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# Direct and indirect costs of nephrolithiasis in an employed population: Opportunity for disease management?

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**Direct and indirect costs of nephrolithiasis in an employed population: Opportunity for disease management?**

*Background.* More than 5% of the United States population has been diagnosed with nephrolithiasis and about one half of (first-time) stone formers will have a recurrence within 5 years. The prevalence of nephrolithiasis is concentrated among working age adults, yet little prior work has examined the economic burden of the disease on employers and their employees. We sought to estimate the direct and indirect costs of nephrolithiasis for working age adults (18–64) with employer-provided insurance.

*Methods.* This was an observational study using retrospective claims data. Detailed medical and pharmacy claims from 25 large employers and absentee data from a subset of firms were used to estimate the direct and indirect costs associated with nephrolithiasis in a privately insured, nonelderly population. Multivariate regression models were used to predict health care expenditures for persons with and without the condition, controlling for differences in patient (health status) and plan characteristics.

*Results.* More than 1% of working-age adults were treated for nephrolithiasis in 2000. Prevalence was considerably higher among men and employees age 55 to 64. About one third of employees treated for nephrolithiasis in 2000 missed work due to the condition, with an average work loss for the entire treated population of 19 hours per person. Conditional on receiving treatment, the incremental costs of nephrolithiasis were $3,494 per person in 2000.

*Conclusion.* The direct and indirect costs of nephrolithiaisis are substantial among working-age adults. Interventions that prevent recurrence among known stone formers may be a cost-effective component of disease management programs.

Most chronic conditions such as hypertension, coronary artery disease, type II diabetes, and chronic obstructive pulmonary disease (COPD) affect late middle-aged and older adults. As such, the economic burden associated with these conditions is largely borne by the Medicare program. While nephrolithiasis is far less prevalent in the general population, it is a chronic condition that primarily affects working-age adults [1]. The incidence of nephrolithiasis peaks between the ages of 20 and 60 and 50% of stone formers will have a recurrence within 5 years [2]. Further, recent evidence suggests the prevalence of nephrolithiasis is increasing rapidly [3]. Data from the National Health and Nutrition Examination Survey (NHANES III, 1998–1994) indicate that over 5% of the United States population has been diagnosed with nephrolithiasis in their lifetime, a 77% increase from the prior survey (NHANES II, 1976–1980) [4]. While the disease is more common in men, prevalence is increasing at a faster rate among women [5].

The rising prevalence of nephrolithiasis and the morbidity associated with it suggest that the economic costs of the disease are substantial. Treatment of nephrolithiasis depends on stone size and location, but typically involves a surgical procedure such as extracorporeal shock wave lithotripsy (ESWL), ureteroscopic laser lithotripsy, or percutaneous nephrostolithotomy (PCNL). These procedures require an inpatient or outpatient surgical visit, and postsurgical care. Stones treated conservatively, in expectation of spontaneous passage, can often result in visits to the emergency room for pain control or treatment of nausea and vomiting.

Dietary modifications, including increasing water intake, restricting dietary sodium, and reducing excessive meat consumption can reduce the risk of stone formation [6]. For individuals with specific metabolic abnormalities, medical therapies such as thiazide diuretics and urinary alkalinizing agents can reduce the risk of a second kidney stone [6]. A meta-analysis of 12 randomized controlled prevention trials revealed that prescribing oral medical therapy after a first stone significantly reduced the risk of new stone formation [7].

The rapid adoption of disease management programs over the past 5 years by United States firms has focused almost exclusively on a small number of highly prevalent conditions such as diabetes, asthma, and heart disease.

**Key words:** costs, economics, nephrolithiasis, kidney stones.

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Yet many less prevalent conditions, such as nephrolithiasis, primarily affect working-age adults and have been shown to respond to secondary prevention programs. Quantifying the full economic burden of the disease can help employers determine whether nephrolithiasis is a worthy target for existing disease management programs.

## METHODS

### Case definition

Administrative codes used to identify individuals with nephrolithiasis and procedures used to treat nephrolithiasis are listed in Table 1.

**Table 1.** International Classification of Diseases, 9th ed., and common procedural terminology—4 administrative code–based algorithms used to define cases of nephrolithiaisis

| |
|---|
| Anyone with |
| ICD-9 diagnosis code |
| 592.0 Calculus of kidney (excludes uric acid stone) |
| 592.0 Kidney infection with calculus |
| 592.1 Calculus of ureter |
| 592.9 Urinary calculus, unspecified |
| 274.11 Uric acid nephrolithiasis |
| 270.0 Cystinuria |
| Anyone with the following diagnosis code and any of the following procedure codes, or the procedure code alone |
| 271.8 Hyperoxaluria |
| ICD-9 procedure code |
| 55.03 Percutaneous nephrostomy without fragmentation |
| 55.04 Percutaneous fragmentation with fragmentation |
| 55.92 Repeat nephroscopic removal during current episode |
| 56.0 Transurethral removal of obstruction from ureter and renal pelvis (stone, blood clot, foreign body) |
| 56.2 Ureterotomy for removal of calculus or exploration |
| 59.8 Transurethral manipulation of obstruction from ureter without removal of obstruction |
| 59.8 Transurethral ureteral stent placement for passage of calculus |
| 59.95 Ultrasonic fragmentation of urinary stones |
| 98.51 ESWL |
| CPT code |
| 50060 Nephrolithotomy; removal of calculus |
| 50065 Secondary surgical operation for calculus |
| 50070 Nephrolithotomy complicated by congenital kidney abnormality |
| 50075 Removal of large staghorn calculus filling renal pelvis (includes anatrophic pyelolithotomy) |
| 50080 Percutateous nephrostolithotomy with or without lithotripsy, up to 2 cm |
| 50081 PCNL, over 2 cm |
| 50130 Pyelotomy, with removal of calculus |
| 50590 ESWL |
| 50610 Ureterolithotomy; upper one third of ureter |
| 50620 Ureterolithotomy, middle one third of ureter |
| 50630 Ureterolithotomy, lower one third of ureter |
| 52320 Cysto, ureteral cath, removal of calculus |
| —52325 With fragmentation of calculus (ultrasound or EHL) |
| —52330 With manipulation, but not removal of stone |
| 52335 Cysto with ureteroscopy and diagnostic |
| —52336 With removal of stone |
| —52337 With lithotripsy |
| other related CPT codes |
| 50945 |
| 50135 |
| 50561 |
| 50580 |
| 51060 |
| 51065 |
| 50961 |
| 50980 |

### Data sources

We used two data sources to examine the direct and indirect costs associated with nephrolithiasis in a privately insured, nonelderly adult population (ages 18–64). Data on medical and pharmaceutical use were obtained from Ingenix, Inc. (Salt Lake City, UT, USA), a health benefits consulting firm. Data on work loss associated with the treatment of nephrolithiasis were based on the Medstat Marketscan Health and Productivity Management Database (Marketscan, Ann Arbor, MI, USA).

### Direct costs

We used a data set of medical and pharmacy claims of 25 large United States employers covering 322,556 beneficiaries age 18 to 64 who were continuously enrolled for the entire 2000 calendar year. We excluded dependents and employees age 65 and older because we could not be sure their medical and pharmacy utilization was not covered by other insurance. Claims files captured all health care claims and encounters, including prescription drugs, inpatient, emergency, and ambulatory services. The medical claims included date of service, diagnosis and procedure codes, types of facility, and providers, and expenditures, including billed charges, negotiated discounts, excluded expenses, deductibles, copayments and payments made by the employer, employee, and other third-party coverage. Drug claims included information on the type of drug (drug name, national drug codes, dosage, supply), place of purchase (retail or mail order), and expenditures.

Claims data contain records only for those who used services. To identify those who may not have used services, enrollment data were also obtained. Enrollment files included each person's age, sex, plan type (FFS, PPO, POS, HMO), zip code of residence, and relationship to employee. The claims data were linked with information about plan benefits. Characteristics of the medical benefit included plan deductibles, copayments and/or coinsurance rates for physician office visits and inpatient services, and plan type. The drug benefit design features we coded included copayments or coinsurance for retail pharmacies and whether the plan required generic substitution.

### Indirect costs

We used the Marketscan data to estimate lost work hours associated with the treatment of nephrolithiasis. The Marketscan data link enrollment files, health care claims, and absence data for a subset of private employers. Absence data are derived from employee time-reporting

**Table 1.** (Continued.)

| |
|---|
| Groupings used in analyzing procedure use |
| Procedure: percutaneous nephrostolithotomy |
| ICD-9 procedure codes |
| 55.03 |
| 55.04 |
| CPT procedure codes |
| 50080 |
| 50081 |
| Procedure: open stone surgery |
| ICD-9 procedure codes |
| 56.2 |
| CPT procedure codes |
| 50060 |
| 50070 |
| 50075 |
| 50125 |
| 50610 |
| 50620 |
| 50630 |
| Procedure: extracorporeal shock wave eithotripsy |
| ICD-9 procedure code |
| 98.51 |
| CPT procedure code |
| 50590 |
| Procedure: ureteroscopic lithotripsy |
| ICD-9 procedure code |
| 59.8 |
| 56.0 |
| 59.95 |
| CPT procedure code |
| 52320 |
| 52325 |
| 52339 |
| 52351 |
| 52352 |
| 52353 |

records collected through employer payroll systems and contain detailed information on when employees were out of work, the number of work hours missed, and the reasons for the absences (sickness, short-term disability, vacation, and other types of leave). The work loss related to medical treatment for nephrolithiasis is then estimated by linking reported work absences with the enrollment file and medical claims. We included only those persons fully enrolled in the health plan throughout the year and have an inpatient or outpatient medical claim with a primary diagnosis for nephrolithiasis. Persons on long-term disability or Consolidated Omnibus Budget Reconciliation Act (COBRA) were excluded in our analysis. The study sample includes 834 employees who were treated for nephrolithiasis in 2000 and whose absentee data were available.

## Estimating medical spending

Multivariate regression models were used to predict medical and pharmacy spending in 2000 for persons with and without a primary diagnosis of nephrolithiaisis in the medical claims. The primary outcomes of interest were annual medical and pharmacy expenditures for each person. Expenditures consisted of total annual payments made by the enrollee (copayments, deductibles, excluded expenses) and by all third-party payers (primary and secondary coverage, net of negotiated discounts) for medical services and outpatient prescription drug claims.

We included a detailed set of covariates to control for observed differences between individuals with and without a primary diagnosis of nephrolithiaisis. We used the eligibility file to control for demographic characteristics, such as age, sex, work status (active or retired), urban residence, and median household income in the zip code of residence. The medical claims were used to identify individuals treated for 34 chronic conditions, such as hypertension, diabetes, congestive heart failure, and asthma. A binary indicator for each condition was included in the models. We used the benefits data to control for the generosity of medical and drug coverage. Plan characteristics included individual deductibles, copayments and/or coinsurance rates for medical services and prescription drugs, and a binary indicator for plan type (HMO, POS, PPO, FFS).

We used ordinary least squares (OLS) to estimate medical and drug expenditures for each individual in the sample. The parameter estimates were used to predict average annual spending for persons with and without nephrolithiasis, controlling for other factors known to affect utilization. We chose OLS because it predicted component expenditures better than generalized linear models and other two-part estimators.

## Estimating work loss

In order to estimate work loss, the dates of an inpatient stay or ambulatory visit with a primary diagnosis of nephrolithiaisis were matched to the individual's absence data. Absences associated with a hospitalization included work loss reported between the admission and discharge dates, including days contiguous to those dates. For example, if a person was admitted to the hospital on June 1 with a primary diagnosis of nephrolithiaisis and discharged on June 5, any sick time or short-term disability in that period, as well as on contiguous days before June 1 and after June 5 would be counted. However, work loss reported on June 7 would not be included if the employee did not miss any work time on June 6. Short-term disability hours for individuals whose start date coincided with a hospital admission and for whom there was a return-to-work date were included. Work absences were capped at 12 hours if the beginning and end dates of the absence were the same.

Work absences associated with ambulatory visits were calculated in two ways. The first method includes absences contiguous to the date of the visit. The second, more conservative approach, excludes absences on contiguous days unless there was some work loss on the day

**Table 2.** Prevalence of upper tract nephrolithiaisis [a]

| | Prevalence rate | Number of persons with nephrolithiasis | Full sample persons |
|---|---|---|---|
| Total | 1.12 | 3600 | 322,556 |
| Age | | | |
| 18-44 | 0.80 | 1115 | 138,647 |
| 45-54 | 1.25 | 1311 | 104,549 |
| 55-64 | 1.48 | 1174 | 79,360 |
| Gender | | | |
| Male | 1.46 | 2642 | 180,651 |
| Female | 0.68 | 958 | 141,905 |

[a]Prevalence based on a medical claim in 2000 with a primary diagnosis of upper tract nephrolithiaisis as defined in Table 1. Source: *Ingenix, 2000.*

**Table 3.** Estimated annual expenditures for privately insured people aged 18 to 64 with and without a medical claim for nephrolithiaisis in 2000[a]

| | 2000 annual expenditures (PPPY) | | | |
|---|---|---|---|---|
| | Persons without nephrolithiaisis ($N = 318,956$) | Persons with nephrolithiaisis ($N = 3600$) | | |
| | Total | Total | Medical | Rx drugs |
| All | $3,038 | $6,532 | $5,381 | $1,151 |
| Age | | | | |
| 18-44 | $2,809 | $6,114 | $5,086 | $1,028 |
| 45-54 | $3,278 | $7,093 | $5,777 | $1,316 |
| 55-64 | $3,123 | $6,525 | $5,375 | $1,150 |
| Gender | | | | |
| Male | $2,808 | $6,302 | $5,227 | $1,075 |
| Female | $3,331 | $6,825 | $5,578 | $1,247 |
| Region | | | | |
| Northeast | $2,948 | $6,442 | $5,367 | $1,075 |
| Midwest | $2,962 | $6,456 | $5,369 | $1,087 |
| South | $3,152 | $6,647 | $5,402 | $1,245 |
| West | $2,978 | $6,472 | $5,351 | $1,121 |

[a]Annual expenditures per person. The sample consists of primary beneficiaries ages 18 to 64 with employer-provided insurance who were continuously enrolled in a health plan in 2000. Estimated annual expenditures were derived from multivariate models that control for age, gender, work status (active/retired), median HH income (zip), urban/rural residence, medical and drug plan characteristics (plan type, deductible, coinsurance/copayments), and comorbid conditions. Source: *Ingenix, 2000.*

of the visit (or preceding day). For example, the first approach would count an appropriate work absence (sick leave) on Wednesday associated with a medical visit for nephrolithiaisis on Tuesday. The second approach would not count Wednesday's work loss unless there was an absence on Tuesday as well. If two outpatient visits occurred in the span of one absence, then hours absent before the first visit counted toward the first visit, and hours absent after the second visit counted toward the second visit. The hours of work lost between the visits counted toward the closest visit. In the event of a tie, the hours were assigned to the first visit.

We used the Stata statistical software package (StataCorp LP, College Station, TX, USA) to conduct above-mentioned statistical analyses.

## RESULTS

The overall prevalence in the Ingenix sample of 322,556 individuals was 1.1%. Prevalence among males was approximately double that of females (1.5% vs. 0.7%) and increased by about 85% from the youngest to the oldest age group (Table 2).

### Direct costs

Annual health care expenditures for a person with a primary diagnosis of nephrolithiaisis were more than double those without such a claim after adjusting for patient demographics, comorbid conditions, and the generosity of health benefits. Adjusted mean annual expenditures were $3038 for working-age adults without a medical claim for nephrolithiasis in 2000 versus $6532 for similar adults with the condition (Table 3). Persons with a primary diagnosis of nephrolithiaisis in 2000 incurred medical expenses of $5381 (82% of total) on average and prescription drug expenses of $1151 (18%). Comparative estimates for similar adults without nephrolithiasis were $2138 and $900, respectively. Differences in spending varied only modestly by age, region of the country, and sex. Females incurred slightly higher expenditures than males. Total medical expenditures were modestly higher in the South (about $200 per person, per year), regardless of treatment for nephrolithiasis.

Approximately 25% of individuals with a diagnosis of nephrolithiasis had a claim for surgical treatment of the condition (Table 4). Rates of use for ureteroscopic lithotripsy and ESWL were considerably higher than for PCNL and open stone surgery. Average expenditures for specific procedures used to treat nephrolithiasis varied from $3624 per PCNL procedure to $1425 per ureteroscopic lithotripsy procedure (Table 4). Subjects undergoing ureteroscopic lithotripsy had lower requirements for a second procedure. The mean number of procedures per patient undergoing ureteroscopic lithotripsy was 1.12, as compared with 1.22 and 1.26 for ESWL and PCNL, respectively (Table 4).

### Indirect costs

We also examined the impact of nephrolithiasis on work loss among 834 employees with complete absentee data (Table 5). Overall, 30% missed work related to their condition, with an average work loss of 19.0 hours per year for the full entire study sample (95% CI 14.5–23.3). Average work loss associated with an inpatient hospitalization for nephrolithiaisis was 47.9 hours (95% CI 30.9–64.9) (Table 6). Similarly, average work loss associated with an ambulatory care visits for nephrolithiasis was 5.1 hours (95% CI 4.4–5.9) (Table 7).

**Table 4.** Procedure use, expenditures, and need for repeat treatment in individuals with nephrolithiasis

| Procedure type | Rate per 100,000 individuals with nephrolithiasis | Average expenditure per procedure | Mean number of procedures per person having the procedure |
|---|---|---|---|
| Total | 24,514 (22,819-26,209) | $1,947 | |
| Percutaneous nephrostolithotomy | 690 (409-970) | $3,624 | 1.26 |
| Open stone surgery | 104 (13-196) | $2,916 | 1.00 |
| Extracorporeal shock wave lithotripsy | 12,769 (11,605-13,933) | $2,295 | 1.22 |
| Ureteroscopic lithotripsy | 10,930 (9930-11,930) | $1,425 | 1.12 |

**Table 5.** Average annual work loss for persons treated for upper tract nephrolithiasis

| Condition | Number of persons[a] | % Missing work | Average work absence (hours) | | |
|---|---|---|---|---|---|
| | | | Inpatient | Outpatient | Total |
| Nephrolithiasis upper tract | 834 | 30.0% | 4.4 (2.5-6.3) | 14.6 (11.5-17.7) | 19.0 (14.5-23.5) |

[a] Unit of observation is an individual with an inpatient or outpatient claim for nephrolithiasis and for whom absence data were collected. Work loss based on reported absences contiguous to the admission and discharge dates of each hospitalization and outpatient visit. 95% confidence interval in parentheses. Source: *Marketscan, 1999*.

**Table 6.** Average work loss associated with a hospitalization or an ambulatory care visit for upper tract nephrolithiasis

| Condition | Inpatient care | | Outpatient care | |
|---|---|---|---|---|
| | Number of hospitalizations[a] | Average work absence (hours) | Number of outpatient visits | Average work absence (hours) |
| Nephrolithiasis upper tract | 77 | 47.9 (30.9-64.9) | 2,373 | 5.1 (4.4-5.9) |

[a] Unit of observation is an episode of treatment. Work loss based on reported absences contiguous to the admission and discharge dates of each hospitalization and outpatient visit. 95% confidence interval in parentheses. Source: *Marketscan, 1999*.

**Table 7.** Average work loss associated with a hospitalization or an ambulatory care visit for upper tract nephrolithiasis

| Condition | Inpatient care | | Outpatient care | |
|---|---|---|---|---|
| | Number of hospitalizations[a] | Average work absence (hours) | Number of outpatient visits | Average work absence (hours) |
| Nephrolithiasis upper tract | 77 | 47.9 (30.9-64.9) | 2,373 | 5.1 (4.4-5.9) |

[a] Unit of observation is an episode of treatment. Work loss based on reported absences contiguous to the admission and discharge dates of each hospitalization and outpatient visit. 95% confidence interval in parentheses. Source: *Marketscan, 1999*.

### Cost-effectiveness

Our estimates of direct and indirect costs suggest that reducing the recurrence of nephrolithiasis in known stone formers may be cost-effective for employers. Based on a 6-year panel of employer data, about 60% of individuals with a medical claim for nephrolithiasis were first time stone formers (based on the absence of a related claim in the previous 5 years). Applying this estimate to our sample of 3600 individuals treated for nepholithiasis in 2000 suggests that 1440 were recurrent stone formers. This group would reflect the "target population" for a disease management program. Prior evidence suggests that 50% of stone formers will have a recurrence within 5 years [8]. If we assume the rate of recurrence is linear over this time, then 144 recurrences will be treated in the first year alone ($1440 \times .5 \times .2$). If 75% of these cases [10] could be prevented with proper dietary and medical therapy, the total savings to the employer through the reduction in direct and indirect costs would be over $440,000 in the first year (108 cases averted; $3494 per case in direct costs; 2.375 lost work days per case). Under these assumptions, an intervention costing $300 per person per year would pay for itself, and could generate additional cost-savings over a longer time frame given the expected increase in known stone formers in subsequent years. However, costs for current medical therapies aimed at stone prevention generally exceed $300 per person per year. Further research into less expensive alternatives (such as fresh lemonade, which increases urinary citrate [9]) is indicated.

## DISCUSSION

We found that in a population of more than 300,000 primary beneficiaries with employer-sponsored health

insurance, a diagnosis of nephrolithiasis resulted in an additional $3494 in health care expenditures in 2000 compared to a similar population without nephrolithiasis. Given that 3600 individuals in this group were treated for nephrolithiasis, the total costs associated with nephrolithiasis exceeded $12.6 million in the study population.

Applying national estimates of the working-age population to prevalence data in our sample suggests that more than 1.3 million people in the labor force ages 18 to 64 receive treatment for nephrolithiasis in a given year. Given an incremental cost of $3494 per person, total health care spending in the United States for evaluation, hospitalization, and treatment of nephrolithiasis is approximately $4.5 billion annually in the employed population. In addition, we estimate that treatment of nephrolithiasis is associated with 3.1 million lost workdays per year (among the privately insured). If each day of work costs an employer $250, a conservative estimate, the indirect costs of nephrolithiaisis are approximately $775 million per year [11].

In our study, ESWL and ureteroscopic lithotripsy were strongly favored over PCNL and open stone surgery in the treatment of subjects with nephrolithiasis. Open stone surgery was vanishingly rare, consistent with best practice guidelines that consider open surgery to be a treatment of last resort [10]. PCNL is more technically challenging than ureteroscopic lithotripsy or ESWL, and is generally only indicated for large renal pelvis stones, which may explain its low utilization rate. Evidence suggests that PCNL is the preferred mode of therapy for renal pelvis stones >1.5 cm in size or in certain lower pole stones due to the need for frequent retreatment compared with ESWL, and that it is underutilized compared to ESWL in these settings [11]. However, our study showed a similar rate of retreatment for both ESWL and PCNL, perhaps reflecting the community-setting results of a technique demonstrating higher efficacy in the setting of academic clinical trials. Retreatment rates were lowest for ureteroscopic lithotripsy, which also incurred the lowest average payment. However, our study cannot control for critical factors that influence retreatment rates, including stone size, location, and composition. It also cannot control for patient preferences in regards to modality of treatment.

Despite the increasing prevalence of nephrolithiasis in the United States, few prior studies have examined the economic burden of the disease. A study by Shuster and Scheaffer surveyed a large number of patients hospitalized with nephrolithiasis in the Carolinas and the Rocky Mountain region. They estimated that the national cost of stone disease was about $315 million for white males age 18 to 60 [12]. However, these data are more than 20 years old, and thus are primarily of historic interest given the dramatic changes in prevention and treatment of nephrolithiasis since that time.

More recently, Clark et al examined the economic costs associated with evaluation and treatment of upper urinary tract calculi in the United States. They estimated the direct and indirect cost of nephrolithiaisis was $1.83 billion in 1993 dollars, with direct costs comprising more than 90% of the total [13].

Our estimate of $5.3 billion per year is considerably higher than Clark et al's figure for several reasons. First, our data are more recent (2000) and include a period of rapid growth in medical spending. Second, the two studies use different methods in measuring costs. Clark et al use average charges to estimate inpatient costs and price fees from military hospitals to compute physician fees and outpatient costs. They also rely on expert opinion to estimate lost work days attributable to nephrolithiaisis. In contrast, we use actual reimbursements to estimate the costs of each service, and we link absentee data to service use to provide more precise estimates of the indirect costs associated with the treatment of nephrolithiaisis.

How does the economic burden of nephrolithiasis compare with other chronic conditions? The incremental costs of nephrolithiasis exceed that of irritable bowel syndrome, as measured in an employed population similar to that of this study [14]. While the incremental costs of nephrolithiasis are comparable to other conditions such as diabetes and asthma [15, 16], total expenditures are much lower due to its relatively lower prevalence.

## LIMITATIONS

Our study has several limitations. First, our data include a sample of large employers from all regions of the country. However, they are not nationally representative. Our estimates may overstate the true burden of disease if these firms provide more generous insurance coverage or facilitate access to more expensive providers and facilities than the national employed population. Second, we identified individuals receiving treatment for nephrolithiaisis based on a primary diagnosis for the condition as reported in the medical claims. Claims data do not capture the severity of illness, nor do they allow us to ascertain with certainty whether work absences were directly related to the treatment of nephrolithiaisis. Finally, we used multivariate models to estimate the incremental costs associated with nephrolithiasis. Although these models included a large set of covariates and binary indicators for comorbidities, there may be unmeasured factors that affect the use of medical services differentially across groups that were omitted from our analysis.

## CONCLUSION

Treatment of nephrolithiaisis places a significant burden on employees and their employers. Taken together, the direct and indirect costs of nephrolithiaisis in the

private sector are estimated to exceed $5.3 billion in 2000. Given recent evidence of the effectiveness of secondary preventative treatment strategies among known stone formers, disease management efforts may be cost-effective in a working-age population.

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