Healthcare resource utilization comparing single-use ureteroscopes with real-time intrarenal pressure monitoring to other single-use ureteroscopes

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ABSTRACT

KEY MESSAGE
• Monitoring intrarenal pressure (IRP) in real time during URS using the LithoVue™ Elite Single-Use Digital Flexible Ureteroscope (LVE) with pressure monitoring may assist urologists in making more informed clinical decisions to maintain lower pressures, thereby potentially mitigating complications like sepsis caused by elevated pressure during URS.

Introduction: This study compared post-procedure healthcare resource utilization with LithoVue™ Elite (LVE) single-use digital flexible ureteroscope with pressure monitoring vs. other (non-pressure sensing) single-use ureteroscopes.
Methods: This retrospective, real-world study used the Premier PINC AI™ Healthcare Database. Adults aged 18+ undergoing ureteroscopy (URS) with lithotripsy between January 1,2024 and March 1, 2025, with ≥30-day post-URS followup were included. The primary outcomes were 10- and 30-day hospital resource utilization (HRU), a composite measure of emergency department (ED) visits or inpatient admission. Propensity score matching (1:3) balanced baseline characteristics. Multivariable logistic regression in the matched cohort adjusted for residual confounding.

Results: A total of 305 patients underwent LVE with pressure monitoring capability (mean [standard deviation (SD)] age 58.6 [16.1], 51.1% female) and 15 048 underwent other single-use ureteroscopes (mean [SD] age 58.7 [15.8], 51.7% female). After matching, 292 LVE patients were compared with 876 controls. Patients undergoing LVE with pressure monitoring capability experienced improved HRU outcomes at 10-day (4.5% vs. 8.7%; ARR 4.2 pp, p=0.016) and 30-day (7.2% vs. 12.0%; ARR 4.8 pp, p=0.019) vs. other single-use ureteroscopes. In adjusted analyses, LVE with pressure monitoring capability was associated with lower odds of HRU at 10-day (odds ratio [OR] 0.355, 95% confidence interval [CI] 0.175–0.718, p=0.004) and 30-day (OR 0.473, 95% CI 0.281–0.797, p=0.005). The odds of 10-day ED visits (OR 0.385, 95% CI 0.149-0.997, p=0.049) and 30-day inpatient admissions (OR 0.436, 95% CI 0.196–0.967, p=0.041) were significantly lower with LVE with pressure monitoring capability.
Conclusions: Use of LVE with pressure monitoring capability was associated with clinically meaningful reductions in early post-URS HRU vs. other single-use ureteroscopes.

INTRODUCTION

Ureteroscopy (URS) is a generally safe, minimally invasive procedure and is the most common surgical treatment for stone disease.[1] URS drives substantial healthcare resource utilization worldwide given its high volume,[2,3] frequency of secondary procedures,[4] and the possibility for post-procedural complications.[1,5,6] The insertion of endoscopic instrumentation into the urinary tract during URS disrupts mucosal barriers, introduces irrigants, and can facilitate bacterial translocation from colonized sites (e.g., bladder or proximal ureter) into the bloodstream or upper tracts.[7,8] The procedural instrumentation—including scope insertion and manipulation and the introduction of adjuncts such as stents—elevates the risk of infectious complications such as urinary tract infections (UTIs) and sepsis.[9] Serious infections with URS vary but may be as high as 6% based on large cohort studies.[10,11] Some evidence indicates there has been an increase in URS procedural risk and post-procedural complications due to increasing usage of URS in higher-risk patients.[10,11]

The LithoVue™ Elite (LVE) Single-Use Digital Flexible Ureteroscope with pressure monitoring capability (Boston Scientific, Marlborough, MA) is the first commercially available ureteroscope system with real-time intrarenal pressure (IRP) monitoring.[12,13] High IRP during URS, often due to irrigation needed for visibility, can lead to potential complications including increased postoperative pain, sepsis, or even renal damage.[14,15] Higher intrarenal pressures can lead to pyelovenous backflow, allowing for bacteria within the urinary tract to enter the bloodstream with potential for sepsis.[16,17] Monitoring IRP in real time during URS may assist urologists in making more informed clinical decisions to maintain lower pressures, thereby mitigating complications like sepsis or renal damage caused by elevated pressure during URS.[12-15,18-21] A previous study comparing LVE with pressure monitoring capability to other single-use ureteroscopes found post-operative infection was significantly lower with LVE with pressure monitoring capability at 30 days post-index (8.2% vs. 15.4%; p=0.016).[22] Furthermore, multivariable analyses confirmed significantly higher odds of 30-day infection with other single-use ureteroscopes (odds ratio [OR] 2.09 [95% confidence interval (CI) 1.19-3.86]; p=0.014). Post-operative sepsis and other infections did not statistically differ; however, post-operative 30-day UTI was significantly less with LVE with pressure monitoring capability (5.2% vs. 10.8%; p=0.033).

A better understanding of the healthcare resource impact of LVE with pressure monitoring capability may assist healthcare providers and payers in identifying opportunities for improving URS quality of care while simultaneously reducing healthcare system burden.The objective of this study was to evaluate the healthcare resource utilization associated with LVE with pressure monitoring capability vs. other single-use ureteroscope technologies without pressure monitoring capabilities among patients undergoing URS with lithotripsy.

METHODS

Data source

This retrospective real-world study used the Premier PINC AI™ Healthcare Database, a large, U.S.-based, all-payer database that includes inpatient, and outpatient encounters from a nationally representative sample of hospitals and health systems. It contains detailed clinical and economic data derived from hospital discharge records, including diagnoses, procedures, and resource utilization.[23] The study was exempt from Institutional Review Board (IRB) approval as data for this research is compliant with the Health Insurance Portability and Accountability Act of 1996.

Patient population

Adults (≥18 years) who underwent single-use URS with lithotripsy between January 1, 2024 and March 1, 2025 were eligible. Encounters were identified using Current Procedural Terminology (CPT®) codes 52353 or 52356 and Healthcare Common Procedure Coding System (HCPCS) code C1747 (Endoscope, single-use [i.e., disposable], urinary tract, imaging/illumination device [insertable]). Eligible patients were required to have ≥30 days of follow-up after the index URS with lithotripsy procedure. The index date was defined as the discharge date from the URS encounter. Patients who underwent URS 32 days or less prior to the index URS procedure, or concurrent percutaneous nephrolithotomy performed at index with the URS with laser lithotripsy procedure were excluded from the analyses. The primary reason for the 32-day window for a prior URS procedure was to avoid overlapping follow-up time in the event a patient had two URS with lithotripsy treatments. This way the follow-up period from the first event could not overlap with the follow-up period with a secondary procedure. These patients were excluded given the differing comorbidity and stone complexity clinical pathways compared to URS with laser lithotripsy alone.

Eligible patients were classified into one of two study groups: (1) LVE with pressure monitoring group: identified by a Unique Product Number (UPN) for LVE; and (2) Control group: procedures coded with Current Procedural Terminology (CPT) 52353 or 52356 and Healthcare Common Procedure Coding System (HCPCS) C1747 without a UPN for LVE with IRP (other single-use ureteroscopes). All codes are listed in Supplemental Table S1.

Study measures

Patient baseline characteristics included age, sex, race (i.e., Asian, Black, Hispanic, Other, Unknown, or White), provider geographic region (i.e., Midwest, Northeast, South, or West), index procedure year, payer type (i.e., Medicaid, Medicare, Other, or Self-Pay), overall comorbidity (Deyo-Charlson Comorbidity Index [CCI][24-26]), presence of diabetes, presence of obesity, presence of sepsis on admission, recurring UTIs (at least two diagnoses within 60 days pre-URS), presence of a UTI at index encounter, presence of kidney stones diagnosis at index encounter, presence of sepsis at index encounter, and presence of other infection at index encounter.

The primary outcome was hospital resource utilization (HRU), a composite measure of emergency department (ED) visits or inpatient admissions within 10 and 30 days. ED visits and inpatient admissions were also evaluated separately and identified using the PAT_TYPE variable in the PAT_DEMO table. Records with PAT_TYPE = '28' were classified as ED visits, while those with PAT_TYPE = '08' were classified as inpatient admissions. The International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis codes used for the analyses are provided in Supplemental Table S1.

Statistical analyses

To reduce confounding, a 1:3 greedy nearest-neighbor propensity score match with a caliper of 0.2 standard deviations of the logit propensity score was performed. The propensity modeled included age, sex, race, index procedure year, payer type, CCI > 4, presence of diabetes, presence of obesity, and presence of sepsis on admission. The utilization of flexible and navigable suction (FANS) ureteral access sheaths was considered as a potential confounder; however, analyses of the dataset revealed that the proportion of patients who received FANS was less than 1% with LVE with pressure monitoring and less than 1% with other single-use ureteroscopes. Covariate balance between groups was assessed using standardized mean difference (SMD) with SMD <0.1, indicating acceptable balance.

Continuous variables and healthcare resource utilization were presented as means (standard deviations) and categorical variables as frequencies (percentages) in the matched cohort. The primary analysis used a multivariable logistic regression model to predict each outcome by exposure status (i.e., LVE vs. other single-use ureteroscopes) to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) adjusting for sex, race, index procedure year, payer type, presence of diabetes, presence of obesity, and presence of sepsis on admission, provider region, recurrent UTI, CCI >4, UTI at index encounter, and kidney stone diagnosis at index encounter or other stone types, including ureteral or bladder stones. Absolute risk reduction (ARR) in percentage point units (pp) and number needed to treat (NNT) at each time window were calculated from matched risks. The ARR was calculated from matched-cohort risks (control – LVE with pressure monitoring capability) at each time window; NNT was computed as 1/ARR (ARR in proportion) and rounded up to the next integer.

A sensitivity analysis was conducted to assess the robustness of the findings by reporting the same outcomes (i.e., composite HRU, ED visits, and inpatient admissions) at alternative time points of 7- and 14-day post-procedure in addition to the primary 10- and 30-day follow-up intervals. Additionally, a subgroup analysis was performed to compare outcomes among patients undergoing URS with LVE and other single-use ureteroscopes for URS at 10 and 30 days stratified by CCI (≤4 vs. >4) to evaluate potential variations in healthcare resource utilization across patient comorbidity score groupings. Finally, a subgroup analysis comparing HRU with LVE with pressure monitoring capability vs. other single-use ureteroscopes was conducted among patients with UTI, sepsis, and UTI and/or sepsis.

All statistical analyses were performed using R Statistical Software (v4.5.1; R Foundation for Statistical Computing; Vienna, Austria)[27] at *a priori* statistical significance of 0.05. Exhibit tables were generated with the TableOne. Propensity score matching was conducted using the R MatchIt package (v4.7.1).[28,29] Conditional logistic regression models were calculated using the Survival package for all analyses in the matched cohorts.

RESULTS

A total of 305 patients were treated with LVE with pressure monitoring capability and 15,048 were treated with other single-use ureteroscopes for URS. After propensity score matching, 292 patients who underwent LVE with pressure monitoring capability were matched to 876 controls (1:3).

Patient baseline demographic and clinical characteristics

Table 1 summarizes baseline characteristics before and after matching. In the matched cohort, mean (SD) age was 58.2 (16.4) years for patients who were treated with LVE with pressure monitoring capability and 58.8 (16.5) years for patients who were treated with other single-use ureteroscopes for URS. Approximately half were male (LVE with pressure monitoring capability 49.7%, other single-use ureteroscopes 49.2%), and most were White (LVE with pressure monitoring capability 76.4%, other single-use ureteroscopes 77.1%), Hispanic (LVE with pressure monitoring capability 10.6%, other single-use ureteroscopes 11.3%), or Black (LVE with pressure monitoring capability 7.9%, other single-use ureteroscopes 6.2%). The majority had a CCI score ≤ 4 (LVE with pressure monitoring capability 82.5%, other single-use ureteroscopes 82.3%).

Healthcare resource utilization

Post-match HRU for LVE with pressure monitoring capability and patients who were treated with all other single-use ureteroscopes are shown in Figures 1 and 2 and Table 2. For the primary outcome (composite ED visit or inpatient admission), the proportion with HRU was significantly lower for LVE with pressure monitoring capability at 10 days (4.5% vs. 8.7%; ARR 4.2 pp; NNT ≈24; p=0.016) and 30 days (7.2% vs. 12.0%; ARR 4.8 pp; NNT ≈21; p=0.019) compared to other single-use ureteroscopes (Figure 1). Adjusted multivariable logistic regression in the matched cohort showed significantly lower odds of HRU with LVE with pressure monitoring capability at 10 days (OR 0.355, 95% CI 0.175-0.718; p=0.004) and 30 days (OR 0.473, 95% CI 0.281-0.797; p=0.005) days compared to patients who were treated with other single-use ureteroscopes (Table 2). Table 3 presents the top ten primary diagnosis code groups of patients with the composite utilization measure at 30 days.

Component outcomes were directionally consistent. The proportions of patients with ED visits (10 days: 2.1% vs. 4.9% and 30-day 3.8% vs. 6.2%) and inpatient admissions (10 days: 2.7% vs. 3.8% and 30-day 4.1% vs. 6.2%) was also lower among patients who were treated with LVE with pressure monitoring capability compared to other single-use ureteroscopes (Figure 2). Patients who underwent LVE with pressure monitoring capability had a statistically significantly lower odds of ED visits at 10 days post-URS (OR 0.385, 95% CI 0.149-0.997; p=0.049) and inpatient admissions at 30 days post-URS (OR 0.436, 95% CI 0.196-0.967; p=0.041) days compared to patients who underwent other single-use ureteroscopes (Table 2).

Healthcare resource utilization at alternative time points of 7- and 14-days post-procedure

The sensitivity analysis demonstrated the robustness of the findings at alternative time points of 7- and 14-days post-procedure (in addition to the primary 10- and 30-day follow-up intervals). Adjusted multivariable logistic regression in the matched cohort showed significantly lower odds of HRU with LVE with pressure monitoring capability at 7 days (OR 0.435, 95% CI 0.202-0.935; p=0.033) and 14 days (OR 0.387, 95% CI 0.203-0.739; p=0.004) compared to patients who underwent other single-use ureteroscopes (Table 4). Additionally, a subgroup analysis was performed to compare outcomes among patients undergoing URS with LVE with pressure monitoring capability and other single-use ureteroscopes for URS at 10 and 30 days stratified by CCI (≤4 vs. >4) to evaluate potential variations in healthcare resource utilization across patient comorbidity score groupings.

Healthcare resource utilization across comorbidity subgroups

The subgroup analysis evaluating outcomes at 10 and 30 days stratified by CCI (≤4 vs. >4) showed lower odds of HRU with LVE among patients with CCI ≤4 at 10 days (OR 0.457, 95% CI 0.232-0.898; p=0.023) and 30 days (OR 0.581, 95% CI 0.336-1.005; p=0.052), although the association was not statistically significant at 30 days (Table 5). HRU trends for patients with CCI >4 were similar to those observed for all patients.

HRU among patients with an encounter for UTI, sepsis, and UTI and/or sepsis

Among patients who had a postoperative healthcare encounter for UTI, sepsis, and UTI and/or sepsis, LVE with pressure monitoring capability was associated with fewer UTI or sepsis-related ED visits and/or hospital admissions at 30 days, especially for UTI and for the UTI/sepsis composite (Supplemental Table S2).

DISCUSSION

In this real-world analysis, the use of LVE with pressure monitoring capability was associated with lower utilization after URS compared with other single-use ureteroscopes lacking pressure monitoring. In the matched cohort, patients treated with LVE with pressure monitoring capability had lower HRU (the composite of ED visits or inpatient admissions) compared with controls at both 10 days (4.5% vs 8.7%) and 30 days (7.2% vs 12.0%). Individual components showed directionally consistent benefits (ED visits at 10 days: 2.1% vs 4.9% and inpatient admissions at 30 days 4.1% vs 6.2%). In the adjusted analysis, LVE with pressure monitoring capability was associated with significantly lower odds of the composite outcome at 10 days (OR 0.355, 95% CI 0.175-0.718; p=0.004) and 30 days (OR 0.473, 95% CI 0.281-0.797; p=0.005). Together, these results indicate clinically meaningful, early reductions in potentially avoidable care post-URS.

URS is performed at high volume[2,3] and is associated with meaningful post-procedural healthcare resource use driven by secondary procedures[4] and complications.[1,5,6] In an increasingly quality- and cost-conscious healthcare environment, there is a need for effective and safer strategies for prevention of URS-related adverse outcomes.[30,31] Evaluating ED visits and inpatient admissions post-URS provides decision-relevant evidence beyond procedural success.

Elevated IRP during URS has been linked to complications such as sepsis and postoperative infections[15,18-21,32,33]—events that often necessitate urgent ED visits or inpatient admissions. LVE provides real-time IRP data that physicians can use to make informed decisions to manage IRP potentially reducing the incidence of such adverse outcomes compared to conventional single-use ureteroscopes lacking this feature.[34] From a payer perspective, the observed ARRs translate into ~21–24 patients treated to avert one ED visit or inpatient admission event and ~36 to avert one ED revisit within 10 days, which is operationally meaningful in a high-volume service line and supports the case for substantial clinical improvement in outcomes of importance to payers. Fewer encounters also imply potential downstream cost savings and improved patient experience, including shorter recovery times, and improved patient quality of life. URS with IRP monitoring may be a means of effectively reducing healthcare resource utilization and addressing the expanding burden of stones.[34] The composite of ED visits or inpatient admissions findings were consistent among patients with lower comorbidity index scores, indicating these patients also benefit from LVE with pressure monitoring capability.

The findings of this study are consistent with the previous study comparing LVE with pressure monitoring capability vs. other single-use ureteroscopes, which found post-operative infection was significantly lower with LVE with pressure monitoring capability at 30 days post-index (8.2% vs. 15.4%; p=0.016).[22] Multivariable analyses in this study confirmed significantly higher odds of 30-day infection with other single-use ureteroscopes (OR 2.09 [95% CI 1.19-3.86]; p=0.014). Post-operative 30-day UTI was also significantly less with LVE with pressure monitoring capability (5.2% vs. 10.8%; p=0.033).

This study has several strengths. It leverages a large, nationally distributed real-world all-payer dataset reflecting routine clinical practice, which enhances generalizability. The reason for the utilization of a U.S. database was due to the size of the database (25% of all U.S. hospital admissions, representing more than 1,370 facilities and more than 341 million unique patients) and due to the relatively recent availability of LVE with pressure monitoring. Once adequate data are available, this study should be repeated in other countries to confirm the consistency of the findings. Another strength of this study is, the application of propensity score matching allowed for adjustment of baseline patient characteristics to address confounding in comparisons of healthcare resource use. Outcomes were assessed at clinically relevant windows (10 and 30 days), with absolute and relative measures reported. Robustness was demonstrated across prespecified sensitivity and subgroup analyses.

There are limitations of this study which should be considered. As with all retrospective database analyses, this study is subject to potential coding errors, misclassification, and incomplete data, which may impact accuracy. Real-world data lack clinical granularity, such as surgical techniques (e.g., adjustment of irrigation pressure or flow rate, pausing of procedure), intraoperative parameters (e.g., stone size, composition, and location, IRP measurements, operative time, antibiotic use) and other patient medication usage, which may influence outcomes but are not captured in the dataset. It was not possible to discern whether and how the information on increased IRP affected clinicians' technique and practice. Studies with more granular clinical information (e.g., prospective studies or electronic health record [EHR] analyses) would be required to better understand how IRP monitoring affects clinical practice. Due to the lack of availability of this information, unmeasured confounding may persist despite matching and statistical adjustment. Another limitation of the PHD hospital dataset is that ED visits and inpatient admissions are captured only at participating facilities, which could underestimate event rates. Finally, the LVE group was substantially smaller than the non-LVE group, likely reflecting limited availability; however, propensity score matching was performed in an attempt to equalize the comparisons. LVE cases may represent a selected population (e.g., early adopters and/or higher-volume surgeons or higher-risk cases), which could introduce selection bias and residual confounding. While propensity score matching was used to balance measured characteristics, unmeasured factors such as surgeon experience and case complexity are not captured in the dataset and may influence outcomes.. Despite this potential bias, the postoperative composite outcome of ED visits or inpatient admissions remained lower in the LVE group. Despite these limitations, this study provides meaningful real-world evidence on healthcare resource utilization following URS, supported by a large and diverse patient population.

CONCLUSIONS

In this national real-world cohort, the use of LVE with pressure monitoring capability was associated with lower odds of potentially avoidable care at 10- and 30-days post-URS compared with other single-use ureteroscope technologies. These findings provide initial real-world evidence that the use of LVE with pressure monitoring capability is associated with lower rates of avoidable ED visits and inpatient admissions. The results may assist clinicians and payers in managing the growing burden of stone disease. Future research is warranted to confirm these findings and to further characterize patient circumstances associated with healthcare resource utilization.

REFERENCES

1. Bhanot R, Jones P, Somani B. Minimally invasive surgery for the treatment of ureteric stones - state-of-the-art review. *Res Rep Urol* 2021;13:227-36.https://doi.org/10.2147/RRU.S311010
2. Haas CR, Li S, Knoedler MA, et al. Ureteroscopy and shock wave lithotripsy trends from 2012 to 2019 within the us medicare dataset: Sharp growth in ureteroscopy utilization. *J Endourol* 2023;37:219-24. https://doi.org/10.1089/end.2022.0402
3. Serrell E, Antar AS, Buinevicius E, et al. Surgical stone trends from 2013 to 2021 in the us medicare population: Before and after the covid-19 pandemic. *J Endourol* 2024;38:902-7. https://doi.org/10.1089/end.2024.0063
4. Iremashvili V, Li S, Penniston KL, et al. Role of residual fragments on the risk of repeat surgery after flexible ureteroscopy and laser lithotripsy: Single center study. *J Urol* 2019;201:358-63. https://doi.org/10.1016/j.juro.2018.09.053
5. De Coninck V, Keller EX, Somani B, et al. Complications of ureteroscopy: A complete overview. *World J Urol* 2020;38:2147-66. https://doi.org/10.1007/s00345-019-03012-1
6. Whitehurst L, Jones P, Somani BK. Mortality from kidney stone disease (ksd) as reported in the literature over the last two decades: A systematic review. *World J Urol* 2019;37:759-76. https://doi.org/10.1007/s00345-018-2424-2
7. Chugh S, Pietropaolo A, Montanari E, et al. Predictors of urinary infections and urosepsis after ureteroscopy for stone disease: A systematic review from eau section of urolithiasis (eulis). *Curr Urol Rep* 2020;21:16. https://doi.org/10.1007/s11934-020-0969-2
8. Sun J, Xu J, OuYang J. Risk factors of infectious complications following ureteroscopy: A systematic review and meta-analysis. *Urol In*t 2020;104:113-24. https://doi.org/10.1159/000504326
9. Somani BK, Giusti G, Sun Y, et al. Complications associated with ureterorenoscopy (urs) related to treatment of urolithiasis: The clinical research office of endourological society urs global study. *World J Urol* 2017;35:675-81. https://doi.org/10.1007/s00345-016-1909-0
10. Bhojani N, Miller LE, Bhattacharyya S, et al. Risk factors for urosepsis after ureteroscopy for stone disease: A systematic review with meta-analysis. *J Endourol* 2021;35:991-1000. https://doi.org/10.1089/end.2020.1133
11. Bhojani N, Eisner B, Monga M, et al. Sepsis prevalence and associated hospital admission and mortality after ureteroscopy in employed adults. *BJU Int* 2023;132:210-6. https://doi.org/10.1111/bju.16029
12. Boston Scientific Inc. Lithovue™ elite single-use digital flexible ureteroscope system with intrarenal pressure monitoring. Accessed July 21, 2025. https://www.bostonscientific.com/en-US/products/Ureteroscopes/LithoVue-Elite.html
13. Bhojani N, Koo KC, Bensaadi K, et al. Retrospective first-in-human use of the lithovue™ elite ureteroscope to measure intrarenal pressure. *BJU International* 2023;132:678-85. https://doi.org/10.1111/bju.16173
14. Pauchard F, Bhojani N, Chew B, et al. How to measure intra-renal pressure during flexible urs: Historical background, technological innovations and future perspectives.

Actas Urológicas Españolas (English Edition) 2024;48:42-51. https://doi.org/10.1016/j.acuroe.2023.10.007
15. Yuen SKK, Zhong W, Chan YS, et al. Current utility, instruments, and future directions for intra-renal pressure management during ureteroscopy: Scoping review by global research in intra-renal pressure collaborative group initiative. *Ther Adv Urol* 2025;17:17562872251314809. https://doi.org/10.1177/17562872251314809
16. Loftus CJ, Hinck B, Makovey I, et al. Mini versus standard percutaneous nephrolithotomy: The impact of sheath size on intrarenal pelvic pressure and infectious complications in a porcine model. *J Endourol* 2018;32:350-3. https://doi.org/10.1089/end.2017.0602
17. Zhong W, Leto G, Wang L, et al. Systemic inflammatory response syndrome after flexible ureteroscopic lithotripsy: A study of risk factors. *J Endourol* 2015;29:25-8. https://doi.org/10.1089/end.2014.0409
18. Tokas T, Herrmann TRW, Skolarikos A, et al. Pressure matters: Intrarenal pressures during normal and pathological conditions, and impact of increased values to renal physiology. *World J Urol* 2019;37:125-31. https://doi.org/10.1007/s00345-018-2378-4
19. Huang HS, Lu ZH, Liu CJ. Ureterorenoscopic (urs) lithotripsy and balloon dilation cause acute kidney injury and distal renal tubule damage: A prospective study. *Biomed Res Int* 2022;2022:5505969. https://doi.org/10.1155/2022/5505969
20. Croghan SM, Cunnane EM, O'Meara S, et al. In vivo ureteroscopic intrarenal pressures and clinical outcomes: A multi-institutional analysis of 120 consecutive patients. *BJU Int* 2023;132:531-40. https://doi.org/10.1111/bju.16169
21. Croghan SM, Skolarikos A, Jack GS, et al. Upper urinary tract pressures in endourology: A systematic review of range, variables and implications. *BJU Int* 2023;131:267-79. https://doi.org/10.1111/bju.15764
22. Bhojani N, Morris K, White J, et al. Post-operative infection with a single-use ureteroscope with real-time intrarenal pressure monitoring vs. All other single-use ureteroscopes. *Expert Rev Med Devices* 2025;22:1135-43. https://doi.org/10.1080/17434440.2025.2557403
23. Premier Inc. Premier healthcare database (phd): Data that informs and performs Accessed August 26, 2025. https://go.premierinc.com/dc/RarcBwqWZ3zWWmw_f5F1l5WnlaBKgv5n7YsLiDVWQI1xtpGREcmxv1n8HRV47wE-STGGaYy4fE39HD_lGjRCVpIgqCVoj2wnCbI08H9I8VREDDBJQnjKwcEM9B4Ky2qm/MzgxLU5CQi01MjUAAAGcgVGoqENBGckp0zASUWPGn1CTzT0uh9QKPXQvsxAbBA9WhufWyjGKT-LcbZuBVJwyZFzontA=
24. Quan H, Li B, Couris CM, et al. Updating and validating the charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol* 2011;173:676-82. https://doi.org/10.1093/aje/kwq433
25. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *J Chronic Dis* 1987;40:373-83. https://doi.org/10.1016/0021-9681(87)90171-8

26. Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in icd-9-cm and icd-10 administrative data. *Med Care* 2005;43:1130-9. https://doi.org/10.1097/01.mlr.0000182534.19832.83
27. R-universe. Finalfit: Quickly create elegant regression results tables and plots when modelling, r package version 1.0.9. . https://github.com/ewenharrison/finalfit
28. Ho D, Imai K, King G, et al. Matchit: Nonparametric preprocessing for parametric causal inference. *Journal of Statistical Software* 2011;42:1 - 28. https://doi.org/10.18637/jss.v042.i08
29. Gasparini A. Comorbidity: An r package for computing comorbidity scores. *Journal of Open Source Software* 2018;3:648. https://doi.org/10.21105/joss.00648
30. Scotland KB, Lange D. Prevention and management of urosepsis triggered by ureteroscopy. *Res Rep Urol* 2018;10:43-9. https://doi.org/10.2147/RRU.S128071
31. Sorenson C, Drummond M, Bhuiyan Khan B. Medical technology as a key driver of rising health expenditure: Disentangling the relationship. *ClinicoEconomics and Outcomes Research: CEOR* 2013;5:223-34. https://doi.org/10.2147/CEOR.S39634
32. Osther PJ, Pedersen KV, Lildal SK, et al. Pathophysiological aspects of ureterorenoscopic management of upper urinary tract calculi. *Curr Opin Urol* 2016;26:63-9. https://doi.org/10.1097/MOU.0000000000000235
33. Osther PJS. Risks of flexible ureterorenoscopy: Pathophysiology and prevention. *Urolithiasis* 2018;46:59-67. https://doi.org/10.1007/s00240-017-1018-6
34. Somani B, Davis N, Emiliani E, et al. Expert consensus on high intra-renal pressure during ureteroscopy: A pan-european delphi panel. *European Urology* 2024;85:S1294. https://doi.org/10.1016/S0302-2838(24)01020-0

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FIGURES AND TABLES

Figure 1. Healthcare resource utilization with LVE with pressure monitoring capability vs. all other single-use ureteroscopes. LVE: LithoVue™ Elite; URS: ureteroscopy.

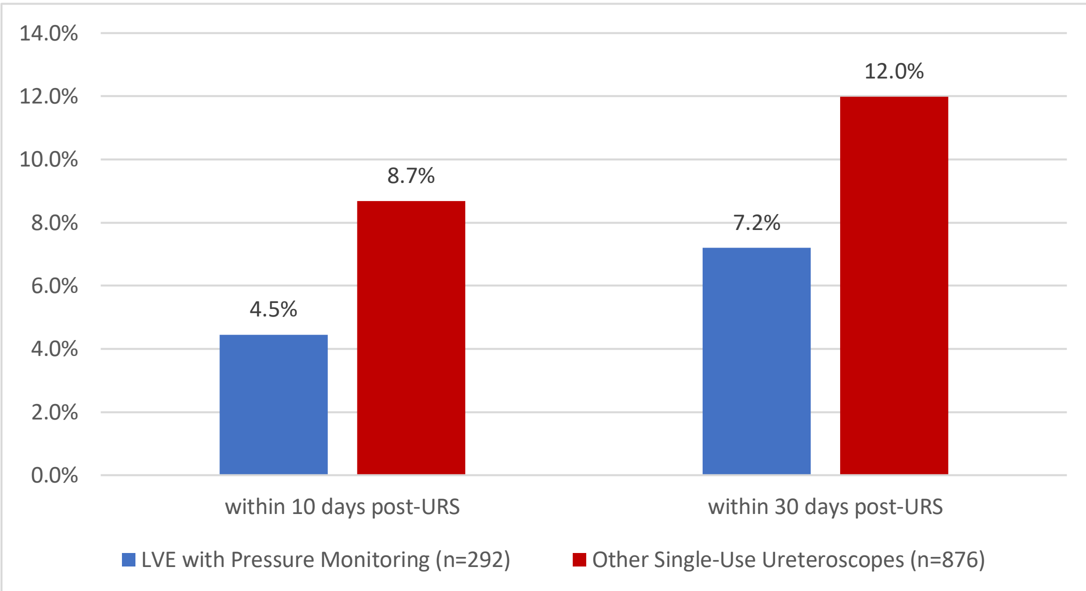

Figure 2. ED visits and inpatient admissions with LVE with pressure monitoring capability vs. all other single-use ureteroscopes. ED: emergency department; LVE: LithoVue™ Elite; URS: ureteroscopy.

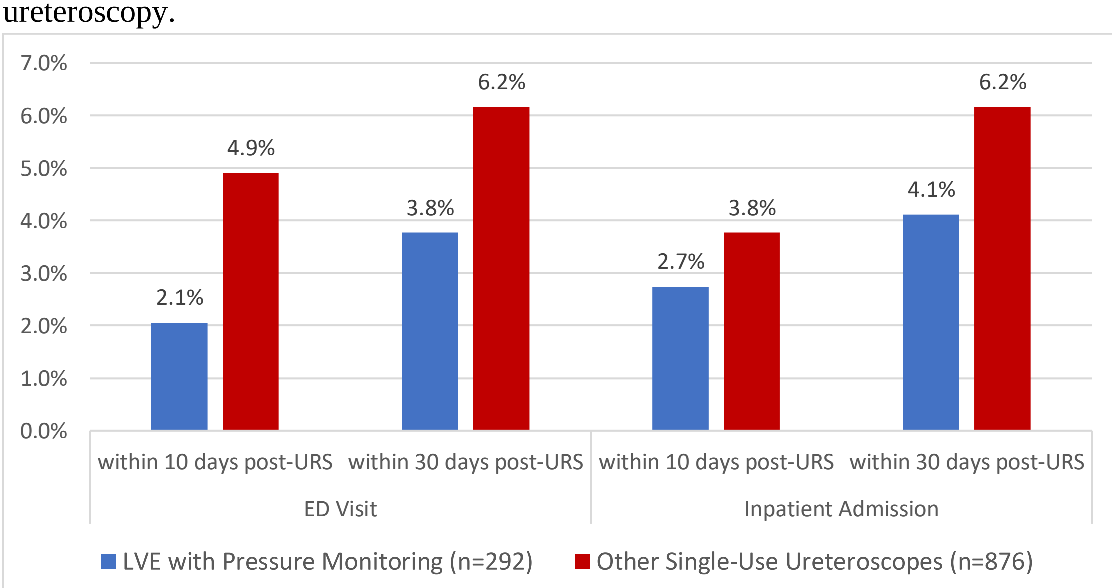

Table 1. Patient baseline demographic and clinical characteristics

Baseline characteristic	Unmatched population			Matched population		
	LVE with pressure monitoring capability (n=305)	Other single-use ureteroscopes (n=15,048)	SMD	LVE with pressure monitoring capability (n=292)	Other single-use ureteroscopes (n=876)	SMD
Age, mean (SD)	58.6 (16.1)	58.7 (15.8)	0.008	58.2 (16.4)	58.8 (16.5)	0.035
Male sex, n (%)	149 (48.9)	7267 (48.3)	0.011	145 (49.7)	431 (49.2)	0.009
Race, n (%)			**0.201**			0.073
Asian	5 (1.6)	230 (1.5)		5 (1.7)	14 (1.6)	
Black	23 (7.5)	795 (5.3)		23 (7.9)	54 (6.2)	
Hispanic	33 (10.8)	1768 (11.7)		31 (10.6)	99 (11.3)	
Other	10 (3.3)	282 (1.9)		10 (3.4)	34 (3.9)	
Unknown	0 (0.0)	175 (1.2)		0 (0.0)	0 (0.0)	
White	234 (76.7)	11798 (78.4)		223 (76.4)	675 (77.1)	
Provider region, n (%)			**0.977**			**0.960**
Midwest	3 (1.0)	3579 (23.8)		3 (1.0)	202 (23.1)	
Northeast	53 (17.4)	1611 (10.7)		53 (18.2)	98 (11.2)	
South	249 (81.6)	8250 (54.8)		236 (80.8)	482 (55.0)	
West	0 (0.0)	1608 (10.7)		0 (0.0)	94 (10.7)	
Index year 2025, n (%)	49 (16.1)	1993 (13.2)	0.080	47 (16.1)	127 (14.5)	0.044
Payer type, n (%)			**0.215**			0.099
Medicaid	45 (14.8)	1355 (9.0)		43 (14.7)	146 (16.7)	
Medicare	128 (42.0)	6422 (42.7)		121 (41.4)	376 (42.9)	

Other	119 (39.0)	6870 (45.7)		115 (39.4)	328 (37.4)	
Self-pay	13 (4.3)	401 (2.7)		13 (4.5)	26 (3.0)	
CCI score ≤4, n (%)	250 (82.0)	12,921 (85.9)	**0.106**	241 (82.5)	721 (82.3)	0.006
Diabetes, n (%)	61 (20.0)	2404 (16.0)	**0.105**	59 (20.2)	173 (19.7)	0.011
Obesity, n (%)	51 (16.7)	2866 (19.0)	0.061	45 (15.4)	121 (13.8)	0.045
Sepsis present on admission, n (%)	6 (2.0)	228 (1.5)	0.035	6 (2.1)	16 (1.8)	0.017
Recurring UTIs (≥2 diagnoses within 60 days pre-URS), n (%)	34 (11.1)	1161 (7.7)	**0.118**	27 (9.2)	63 (7.2)	0.075
UTI at index encounter, n (%)	22 (7.2)	1392 (9.3)	0.074	18 (6.2)	79 (9.0)	**0.108**
Kidney stone at index encounter, n (%)	162 (53.1)	6791 (45.1)	**0.160**	153 (52.4)	383 (43.7)	**0.174**
Sepsis at index encounter, n (%)	6 (2.0)	322 (2.1)	0.012	6 (2.1)	18 (2.1)	<0.001
Other infection at index encounter, n (%)	34 (11.1)	1236 (8.2)	0.099	30 (10.3)	73 (8.3)	0.067

Absolute SMD <0.100 was used as the threshold to indicate good balance. Bolded values denote SMD≥0.100. CCI: Charlson comorbidity index; LVE: LithoVue™ Elite; SD: standard deviation; SMD: standardized mean difference; UTI: urinary tract infection.

Table 2. Association between the use of LVE with pressure monitoring capability and healthcare resource utilization from multivariable logistic regressions

Healthcare resource	OR	CI		p
		Lower limit	Upper limit	
ED visit or inpatient admission				
Within 10 days post-URS	0.355	0.175	0.718	**0.004**
Within 30 days post-URS	0.473	0.281	0.797	**0.005**
ED visit				
Within 10 days post-URS	0.385	0.149	0.997	**0.049**
Within 30 days post-URS	0.598	0.286	1.253	0.173
Inpatient admission				
Within 10 days post-URS	0.386	0.126	1.184	0.096
Within 30 days post-URS	0.436	0.196	0.967	**0.041**

Bolded values denote statistically significant differences at $p<0.05$. CI: confidence interval; ED: emergency department; LVE: LithoVue™ Elite; OR: odds ratio; URS: ureteroscopy.

Table 3. Top ten primary diagnosis code groups of patients with the composite measure of emergency department visits or inpatient admissions at 30 days

LVE with pressure monitoring capability (n=21)				**Other single-use ureteroscopes (n=105)**			
Code category	**Diagnosis**	**n**	**%**	**Code category**	**Diagnosis**	**n**	**%**
T83	Complications of genitourinary prosthetic devices, implants and grafts	5	23.8%	A41	Other sepsis	18	17.1%
A41	Other sepsis	2	9.5%	T83	Complications of genitourinary prosthetic devices, implants and grafts	15	14.3%
N20	Calculus of kidney and ureter	2	9.5%	N13	Obstructive and reflux uropathy	14	13.3%
R07	Pain in throat and chest	2	9.5%	R10	Abdominal and pelvic pain	9	8.6%
R10	Abdominal and pelvic pain	2	9.5%	N30	Inflammation of the urinary bladder	7	6.7%
B37	Infection with a fungus of the genus candida	1	4.8%	N39	Urinary tract infection, site not specified	6	5.7%
D46	Infection in humans and animals caused by fungi in the class zygomycetes	1	4.8%	G89	Pain, not elsewhere classified	3	2.9%
E11	Type 2 diabetes mellitus with hyperosmolarity	1	4.8%	N20	Calculus of kidney and ureter	3	2.9%
E22	Hyperfunction of pituitary gland	1	4.8%	R11	Nausea and vomiting	3	2.9%
I50	Heart failure	1	4.8%	O26	Maternal care for other conditions predominantly related to pregnancy	2	1.9%

N39	Urinary tract infection, site not specified	1	4.8%	R33	Retention of urine	2	1.9%
Z87	Personal history of other diseases and conditions	1	4.8%				
Z98	Other postprocedural states	1	4.8%				

The reported diagnoses included more than ten distinct conditions, as some diagnoses shared the same rates. LVE: LithoVue™ Elite.

Table 4. Sensitivity analysis showing association between the use of LVE with pressure monitoring capability and healthcare resource utilization from multivariable logistic regressions at 7- and 14-days post-procedure

Healthcare resource	OR	CI		p
		Lower limit	Upper limit	
ED visit or inpatient admission				
Within 7 days post-URS	0.435	0.202	0.935	**0.033**
Within 14 days post-URS	0.387	0.203	0.739	**0.004**
ED visit				
Within 7 days post-URS	0.382	0.135	1.084	0.071
Within 14 days post-URS	0.470	0.197	1.124	0.089
Inpatient admission				
Within 7 days post-URS	0.953	0.263	3.458	0.941
Within 14 days post-URS	0.351	0.135	0.913	**0.032**

Bolded values denote statistically significant differences at $p<0.05$. CI: confidence interval; ED: emergency department; LVE: LithoVue™ Elite; OR: odds ratio; URS: ureteroscopy.

Table 5. Subgroup analysis showing association between the use of LVE with pressure monitoring capability and healthcare resource utilization from multivariable logistic regressions for patients with CCI ≤4 and CCI >4

	CCI score ≤4				**CCI score >4**			
		CI				**CI**		
Healthcare resource	**OR**	**Lower limit**	**Upper limit**	**p**	**OR**	**Upper limit**	**Lower limit**	**p**
ED visit or inpatient admission								
Within 10 days post-URS	0.457	0.232	0.898	**0.023**	0.480	0.101	2.278	0.355
Within 30 days post-URS	0.581	0.336	1.005	**0.052**	0.240	0.051	1.126	0.070
ED visit								
Within 10 days post-URS	0.350	0.136	0.904	**0.030**	1.500	0.136	16.542	0.741
Within 30 days post-URS	0.615	0.305	1.240	0.174	0.500	0.060	4.153	0.521
Inpatient admission								
Within 10 days post-URS	0.813	0.327	2.021	0.655	0.272	0.033	2.274	0.230
Within 30 days post-URS	0.683	0.320	1.457	0.323	0.180	0.022	1.450	0.107

Bolded values denote statistically significant differences at p<0.05. CI: confidence interval; ED: emergency department; LVE: LithoVue™ Elite; OR: odds ratio; URS: ureteroscopy.