

## Health-Related Consequences of Overactive Bladder

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### Abstract

**Objective:** Overactive bladder (OAB) is a condition of urgency, with or without urge incontinence, usually with frequency and nocturia. This study assesses whether people with OAB are at greater risk for urinary tract infections (UTIs), falls and injuries, and increased number of visits to the doctor compared to age- and gender-matched controls. The study also estimates costs associated with these health-related consequences.

**Patients & Methods:** A US representative telephone survey under the National Overactive Bladder Evaluation (NOBLE) Program was conducted with 5204 English-speaking adults older than 18 years. The survey asked respondents about bladder symptoms. Based on the telephone survey, 865 symptom-identified OAB cases and 903 age- and gender-matched controls were sent a postal questionnaire. A total of 397 cases and 522 controls returned the questionnaires. Nonrespondent cases and controls did not differ with regard to age, gender, educational status, diabetes, congestive heart failure, and self-rated health status. Regression analyses were conducted to assess the effect of OAB on health-related consequences, controlling for age, gender, race, education, marital status, number of previous births, self-reported health status, diabetes, and congestive heart failure.

**Results:** People with OAB reported 0.84 (20%) more visits to the physician ( $P < .05$ ) and 0.21 (138%) more UTIs in the last year than people without OAB ( $P < .001$ ). Overactive bladder cases also had over twice the odds of being injured in a fall than people without OAB (odds ratio = 2.26; 95% confidence interval 1.46, 3.51). Consistent with having more falls, OAB cases had an increased risk of bone fracture ( $P < .1$ ). This effect, however, was not statistically significant (at  $\alpha$  level 0.05) due to the limited sample size. The estimated

cost of UTIs associated with OAB was approximately \$1.37 billion US dollars in year 2000. The cost of falls without bone fracture due to OAB was \$55 million. Falls with bone fracture accounted for approximately \$386 million; however, further research with a larger sample is needed to accurately estimate these costs.

**Conclusion:** People with OAB self-report significantly more UTIs and a greater risk of being injured in a fall. Given the large prevalence of UTIs and concerns of overprescribing antibiotics, these results are important for health plans and policy makers. In addition, people with OAB visit their physicians more often than people without OAB. These consequences entail significant economic costs, of which a large percentage will be incurred by health plans. To the extent that OAB causes these consequences, there may be significant savings from effectively treating OAB.

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Overactive bladder (OAB) is a condition of urgency, with or without urge incontinence, usually with frequency and nocturia.<sup>1,2</sup> The unpredictable urges can disrupt activities and affect quality of life.<sup>3-5</sup> People with OAB often have to stop their activities to use the bathroom. They also report worrying about having the urge to urinate, and thus modify their lifestyles and restrict their activities.

A significant portion of the population endures the economic, physical, and emotional burdens of OAB.<sup>6-8</sup> A recent nationally representative survey found that the overall prevalence of OAB was 16.9% among women and 16.0% among men.<sup>9</sup>

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Research has found that prevalence of OAB increases with age and that older adults are more likely to have OAB with urge incontinence.<sup>9,10</sup> Although OAB is common among older women, it also affects up to 1 in 5 men older than 55 years.<sup>8</sup>

Overactive bladder occurs with and without urge urinary incontinence.<sup>9,11</sup> Overactive bladder with or without urge incontinence carries a social stigma, and many people are reluctant to discuss the subject with their doctors. Although many people may not seek treatment for OAB, patients may use additional healthcare resources because of OAB-related complications. In a recent article, Brown et al<sup>1</sup> suggested that OAB may place people at greater risk for urinary tract infections (UTIs), falls, and injuries. We know that UTIs are more prevalent among people with urinary incontinence.<sup>12,13</sup> Also, incontinence may be a risk factor for falls and fractures,<sup>14-17</sup> although some research has found little association.<sup>18,19</sup> To date, the extent to which these consequences are associated with OAB is unknown. This study is the first evaluation of the health-related consequences associated with OAB.

## Methods

A US representative telephone survey under the National Overactive BLadder Evaluation (NOBLE) Program was conducted with 5204 English-speaking adults older than 18 years.<sup>9</sup> During the survey, people were asked about bladder control symptoms. This information was used to identify OAB prevalence and OAB risk factors. After the telephone survey, a nested case-control survey was undertaken. A total of 865 symptom-identified OAB cases and 903 age- and gender-matched controls were sent a postal questionnaire to assess the number of UTIs, whether they fell, and number of medical visits in the past year.

A total of 459 (53%) cases and 566 (63%) controls responded. Changes in the OAB case definition occurred between the recruitment and the data collection. These changes led to the exclusion of 62 cases. It was decided that the nested case-con-

trol study should maintain the proportion of redesignated controls to the total control sample (women only). Therefore, 44 female controls were randomly excluded from the final analytical dataset. The redefinition of cases and controls was done by the survey research firm prior to the analyses presented here. The final analytical dataset included 397 cases and 522 controls.

Although response rates were comparable to postal surveys that did not use financial incentives,<sup>20-22</sup> there was a concern about nonresponse bias. This bias would be particularly troublesome if OAB cases systematically differed from controls. Given that all cases and controls completed a baseline telephone interview, respondents ( $n = 919$ ) were compared with nonrespondents ( $n = 743$ ) using a Chow test. Using logistic regression models, where the dependent variable was nonrespondent status (1 = nonrespondent and 0 = respondent), OAB cases were assessed for differences from controls with regard to age, gender, educational status, diabetes, congestive heart failure, and self-rated health status. In each of the logistic models, OAB status was interacted with one of the demographic or health variables. In each case, the interactions were not statistically significant ( $P > .20$ ; data not shown), suggesting that OAB respondents were not systematically different from controls.

Five dependent variables were considered in this study; all were based on self-report. They included (1) number of visits to the physician, (2) number of physician-diagnosed UTIs, (3) injuries from a falls, (4) bone fractures from a fall, and (5) the number of fall-related injuries. All dependent variables referred to the past year.

The key independent variable was whether the person had OAB. Overactive bladder was operationally defined through an algorithm that was based on participant-reported symptoms. The algorithm is presented in the **Appendix**.

Other independent variables included age, gender, marital status, and number of births. Self-reported race was included, but due to sample sizes, it was limited to

white versus nonwhite. Education was included such that people with a high school education or more were differentiated from those with less education. To control for health-related risk factors, we included variables that identified the presence of diabetes and congestive heart failure. We also included self-reported health status, where respondents selected excellent, very good, good, fair, or poor; fair or poor were combined due to the small samples.

A bivariate analysis was conducted with the dependent and independent variables. For tests of proportions, Pearson's chi-squared statistic was used. Means were compared with the Wilcoxon rank sum test.

Injury and bone fracture from falling were modeled with logistic regression. The number of physician visits in the last year, the number of UTIs in the past year, and number of injuries in the last year were analyzed with count data models. The Poisson regression is perhaps the most familiar count data model, although it assumes the conditional variance is equal to the conditional mean.<sup>23</sup> This requirement is usually overly restrictive, and likelihood ratio tests confirmed that it is not warranted with these data. Therefore, we used a negative binomial model. Details on the negative binomial model can be found in Cameron and Trivedi.<sup>23</sup>

The odds-ratios from the logistic regression models with their 95% confidence intervals (CIs) were presented. For the negative binomial models,  $\beta$  coefficients and 95% CIs were included. The  $\beta$  coefficients from the negative binomial models are not readily interpretable as marginal effects. Therefore, the table was augmented with the marginal effects calculated as the average predicted change.<sup>23</sup> All regression models controlled for age, gender, race, education, marital status, number of births, self-reported health status, presence of diabetes, and presence of congestive heart failure.

Survey participants were not asked about healthcare costs for OAB. To estimate the cost of the UTIs, falls, and fractures attributable to OAB, gross cost methods were used<sup>24</sup> and combined the

regression results with prevalence estimates and unit costs, producing an expected cost. Urinary tract infection treatment costs for year 2000 were estimated at \$104.40. This cost included a current procedural terminology (CPT) payment of \$97.76 for a moderate evaluation in a physician visit, \$4.39 for a urinalysis, and \$2.25 for antibiotic treatment. The antibiotic treatment was assumed to be a 5-day regimen of trimethoprim, at 200 mg twice a day.<sup>25</sup> For falls and injuries, research has shown that costs increase monotonically with severity. One or more injurious falls among adults, especially hip fractures, has been linked to higher treatment costs of approximately \$8000 to \$11 000.<sup>26,27</sup> The total costs of fractures increases to approximately \$20 000 when subsequent outpatient care, nursing home, and home care cost are included.<sup>26</sup> However, little research has been done on the costs of injurious falls among younger adults. For people younger than 65 years, 6% of the people in our sample reported a hip fracture; it was assumed that the remainder had wrist (Colles) fractures. For people older than 65 years, 10% reported a hip fracture, and again we assumed the remainder had wrist fractures. The cost per wrist fracture was estimated at \$331, which is the average Medicare reimbursement for year 2000 for the 4 CPT codes associated with a Colles fracture. The cost of the hip fracture was based on Rizzo et al's research,<sup>26</sup> adjusted for inflation. The expected cost per fracture was calculated to be \$1571 for people younger than 65 years and \$2397 for people older than 65 years. A fall without a fracture was estimated at \$125.32 (\$96.76 for an evaluation and \$28.56 for an X ray). The cost for additional doctor visits was not calculated as some of these visits are likely to be for treating OAB itself.

## Results

Individuals with OAB had similar demographic characteristics compared with people without OAB. Individuals with OAB had worse self-reported health status and a higher prevalence of diabetes and

**Table 1.** Sample Characteristics of OAB Cases and Controls: Means and Percentages

	Total	With OAB	Without OAB	OAB Difference
Sample Size	919	397	522	<i>P</i>
<b>Dependent variables</b>				
Times saw doctor in last year	6.540	7.781	5.597	.011
At least one UTI in last year (%)	15.13	21.66	10.15	<.001
Number of UTIs in last year	0.284	0.457	0.154	<.001
Injured from fall in last year (%)	12.6	17.7	8.9	<.001
Broke a bone in a fall in the last year (%)	3.7	5.0	2.7	.061
Number of fall-related injuries in last year	0.217	0.287	0.163	.060
<b>Independent variables</b>				
Has OAB (%)	43.2	1.0	0.0	—
Age (years)	54.221	56.730	52.312	<.001
Gender (% female)	60.4	53.1	65.9	<.001
Race/ethnicity (% nonwhite)	15.6	15.6	15.5	.967
Marital status				.929
Married or living as married (%)	58.4	58.4	58.4	
Widowed (%)	12.6	13.4	12.1	
Divorced or separated (%)	16.1	15.9	16.3	
Never married (%)	12.8	12.3	13.2	
Number of births	1.404	1.388	1.416	.005
High school education or more (%)	55.0	50.9	58.0	.031
Has diabetes (%)	9.7	13.9	6.5	<.001
Has congestive heart failure (%)	5.3	8.1	3.3	.001
Self-reported health status				<.001
Excellent (%)	16.8	14.1	18.9	
Very good (%)	34.4	24.4	42.0	
Good (%)	29.6	33.0	27.0	
Fair or poor (%)	19.2	28.5	12.1	

OAB indicates overactive bladder; UTI, urinary tract infection.

congestive heart failure (Table 1). In addition, the case-control dataset included significantly more female controls (66%) than female cases (53%) ( $P < .001$ ).

The number of self-reported physician visits in the past year ranged from 0 to 200. In both the bivariate and multivariate analyses, we found that people with OAB had more overall visits to a physician in the past year. The marginal effect in the negative binomial model indicated that people with OAB had an average of 0.84 additional visits to the physician than people without OAB ( $P < .05$ ; Table 2).

Approximately 10.2% of people without OAB reported having at least 1 doctor-diagnosed UTI in the past year. This is consistent with a recent study on the prevalence of UTIs.<sup>28</sup> Approximately 21.7% of people with OAB reported a UTI in the past year, which was a significantly higher proportion than people without OAB ( $P < .001$ ; Table 1). The number of UTIs in people with OAB in the last year ranged from 0 to 10, and the presence of OAB was associated with 0.214 additional UTIs in the last year ( $P < .001$ ). People with OAB had a significantly greater number of

**Table 2.** Negative Binomial Models of the Effect of OAB on Physician Visits and UTIs

	Number of Doctor Visits		Number of UTIs	
	Coeff	Margeff*	Coeff	Margeff*
Has OAB	0.148 (0.005, 0.291) <sup>†</sup>	0.840	1.184 (0.775, 1.594) <sup>†</sup>	0.214
Age (years)	0.014 (0.009, 0.019) <sup>†</sup>	0.078	-0.014 (-0.028, 0.000)	-0.002
Gender (male = 0, female = 1)	0.313 (0.124, 0.502) <sup>†</sup>	1.711	1.686 (1.096, 2.276) <sup>†</sup>	0.249
Race/ethnicity (0 = white, 1 = non-white)	-0.275 (-0.473, -0.076) <sup>†</sup>	-1.406	0.219 (-0.318, 0.757)	0.037
Marital status <i>Married or living as married (reference group)</i>				
Widowed	0.162 (-0.064, 0.388)	0.970	0.143 (-0.478, 0.764)	0.024
Divorced or separated	-0.022 (-0.215, 0.171)	-0.124	-0.651 (-1.231, -0.072) <sup>†</sup>	-0.083
Never married	0.282 (0.051, 0.513) <sup>†</sup>	1.762	-0.175 (-0.85, 0.499)	-0.026
Number of births	-0.002 (-0.057, 0.054)	-0.009	-0.005 (-0.139, 0.129)	-0.001
High school education or more (no = 0, yes = 1)	0.265 (0.127, 0.403) <sup>†</sup>	1.469	0.086 (-0.328, 0.500)	0.013
Has diabetes	0.312 (0.071, 0.553) <sup>†</sup>	1.998	0.578 (-0.034, 1.190)	0.116
Has congestive heart failure	0.526 (0.209, 0.844) <sup>†</sup>	3.791	0.018 (-0.837, 0.872)	0.003
Self-reported health status <i>Excellent (reference group)</i>				
Very good	0.592 (0.386, 0.799) <sup>†</sup>	3.682	0.412 (-0.276, 1.101)	0.069
Good	0.603 (0.388, 0.818) <sup>†</sup>	3.900	1.042 (0.368, 1.717) <sup>†</sup>	0.211
Fair or poor	1.116 (0.876, 1.356) <sup>†</sup>	9.404	1.240 (0.514, 1.965) <sup>†</sup>	0.305
Constant	-0.077 (-0.433, 0.280)		-3.313 (-4.458, -2.169) <sup>†</sup>	
Log $\alpha$	-0.198		2.842	
Observations	887	887	899	899

95% confidence intervals in parentheses.

\*Marginal effects are calculated as the average predicted change.

<sup>†</sup>Significant at 5%.

<sup>‡</sup>Significant at 1% (2-tailed test).

OAB indicates overactive bladder; UTI, urinary tract infection.

**Table 3.** The Effect of OAB on Falls and Injuries

	Injured from Fall Odds Ratio	Broken Bone from Fall Odds Ratio	Number of Injuries	
			Neg Bin Coeff	Margeff <sup>*</sup>
Has OAB	2.265 (1.460, 3.513) <sup>†</sup>	1.528 (0.727, 3.212)	0.510 (0.018, 1.001) <sup>†</sup>	0.087
Age (years)	0.995 (0.980, 1.011)	0.997 (0.971, 1.023)	-0.010 (-0.028, 0.008)	-0.002
Gender (male = 0, female = 1)	2.247 (1.271, 3.973) <sup>†</sup>	0.961 (0.367, 2.512)	0.633 (-0.014, 1.280)	0.099
Race/ethnicity (0 = white, 1 = non-white)	1.445 (0.840, 2.484)	1.387 (0.581, 3.313)	0.088 (-0.534, 0.709)	0.015
Marital status <i>Married or living as married (reference group)</i>				
Widowed	1.386 (0.681, 2.824)	1.327 (0.442, 3.978)	0.371 (-0.434, 1.176)	0.070
Divorced or separated	1.667 (0.965, 2.879)	1.085 (0.408, 2.882)	0.456 (-0.186, 1.098)	0.088
Never married	1.468 (0.746, 2.886)	1.146 (0.356, 3.690)	0.754 (-0.064, 1.571)	0.167
Number of births	0.918 (0.782, 1.078)	1.006 (0.781, 1.295)	0.042 (-0.136, 0.220)	0.007
High school education or more (no = 0, yes = 1)	1.118 (0.726, 1.720)	0.702 (0.337, 1.461)	0.262 (-0.223, 0.746)	0.042
Has diabetes	0.919 (0.448, 1.885)	1.117 (0.384, 3.252)	-0.196 (-1.092, 0.699)	-0.030
Has congestive heart failure	0.854 (0.322, 2.265)	0.599 (0.124, 2.901)	-0.125 (-1.231, 0.981)	-0.019
Self-reported health status <i>Excellent (reference group)</i>				
Very good	1.211 (0.594, 2.471)	1.289 (0.334, 4.967)	0.188 (-0.603, 0.978)	0.032
Good	1.427 (0.697, 2.922)	1.280 (0.326, 5.017)	0.366 (-0.431, 1.163)	0.065
Fair or poor	2.463 (1.168, 5.196) <sup>†</sup>	3.731 (0.996, 13.982)	1.387 (0.554, 2.220) <sup>†</sup>	0.376
Constant	—	—	-2.706 (-4.013, -1.400) <sup>†</sup>	
Log $\alpha$ (neg Bin only)	—	—	1.841	
Observations	874	919	919	919

95% confidence intervals in parentheses.

\*Marginal effects are calculated as the average predicted change.

<sup>†</sup>Significant at 5%.

<sup>‡</sup>Significant at 1% (2-tailed test).

OAB indicates overactive bladder.

fall-related injuries ( $P < .01$ ), and had marginally significant higher odds of bone fracture due to a fall ( $P < .1$ ) (Table 3).

In a sensitivity analysis, removing 5% of the high-leverage cases, as identified with Cooks distance, had little effect on the coefficients. The most notable change was whether this study controlled for self-reported health status. When this variable was not included in the analysis, the effects were larger and more significant. For example, without controlling for health status, people with OAB had 63% higher odds of having an injurious fall in the past year ( $P = .02$ ). Although including health status may overadjust the results and remove covariance associated with OAB, this study provides a conservative estimation. Tables 2 and 3 report the regressions that controlled for health status.

In the main analysis, we included all cases and controls. Twenty-four OAB cases reported current use of tolterodine tartrate or oxybutynin, and of these only 12 had more than 2 months of use. Excluding these treated cases had little effect on the results.

Combining marginal effects from the regression models with unit costs and OAB prevalence estimates allowed us to calculate the costs of UTIs and falls associated with OAB. These costs totaled \$1.79 billion (year 2000 dollars), approximately \$53 per person with OAB. Of these costs, 83% (\$1.49 billion) were incurred by women. The costs of injurious falls and fractures associated with OAB were \$423 million. The cost of fractures was \$368 million; its inclusion in the total cost is debatable given that the logistic regression for fractures was marginally significant due to the limited sample size.

### Conclusion

These nationally representative data indicate that people with OAB are at increased risk for UTIs and for being injured in a fall. Although these complications have been reported for people with urinary incontinence, this is the first study to find that these problems are associated with OAB. In addition, these data show that people with OAB make more

visits to their physicians than people without OAB.

Although this study found that people with OAB are at greater risk of bone fracture from a fall, this effect was only marginally significant because of the rarity of the event and our limited sample size. It is expected that this effect would have been significant with a larger sample because recent research has found that women with urge incontinence were more likely to fall and fracture a bone than people without urge incontinence.<sup>16</sup>

One limitation of this study is that data are all based on self-report. This has 2 implications. First, although people were asked about doctor-identified UTIs, the UTIs were not confirmed by culture. From a clinical perspective, a urine culture would be ideal to determine the presence of a UTI. However, from a health services perspective, self-report may be valid as physicians often provide UTI treatment based solely on clinical assessment or telephone consultation.<sup>29</sup> Future studies may want to use administrative laboratory data to confirm these results. However, in most cases, administrative data are not drawn from a random sample, which is one of the strengths of these data.

Second, previous research has shown that self-reported utilization can be inaccurate, especially among people who use a lot of medical care.<sup>30</sup> However, in this study, it was assumed that these biases were consistent in the cases and controls, and that the relative difference between the 2 groups remains unbiased.

The response rates also raise some concern. Fortunately, all of the people who were mailed a questionnaire had completed a previous telephone survey. This provided data to compare respondents with nonrespondents. Compared with all respondents, nonrespondents were more likely to be OAB controls, to be older, and to have a worse self-reported health status. However, nonresponse did not selectively differ between OAB cases and controls; when case and control respondents were compared with case and control nonrespondents, there were no significant differences for age, gender,

educational status, presence of diabetes, presence of congestive heart failure, and self-rated health status.

Administrative data would likely provide a more precise estimate for the cost of UTIs and injurious falls associated with OAB. For the cost estimate the gross-cost method was used.<sup>24</sup> The costs for UTIs and falls attributable to OAB were more than \$1.79 billion dollars in 2000. Most of these costs (76%) were related to UTIs and the remainder was for injurious falls and fractures. These consequence costs are not incurred exclusively by the patient. Payers, including Medicare, Medicaid, and managed care plans, may want to consider paying for OAB treatment if this would reduce UTIs and falls. However, this assumes that UTIs are caused by OAB. While an association between UTIs and OAB exists, the direction of causation remains unclear. Further research is needed to clarify this pathway. If evaluating and treating patients with OAB would reduce these costs, then future research needs to capture these costs in cost-effectiveness analyses. It would also be important for cost-effectiveness analysis to use quality-adjusted life-years as the effectiveness measure, as they can capture, at least partly, the effect of OAB on quality of life.

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#### ... REFERENCES ...

- Brown JS, McGhan WF, Chokroverty S.** Comorbidities associated with overactive bladder. *Am J Manag Care.* 2000;6(suppl 11):S574-579.
- Wein AJ.** Overactive bladder: defining the disease. *Am J Manag Care.* 2000;6(suppl 11):S559-564; discussion S607-619.
- Liberman JN, Hunt TL, Stewart WF, et al.** Health-related quality of life among adults with symptoms of overactive bladder: results from a U.S. community-based survey. *Urology.* 2001;57(6):1044-1050.
- Abrams P, Kelleher CJ, Kerr LA, Rogers RG.** Overactive bladder significantly affects quality of life. *Am J Manag Care.* 2000;6(suppl 11):S580-590.
- Kobelt G, Kirchberger I, Malone-Lee J.** Review. Quality-of-life aspects of the overactive bladder and the effect of treatment with tolterodine. *BJU Int.* 1999;83(6):583-590.
- Hu TW, Wagner TH.** Economic considerations in overactive bladder. *Am J Manag Care.* 2000;6(suppl 11):S591-598.
- Geirsson G, Fall M, Lindstrom S.** Subtypes of overactive bladder in old age. *Age Ageing.* 1993;22(2):125-131.
- Jackson S.** The patient with an overactive bladder—symptoms and quality-of-life issues. *Urology.* 1997;50(suppl 6A):18-22; discussion 23-24.
- Stewart WF, Van Rouyen J, Cundiff G, et al.** Overactive bladder in the United States: what is the burden? Paper presented at: ICS; September 18-21, 2001; Seoul, Korea.
- Milsom I, Stewart W, Thuroff J.** The prevalence of overactive bladder. *Am J Manag Care.* 2000;6(suppl 11):S565-573.
- Payne CK.** Epidemiology, pathophysiology, and evaluation of urinary incontinence and overactive bladder. *Urology.* 1998;51(suppl 2A):3-10.
- Stamm WE, Raz R.** Factors contributing to susceptibility of postmenopausal women to recurrent urinary tract infections. *Clin Infect Dis.* 1999;28(4):723-725.
- Moller LA, Lose G, Jorgensen T.** The prevalence and bothersomeness of lower urinary tract symptoms in women 40-60 years of age. *Acta Obstet Gynecol Scand.* 2000;79(4):298-305.
- Luukinen H, Koski K, Kivela SL, Laippala P.** Social status, life changes, housing conditions, health, functional abilities and life-style as risk factors for recurrent falls among the home-dwelling elderly. *Public Health.* 1996;110(2):115-118.
- Tromp AM, Smit JH, Deeg DJ, Bouter LM, Lips P.** Predictors for falls and fractures in the Longitudinal Aging Study Amsterdam. *J Bone Miner Res.* 1998;13(12):1932-1939.
- Brown JS, Vittinghoff E, Wyman JF, et al.** Urinary incontinence: does it increase risk for falls and fractures? Study of Osteoporotic Fractures Research Group. *J Am Geriatr Soc.* 2000;48(7):721-725.
- Yasumura S, Haga H, Nagai H, Suzuki T, Amano H, Shibata H.** Rate of falls and the correlates among elderly people living in an urban community in Japan. *Age Ageing.* 1994;23(4):323-327.
- Luukinen H, Koski K, Laippala P, Kivela SL.** Factors predicting fractures during falling impacts among home-dwelling older adults. *J Am Geriatr Soc.* 1997;45(11):1302-1309.
- Tinetti ME, Speechley M, Ginter SF.** Risk factors for falls among elderly persons living in the community. *N Engl J Med.* 1988;319(26):1701-1707.
- Perneger TV, Etter JF, Rougemont A.** Randomized trial of use of a monetary incentive and a reminder card to increase the response rate to a mailed health survey. *Am J Epidemiol.* 1993;138(9):714-722.
- Jones R, Pitt N.** Health surveys in the workplace: comparison of postal, email and World Wide Web methods. *Occup Med (Lond).* 1999;49(8):556-558.



22. **Wagner TH, Hibbard JH.** Who uses self-care books, advice nurses, and computers for health information? *Int J Technol Assess Health Care.* 2001;17(4):590-600.
23. **Cameron AC, Trivedi PK.** *Regression Analysis of Count Data.* Cambridge: Cambridge University Press; 1998.
24. **Gold MR, Siegel JE, Russell LB, Weinstein MC, eds.** *Cost-Effectiveness in Health and Medicine.* Oxford: Oxford University Press; 1996.
25. *Redbook.* Montvale, NJ: Medical Economics Company; 2000.
26. **Rizzo J, Friedkin R, Williams C, Nabors J, Acampora D, Tinetti M.** Health care utilization and costs in a Medicare population by fall status. *Med Care.* 1998;36(8):1174-1188.
27. **Reginster JY, Gillet P, Ben Sedrine W, et al.** Direct costs of hip fractures in patients over 60 years of age in Belgium. *Pharmacoeconomics.* 1999;15(5):507-514.
28. **Foxman B, Barlow R, D'Arcy H, Gillespie B, Sobel JD.** Urinary tract infection: self-reported incidence and associated costs. *Ann Epidemiol.* 2000;10(8):509-515.
29. **Saint S, Scholes D, Fihn SD, Farrell RG, Stamm WE.** The effectiveness of a clinical practice guideline for the management of presumed uncomplicated urinary tract infection in women. *Am J Med.* 1999;106(6):636-641.
30. **Wallihan DB, Stump TE, Callahan CM.** Accuracy of self-reported health services use and patterns of care among urban older adults. *Med Care.* 1999;37(7):662-670.

**Appendix: Algorithm for Scoring Overactive Bladder (OAB)**

**FEMALES:**

A composite score was calculated using measures for the following features: leakage, nocturia, distress caused by bladder control problems, bladder surgery, and urgency.

Leakage was defined as a composite score of the following variables:

- Urine loss more than rarely—add 1 point
- Urine loss more than 3 times in the last 4 weeks —add 1 point
- Urine loss more than 14 times in the last 4 weeks—add 1 point
- Urine loss due to dribble—subtract 1 point
- Frequency of urine loss more than rarely—add 1 point
- Urine loss due to physical pressure more than rarely—subtract 1 point
- Urine loss due to sudden, uncomfortable urge more than rarely—add 1 point
- Wore pad more than rarely—add 1 point

Other questions were asked about nocturia, distress, and bladder surgery. One point was added if nocturia, distress, or bladder surgery occurred.

*Nocturia* was defined as urinating more than 14 times at night during the past 4 weeks.

*Distress over bladder control* was measured by “How much does this distress you?” coded moderately (2), quite a bit (3), or extremely (4) distressed.

Urgency was measured with 2 variables:

- Need to urinate: can't wait—add 1 point
- Intensity of the urge to urinate on a 1-10 scale. If 3 or more—add 1 point

These variables were weighted and a cut-off for OAB of 0.58 was set based on a logistic regression sensitivity analysis.

(Continued)

**Appendix:** Algorithm for Scoring Overactive Bladder (OAB) (*Continued*)**MALES:**

OAB in males was defined using measures for frequency, accidental urine loss, severity of the urge to urinate, frequency of urine loss, and annoyance/bother with bladder control issues.

## Frequency:

- If urinated more than 7 time per day—add 1 point
- Lost urine on the way to the bathroom—add 1 point
- Intensity of urge to urinate—5 or more on 10-point scale—add 1 point
- Frequency of more than few drops of urine – more than rarely—add 1 point
- Annoyed by bladder control more than “not at all”—add 1 point

A composite score was calculated and multiplied by a constant derived from logistic regression. A cut-off of 0.16 defined OAB for males.

**OAB-Wet Criteria**

Urinary incontinence (UI) was defined as follows:

Subject answered YES to at least 1 of the screening questions:

- Wore pad in last 4 weeks
- Lost or leaked urine for any reason
- Lost urine on the way to the bathroom
- Lost urine before reaching the bathroom

In addition, the subject had to fulfill *at least 1* of the 5 following criteria:

*UI Criteria 1*

- Wore pad (<1/2 time, >1/2 time, always) AND
- Urine loss because of sudden urge (<1/2 time, >1/2 time, always)

*UI Criteria 2*

- Taking bladder medications: doxazosin mesylate (1), tolterodine tartrate (2), or oxybutynin (3)

*UI Criteria 3*

- Frequency of urine loss (rarely, <1/2 time) AND
- Number of times lost urine (>3)

*UI Criteria 4*

- Frequency of urine loss (rarely, <1/2 time) AND
- Number of times lost urine (unknown) AND
- Wore pad (<1/2 time, >1/2 time, always) OR
- Had bladder problem (2)

*UI Criteria 5*

- Frequency of urine loss (>1/2 time, always) AND
- Number of times lost urine ( $\geq 3$  or unknown)

If either of the following criteria is met, the subject is not thought to have UI:

*Exclusion 1*

- Frequency of urine loss (never) AND
- Number of times lost urine (0 or 1)

*Exclusion 2*

- Lost urine because of physical pressure (always) AND
- Lost urine because of sudden urge (never, rarely)