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ORIGINAL RESEARCH ARTICLE

National trends in hospital encounters, outpatient consultations and surgeries for urolithiasis in Norway

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ABSTRACT

Introduction: There are few studies evaluating the burden of urolithiasis on healthcare systems in Scandinavia. This study aimed to assess national trends in hospital encounters and surgical interventions for urolithiasis in Norway.

Methods: National data on hospital admissions, outpatient consultations, inpatient stays and surgical procedures were obtained from the Norwegian Directorate for Health and the Norwegian Patient Register for 2012–2023 and the operative data for 2019–2024. Variables included age and sex. Poisson regression estimated annual changes.

Results: Between 2012 and 2023, 109,490 unique patients had a hospital encounter for urolithiasis, increasing by 2.9% annually ($p < 0.001$). The increase was greater in males (3.2% vs. 2.6%, $p < 0.001$) and in those ≥70 years (6.4% vs. 2.0%, $p < 0.0001$). Outpatient consultations increased by 3.2% per year, with the steepest rise among older adults. Inpatient days declined annually by 2.45% ($p < 0.001$), while ambulatory treatments increased by 17.4% ($p < 0.0001$). Between 2019–2024, ureteroscopy (URS) increased from 68.6% to 80.4% of renal stone procedures and from 99% to 100% for ureteral stones. By 2024, URS accounted for 88% of all stone procedures, while shock wave lithotripsy (SWL) declined to zero for ureteral stones.

Conclusion: Urolithiasis places an increasing burden on the Norwegian healthcare system, particularly among older adults. Surgical management in Norway favours URS, representing one of the highest national proportions reported.

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Introduction

Urolithiasis is a common condition, affecting an estimated 1–20% of the global population, with recurrence rates reaching up to 50% within 10 years [1]. Overall, the global incidence trends suggest a continued rise, often attributed to lifestyle factors, higher rates of obesity and incidental imaging findings [2–4]. However, data from Western Europe have indicated a plateau in recent years [5]. In addition to the psychological burden on patients, urolithiasis imposes a substantial socio-economic impact [6–8]. Geraghty et al. reported the mean cost of a stone episode to range from £1,277 to £2,887 [9]. In the United States, more than 3 million workdays are lost annually due to this condition [10]. Examining national trends in healthcare utilisation can provide valuable insights into demographic shifts, resource allocation and future planning. The aim of this study was to assess national trends in hospital encounters and surgical interventions related to urolithiasis in Norway.

Materials and methods

Data on key healthcare events related to urolithiasis, including hospital admissions, outpatient consultations and inpatient length of stay, were obtained from the Norwegian Patient Register (NPR) via the Norwegian Directorate for Health who identified patients recorded with an ICD-10 N20.* diagnosis for the period 2012–2023. Extracted variables included patient age and sex. The NPR provides national coverage and contains information on all patients who have received treatment in secondary care, including hospitals and contracted specialists.

Of note, diagnostic codes were assigned based on clinicians' assessments and not necessarily confirmed by imaging such as computed tomography (CT). Consequently, some cases recorded as urolithiasis may not represent fully confirmed stone disease, for example when renal colic was managed conservatively without imaging confirmation.

In our study, the term 'hospital encounters' denotes the combined total of inpatient admissions, day-case treatments and specialist outpatient visits.

Data on surgical procedures performed between 2019 and 2024 were obtained from the Norwegian Institute of Public Health, using the relevant procedural codes in Chapter K (urinary organs, male genitalia and retroperitoneum) of the Norwegian version of the Nordic Medico-Statistical Committee (NOMESCO) classification system. Norway, which had a population of

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5,488,984 by the end of 2023, operates a public and universal healthcare system.

Statistical analysis and ethical considerations

Poisson regression analysis was used to estimate annual changes. Covariates (e.g. gender and 10-year age group) were applied selectively and where appropriate. When rates per 1,000 persons were analysed, annual population figures from Statistics Norway were used to adjust for changes in population size over time [11]. Future projections for 2030 were calculated by extrapolating the Poisson regression model based on observed annual trends between 2012 and 2023. Except for purely descriptive numbers such as crude rates per 1,000 persons and simple counts for which no p-values were calculated, all p-values provided come from Poisson regression models.

Statistical significance was determined at $p < 0.05$, and analyses were performed in IBM SPSS Statistics 29.0. Figures were then generated in R (R Foundation for Statistical Computing, Vienna, Austria). As all data were anonymised at source, ethical approval was not required.

Results

Hospital encounters

Between 2012 and 2023, 109,490 unique patients in Norway were recorded in a hospital encounter for urolithiasis. The annual number of patients in this category increased on average by 2.9% per year ($p < 0.001$) (Table 1). This was higher in males compared to females (3.2% vs. 2.6%, $p < 0.001$). The increase was also higher in patients ≥ 70 years compared to all ages < 70 years (6.4% vs. 2.0%, $p < 0.0001$).

At the start of the study period, the male-to-female ratio was 1.7:1. It remained largely stable and only widened slightly to 1.8:1 by 2023. During this time, the rate per 1,000 persons in Norway increased from 1.5 to 2.0 for patients having a hospital encounter for urolithiasis. The annual change increased by 2.2% (p <0.001). There was no significant difference in change per rate between males and females (2.5% vs. 1.7%, $p = 0.9$). The fastest growing rate was among 70–79 years olds (+6.9%) and ≥ 80 years (+4.7%).

Outpatient consultations

From 2012 to 2023, a total of 131,131 outpatient consultations for urolithiasis were recorded, corresponding to 80,976 unique patients. There was an annual increase of 3.2% consultations per year ($p < 0.001$). The fastest growing rate was among 70–79 years olds (+7.0%) and the ≥80 years (+5.0%). The annual rate of consultations per patient decreased by 0.7% ($p = 0.9$). In 2023, this rate was 1.6. The highest rate was among 0–9-year-olds, with a mean rate of 1.8. In 2014, the ratio of patients with hospital admission to outpatient clinic visit was 1.03 but declined to 0.61 by 2023.

Days in hospital

The total number of hospital inpatient days decreased annually by 2.5% ($p < 0.001$). It decreased across all age groups except for 70–79-year-olds, where it increased by 1.1% annually ($p < 0.001$).

Hospital overnight stays

Overall, the rate decreased by 1.9% per year ($p < 0.0001$). There was a decrease across all age groups, except for 70–79-year-olds and ≥80 years, where the rates increased annually by 3.8% ($p < 0.0001$) and 3.2% ($p < 0.0001$), respectively.

Ambulatory treatments

There was an overall increase by 17% annually ($p < 0.0001$). While the majority (58%) of these patients were 20–59 years ($n = 10,955$), it was the 70–79-year-old group that had the greatest annual increase (21%, $p < 0.0001$). In 2023, ambulatory treatments accounted for 38% of all urolithiasis surgeries.

Projections for 2030

Extrapolations suggest that by 2030, hospital encounters for urolithiasis will reach about 13,000, and outpatient consultations will exceed 16,000 annually. The rate per 1000 persons is projected to rise to 2.3, while overnight stays and days in hospital are expected to decline. Ambulatory treatments are projected to surpass 10,000 (Table 1).

Table 1. Trends in hospital data over time for urolithiasis.

	2012	2023	Annual change between 2012 and 2023	Key finding	Projection for 2030
Hospital encounters	7,569	10,817	+2.9%*	Increase the highest in patients ≥ 70 years	13,048
Hospital encounters per 1,000 persons	1.5	2.0	+2.2%*	The fastest growing rate was among 70–79 years olds (+6.9%*) and ≥80 years (+4.7%*).	2.3
Overnight stay in hospital	5,740	5,179	−1.9%*	Decrease across all age groups except for patients ≥70 years	4,526
Outpatient consultations	9,719	13,609	+3.2%*	The fastest growing rate among 70–79 years olds (+7.0%*) and the ≥80 years (+5.0%*).	16,165
Consultations per patient	1.8	1.6	−0.7%	The highest ratio was among 0–9-year-olds.	1.5
Days in hospital	12,034	10,040	−2.5%*	Decrease across all age groups except for patients ≥70 years	8,713
Ambulatory treatments	292	2,746	+17%*	The majority (58%) performed in patients under 60 years	10,097

*$p < 0.05$.

Operative procedures (2019–2024)

Renal stones

In 2019, procedures for renal stones were distributed as follows: ureteroscopy (URS) 68.6% (n = 1,754), shockwave lithotripsy (SWL) 17.3% (n = 443) and percutaneous nephrolithotomy (PCNL) 14.1% (n = 360). The mean annual increase for URS was +6% ($p < 0.001$), and by 2024, it accounted for 80.4% of all renal stone procedures. For SWL, this decreased by 13.2% annually ($p < 0.001$), and in 2024, it accounted for 7.6% of all renal stone procedures. Finally, PCNL decreased by 0.6% annually ($p = 0.67$), and in 2024, it accounted for 11.9% of all renal stone procedures (Figure 1).

Ureteral stones

In 2019, URS accounted for 99% (n = 1,538) of all procedures for ureteral stones, with SWL accounting for only 1% (n = 15). The number of URS procedures increased by +4.4% per year ($p < 0.001$), and by 2024, URS accounted for 100% of all procedures for ureteral stones. SWL decreased by 13.6% per year ($p < 0.001$). By 2024 and for the first time, there were zero SWL procedures recorded nationally.

By 2024, URS accounted for 88% (n = 4,206) of all procedures for urolithiasis (ureteral and renal stones combined).

Discussion

The findings of this study highlight the substantial and growing burden that urolithiasis places on healthcare resources, affecting both outpatient services and inpatient care. While previous studies have suggested a narrowing gender gap in urolithiasis incidence, our data indicate a subtle widening of this disparity in Norway [12, 13]. Another notable shift is the increasing proportion of older adults requiring healthcare services for urolithiasis, likely reflecting demographic shifts within Norway's population. Between 2012 and 2023, the proportions of individuals aged 67–79, 80–90 and ≥ 90 years increased by 38%, 18% and 7.9%, respectively [14]. Although day-surgery procedures have increased significantly, the projected figure for 2030 appears unrealistic, as demand is not expected to reach this level, and the necessary infrastructure is not currently in place. The expansion of day-surgery pathways, along with the implementation of renal colic management pathways aimed at avoiding unnecessary overnight admissions, has likely contributed to the patterns observed in this study [15–17]. Furthermore, advances in medical care have facilitated the use of surgical intervention in older patients with multiple comorbidities, whereas previously such cases may have been managed conservatively [18, 19].

The predominance of URS has been recorded in many countries [20, 21]. Monga et al. recorded that this modality accounted for two-thirds of all stone treatments in the United States [22]. Ordon et al. reported the rate to be 73.5% for URS in Canada [23]. To our knowledge, the proportion of URS observed in Norway is, among the highest reported internationally and represents the first national-level report of zero SWL procedures performed for ureteric stones during a calendar year. In a country with a relatively small population dispersed over a large geographical area, patients may opt, together with their local urologist, to undergo multiple URS sessions at their nearest hospital rather than travel long distances for a single-session PCNL. The learning curve for URS is considerably shorter than for PCNL, and urologists in smaller centres may feel more confident performing URS within their routine practice [24]. Furthermore, advances in energy sources and suction devices have expanded the feasibility of URS, enabling its use for larger stone burdens than was previously considered feasible [25–28].

Although novel technologies such as burst wave lithotripsy have the potential to advance SWL, their use remains limited to only a small number of centres worldwide [29]. SWL continues to feature prominently in the EAU Guidelines, but successful implementation requires a centre to have both the necessary infrastructure and personnel with sufficient experience [30]. The considerable upfront investment required for a fixed lithotripter can be a barrier. In such cases, a mobile or visiting SWL service can represent a viable alternative [31, 32]. However, in countries with challenging geography, such as Norway, smaller and more remote hospitals may therefore choose to invest in URS and newer laser systems, rather than maintain or establish a SWL service.

Changes in diagnostic pathways across Nordic countries may partly explain the rise in stone surgeries observed in our study. A prospective study in Norway by Galtung et al. determined that a single nephrographic-phase CT is sufficient to detect urinary stones in patients with visible haematuria [33]. In Sweden, Utter et al. found that acute CT for patients with flank pain reduced the time to surgery and ultimately, stone-free status. However, this trend may have also increased the number of interventions for stones likely to have passed spontaneously [34]. Together, these shifts may suggest that increased CT imaging may be contributing to the growing treatment burden we observed.

Limitations and strengths

There are several limitations to this study. First, data were anonymised at the source and not linked to individual patients, preventing identification of repeat treatments as well as accurate estimation of cumulative lifetime incidence. Second, a separate category for emergency hospital admissions was unavailable. Although a strength of the study is that stone events were based on formal clinical coding rather than patient self-reporting such as the National Health and Nutrition Examination Survey (NHANES), diagnostic coding of urolithiasis itself is not without limitation because it reflects clinical judgement and may not always be supported by CT or other imaging confirmation [35]. Moreover, the national data sources used have not been formally validated for urolithiasis.

Notwithstanding this, our study findings are sourced from a nationwide and public health service in which private stone surgery is not available, and all procedures are performed as part of

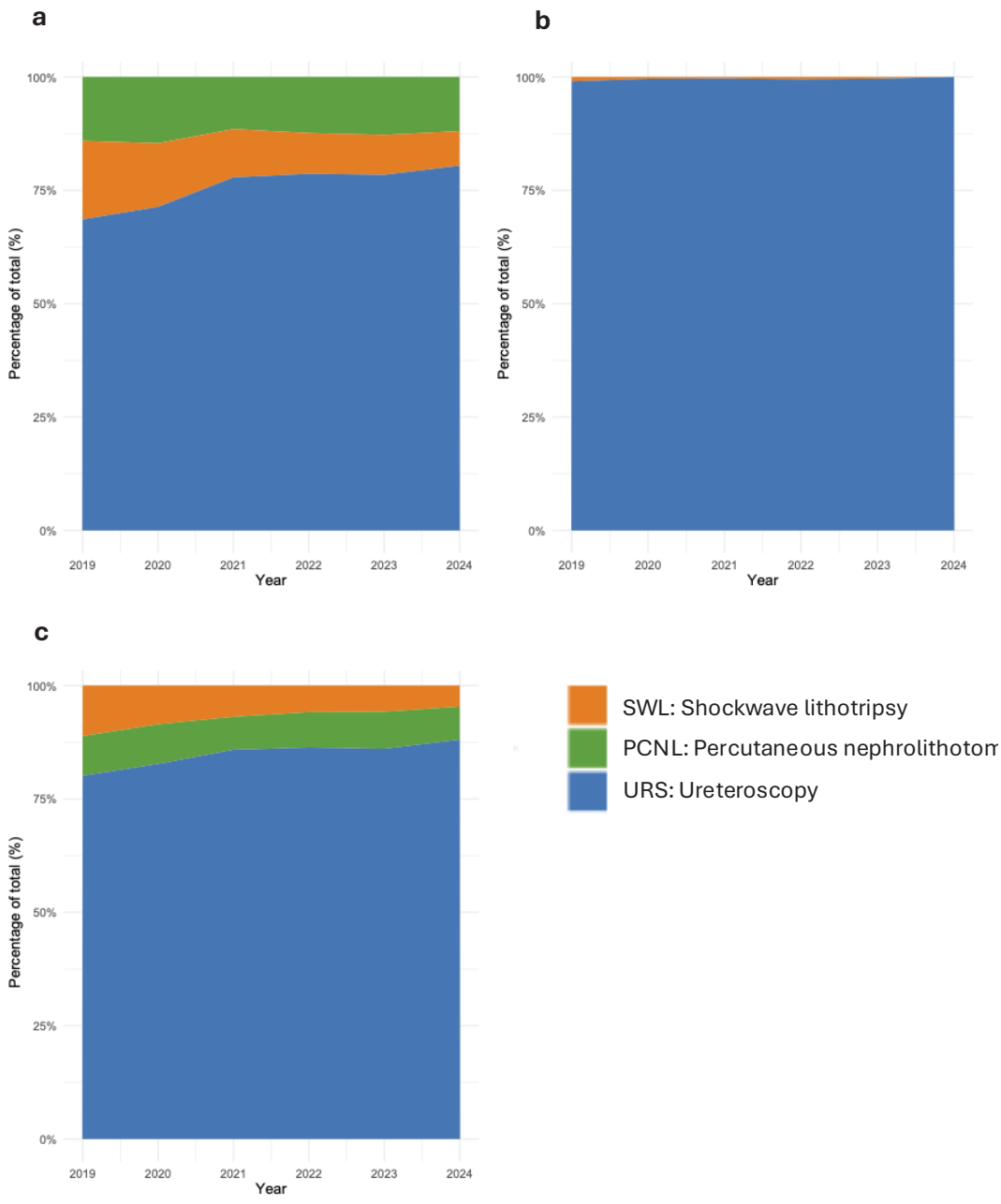

Figure 1. Panels show the proportion of each procedure type as a percentage of total cases from 2019 to 2024: (a) kidney stones only, (b) ureteral stones only and (c) renal and ureteral stones combined.

a universal healthcare model. Consequently, unlike in other healthcare systems, an individual's level of medical insurance does not influence the treatment options offered [36]. By contrast, data from other countries are often extrapolated from insurance claims databases that do not have nationwide coverage [37, 38].

Conclusion

Urolithiasis places an increasing burden on the Norwegian healthcare system, with rising numbers of hospital encounters, particularly among older adults. Surgical management continues to be dominated by URS, which accounted for nine out of 10 urolithiasis procedures by 2024.

Disclosure statement

MSÆ and ØU have previously acted as educational consultants for Olympus. PJJ has received funding from the Norwegian Institute of Urology. There are no other potential conflicts to declare.

Use of AI

In accordance with the journal's policy and in the interest of transparency, ChatGPT 4-0 was employed during the preparation of this manuscript, primarily to enhance language and readability. The authors independently verified the accuracy and validity of all content.

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