



Work absence and productivity loss of patients undergoing a trial of spontaneous passage for ureteral stones

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Abstract

Patients with ureteral stones are often managed with a spontaneous trial of passage. While cost effective, the current literature has not examined the effects of a trial of passage on patients' work productivity. In this study, we aim to characterize work absence and productivity losses in a cohort of patients undergoing a trial of passage for ureteral stones. Actively employed patients aged 18 to 64 and discharged from Duke emergency departments without surgical intervention for ureteral stones ≤ 10 mm were contacted by phone four weeks after their presentation. Participants completed the Institute for Medical Technology Assessment Productivity Cost Questionnaire which assesses three domains: absenteeism — missed work; presenteeism — productivity when returning to work; and unpaid work — assistance with household work. Linear regression associated demographic and stone factors with productivity losses. 109 patients completed the survey. In total, 67% of patients missed work, 46% had decreased productivity when returning to work, and 55% required assistance with unpaid work. 59% of patients with stones ≤ 5 mm missed work versus 84% with stones > 5 mm ($p=0.009$). African American race (coefficient 23.68, 95% confidence interval 2.24–45.11, $p=0.031$), first-time stone formers (coefficient 20.28, 95% confidence interval 2.50–38.07, $p=0.026$), and patients with stones > 5 mm (coefficient 25.34, 95% CI 5.25–45.44, $p=0.014$) were associated with increased productivity losses. The majority of patients miss work while undergoing a trial of passage and many have decreased productivity when returning to work. This information may help counsel patients in emergency departments, especially first-time stone formers, and prevent return visits.

Keywords Kidney calculi · Cost of Illness · Adult

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Introduction

Nephrolithiasis affects almost 9% of the U.S. population with an expected economic burden of at least \$3 billion by 2030 [1, 2]. Many patients with an obstructing ureteral stone present to an emergency department (ED), resulting in 1.2 million visits annually [3]. Patients with well controlled pain and without signs of infection or renal failure are often offered a trial of spontaneous stone passage. Guidelines recommend observation or medical expulsive therapy for ureteral stones ≤ 10 mm which has been shown to be cost effective and safe compared to urgent surgical intervention [4–6].

While studies have evaluated a trial of passage in regards to health system expenditures, the effects of a trial of passage on patients and their lifestyles remain largely unexplored. Patients with nephrolithiasis are increasingly recognized to suffer from financial toxicity and have worse quality of life compared to healthy patients [7, 8]. In addition to the direct costs associated with medical care, patients may experience indirect costs such as lost income from missed work or requiring caregivers to miss work due to their illnesses. Work absence may particularly affect patients of low socioeconomic status who have less of a financial buffer or those who are self-employed.

Information on work absence may help counsel patients on options for management of their ureteral stones while in the emergency department. Knowledge of expected time off work may help patients choose between primary endoscopic management and a trial of spontaneous passage. Additionally, setting accurate patient expectations may help prevent return visits to the ED. Using a prospective survey, we characterize work productivity losses for patients undergoing a trial of spontaneous passage for ureteral stones.

Methods

The Duke University Health system consists of three hospitals: a quaternary referral center, a metropolitan community hospital, and a suburban community hospital. We identified actively employed patients from ages of 18 to 64 presenting to Duke University EDs with ureteral stones confirmed by computerized tomography (CT) scans between February 7, 2022 and February 7, 2023. Patients were excluded if they were non-English speaking or had bilateral ureteral stones. To identify patients who were discharged from the ED on a trial of passage, we excluded any patients admitted to the hospital or those who underwent procedural intervention (ureteral stent placement, ureteroscopy, or percutaneous nephrostomy tube placement) during the initial presentation to the ED. Patients with stones > 10 mm were also

excluded, as these would not be expected to pass spontaneously. Observation status for patients was allowed. Only the initial ED visit was used to determine eligibility for the study, however we also identified patients with subsequent ED presentations and those requiring intervention or admission during subsequent episodes of care.

Using the primary phone number provided at the time of ED presentation, all patients were contacted by phone four weeks following their initial ED presentation. For those that did not initially answer, we again attempted phone contact one week later. Participants were consented by phone for the study. Participants were verbally asked the Institute for Medical Technology Assessment Productivity Cost Questionnaire (PCQ), a validated survey to assess health related productivity losses [9]. The survey has been validated to assess health related productivity losses and assess three domains: absenteeism — missed work following the ED visit; presenteeism — reduced productivity when returning to work; and loss of productivity related to requiring assistance with unpaid work — such as household work, child care, and volunteer work. Participants were also asked if they were a first-time stone former, if they had sick leave through their work, income and household demographic information, and how many hours and days a week they worked. Patients could opt out of providing annual income. Number of work hours per day were calculated by dividing the hours per week by the days per week worked. Subjective passage of the stone was assessed and defined as visualizing the stone in a toilet or a distinct time point where symptoms resolved and did not return. Patients undergoing surgical intervention, whether elective or urgent, after being discharged from the ED were identified. These patients were classified as having not passed their stone. We also identified patients on an alpha blocker at the time of ED presentation or prescribed an alpha blocker. Demographic information was obtained from the patient's medical record.

Charlson comorbidity index was calculated based on the patient's history in the medical record [10]. Stone characteristics including size and location were measured by the research team from CT scans at the time of ED presentation. Stone size was measured as the largest diameter on either coronal or axial views. Patients were divided into two groups based on size of the stone. Patients with size ≤ 5 mm are expected to have a higher chance at passing their stone compared to patients with stone size > 5 mm. Size cutoffs were drawn from the SUSPEND trial [11]. Stones below the iliac vessels were determined to be distal, with those above the vessels characterized as proximal. Patients were deemed to have an additional ED visit within 30 days of the first ED visit if they presented to a Duke ED for any reason within 30 days.

Primary endpoints included the percentage of patients reporting absenteeism, presenteeism, and loss of unpaid work. For patients who reported productivity losses, we also evaluated the number of days this occurred while undergoing spontaneous passage of their stone. Secondary endpoint was the total productivity loss measured in hours. Total productivity losses were calculated with the following

equation: ((number of days absent) x (hours per day of work)) + ((days of productivity affected) x (1-(percentage of productivity on days productivity was affected)) x (hours per day of work)) + ((number of days of assistance with unpaid work) x (hours per day of assistance with unpaid work)). If a patient underwent surgery after the initial ED visit, productivity losses included time spent recovering from surgery. Chi-squared tests were used to compare the number of patients with productivity losses between those with stones ≤ 5 mm and those with stones > 5 mm. Linear regression was used to associate age, sex, race, health insurance, primary income earner, first-time stone former, stone size, and stone location with total productivity losses. Statistical analysis was performed with Stata 15.1 (College Station, TX). This study was approved by the Duke University Institutional Review Board (Pro00109982).

Table 1 Characteristics of survey participants ($n=109$)

Variable	<i>n</i> (%)
Age, mean (standard deviation)	41 (12)
Sex, male	68 (62)
Race	
• White	70 (64)
• African American	29 (27)
• Asian	3 (3)
• Other/unknown	7 (6)
Ethnicity	
• Not Hispanic/Latino	99 (91)
• Hispanic/Latino	4 (4)
• Not reported	6 (6)
Health Insurance	
• Private	90 (83)
• Medicaid	6 (6)
• Uninsured	13 (12)
Education	
• Some high school	1 (1)
• Completed high school	7 (6)
• Some college or associates degree	44 (40)
• Complete college	35 (32)
• Graduate or professional degree	22 (20)
Paid sick leave through work	71 (65)
Primary income earner	87 (80)
Household members, median (IQR)	3 (2–4)
Annual household income, median (IQR)	\$85,000 (\$55,000–150,000)*
Work days per week, median (IQR)	5 (5–5)
Work hours per week, median (IQR)	40 (40–50)
Charlson Comorbidity index, median (IQR)	0 (0–1)
First-time stone former	55 (50)
Stone size	
• ≤ 5 mm	76 (70)
• > 5 mm	33 (30)
Stone location	
• Proximal	32 (29)
• Distal	77 (71)
Alpha blocker prescription	85 (78%)
Stone symptoms at time of survey	22 (20)
Passed stone at time of survey	69 (63)
Days until stone passed, median (interquartile range)	3 (1–7)
Surgical procedure prior to survey	12 (11)
Days until surgical procedure, median (IQR)	21.5 (8–26.5)
Additional ED visit within 30 days of first visit	16 (15)

* $n=92$ for annual household income as 17 patients opted out of providing this information

Results

A total of 404 patients met initial screening criteria. We were able to contact 180 (45%) patients and 109 (27%) patients agreed to participate. Patient demographic variables are shown in Table 1.

Patients had an average age of 41 (standard deviation 12 years), were 62% (68/109) male, and 64% (70/109) white. 70% (76/109) of patients had stones ≤ 5 mm and 71% (77/109) were located in the distal ureter. For patients with stones ≤ 5 mm, 72% (55/76) of patients reported stone passage, and median time to passage was 3 days (interquartile range [IQR] 1–5 days). For patients with stones > 5 mm, 42% (14/33) of patients reported stone passage, and median time to passage was 8.5 days (IQR 3–21 days). In total, 11% (12/109) of patients had surgery before the time of survey with a median of 21.5 days (IQR 8–26.5 from the ED visit to surgery). Additionally, 15% (16/109) had an additional ED visit within 30 days of their initial visit.

The number of patients who endorsed decreased productivity based on the domains of the PCQ are shown in Table 2.

In total, 67% (73/109) of patients missed work, 46% (50/109) of patients had decreased productivity when returning to work, and 55% (60/109) required assistance with unpaid work. Out of the entire cohort, 13% (14/109) of patients did not have any productivity losses. Compared to those with stones > 5 mm, patients with stones ≤ 5 mm were less likely to miss work (59% vs. 84%, $p=0.009$). For patients who had work productivity losses, answers from the PCQ stratified by stone size are shown in Supplemental Table 1.

The number of days affected for each PCQ category are shown in Fig. 1.

Table 2 Number of patients who endorsed decreased productivity by stone size

Absenteeism	Total Cohort <i>n</i> = 109	Stone \leq 5 mm <i>n</i> = 76	Stone $>$ 5 mm <i>n</i> = 33	<i>p</i> *
• Missed work, <i>n</i> (%)	73 (67)	45 (59)	28 (84)	0.009
Presenteeism				
• Decreased productivity, <i>n</i> (%)	50 (46)	37 (49)	13 (42)	0.373
Assistance with unpaid work				
• Required assistance with unpaid work, <i>n</i> (%)	60 (55)	45 (59)	15 (45)	0.187

**p* values calculated with chi-squared test

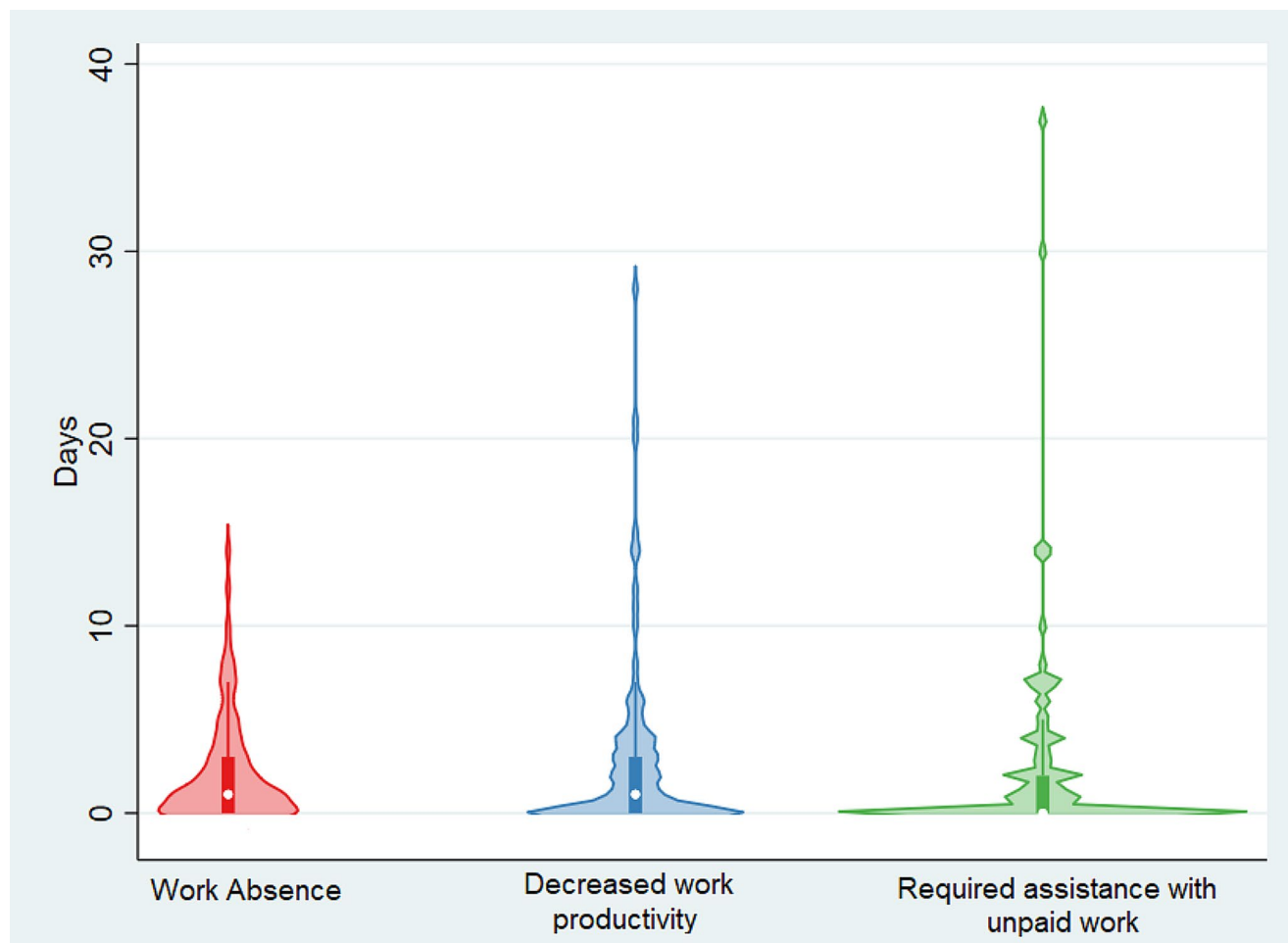


Fig. 1 Number of patients who report each number of days absent from work, days of decreased productivity and days requiring assistance with unpaid work

Patients who reported a work absence with stones \leq 5 mm missed a median of 2 days of work (interquartile range [IQR] 1–3 days). Those with stones $>$ 5 mm missed a median of 3 days (IQR 1–7 days) of work.

In total, 49% of patients with stones \leq 5 mm reported decreased productivity at work compared to 42% for those with stones $>$ 5 mm ($p=0.373$). Decreased productivity was reported for a median of 3 days (IQR 2–5 days) for stones \leq 5 mm and a median of 4 days (IQR 2–7 days) for stones $>$ 5 mm. Assistance with unpaid work was reported by 59% of patients with stones \leq 5 mm and 45% of patients

with stones $>$ 5 mm ($p=0.187$). For all patients, total losses were a median of 16 h (IQR 5–33) for stones \leq 5 mm and a median of 37 h (IQR 12–72) for patients with stones $>$ 5 mm.

Results of the linear regression for total productivity losses are shown in Table 3.

First time stone formers were associated with higher productivity losses compared to recurrent stone formers (coefficient 20.28, 95% confidence interval [95% CI] 2.50–38.07, $p=0.026$). Additionally, African American race (coefficient 23.68, 95% CI 2.24–45.11, $p=0.031$) and patients

Table 3 Factors associated with hours of productivity loss

Variable	Coefficient (95% CI)	<i>p</i>
Age	-0.61 (-1.44, 0.22)	0.149
Sex		
• Male	-	-
• Female	4.76 (-13.44, 22.96)	0.605
Race		
• White	-	-
• African American	23.68 (2.24, 45.11)	0.031
• Asian	21.67 (-32.19, 75.52)	0.427
• Other/unknown	-0.17 (-37.73, 37.39)	0.993
Health Insurance		
• Private	-	-
• Medicaid	-24.96 (-64.16, 14.25)	0.209
• Uninsured	0.21 (-27.63, 28.04)	0.988
Primary income earner		
• No	-	-
• Yes	1.81 (-21.06, 24.67)	0.875
First time stone former		
• No	-	-
• Yes	20.28 (2.50, 38.07)	0.026
Stone size		
- ≤5 mm	-	-
- >5 mm	25.34 (5.25, 45.44)	0.014
Stone location		
• Distal	-	-
• Proximal	13.60 (-6.04, 33.25)	0.173

with stones > 5 mm (coefficient 25.34, 95% CI 5.25–45.44, $p=0.014$) were associated with higher productivity losses.

Discussion

This novel study examining work productivity loss during a spontaneous trial of passage for ureteral stones demonstrates that the majority of patients miss work following an ED visit though most return to work within a couple days. Patients returning to work still demonstrate a decrease in productivity and require help with daily tasks at home while undergoing a trial of passage.

Financial toxicity has become an important healthcare consideration. It is divided into multiple components such as direct and indirect costs. Direct costs include the patient payments for surgery, imaging, medications, and office visits. Indirect costs include less tangible items, such as time off work, drive time to appointments, and cost of caregiver support. Nephrolithiasis affects patients of working ages and approximately 50% of first-time stone formers will go on to form another stone [12, 13]. Financial toxicity is an especially relevant and recurrent problem for this population. In a sample of privately employed patients, approximately 30% of patients missed work due to nephrolithiasis and missed 19 h of working time annually [14]. However,

this study did not stratify missed work by office visits versus surgical care. In addition, Cabo et al. found that 25% of patients with nephrolithiasis met criteria for financial toxicity using a large online survey [7]. This was followed up with a cross-sectional primary study at their clinic which demonstrated 20% of patients seeking care for nephrolithiasis experience financial toxicity [15]. Indirect costs contribute to financial toxicity, however have not been studied in nephrolithiasis. Patients of low socioeconomic status may be particularly vulnerable to indirect costs. They may have less savings to fall back on, increasing the importance of each working day. They are also less likely to have paid leave [16]. Our study highlights the burden of indirect costs for patients undergoing a trial of stone passage. After being discharged from the ED, the majority of patients miss work, even those with small stones that are expected to pass.

The expectation of productivity loss should factor into shared decision making while in the ED. First-time stone formers had higher productivity losses which indicates that expectations and coping strategies may reduce productivity losses for recurrent stone formers. We also found that African American patients had higher total productivity losses. Previous studies have shown that African American patients receive less opioids in emergency departments and were less likely to receive ketorolac for nephrolithiasis, however this study did not assess outpatient prescriptions [17]. Amongst visits for all pain conditions, whites have been shown to have increased prescription of opioids compared to African Americans, Hispanics, and Asians [18]. It is possible that inadequate pain control leads to increased productivity losses in African Americans undergoing a trial of passage. Additionally, almost half of patients will have decreased productivity, when returning to work. Productivity losses may significantly affect patients who may be self-employed or rely on revenue generation for their compensation. Finally, our data shows that the majority of patients will rely on social support for unpaid labor such as chores around the house, taking care of children, or getting groceries. Patients who live alone may find these tasks especially difficult when undergoing a trial of passage. Caregivers who must take off work may decrease the total household productivity and further contribute to financial burden.

Our results have several implications for counselling in emergency departments. Approximately 11% of patients with ureteral stones present back to EDs within 30 days, usually due to recurrent pain [19]. Primary emergent ureteroscopy has been shown to be safe with a stone free rate of 90% [20]. Patients who cannot miss work may view primary surgical treatment as an alternative to expulsive therapy for their stone. However, patients undergoing ureteroscopy may have a ureteral stent which can continue to cause pain and impact quality of life through post-operative day 7 [21].

In our study, patients who reported work absence missed a median of 2 days of work which, based on pain duration with a ureteral stent, may be less than those undergoing primary surgical treatment. Adding 2 days of work absence and 3 days of decreased productivity together yields 5 days of impairment following an acute stone episode, which is similar to when pain intensity returns to baseline after ureteroscopy and stent placement [21]. Patient knowledge that they may miss work or have decreased productivity may prevent return ED visits. Patients with stones > 5 mm may be candidates for primary ureteroscopy, however we demonstrate that 42% of these patients report passing their stone and they only miss a median of 3 days of work. While, patients with stones > 5 mm may still be candidates for delayed elective surgery over primary urgent ureteroscopy, both physicians and patients should understand that these individuals have higher productivity losses compared to those with stones ≤ 5 mm. Indirect costs, such as work absence, are important primary endpoints for future comparative studies between spontaneous trial of passage and primary surgical treatment of ureteral stones.

This study has several limitations. As a survey, it relies on accurate patient responses and does not use employer collected data. It is subject to recall bias as the severity of stone event may affect how patients remember their missed working days, productivity, or help around the house. Response bias may influence our results as we were able to contact 45% of eligible patients, of whom 61% agreed to participate. Subjective stone passage or resolution of symptoms may not correspond with actual stone passage and some of these patients may develop “silent hydronephrosis.” However, resolution of stone symptoms may be a more important measure when assessing decreased productivity in patients undergoing a trial of passage as this is likely what drives return to work over actual passage of the stone. Work absence may be underestimated as some patients may undergo their trial of passage on weekend days or vacation days where they were not scheduled to work. While we only include working patients in our study, we do not stratify by the type of work. Those that are self-employed may be less likely to miss work as there is not backup. Additionally, we did not assess whether manual labor affects missed work compared to those that work from home or have a non-manual labor job. Income dependence may influence patients to work, even when in pain. The median income in our study was \$85,000 which is greater than the U.S. median of \$74,580 [22]. However, 17 patients declined to provide information on annual household income, so we could not evaluate the effect of income on productivity losses. This may reflect our study using a single academic hospital system. Our results may be affected by the local demographic and socioeconomic factors. While our demographics are

similar to the overall employed population, the results may not be generalizable to all individuals [23]. Our work focuses on the patient impact of ureteral stones, however other institutions such as employers and society are also affected. Employees may be paid in differing ways, whether that be salaried or hourly wage. Thus, we chose to quantify productivity losses and are unable to calculate indirect financial costs to employees or employers. Finally, we were only able to measure repeat ED visit to Duke affiliated facilities. This may be an underestimate as some patients may present to other emergency departments not captured in our medical record.

Conclusions

Patients presenting to emergency departments with ureteral stones and undergoing a trial of passage should expect to miss work and have decreased productivity when they return to work. This information may inform shared decision making in EDs and help prevent return visits.

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Declarations

Competing interests The authors declare no competing interests.

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