          |               |                   | 1995  |               |                   | 1998  |               |                   | 2001  |               |                   |
|-----------------------|---------------|---------------|-------------------|-------|---------------|-------------------|-------|---------------|-------------------|-------|---------------|-------------------|
|                       | Count         | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate | Count | Rate (95% CI) | Age Adjusted Rate |
| Totals:               | 5,540         | 37 (33-42)    |                   | 3,120 | 20 (17-24)    |                   | 2,800 | 19 (16-23)    |                   | 3,260 | 21 (18-24)    |                   |
| Younger than 65       | 560           | 18 (11-25)    |                   | 620   | 18 (12-24)    |                   | 900   | 26 (19-34)    |                   | 760   | 20 (14-26)    |                   |
| 65 or Older           | 4,980         | 42 (37-48)    | 47                | 2,500 | 21 (18-25)    | 23                | 1,900 | 17 (14-21)    | 17                | 2,500 | 22 (18-25)    | 22                |
| Age:                  |               |               |                   |       |               |                   |       |               |                   |       |               |                   |
| 65-69                 | 800           | 20 (14-26)    |                   | 440   | 11 (6.6-16)   |                   | 520   | 15 (9.5-21)   |                   | 600   | 17 (11-23)    |                   |
| 70-74                 | 1,300         | 40 (30-50)    |                   | 380   | 11 (6.3-16)   |                   | 580   | 19 (12-26)    |                   | 720   | 23 (16-31)    |                   |
| 75-79                 | 1,380         | 61 (47-75)    |                   | 900   | 40 (28-51)    |                   | 300   | 13 (6.5-20)   |                   | 660   | 27 (18-36)    |                   |
| 80-84                 | 660           | 50 (33-68)    |                   | 520   | 37 (23-52)    |                   | 320   | 23 (12-35)    |                   | 220   | 15 (6.0-23)   |                   |
| 85-89                 | 300           | 50 (25-76)    |                   | 220   | 35 (14-55)    |                   | 160   | 25 (7.5-42)   |                   | 280   | 39 (18-59)    |                   |
| 90-94                 | 540           | 267 (166-367) |                   | 40    | 19 (0.0-45)   |                   | 20    | 9.3 (0.0-27)  |                   | 20    | 8.6 (0.0-26)  |                   |
| 95-97                 | 0             | 0.0           |                   | 0     | 0.0           |                   | 0     | 0.0           |                   | 0     | 0.0           |                   |
| 98 or Older           | 0             | 0.0           |                   | 0     | 0.0           |                   | 0     | 0.0           |                   | 0     | 0.0           |                   |
| Race/ethnicity        |               |               |                   |       |               |                   |       |               |                   |       |               |                   |
| White                 | 2,960         | 24 (20-27)    | 22                | 1,620 | 12 (9.7-15)   | 12                | 1,700 | 14 (11-17)    | 13                | 2,180 | 17 (14-20)    | 16                |
| Black                 | 2,440         | 191 (157-225) | 208               | 1,180 | 85 (63-107)   | 90                | 840   | 63 (44-82)    | 66                | 600   | 41 (26-56)    | 44                |
| Asian                 | Not available | Not available | Not available     | 0     | 0.0           | 0.0               | 20    | 15 (0.0-43)   | 15                | 0     | 0.0           | 0.0               |
| Hispanic              | Not available | Not available | Not available     | 180   | 91 (31-150)   | 101               | 160   | 48 (15-81)    | 48                | 200   | 53 (20-86)    | 59                |
| North American native | Not available | Not available | Not available     | 0     | 0.0           | 0.0               | 20    | 72 (0.0-211)  | 72                | 120   | 360 (72-649)  | 300               |
| Region:               |               |               |                   |       |               |                   |       |               |                   |       |               |                   |
| Midwest               | 1,560         | 42 (33-51)    | 40                | 1,180 | 31 (23-38)    | 24                | 960   | 26 (19-33)    | 25                | 880   | 23 (16-30)    | 22                |
| Northeast             | 780           | 25 (17-32)    | 23                | 400   | 13 (7.1-18)   | 15                | 560   | 20 (13-28)    | 22                | 560   | 19 (12-26)    | 20                |
| South                 | 2,600         | 50 (41-58)    | 52                | 1,020 | 19 (13-24)    | 20                | 700   | 13 (8.7-17)   | 13                | 980   | 17 (12-22)    | 17                |
| West                  | 580           | 24 (15-33)    | 23                | 400   | 17 (9.7-25)   | 19                | 480   | 21 (13-30)    | 21                | 820   | 33 (23-43)    | 35                |

Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 male Medicare beneficiaries in the same demographic stratum, age adjusted rate adjusted to the 2000 United States Census and individuals of other races, unknown race and ethnicity, and other region included in the total (counts less than 600 should be interpreted with caution) (source: Centers for Medicare and Medicaid Services, 5% Carrier and Outpatient Files, 1992, 1995, 1998 and 2001).

TABLE 4. 1992–2000 Physician office visits for males with urethral stricture listed as any diagnosis

|                       | Count     | Rate (95% CI)       | Av Annualized Rate/Yr | Age Adjusted Rate |
|-----------------------|-----------|---------------------|-----------------------|-------------------|
| Totals:               | 1,460,899 | 1,146 (858–1,434)   | 229                   | 1,138             |
| Age:                  |           |                     |                       |                   |
| Younger than 65       | 870,812   | 762 (476–1,048)     | 152                   |                   |
| 65 or Older           | 590,087   | 4,465 (3,198–5,731) | 893                   |                   |
| White race/ethnicity* | 1,026,894 | 1,106 (794–1,417)   | 221                   | 1,049             |
| MSA*                  | 1,114,540 | 1,144 (849–1,440)   | 229                   | 1,145             |

Rate per 100,000 based on 1992, 1994, 1996, 1998 and 2000 population estimates from CPS, CPS Utilities, Unicon Research Corp. for relevant demographic categories of male civilian noninstitutionalized population in the United States, age adjusted rate adjusted to the United States Census derived age distribution of the mid point of years and individuals of missing or unavailable race and ethnicity, and with missing MSA included in the total (counts may not sum to total due to rounding) (source: National Ambulatory Medical Care Survey, 1992, 1994, 1996, 1998 and 2000).  
 \* Black and other race/ethnicity and nonMSA values do not meet reliability or precision standard.

thral stricture disease in the population older than 65 years was 6,557/100,000 for year 2001 (table 6). This means that 6.5% of those with a diagnosis of urethral stricture disease who were older than 65 years underwent a retrograde urethrogram in any given year.

**Dilation.** When coded using the International Classification of Diseases, 9th revision, the rate of urethral dilation in the office setting in 2001 was 19,658/100,000 in Medicare beneficiaries 65 years or older. This exceeded the number of ureteroscopies performed in the same population by double.<sup>13</sup> Office dilation became much less common from 1992 to 2001, decreasing more than 50%.

**Economic Impact**

**Overall.** The estimated total annual expenditure for male urethral stricture disease was \$191 million in 2000 (table 7). Of those costs 69% were for ambulatory surgery visits. These costs were much lower than those for a more common urological disease, such as nephrolithiasis, which cost \$2.1 billion in 2000.<sup>13</sup>

**Individual.** Annual health care expenditures of an insured male with urethral stricture disease was almost 3-fold compared to those of males without stricture (\$3,713 vs \$10,472) (table 8).

**Associated Illness**

Although causation could not be determined from these data sets, the percent of men with urethral stricture disease who also had a diagnosis of urinary tract infection in that year was high at 42%. Men with urethral stricture disease had an 11% chance of being diagnosed with urinary incontinence in the same year (2001 Medicare data).

**DISCUSSION**

**Rates of Male Urethral Stricture**

Even with complex analysis of huge health care data sets the true incidence of urethral stricture is only estimable. In a population of older veterans the rate was as high at 0.6%. However, even these estimates likely undercount the true

incidence of urethral stricture disease because the Veterans' Hospital databases include mostly older patients. In 2000 urethral stricture resulted in thousands of inpatient, outpatient and emergency room visits, tens of thousands of ambulatory surgery visits and hundreds of thousands of office visits. Urethral strictures resulted in a 6.5% rate of affected patients undergoing radiographic studies (retrograde urethrogram) and a rate of urethral dilation that exceeded even that of commonly performed procedures such as ureteroscopy for stone. Those affected by stricture had a high rate of untoward sequelae, including urinary tract infection (41%) and incontinence (11%).

**Who Has Strictures?**

**Race effect.** Some but not all of the analyzed data sets indicated that black Americans may have higher stricture rates than white Americans. In general sample numbers for Asian, Hispanic and Native American patients were too low to draw accurate conclusions. National inpatient samples using HCUP data showed no effect of race, while inpatient and outpatient samples from Medicare showed an incidence of urethral strictures that was more than double in the black population (tables 1 to 3). Caution must always be used when interpreting Medicare data because these patients are usually older than 65 years and data may underestimate the rate of strictures in younger patients. This has implications for the etiology of strictures, which remains largely unknown, and funding for programs to investigate stricture disease in susceptible populations.

**Age effect.** A clear trend of increasing incidence of treatment for urethral stricture with age was seen across multi-

TABLE 5. 1994–1996 Ambulatory surgery visits for males with urethral stricture listed as any diagnosis

|             | Count   | Rate (95% CI)     | Av Annualized Rate/Yr | Age Adjusted Rate |
|-------------|---------|-------------------|-----------------------|-------------------|
| Totals:     | 227,322 | 180 (163–197)     | 60                    | 179               |
| Age:        |         |                   |                       |                   |
| 0–2         | 8,035   | 131 (55–207)      | 44                    |                   |
| 3–10        | 27,158  | 167 (130–204)     | 56                    |                   |
| 11–17       | 6,666   | 50 (22–78)        | 17                    |                   |
| 18–34       | 20,668  | 64 (45–82)        | 21                    |                   |
| 35–44       | 22,198  | 108 (74–142)      | 36                    |                   |
| 45–54       | 26,188  | 177 (124–229)     | 59                    |                   |
| 55–64       | 34,910  | 357 (257–457)     | 119                   |                   |
| 65–74       | 39,404  | 489 (383–595)     | 163                   |                   |
| 75–84       | 32,799  | 812 (632–991)     | 271                   |                   |
| 85 or Older | 9,296   | 1,079 (578–1,580) | 360                   |                   |
| Region:     |         |                   |                       |                   |
| Midwest     | 76,431  | 256 (221–292)     | 85                    | 257               |
| Northeast   | 54,798  | 222 (167–277)     | 74                    | 220               |
| South       | 74,448  | 172 (145–199)     | 57                    | 168               |
| West        | 21,645  | 76 (57–95)        | 25                    | 76                |

Rate per 100,000 based on 1994, 1995 and 1996 population estimates from CPS, CPS Utilities, Unicon Research Corp. for relevant demographic categories of male civilian noninstitutionalized population in the United States, grouped years age adjusted to the United States Census derived age distribution of the mid point of years and individual years age adjusted to the United States Census derived age distribution of the year under analysis (counts may not sum to total due to rounding) (source: National Survey of Ambulatory Surgery, 1994, 1995 and 1996).

TABLE 6. Use of retrograde urethrocytography (Common Procedural Terminology 74450 or International Classification of Diseases, 9th revision 87.76) or injection procedure for urethrogram (Common Procedural Terminology 51610) in males 65 years or older with urethral stricture in any setting

|                       | 1992          |                       |                   | 1995   |                      |                   | 1998   |                       |                   | 2001  |                      |                   |
|-----------------------|---------------|-----------------------|-------------------|--------|----------------------|-------------------|--------|-----------------------|-------------------|-------|----------------------|-------------------|
|                       | Count         | Rate (95% CI)         | Age Adjusted Rate | Count  | Rate (95% CI)        | Age Adjusted Rate | Count  | Rate (95% CI)         | Age Adjusted Rate | Count | Rate (95% CI)        | Age Adjusted Rate |
| Totals:               | 13,840        | 7,322 (6,797–7,847)   |                   | 12,060 | 7,157 (6,607–7,708)  |                   | 10,580 | 7,774 (7,137–8,410)   |                   | 8,200 | 6,557 (5,944–7,170)  |                   |
| Age                   |               |                       |                   |        |                      |                   |        |                       |                   |       |                      |                   |
| 65–69                 | 4,040         | 10,504 (9,134–11,875) |                   | 2,980  | 9,324 (7,897–10,751) |                   | 2,520  | 10,535 (8,796–12,274) |                   | 1,980 | 9,340 (7,590–11,090) |                   |
| 70–74                 | 4,000         | 8,368 (7,257–9,479)   |                   | 3,720  | 8,832 (7,621–10,043) |                   | 2,760  | 8,550 (7,187–9,913)   |                   | 2,360 | 8,049 (6,658–9,441)  |                   |
| 75–79                 | 2,880         | 6,135 (5,164–7,107)   |                   | 2,540  | 6,144 (5,109–7,179)  |                   | 2,720  | 7,902 (6,627–9,178)   |                   | 1,960 | 6,347 (5,130–7,565)  |                   |
| 80–84                 | 1,780         | 5,414 (4,319–6,509)   |                   | 1,680  | 5,280 (4,180–6,380)  |                   | 1,480  | 5,777 (4,500–7,053)   |                   | 1,100 | 4,622 (3,429–5,815)  |                   |
| 85–89                 | 800           | 4,884 (3,407–6,361)   |                   | 760    | 5,080 (3,509–6,651)  |                   | 760    | 5,094 (3,519–6,669)   |                   | 560   | 3,911 (2,493–5,328)  |                   |
| 90–94                 | 280           | 5,109 (2,500–7,719)   |                   | 220    | 4,198 (1,775–6,622)  |                   | 320    | 8,290 (4,404–12,176)  |                   | 180   | 3,766 (1,360–6,172)  |                   |
| 95–97                 | 0             | 0.0                   |                   | 80     | 10,256 (769–19,744)  |                   | 20     | 2,222 (0.0–6,556)     |                   | 40    | 7,143 (0.0–16,607)   |                   |
| 98 or Older           | 0             | 0.0                   |                   | 0      | 0.0                  |                   | 0      | 0.0                   |                   | 0     | 0.0                  |                   |
| Race/ethnicity:       |               |                       |                   |        |                      |                   |        |                       |                   |       |                      |                   |
| White                 | 11,380        | 7,204 (6,634–7,775)   | 7,204             | 10,280 | 7,117 (6,524–7,710)  | 7,117             | 8,840  | 7,619 (6,937–8,302)   | 7,533             | 7,060 | 6,717 (6,041–7,394)  | 6,736             |
| Black                 | 1,600         | 8,073 (6,377–9,768)   | 7,871             | 1,360  | 8,047 (6,213–9,882)  | 8,047             | 1,160  | 8,555 (6,453–10,656)  | 9,440             | 580   | 4,715 (3,041–6,390)  | 4,553             |
| Asian                 | Not available | Not available         | Not available     | 20     | 2,381 (0.0–7,024)    | 2,381             | 40     | 4,878 (0.0–11,463)    | 2,439             | 60    | 4,054 (0.0–8,581)    | 4,054             |
| Hispanic              | Not available | Not available         | Not available     | 120    | 6,122 (1,378–10,867) | 6,122             | 400    | 11,696 (6,871–16,520) | 12,281            | 220   | 6,707 (2,866–10,549) | 6,098             |
| North American native | Not available | Not available         | Not available     | 0      | 0.0                  | 0.0               | 0      | 0.0                   | 0.0               | 0     | 0.0                  | 0.0               |
| Region:               |               |                       |                   |        |                      |                   |        |                       |                   |       |                      |                   |
| Midwest               | 3,720         | 7,626 (6,572–8,680)   | 7,790             | 3,120  | 7,166 (6,082–8,250)  | 6,982             | 2,880  | 7,912 (6,673–9,151)   | 7,857             | 1,680 | 5,125 (4,057–6,193)  | 5,003             |
| Northeast             | 2,760         | 7,697 (6,464–8,929)   | 7,418             | 2,400  | 7,528 (6,233–8,824)  | 7,654             | 1,920  | 7,339 (5,925–8,754)   | 7,187             | 1,440 | 6,338 (4,921–7,755)  | 6,514             |
| South                 | 5,780         | 7,585 (6,744–8,427)   | 7,559             | 4,700  | 6,924 (6,070–7,778)  | 6,865             | 3,800  | 7,244 (6,252–8,235)   | 7,396             | 3,460 | 7,257 (6,214–8,299)  | 7,173             |
| West                  | 1,520         | 6,022 (4,711–7,334)   | 6,181             | 1,740  | 7,831 (6,251–9,410)  | 8,101             | 1,860  | 10,043 (8,105–11,982) | 9,935             | 1,560 | 8,117 (6,389–9,844)  | 8,429             |

Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 male Medicare beneficiaries 65 years or older with urethral stricture, age adjusted rate adjusted to the United States Census 2001 and individuals of other races, unknown race and ethnicity, and other region included in the total (counts less than 600 should be interpreted with caution). (source: Centers for Medicare and Medicaid Services, 1992, 1995, 1998 and 2001).

TABLE 7. Male urethral stricture expenditures by service site

|                    | 1994<br>\$ Expenditure (%) | 1996<br>\$ Expenditure (%) | 1998<br>\$ Expenditure (%) | 2000<br>\$ Expenditure (%) |
|--------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Hospital outpt     | 3,985,122 (2.3)            | 4,339,936 (2.3)            | 8,002,002 (3.9)            | 5,081,869 (2.7)            |
| Physician office   | 9,210,826 (5.3)            | 14,957,752 (8.0)           | 17,114,631 (8.3)           | 22,683,608 (11.9)          |
| Ambulatory surgery | 130,472,080 (74.5)         | 142,088,620 (76.0)         | 152,419,401 (73.7)         | 132,300,099 (69.2)         |
| Emergency room     | — (0.0)                    | — (0.0)                    | —                          | —                          |
| Inpt               | 31,519,724 (18.0)          | 25,656,338 (13.7)          | 29,305,944 (14.2)          | 31,008,773 (16.2)          |
| Totals             | 175,187,753                | 187,042,646                | 206,841,978                | 191,074,350                |

Source: National Ambulatory Medical Care Survey, National Hospital Ambulatory Medical Care Survey, HCUP and Medical Expenditure Panel Survey, 1994, 1996, 1998 and 2000.

ple databases (tables 1 to 5). This likely represents a true increase in urethral stricture disease with age with a marked increase in those older than 55 years (fig. 1).

**Geographic location.** Few databases achieved numbers high enough to discuss the effect of location on the incidence of strictures but analysis of inpatient data from HCUP indicate that the incidence of stricture was more common by 2.6-fold at urban hospitals. This could be because of a true increase in incidence in the urban setting or it could reflect the tendency to refer patients with urethral strictures to urban medical centers for definitive treatment. Clear trends in diagnosis rates across the zones of the United States (Northeast, Midwest, South and West) were not seen.

**Cost of Strictures**

Stricture disease is expensive with costs of almost \$200 million in 2000. The individual cost of strictures was more than \$6,000 per affected individual in 2002. Other investigators concluded that lifetime treatments with usually repeat direct visual internal urethrotomy costs an average of \$17,747 per patient in the United States and the lifetime costs of immediate urethral reconstruction was \$16,444.<sup>14</sup> British reports put the cost of direct visual internal urethrotomy or dilation at \$3,375 compared to

\$7,522 for 1-stage urethroplasty and \$15,555 for 2-stage urethroplasty.<sup>8</sup>

**Decreasing Stricture Rates With Time**

Multiple data sets indicate that the rate of stricture disease is decreasing with time. The reasons for this are unknown but 2 hypotheses are 1) a decreased incidence of stricture disease and 2) increasingly successful treatment for stricture disease. It is possible that better treatment for infectious urethritis is decreasing the incidence of disease, although a separate specific study of this question would be needed to determine the etiology with certainty. It is also probable that increasingly successful surgical treatments for urethral stricture, such as buccal mucosal urethroplasty, are decreasing disease recurrence, which results in a lower incidence of strictures with time.

**Limitations**

All statistical analyses require assumptions that may not be true and manipulations of data that may not be accurate by definition. The limitations of these data sets were previously discussed.<sup>12</sup> However, in general we attempted to remove sources of error when analyzing these data sets. For example, the number of patients with urethral stricture was generally lower than that for other urological diseases and, when patient counts were too low to allow statistical significance, data analysis was not reported. Improved data collection methods would help better analyze the impact of rarer diseases such as urethral stricture in the future.

We also believe that some data sets, such as VA and Medicare databases, will underestimate the rate of urethral strictures because they do not typically capture younger patients. This might especially affect the strictures most commonly seen in young individuals, such as after trauma, after hypospadias surgery and as a result of balanitis xerotica obliterans.

**CONCLUSIONS**

Male urethral stricture disease occurs at a rate as high as 0.6% in some susceptible populations and it results in more than 5,000 inpatient visits yearly. Yearly office visits for urethral stricture numbered almost 1.5 million between 1992 and 2000. The total cost of urethral stricture disease in 2000 was almost \$200 million and the yearly personal cost of the disease averaged more than \$6,000. Urethral stricture disease appears to be more common in elderly patients and in black patients, and by most measures the incidence of urethral stricture disease has decreased with time. Patients

TABLE 8. Estimated annual expenditures for privately insured male employees with and without medical claim for urethral stricture in 2002

|           | No Stricture<br>\$ Expenditures/Yr/Pt |       |         | Stricture<br>\$ Expenditures/Yr/Pt |       |        |
|-----------|---------------------------------------|-------|---------|------------------------------------|-------|--------|
|           | Prescription                          |       | Totals  | Prescription                       |       | Totals |
|           | Medical                               | Drugs |         | Medical                            | Drugs |        |
| No. pts   |                                       |       | 284,831 |                                    |       | 500    |
| All       | 2,677                                 | 1,036 | 3,713   | 9,227                              | 1,245 | 10,472 |
| Age:      |                                       |       |         |                                    |       |        |
| 18-34     | 1,287                                 | 658   | 1,945   | 4,262                              | 870   | 5,132  |
| 35-44     | 2,137                                 | 879   | 3,016   | 9,088                              | 898   | 9,986  |
| 45-54     | 3,047                                 | 1,217 | 4,264   | 11,848                             | 859   | 12,707 |
| 55-64     | 3,239                                 | 1,129 | 4,368   | 9,187                              | 1,921 | 11,108 |
| Region:   |                                       |       |         |                                    |       |        |
| Midwest   | 2,587                                 | 1,028 | 3,615   | 8,918                              | 1,247 | 10,165 |
| Northeast | 2,610                                 | 1,119 | 3,729   | 8,997                              | 1,349 | 10,346 |
| South     | 2,730                                 | 968   | 3,698   | 9,411                              | 1,151 | 10,562 |
| West      | 2,940                                 | 1,064 | 4,004   | 10,134                             | 1,309 | 11,443 |

Sample consists of primary beneficiaries 18 to 64 years old with employer provided insurance who were continuously enrolled in 2002 and estimated annual expenditures were derived from multivariate models controlled for age, gender, work status (active/retired), median household income based on zip code, urban/rural residence, medical and drug plan characteristics (managed care, deductible or co-insurance/co-payments) and binary indicators for 28 chronic disease conditions (source: Ingenix, 2002).

with urethral stricture disease appear to have a high rate of urinary tract infection (41%) and incontinence (11%). To our knowledge demographic data such as these have not previously been available and they should help in understanding this enigmatic disease.

#### Abbreviations and Acronyms

|      |   |   |
|------|---|---|
| CPS  | = | Current Population Survey               |
| HCUP | = | Healthcare Cost and Utilization Project |
| MSA  | = | metropolitan statistical area           |
| VA   | = | Veterans Administration                 |

#### REFERENCES

- Romero Perez P and Mira Llinares A: Complications of the lower urinary tract secondary to urethral stenosis. *Actas Urol Esp* 1996; **20**: 786.
- Romero Perez P and Mira Llinares A: Male urethral stenosis: review of complications. *Arch Esp Urol* 2004; **57**: 485.
- Hodonou R, Hounnasso PP, Gbessi DG and Akpo C: Penile-perineal-scrotal gangrene. Epidemiologic, diagnostic, and therapeutic features. Report of 32 cases. *Prog Urol* 2000; **10**: 271.
- Chilton CP, Shah PJ, Fowler CG, Tiptaft RC and Blandy JP: The impact of optical urethrotomy on the management of urethral strictures. *Br J Urol* 1983; **55**: 705.
- Kinder PW and Rous SN: The treatment of urethral stricture disease by internal urethrotomy: a clinical review. *J Urol* 1979; **121**: 45.
- Heyns CF, Steenkamp JW, De Kock ML and Whitaker P: Treatment of male urethral strictures: is repeated dilation or internal urethrotomy useful? *J Urol* 1998; **160**: 356.
- Pansadoro V and Emiliozzi P: Internal urethrotomy in the management of anterior urethral strictures: long-term followup. *J Urol* 1996; **156**: 73.
- Greenwell TJ, Castle C, Andrich DE, MacDonald JT, Nicol DL and Mundy AR: Repeat urethrotomy and dilation for the treatment of urethral stricture are neither clinically effective nor cost-effective. *J Urol* 2004; **172**: 275.
- Andrich DE, Dungleison N, Greenwell TJ and Mundy AR: The long-term results of urethroplasty. *J Urol* 2003; **170**: 90.
- Coursey JW, Morey AF, McAninch JW, Summerton DJ, Secrest C, White P et al: Erectile function after anterior urethroplasty. *J Urol* 2001; **166**: 2273.
- Williams RD: Urologic Diseases in America Project. *J Urol* 2005; **173**: 679.
- Litwin MS, Saigal CS, Yano EM, Avila C, Geschwind SA, Hanley JM et al: Urologic Diseases in America Project: analytical methods and principal findings. *J Urol* 2005; **173**: 933.
- Pearle MS, Calhoun EA and Curhan GC: Urologic Diseases in America Project: urolithiasis. *J Urol* 2005; **173**: 848.
- Rourke KF and Jordan GH: Primary urethral reconstruction: the cost minimized approach to the bulbous urethral stricture. *J Urol* 2005; **173**: 1206.