

# NEPHROLITHIASIS IN VIETNAM: AN ANALYSIS OF TREATMENT COSTS IN A UROLOGICAL HOSPITAL

Trung Quang Vo (PhD. Pharm)

Department of Economic and Administrative Pharmacy (EAP), Faculty of Pharmacy, Pham Ngoc Thach  
University of Medicine, Ho Chi Minh City 700000, Vietnam

Address: 01 Duong Quang Trung Street, Ward 12, District 10, Ho Chi Minh City 700000, Vietnam

Phone: +84.2838.668.019, Fax: +84.28.38.650.025; Mobile: +84.988.422.654

Email: voquangtrungdk@gmail.com

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## **ABSTRACT**

**Background:** *Nephrolithiasis imposes a weighty economic burden on individuals and their families, the healthcare system and society.*

**Objectives:** *This study was aimed at assessing the costs of treating nephrolithiasis and deriving data on the economic burden of kidney stone disease in actual clinical practice in Vietnam.*

**Methods:** *This prospective study was grounded in a prevalence- and social perspective-based approach and was conducted in 2017 to estimate the direct and indirect costs incurred from nephrolithiasis treatment.*

**Results:** *The pre-hospital costs borne by inpatients and outpatients in 2017 were 3,087,260 and 3,031,427 VND, respectively, out of which indirect expenses accounted for the highest proportion at over 80% in both groups. The average costs of hospital treatment incurred by the inpatients and outpatients were 21,078,385 and 5,658,313 VND, respectively, amongst which direct medical costs constituted the highest percentage at more than 80% in both groups. The average costs of hospital visits for the patients were 2,101,558 and 1,976,736 VND, respectively. The largest share out of these amounts is that of indirect costs, which exceeded 80% of the total in both patient groups.*

**Conclusion:** *Nephrolithiasis management and treatment cause considerable financial hardship on the public healthcare system of Vietnam. Analytically demonstrating the magnitude of this economic impact may help facilitate health and social policy interventions for improving the prevention and treatment of the disease.*

**Keywords:** *Cost analysis, Cost of illness, Hospital, Nephrolithiasis, Urology, Vietnam.*

## INTRODUCTION

Urinary stones in general and kidney stones in particular are chronic diseases whose prevalence has been increasing in recent decades. These conditions are caused by gravel that results from the deposition of insoluble salts and minerals in urine - a process that can occur in both the upper (kidney, renal pelvis, ureter) and lower (bladder, urethra) parts of the urinary tract. Urinary stones can be classified into many types on the basis of chemical composition, but the most common form are calcium stones (calcium oxalate, calcium phosphate, calcium oxalate phosphate). When a stone is caught in narrow areas along the urinary tract, the first half of this organ strengthens contractions to expel the stone. The process of contraction lasts more than three months and diminishes flow through the ureter, which in turn, gradually thickens and narrows. The upshot of these effects is a reduction in kidney function, which causes water and salt stagnation in these excretory organs, easily leading to infection and, eventually, anuria. Statistics showed that 5% of the US population suffer from kidney stones,<sup>1</sup> and its treatment has been estimated to cost US\$2.1 billion annually.<sup>2</sup> This cost includes direct expenditures on treatment and indirect expenses stemming from losses due to reduced labour productivity. Whereas other chronic diseases, such as hypertension, cardiovascular disease and chronic obstructive pulmonary disease, have a high incidence in middle-aged and elderly people, urinary stones primarily affect adults, which, in the city, covers working individuals aged 20 to 64 years.<sup>3</sup>

A 2003 study conducted by Grases et al.<sup>15</sup> showed that 50% of patients whose kidney stones had been completely removed are at risk of re-forming stones. This risk may, nonetheless, be minimised through reduced protein intake and increased daily consumption of water, according to Mardis HK and Civil Affairs (2004). In special cases of metabolic abnormalities, limiting kidney stone recurrence involves administering additional support drugs, such as thiazide diuretics or urine alkaline agents, to patients.<sup>4,5</sup> The increased morbidity and economic burdens caused by urinary stone disease have prompted many investigations, with studies focusing particularly on analysing the causes of the disease and evaluating the effectiveness of treatment methods, including physical lithotripsy and the administration of stone-dissolving drugs. Research has also been devoted to assessing the effectiveness of relapse prevention measures. Inquiries into the costs of disease treatment and estimates of ensuing financial hardships indicated inconsistencies in expenditures across different areas and healthcare systems. Note, however, that such studies were limited and performed many years ago; the data that they presented may thus be outdated or inaccurate. In Vietnam, studies and data on the costs of treating urinary stones are equally deficient. A number of epidemiological that probed into the condition revealed that disease incidence levels in Vietnamese communities and hospitals are about 10% and 30%, respectively. In consideration of these issues, the present research assessed the costs involved in nephrolithiasis treatment and obtained data on the economic burdens presented by the disease in actual clinical practice in Vietnam.

## MATERIALS AND METHODS

### Study design and study site

This research was a cross-sectional, prospective cost-of-illness study conducted in the first six months of 2017. Data were collected from Binh-Dan Hospital, which is located in Ho Chi Minh City, southern Vietnam. The hospital is a central healthcare facility that specialises in urology and gastroenterology. Established in 1954, it is the cradle of the surgical industry in Ho Chi Minh City and southern provinces in the country. With a long tradition of teaching and learning in cooperation with leading medical schools, Binh-Dan Hospital employs and educates generations of faculty and medical students. It is a prestigious option for the acquisition of medical examinations, treatment and clinical practice training. With nearly a 790 -bed capacity, the annual number of operations in the hospital is over 10,000 for general surgeries and 13,000 for urological surgeries. The patients visiting the hospital for outpatient examination and treatment number nearly 400,000 per year.

Data on patient characteristics and costs over the period 2014 to 2017 were obtained from Binh-Dan Hospital's electronic database. The computerised information stored in the database comprises hospital identification, demographic information, socioeconomic status and cost component information. Data that are not recorded in the database (e.g. income, educational level, occupation) were obtained through face-to-face interviews with patients or caregivers.

### Study subjects

All the patients at Binh-Dan Hospital were evaluated to determine their eligibility for participation on the basis of inclusion and exclusion criteria. The minimum sample size for outpatients was 191 individuals, and that for inpatients was 114 subjects.

The inclusion criteria were a diagnosis of kidney stones in accordance with the International Classification of Diseases, 10<sup>th</sup> revision, wherein the code for nephrolithiasis is N20.0; full patient records in the hospital database, including demographic characteristics and treatment costs; and complete treatment sought in the hospital from January to March 2017. The exclusion criteria were transfer to another treatment facility and voluntary withdrawal from treatment, the existence of a language or mental disorder and refusal to participate in the study.

### Cost components

The direct medical costs considered in this work comprised expenses related to physician consultations, hospital bed days, laboratory tests, imaging examinations (e.g. X-ray, computed tomography scan), pharmaceuticals (e.g. antibiotics, analgesics, anti-inflammatory and stone-dissolving agents, vitamin supplements), medical procedures (e.g. shock wave lithotripsy, percutaneous nephrolithotomy, ureteroscopy) and medical supplies (e.g. bandage, syringe, needle). Patients who were not admitted into the facility were indicated as having incurred no hospitalisation costs. Each identified expenditure was calculated by multiplying the price per service by the number of services used by a patient. The cost of comorbidity treatment was excluded from the analysis. Direct non-medical costs included patient and caregiver expenditures on food, transport and accommodations during treatment and the wages of caregivers. Indirect costs were those originating from productivity losses due to hospitalisation and were calculated as the length of stay multiplied by the average daily income of both patients and caregivers.<sup>6</sup>

### Data analysis

Descriptive statistics were employed to illustrate the characteristics of the insured and uninsured patients in the study sample. These attributes encompassed sociodemographic characteristics, outpatient and inpatient expenses, direct medical costs, length of stay and health insurance reimbursement. As for econometric data, cost distributions were heavily skewed. To solve this problem, the bootstrap method for resampling with replacement was used. This process was repeated 2,000 times using the percentile method to compute mean values and the 95% confidence interval. The normality of continuous variables related to costs was tested via the non-parametric one-sample Kolmogorov–Smirnov test. Because all the continuous variables were non-normally distributed, the Kruskal–Wallis H test was carried out to determine the differences amongst  $\geq 3$  continuous variables. A p-value less than 0.05 was considered statistically significant. All the calculations were executed using Microsoft Excel 2013 and the Statistical Package for the Social Sciences 20.0.

### Ethical considerations

This study was reviewed and approved by the ethics committees of Binh-Dan Hospital. Participation was voluntary and anonymous, and the patients were informed of their right to discontinue the interviews should they have felt uncomfortable.

## RESULTS

### Demographic characteristics of patients

Of the 321 patients with kidney stones, 201 sought outpatient services, and 120 were admitted as inpatients. The *average age* of the outpatients was  $48.9 \pm 11.1$  years, making these subjects younger than the inpatients ( $54.4 \pm 11.7$  years). In terms of *gender*, the proportion of the female patients was higher than that of the male patients, with 53.3% of inpatients and 60.2% of outpatients comprising the former. With regard to *place of residence*, the number of inpatients living in rural areas (47.5%) was lower than the number of such subjects residing in urban regions. The outpatients living in rural areas outnumbered those living in urban areas (53.2% versus 46.8%).

The patients with *health insurance* accounted for the highest proportion of the inpatient and outpatient groups at 80%. With respect to *educational level*, the inpatient group had 65 patients who finished high school education or higher (54.2%), 20 who completed primary education (16.7%), 19 patients who exhibited literacy (15.8%) and 16 who acquired lower secondary education (13.3%). In the outpatient group, 91 (45.3%) and 31 (15.4%) patients finished high school and above and primary education, respectively. The group also comprised 40 (19.9%) and 39 (19.4%) illiterate patients and those who completed middle school education, respectively.

As regards *occupation*, the number of inpatients who had jobs, were unemployed, were retired and had other jobs were 61 (50.8%), 12 (10.0%), 12 (10.0%) and 35 (29.2%), respectively. The corresponding figures for the outpatient group were 108 (53.7%), 32 (15.9%), 18 (9.0%) and 43 (21.4%), respectively. The *average income* of the inpatients was  $6.1 \pm 5.0$  million VND, whereas that of the outpatients was  $6.1 \pm 6.3$  million VND. In particular, the group of patients without income accounted for the highest number of inpatients (54 patients, 45%), and the group of patients earning 4 to 7 million VND accounted for the largest proportion in the outpatient group (82 patients, 40.8%).

As for *disease duration* and *stage*, the average duration of the condition amongst the outpatients was higher than that amongst the inpatients, that is,  $8.4 \pm 4.1$  and  $7.0 \pm 4.6$  years, respectively. Of the participants, 52.5% and 49.8% of the inpatients and outpatients had the disease in the primary stage, respectively. In the matter of *comorbidities*, the most commonly occurring amongst the inpatients were hypertension (31 patients, 25.8%), and that amongst the outpatients was diabetes (41 patients, 20.4%). Finally, in terms of *lifestyle*, 56.7%, 77.5% and 67.5% of the inpatients exercised, smoked and drank, respectively. The figures for the outpatient group were 46.5%, 69.2% and 71.1%, respectively.

### Costs of treating kidney stones at Binh-Dan Hospital in 2017

#### Costs prior to hospital treatment (self-treatment)

A total of 118 patients had their kidney stones treated at other health facilities before seeking treatment at Binh-Dan Hospital. The total pre-admission costs incurred by these patients was 364,296,663 VND, of which the highest was constituted by indirect costs (291,040,003 VND), followed by direct medical expenses (42,350,000 VND) and direct non-medical expenses (30,906,660 VND). The average total cost of treatment before admission was 3,087,260 VND; the average direct medical and direct non-medical costs were 481,250 and 351,212 VND, respectively. The indirect costs averaged over 114 patients was 2,552,982 VND (Table 1).

A total of 197 outpatients had their kidney stones treated at other health facilities before seeking medical help at Binh-Dan Hospital. The total pre-treatment costs borne by these individuals was 597,191,131 VND, of which the highest was accounted for by indirect costs (422,890,567 VND), followed by direct medical expenses (152,235,000 VND) and direct non-medical expenses (22,065,564 VND). The average total cost of treatment for the outpatients was 3,031,427 VND. A course of treatment resulted in direct medical and direct out-of-health costs amounting to averages of 1,095,216 and 149,092 VND, respectively. The indirect costs averaged over 193 patients was 2,191,143 VND (Table 1).

**Table 1:** Cost components prior to hospital treatment

	Number of patients	Average/person (VND)	Economic burden (VND)
Direct medical cost	88	481,250	42,350,000
Direct non-medical cost	88	351,212	30,906,660
Food	29	448,621	13,010,009

Inpatient	Transport	88	203,371	17,896,651
	<b>Indirect costs</b>	114	2,552,982	291,040,003
	Patient	83	1,615,141	134,056,669
	Caregiver	105	1,495,079	156,983,334
	<b>Total cost</b>	<b>118</b>	<b>3,087,260</b>	<b>364,296,663</b>
Outpatient	<b>Direct medical cost</b>	139	1,095,216	152,235,000
	<b>Direct non-medical cost</b>	148	149,092	22,065,564
	Food	38	318,684	12,110,000
	Transport	138	72,142	9,955,564
	<b>Indirect costs</b>	193	2,191,143	422,890,567
	Patient	119	1,425,411	169,623,900
	Caregiver	172	1,472,481	253,266,667
	<b>Total cost</b>	<b>197</b>	<b>3,031,427</b>	<b>597,191,131</b>

### Costs incurred during hospital treatment

#### Costs shouldered by inpatients

The total cost of pre-treatment shouldered by 120 inpatients was 2,529,406,228 VND, out of which the highest was accounted for by direct medical expenses (2,067,296,578 VND), followed by indirect costs and direct medical expenses (381,916,667 and 80,192,983 VND, respectively). The average total expenses paid by the patients was 21,078,385 VND. The average direct medical cost amounted to 17,227,471 VND, the average direct out-of-health cost was 668,275 VND and the average indirect cost reached 3,264,245 VND (Table 2). The total cost of treatment for 201 outpatients was 1,137,320,987 VND, of which the highest proportion was constituted by direct medical costs (957,211,098 VND), followed by direct out-of-health costs (135,440,000 VND) and indirect costs (44,669,889 VND). The average total cost incurred by the outpatients was 5,658,313 VND. In particular, the average direct medical costs amounted to 4,762,244 VND, the average direct out-of-health costs reached 673,831 VND and the average indirect costs amounted to 282,721 VND (Table 2).

**Table 2:** Cost components during hospital treatment

		Number of patients	Average/person (VND)	Economic burden (VND)
Inpatient	<b>Direct medical cost</b>	120	17,227,471	2,067,296,578
	<b>Direct non-medical cost</b>	120	668,275	80,192,983
	Food	120	422,958	50,755,000
	Transport	120	245,317	29,437,983
	<b>Indirect costs</b>	117	3,264,245	381,916,667
	Patient	87	1,784,176	155,223,334
	Caregiver	113	2,006,136	226,693,333
	<b>Total cost</b>	120	21,078,385	2,529,406,228
Outpatient	<b>Direct medical cost</b>	201	4,762,244	957,211,098
	<b>Direct non-medical cost</b>	201	673,831	135,440,000
	Food	3	183,333	550,000
	Transport	201	671,095	134,890,000
	<b>Indirect costs</b>	158	282,721	44,669,889
	Patient	121	204,269	24,716,555

	Caregiver	103	193,722	19,953,333
	<b>Total cost</b>	201	5,658,313	1,137,320,987

The total direct medical cost incurred from the treatment of kidney stones in 120 inpatients was 2,067,296,578 VND. Out of this amount, the highest proportion was accounted for by surgery-surgery expenses (891,625,300 VND, 43.13 %), followed by bed day costs (537,280,900 VND, 25.99%), pharmaceutical costs (295,559,208 VND, 14.30%) and medical examination expenses (500,000 VND, 0.02%). The average expenses allocated to bed days and pharmaceuticals were 4,477,341 and 2,462,993 VND, respectively. Amongst 120 inpatients, 119 used medical supplies, 116 underwent tests and 112 availed of other services. These amounted to average expenses of 1,366,062, 1,003,847 and 104,446 VND, respectively. Diagnostic imaging was performed for 96 patients, incurring them an average cost of 537,767 VND (Table 3).

The average costs of medical examinations, surgery-surgery and other services were 175,330, 2,493,150 and 141,250,000 VND, respectively. Out of 201 outpatients, 163 were administered pharmaceuticals, incurring them an average cost of 292,807 VND. Imaging and testing were performed for 30 patients, which resulted in average costs of 125,763 and 620,530 VND, respectively. Only 12 of the 201 patients used medical supplies, which amounted to an average cost of 17,679,068 VND (Table 3).

**Table 3:** Direct medical costs incurred during hospital treatment

		Number of patients	Average/person (VND)	Economic burden (VND)
Inpatient	<b>Direct medical cost</b>	120	17,227,471	2,067,296,578
	<b>Direct non-medical cost</b>	120	668,275	80,192,983
	Food	120	422,958	50,755,000
	Transport	120	245,317	29,437,983
	<b>Indirect costs</b>	117	3,264,245	381,916,667
	Patient	87	1,784,176	155,223,334
	Caregiver	113	2,006,136	226,693,333
	<b>Total cost</b>	120	21,078,385	2,529,406,228
Outpatient	<b>Direct medical cost</b>	201	4,762,244	957,211,098
	<b>Direct non-medical cost</b>	201	673,831	135,440,000
	Food	3	183,333	550,000
	Transport	201	671,095	134,890,000
	<b>Indirect costs</b>	158	282,721	44,669,889
	Patient	121	204,269	24,716,555
	Caregiver	103	193,722	19,953,333
	<b>Total cost</b>	201	5,658,313	1,137,320,987

The total cost of surgery for 110 inpatients was 891,625,300 VND. Out of this amount, the cost of open surgery accounted for the majority at 66.40% (592,058,806 VND), whereas the cost of shock wave lithotripsy accounted for the lowest at 4.75% (42,354,240 VND). Amongst the 110 patients, 62 had open surgery, and these patients collectively underwent the procedure 75 times. The average cost of open surgery in a course of treatment was 9,549,336 VND, and this procedure was performed 58 times for 30 patients. The average cost of the procedure in a course of treatment was 1,904,214 VND. Meanwhile, only four patients were subjected to percutaneous nephrostolithotomy, which was performed 15 times for the patients. The average cost of the aforementioned procedure in a course of treatment was 31,256,126 VND (Table 4).

**Table 4:** Surgical costs incurred during treatment at the hospital

		Number of uses	Number of patients	Average/person (VND)	Economic burden (VND)	Percentage (%)
Inpatient	Shock wave lithotripsy (SWL)	9	7	6,050,606	42,354,240	4.75
	Percutaneous nephrostolithotomy (PCNL)	15	4	31,256,126	125,024,506	14.02
	Ureteroscopic lithotripsy (URS)	20	7	10,723,046	75,061,325	8.42
	Open surgery	75	62	9,549,336	592,058,806	66.40
	Other interventions	58	30	1,904,214	57,126,422	6.41
	<b>Total</b>	<b>177</b>	<b>110</b>	<b>8,105,685</b>	<b>891,625,300</b>	<b>100.00</b>
Outpatient	Shock wave lithotripsy (SWL)	210	200	2,480,100	496,020,000	99.48
	Other interventions	3	3	870,000	2,610,000	0.52
	<b>Total</b>	<b>213</b>	<b>203</b>	<b>2,456,305</b>	<b>498,630,000</b>	<b>100.00</b>

With regard to pharmaceutical costs, the medications that were most frequently prescribed were analgesics and anti-inflammatory agents, which were administered over 734 admissions of inpatients and 119 visits from outpatients. Antibiotics and stone-dissolving drugs were used to a lower extent, yet these medications differ minimally from analgesics and anti-inflammatory drugs. Vitamins and minerals were consumed the lowest, administered only 61 times to inpatients and 10 times to outpatients. In general, the frequency of drug use for outpatient treatment was six times higher than that for inpatient treatment (Table 5).

**Table 5:** Frequency of drug use in the treatment of kidney stones (2017)

Type of medicine	Inpatients	Outpatients	Total
Antibiotic	656	107	763
Pain relief, anti-inflammatory	734	119	853
The drug dissolves stones	582	95	677
Vitamins, minerals	61	10	71
Other drugs	743	121	864
<b>Total</b>	<b>2,776</b>	<b>452</b>	<b>3,228</b>

#### Post-treatment costs

A total of 112 inpatients carried on with kidney stone treatment after discharge, and such service cost them 235,374,543 VND. Out of this amount, the largest proportion was accounted for by indirect costs (219,713,334 VND), followed by direct medical expenses (3,340,000 VND) and direct non-medical expenses (2,321,209 VND). The average total cost of continuing treatment after discharge was 2,101,558 VND. The average direct medical cost was 513,077 VND, the average direct medical outlay was 92,848 VND and the average indirect cost was 2,072,767 VND (Table 6).

The total cost incurred by 180 outpatients was 302,645,915 VND, out of which indirect costs made up the highest at 282,622,280 VND. This was followed by direct medical costs at 15,470,000 VND and direct out-of-health costs at 4,553,635 VND. The average total cost was 1,976,736 VND. In particular, the average direct medical cost was 513,077 VND, the average direct medical outlay was 89,645 VND and the average indirect cost was 1,933,334 VND (Table 6).

**Table 6:** Expenses after treatment

		Number of patients	Average/person (VND)	Economic burden (VND)
Inpatient	<b>Direct medical cost</b>	26	513,077	13,340,000
	<b>Direct non-medical cost</b>	25	92,848	2,321,209
	Food	9	211,111	1,900,000
	Transport	25	16,848	421,209
	<b>Indirect costs</b>	106	2,072,767	219,713,334
	Patient	81	1,195,473	96,833,334
	Caregiver	98	1,253,878	122,880,000
	<b>Total cost</b>	<b>112</b>	<b>2,101,558</b>	<b>235,374,543</b>
Outpatient	<b>Direct medical cost</b>	29	513,077	15,470,000
	<b>Direct non-medical cost</b>	29	89,645	4,553,635
	Food	10	211,111	2,940,000
	Transport	29	16,848	1,613,635
	<b>Indirect costs</b>	175	1,933,334	282,622,280
	Patient	111	1,195,473	115,055,614
	Caregiver	164	1,253,878	167,566,667
	<b>Total cost</b>	<b>180</b>	<b>1,976,736</b>	<b>302,645,915</b>

## DISCUSSION

This study, which is the first to look into the costs of kidney stone treatment in Vietnam, found that the average total cost of treatment was about 23 million VND for inpatients and 10 million VND for outpatients. In the last few decades, the number of studies delving into the economic impact of kidney stones has been somewhat limited. Research on the costs of treating urinary stones in general and kidney stones in particular were conducted many years ago. To facilitate a comparison, the current research converted the costs reported in the aforementioned studies into Vietnamese dong in 2017. The present work documented the total cost averaged over an entire cash cycle. The figures calculated (i.e. 23 million and 10 million VND) were much lower than the costs of treating kidney stones in Sweden, England and Germany, where the average costs per round of treatment incurred by patients were 74 million, 89 million and 152 million VND, respectively.<sup>3,7-10</sup> However, this comparison is only relative because some countries do not publish information on the consumer price index on statistical data pages; thus, adjusting costs to account for inflation is impossible.<sup>4,5,11-13</sup>

Amongst the component costs determined in this work, direct medical costs always accounted for the highest proportion for both the inpatient and outpatient groups. However, before and after hospital visits, the patients and their families suffered mainly from the losses caused by indirect costs, namely, loss of income and reduced labour productivity. These problems confronted both patients and caregivers, accounting for over 90% of costs before and after hospital treatment. Delving deeper into the analysis of the component costs revealed the extensive implementation of advanced surgical interventions, such as extracorporeal lithotripsy or percutaneous endoscopy. With reference to pharmaceuticals, the use of herbal medicines has increased over the years, with many new types of such medications being produced, consistent with the trend of consumer return to natural products.

Amongst the inpatients, those aged 60 and older were the most frequently hospitalised for kidney stones (42 patients, 35.0%). In the outpatient group, this was accounted for by the patients in the 40 to 49 age bracket (62 patients, 30.8%) and the 50 to 59 age group (63 patients, 31.3%). In both groups, the patients under 30 years of age were hospitalised the least even though the proportion of outpatients was significantly higher than that of the inpatients (5.0% and 1.7%, respectively). The average direct medical cost incurred by the 120 inpatients was about 17 million VND, causing a burden of more than 2 billion VND given their use of three services: surgical procedure (43.1%), bed days (26.0%) and pharmaceuticals



(14.3%). The average direct medical cost shouldered by the 201 outpatients was 4,762,244 VND, causing a burden of more than 950 million VND given their use of the following services: surgical procedure (52.1%), medical supplies (22.2%) and other services (14.8%).

The employed participants accounted for over 50% of the sample for both inpatients (50.8%) and outpatients (53.7%). This is consistent with the worldwide epidemiological report on kidney stones, which showed that the disease tremendously affects the labour force of society; it not only affects the employment of patients but also diminishes labour productivity. The present study had a large sample size, and bootstrapping was applied to process the data, thereby reducing deviations on costs. Most government policies often focus on improving public health but rarely address the economic burdens imposed by illnesses. The assessment of the effects of kidney stones on finances has substantially advanced decision making in the domain of public health. This research, which centred on the direct medical costs arising from kidney stone treatment, can contribute to this important goal. First, going beyond health effects to cover economic impact can help raise awareness regarding the prevention of kidney stones. Second, this study can inform the prioritisation of resource allocation to research on or the prevention of kidney stones. Finally, the analysis of the direct medical costs of kidney stone treatment in the Vietnamese context can facilitate the evaluation of the actual costs that patients will have to pay when they undergo treatment.

## CONCLUSION

The results of this research can serve as an overview for policy makers on insights that can advance the formulation and implementation of appropriate policies for a national healthcare program in Vietnam. Future studies can expand the scope of the present work by analysing drug-related and surgical costs and indirect costs due to loss of labour productivity.

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## CONFLICTS OF INTERESTS

The authors have no conflicts of interests to declare.

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