Poster Session 3: Endourology/Stones
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MP 3.1
The 3 Cs of the ideal ureteroscopy: A patient-centered composite outcome for understanding the success of a ureteroscopic stone procedure

Michael Uy[1], Caitlin Seibel[1], Stephanie Daignault-Newton[1], Eduardo Kleer[2], Naveen Kachroo[3], Richard Sarle[4], Wilson Sui[1], Casey Dauw[1], Khurshid Ghani[1], for the Michigan Urological Surgery Improvement Collaborative[1]
[1]Department of Urology, University of Michigan, Ann Arbor, United States; [2]Department of Urology, Trinity Health IHA Medical Group, Ann Arbor, United States; [3]Department of Urology, Henry Ford Hospital, Wyandotte, United States; [4]Department of Urology, University of Michigan (Sparrow), Lansing, United States

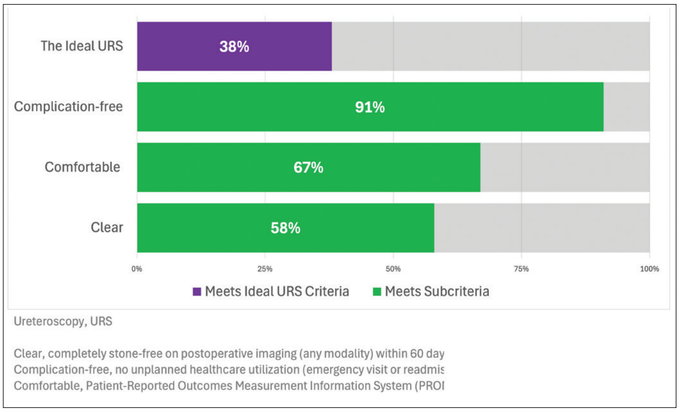
Introduction: Traditional measures of success after ureteroscopy (URS) focus on stone-free rates, with patient-reported outcomes and downstream healthcare utilization seldom reported. These factors are important to both patients and healthcare systems. We sought to define a composite outcome for the ideal URS patient journey encompassing technical success and patient experience to determine the proportion of patients achieving it.

Methods: The ideal URS was defined as meeting all the criteria of the "three Cs": 1)clear, completely stone-free in a single session on postoperative imaging within 60 days; 2) complication-free, no unplanned healthcare utilization (emergency visit or hospitalization) within 30 days; and 3) comfortable, defined as a Patient-Reported Outcomes Measurement Information System (PROMIS) Pain Interference score ≤50 at 4–6 weeks. Patients undergoing URS were identified from the Michigan Urological Surgery Improvement Collaborative (MUSIC) clinical registry. Those with chronic pain disorders, anatomical abnormalities, intraoperative complications, or staged procedures were excluded. Multivariable logistic regression, adjusting for baseline pain, stone characteristics, and patient and intraoperative factors, was used to identify predictors of achieving an ideal URS.

Results: A total of 608 patients undergoing URS had had complete followup data of all metrics. Postoperative stents were placed in 72% of patients, with a median dwell time of seven days (IQR 3). Stones were located in the kidney in 36.5% of patients, and in the ureter ± kidney in 63.5%, with median stone diameter of 8 mm (IQR 5). Overall, 234 patients (38%) met all three Cs criteria (Figure 1). Among the individual components, the lowest proportion achieved was being clear with 347 patients (58%), followed by being comfortable in 403 patients (67%). Renal stones were significantly associated with decreased odds of achieving an ideal URS (OR 0.5, 95% CI 0.3–0.8, p=0.002).

Conclusions: Four out of 10 patients achieved an ideal URS outcome, with stone clearance and postoperative pain representing the most common limiting factors. The three Cs framework offers a patient-centered measure of URS success that can drive quality improvement initiatives and inform the design of future studies.

Funding: Support for MUSIC is provided by Blue Cross and Blue Shield of Michigan as part of Value Partnerships Program.



MP 3.1. Figure 1. Proportion of patients achieving the ideal URS and individual components.

MP 3.2
Characterizing pain interference after ureteroscopy: Who does it affect and for how long?

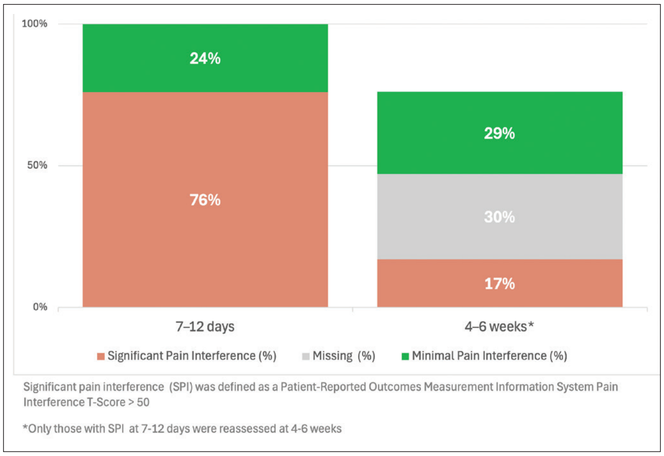
Michael Uy[1], Caitlin Seibel[1], Stephanie Daignault-Newton[1], Eduardo Kleer[2], Hector Pimental[3], Brian Seifman[4], Wilson Sui[1], Khurshid Ghani[1], Casey Dauw[1], for the Michigan Urological Surgery Improvement Collaborative[1]
[1]Department of Urology, University of Michigan, Ann Arbor, United States; [2]Department of Urology, Trinity Health IHA Medical Group, Ann Arbor, United States; [3]Department of Urology, Corewell Health, Grand Rapids, United States; [4]Department of Urology, Michigan Institute of Urology, Rochester Hills, United States

Introduction: Postoperative pain is common after ureteroscopy (URS) with lithotripsy, yet the duration of symptoms and the factors associated with pain are not well-described. We aimed to define the proportion of patients experiencing pain postoperatively and identify predictors of persistence to guide patient expectations.

Methods: Using the Michigan Urological Surgery Improvement Collaborative (MUSIC) clinical registry, we identified patients undergoing URS who completed Patient-Reported Outcomes Measurement Information System (PROMIS) Pain Interference (PI) assessments at baseline, 7–12 days, and optionally at 4–6 weeks postoperatively. Patients with pain disorders, intraoperative complications, or anatomical abnormalities were excluded. Significant pain interference (SPI) was defined as a PROMIS-PI T-score >50. We quantified the proportion of patients reporting SPI at each timepoint and used logistic regression, adjusted for baseline PI, stone characteristics, and patient and intraoperative factors, to identify predictors of SPI.

Results: Among 1380 patients who underwent URS and completed PROs, 38% had renal stones only and 62% had ureteral (±renal) stones. The median stone size was 8 mm (IQR 5), and 70% received a postoperative stent. Followup at 4–6 weeks was completed by 60% of patients. At 7–12 days, 1050 patients (76%) reported SPI. Of these, 234 (17%) continued to report SPI at 4–6 weeks (Figure 1). On multivariable regression, factors independently associated with SPI at 7–12 days included higher preoperative PI, renal stone location, younger age, larger stones, and postoperative stent placement (p≤0.001≤0003). At 4–6 weeks, elevated preoperative PI remained the only significant predictor of persistent pain (p=0.007).

Conclusions: Three out of four patients undergoing URS experience significant PI within the first 12 days, decreasing to one out of five by 4–6 weeks. Early pain is associated with baseline pain burden, stone characteristics, and postoperative stent placement, whereas persistent pain at 4–6 weeks is primarily associated



MP 3.2. Figure 1. Pain interference status following ureteroscopy.

with elevated baseline PI. These findings underscore the importance of assessing baseline symptoms for postoperative counseling and expectation management.

Funding: Support for MUSIC is provided by Blue Cross and Blue Shield of Michigan as part of Value Partnerships Program.

MP 3.3

Variability in pre- and postoperative antibiotic prescription rates and impact on infection outcomes after ureteroscopy

Michael Uy[1], Suprita Krishna[1], Kushbu Narender Singh[2], Jerison Ross[1], Anna Johnson[1], Caitlin Seibel[1], Stephanie Daignault-Newton[1], Khurshid Ghani[1], Casey Dauw[1], Wilson Sui[1], for the Michigan Urological Surgery Improvement Collaborative[1]

[1]Department of Urology, University of Michigan, Ann Arbor, United States; [2]Michigan Value Collaborative, University of Michigan, Ann Arbor, United States

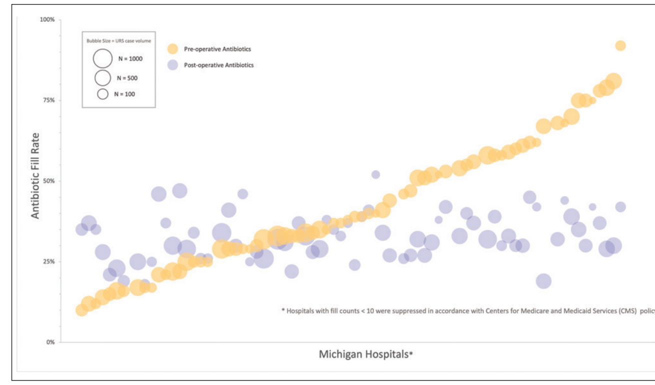
Introduction: Antibiotics are often prescribed before or after ureteroscopy (URS) to prevent postoperative infections; however, practice patterns vary widely due to limited high-quality evidence and unclear guidelines. We aimed to characterize hospital-level variability in antibiotic prescription rates and examine their associations with infection-related outcomes.

Methods: Using Michigan statewide claims data, patients who underwent URS from January 2018 to December 2023 were identified. Antibiotic prescription rates were calculated 30 days preoperatively and 14 days postoperatively. We examined hospital-level associations between prescription rates and 30-day urinary tract infection (UTI)-related admissions using weighted regression and compared outcomes between hospitals in the highest vs. lowest quartiles of prescription rates.

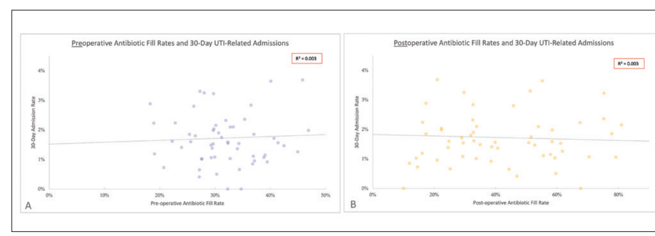
Results: A total of 24 058 ureteroscopies were performed across 57 hospitals, with URS volumes ranging from 101–1380 cases. Antibiotic use varied widely, with preoperative prescription rates ranging from 18.3–46.9%, and postoperatively from 10–81.0% (Figure 1). Thirty-day UTI-related admissions occurred in 418 patients (1.7%). Prescription rates were not associated with 30-day UTI admissions for either pre- or postoperative antibiotics (Figure 2). Hospital URS volume was not associated with pre- or postoperative antibiotic fill rates (R2=0.016 and 0.054, respectively). There was no evidence of differences in admission rates between hospitals in the highest and lowest prescription quartiles (pre-op 1.8% vs. 1.7%; post-op 1.5% vs. 1.8%).

Conclusions: Antibiotic prescription practice patterns before and after URS varies widely across Michigan. Higher hospital-level antibiotic prescription rates were not associated with reduced 30-day UTI-related admissions. These results suggest that many patients may be exposed to unnecessary antibiotics, underscoring the need for more evidence-based prescribing protocols and antimicrobial stewardship efforts in the perioperative setting.

Funding: Data was provided by the Michigan Value Collaborate, which is funded by Blue Cross Blue Shield of Michigan.



MP 3.3. Figure 1. Variation in pre- and postoperative antibiotic fill rates across Michigan hospitals.



MP 3.3. Figure 2. Hospital-level associations between preoperative (A) and postoperative (B) antibiotic fill rates and 30-day UTI-related admissions.

MP 3.4

Leveraging non-destructive, three-dimensional micro-CT imaging to assess calcium oxalate and uric acid compositions of renal calculi

Abbas Hammoud[1], Gavin Hughes[1], Jonguk Lee[2], Rachel Wong[1], Mohamad Baker Berjaoui[1], Nikhile Mookerji[1], Leo Chen[1], Brian Carrillo[3], Monica Farcas[1]

[1] Division of Urology, Department of Surgery, St. Michael's Hospital, University of Toronto, Toronto, Canada; [2]Department of Medicine, Faculty of Health Sciences, McMaster University, Hamilton, Canada; [3]Wellspring Research, Toronto, Canada

Introduction: Urologists try to predict kidney stone composition using indicators like Hounsfield units and urine pH; however, definitive stone analysis relies on Fourier transform infrared spectroscopy (FTIR), a destructive technique that requires stone pulverization. For a stone of mixed composition, the 3D spatial distribution of its components may be relevant to its management. For example, a core of calcium oxalate (CaO) encased in a shell of uric acid (UA) may react differently to dissolution therapy than a majority UA stone with specs of CaO scattered throughout. Unfortunately, such information is completely lost in FTIR. In contrast, volumetric micro-CT (mCT) is a non-destructive imaging modality with sufficient resolution to identify and determine the spatial distributions of different materials. This makes mCT a promising tool for 3D, non-destructive compositional analysis of stones. Our study aimed to evaluate the ability of mCT to predict CaO:UA ratios and distributions in PCNL-derived stones and to validate predictions against FTIR analysis.

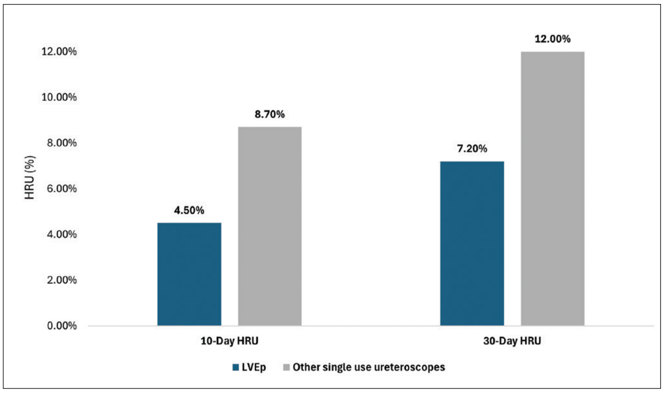
Methods: Kidney stone fragments were retrieved from 29 patients who underwent PCNL at St. Michael's Hospital (Toronto, Canada). A representative fraction of each stone was sent for FTIR, and the rest was scanned with mCT. On FTIR, 19/29 patients had pure CaOx, 6/29 had pure UA, and 4/29 had mixed CaOx/UA stones. Stones from two patients with pure CaOx and UA (on both FTIR and mCT) were used for calibration. Pure CaOx/UA intensity distributions were plotted and analyzed. Fisher's d' metric was used to assess histogram separability, and a receptor operator curve (ROC) analysis was performed to determine the optimal intensity threshold for material classification. This threshold was then used to classify voxels in the remaining (test) stones as CaOx or UA. Each material's relative composition was computed as the ratio of its voxel count to the total count. mCT-derived compositions of CaOx and UA were compared to FTIR for each patient, and a visual inspection of incorrectly classified voxels was performed to investigate errors.

Results: Calibration histograms for CaOx and UAa demonstrated excellent separability, with Fisher's d'=4.2. ROC analysis yielded an intensity threshold with high discriminatory power (AUC 99%). The threshold achieved a 100% accuracy on test stones that were pure CaOx on FTIR (n=18). When applied to test stones that were pure UA on FTIR (n=5), the threshold resulted in a mean error of 11±13% (i.e., on average, 11% of voxels in each pure UA stone were classified as CaOx). For the four stones found to be mixed on FTIR, the threshold resulted in a mean error of 24±22%. Visual inspection revealed that our classification separated CaOx and UA well in all mixed test stones. This suggests that errors in the mCT classification can potentially be attributed to FTIR and mCT analyzing different stone fragments from each patient.
Conclusions: Our study suggests that mCT can nondestructively compete with FTIR in kidney stone composition analysis.
Acknowledgements: This work was presented at the AUA 2026 Annual Meeting.

MP 3.5
Pressure-monitoring single-use ureteroscopes demonstrate lower hospital resource utilization compared to conventional single-use devices

Naeem Bhojani[1], Connor M. Forbes[2], Ben H. Chew[2], Kathryn Morris[3], Theodore Tsacogianis[3], Jenifer White[3], Sirikan Rojanasarot[3], Abimbola Williams[3], Natalie Edwards[4], Manoj Monga[5]
[1]Division of Urology, Université de Montréal, Montreal, Canada; [2]Department of Urologic Sciences, University of British Columbia, Vancouver, Canada; [3]Boston Scientific, Marlborough, United States; [4]Health Services Consulting Corporation, Marlborough, United States; [5]Department of Urology, University of California San Diego School of Medicine, La Jolla, United States

Introduction: Monitoring intrarenal pressure (IRP) in real time during ureteroscopy (URS) with lithotripsy may assist urologists in making more informed clinical decisions to maintain lower pressures, thereby potentially mitigating complications like sepsis. This study compared post-procedure hospital resource utilization (HRU; emergency department [ED] visits, or inpatient admissions) with LithoVue™ Elite Single-Use Digital Flexible Ureteroscope with pressure monitoring (LVEp) vs. other (non-pressure sensing) single-use ureteroscopes.
Methods: Adults undergoing index URS with between January 1, 2024, and March 1, 2025, in the Premier PINC AI™ Healthcare Database with ≥30-day post-URS followup were included. HRU was measured 10 and 30 days post-URS. A 1:3 propensity score matching method was applied to balance the two groups. Multivariable logistic regression adjusted for residual confounding.
Results: After matching, 292 LVEp patients (mean [SD] age 58.2 [16.4], 50.3% female) were compared with 876 controls (mean [SD] age 58.8 [16.5], 50.8% female). Patients undergoing LVEp with pressure monitoring had lower post-URS HRU at 10 days (4.5% vs. 8.7%; absolute risk reduction [ARR] 4.2 percentage points [pp]; p=0.016) and at 30 days (7.2% vs. 12.0%; ARR 4.8 pp; p=0.019) vs. other single-use ureteroscopes. Hospital resource utilization outcomes shown in Figure 1. Multivariable logistic regression analyses confirmed that patients who were treated with LVE had 64% lower odds of HRU at 10 days (OR 0.36, 95% CI 0.18–0.72, p=0.004) and 53% lower odds of HRU at 30 days (OR 0.47, 95% CI 0.28–0.80, p=0.005) vs. patients treated with other single-use ureteroscopes.
Conclusions: Use of LVEp is associated with lower odds of post-URS HRU compared to patients treated with other (non-pressure-sensing) single-use ureteroscopes. This finding may help physicians and healthcare payers reduce postoperative sequelae from the growing burden of stone disease.
Funding: Boston Scientific provided statistical support.

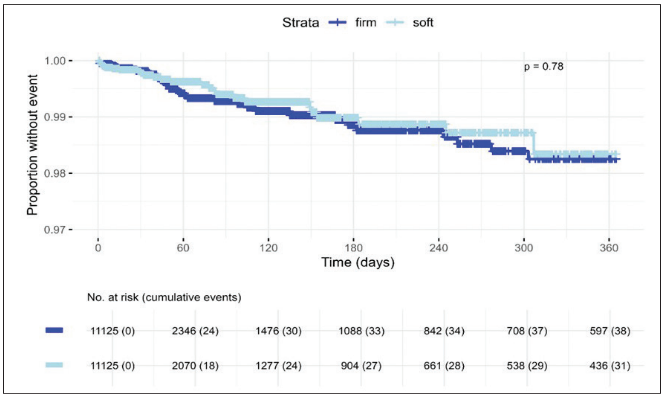


MP 3.5. Figure 1. Hospital resource utilization at 10 and 30 days.

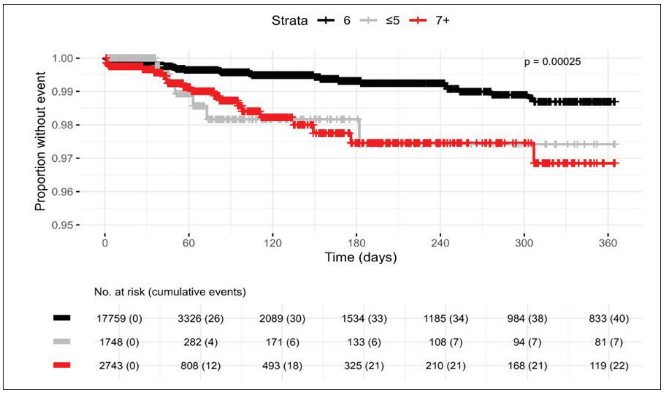
MP 3.6
Association between ureteral stent durometer, diameter, and patient outcomes

Connor M. Forbes[1], Ali Algonaim[1], Angeline S. Andrew[2], Ben H. Chew[1]
[1]Department of Urologic Sciences, University of British Columbia, Vancouver, Canada; [2]Boston Scientific Corporation, Marlborough, United States

Introduction: Many ureteral stents are designed for long indwell times up to 365 days, but clinical evidence is lacking. Smaller (≤5 Fr) and softer durometer stents have been thought to be more comfortable. We assessed patient outcomes with ureteral stents approved for long indwell times using a large, retrospective U.S. cohort.
Methods: Retrospective data from electronic health records compiled by Truveta, Inc. was assessed for non-metallic stents indicated for indwelling time up to 365 days between January 2020 and July 2025. Stents were classified by durometer (soft vs. firm) and diameter (≤5, 6, or ≥7 Fr). After balancing the demographics using propensity score matching, healthcare event outcomes were identified using ICD-10 codes for mechanical complications likely related to obstruction of the indwelling ureteral stent (T83.192), for displacement of the indwelling stent (T83.122), or for stent-associated pain (T83.84XA).
Results: In the dataset of 22 250 patients, mechanical complication events were rare, occurring only in only 1.7% of cases. Event rates did not differ by stent durometer (p=0.78) (Figure 1) but were significantly lower in 6 Fr stents compared to smaller or larger stents (p=0.00025) (Figure 2). Pain events did not significantly differ by stent durometer or stent diameter.
Conclusions: In this large dataset, 6 Fr ureteral stents were associated with the lowest rate of mechanical complications compared to larger or smaller stent diameters, without any increase in healthcare encounters for stent-associated symptoms. There was no difference in complication rates between soft and firm stents.
Funding: Data analysis supported by Boston Scientific Corp.



MP 3.6. Figure 1. Rate of mechanical complications of indwelling ureteral stents by stent durometer. 365-day cumulative incidence: 1.7% for firm and 1.7% for soft stents.



MP 3.6. Figure 2. Rate of mechanical complications of indwelling ureteral stents by stent diameter. 365-day cumulative incidence: ≤5 Fr 2.6%, 6 Fr 1.3%, ≥7+ Fr 3.1%.

MP 3.7

Predictability of operative time in endourology: Stone procedures exhibit greater variability than benign prostatic hyperplasia procedures

Ali Hosseinzadeh[1], Ali Algoniam [2], Jarrah Aburezq[2], Ryan F. Paterson[2], Ben H. Chew[2], Connor M. Forbes[2]
[1]Faculty of Medicine, University of British Columbia, Vancouver, Canada; [2]Department of Urologic Sciences, University of British Columbia, Vancouver, Canada

Introduction: Accurate operative time estimation is essential for efficient scheduling, cost management, and patient safety. In endourology, discrepancies between estimated and actual case times remain poorly defined across procedures. This study compared surgeon-estimated vs. actual operative times among endourologic procedures to optimize resource use and case mix on operative days.
Methods: A retrospective review of 956 urologic cases from three surgeons at Vancouver General/UBC Hospitals (January 2019 to October 2024) was performed. The primary outcome was the paired mean difference between estimated and actual operative times by case type. A priori power analysis (SD 79 min; α=0.05) indicated ≥294 cases were needed to detect a 15-minute bias with 90% power. Multivariable linear regression identified predictors of time deviation.
Results: Mean patient age was 65±16 years, with 80% being male. Overall, cases finished 26±34 minutes earlier than estimated ($p<0.001$), with marked variation by procedure. PCNL (-41±52 min, $p<0.001$) and ureteroscopy (-22±37 min, $p<0.001$) showed the greatest variability, while HoLEP (-27±30 min), TURP (-24±24 min), and TURBT (-21±18 min) were more consistent (Table 1). Ureteroscopy with nephroscopy had poorer predictability than ureteroscopy alone (24±55 vs. 4±34 min, p=0.01). The regression model confirmed significant variation by procedure type (F=2.34, p=0.017; adjusted R^2=0.011), with no significant patient-level predictors.
Conclusions: Stone-related procedures exhibit the greatest unpredictability among endourologic procedures, with more complex cases having higher unpredictability. Within an endourologic practice, spreading case types with higher unpredictability over multiple OR days may prevent late staffing needs and optimize OR time use. Next steps would be to correlate OR times to stone complexity using standardized classifications.

MP 3.7. Table 1. Procedure-specific differences between actual and estimated operative times

Procedures	PCNL	Ureteroscopy	HoLEP	TURP	TURBT	Other
Number of cases	30	207	271	118	80	250
Age (median, Q1–Q3)	55 (46–69)	62 (48–72)	74 (68–78)	69 (63–77)	75 (67–79)	61 (39–73)
Sex (M/F)	18 M/ 12 F	127 M/80 F	271 M	118 M	59 M/ 21F	171 M/ 79 F
ASA I	3 (10%)	37 (18%)	41 (15%)	24 (20%)	10 (13%)	69 (28%)
ASA II	17 (57%)	80 (39%)	127 (47%)	40 (34%)	31 (39%)	85 (34%)
ASA III	9 (30%)	71 (31%)	97 (36%)	50 (42%)	38 (48%)	69 (28%)
ASA IV	1 (3%)	19 (9%)	6 (2%)	4 (3%)	1 (1%)	25 (10%)
ASA V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (1%)
Estimated OR time (median, Q1–Q3)	180 (153–180)	70 (60–100)	135 (120–150)	60 (50–74)	40 (30–60)	60 (40–180)
Actual OR time (median, Q1–Q3)	187 (166–243)	85 (63–116)	141 (122–163)	68 (55–76)	47 (39–63)	65 (45–178)
Estimated vs, actual OR time (median, Q1–Q3)	-49 (-80 to -1)	-21 (-41 to -4)	-30 (-45 to -13)	-21 (-34 to -9)	-20 (-31 to -12)	-28 (-50 to -7)
Estimated vs, actual OR time (mean, SD)	-41 (52)	-22 (37)	-27 (30)	-24 (24)	-21 (18)	-30 (40)

MP 3.8

Comparison of clinical outcomes and laser energy consumption of the holmium:YAG laser vs. the thulium fiber laser for the treatment of upper urinary tract calculi

Eduardo Gonzalez Cuenca[1], Mario Basulto[1], Tariq Alotaibi[1], Solon Ierides[1], Abdulla Al-Turki[1], Jennifer Bjazevic[1], Hassan Razvi[1]
[1]Department of Urology, St Joseph's Hospital, Western University, London, Canada

Introduction: Urolithiasis is an increasingly prevalent global disease, with rising incidence and significant regional variation. Ureteroscopy has become the standard treatment modality, with the holmium:YAG (Ho:YAG) laser serving as the established gold standard for intracorporeal lithotripsy. The thulium fiber laser (TFL) offers theoretical advantages, including higher water absorption, reduced retropulsion, and improved dusting efficiency. This study compares the clinical efficiency of TFL with Ho:YAG laser technology for renal stone fragmentation during ureteroscopy.
Methods: A single-center, randomized, prospective, controlled trial was conducted. Patients undergoing elective flexible ureteroscopy for renal stones were recruited. Inclusion criteria were standardized to stones 8–20 mm in size with a density >600 Hounsfield units (HU). Patients were randomized 1:1 to Ho:YAG or TFL lithotripsy. Primary outcomes included total operative time (TOT), laser-on time, ablation speed (mm^3/s), and laser energy consumption (J/mm^3). Secondary outcomes included stone-free rate at three months based on non-contrast CT and complications.
Results: Fifty-two patients were analyzed using SPSS version 30 (Ho:YAG n=27, TFL n=25). Demographics and stone characteristics were comparable; median

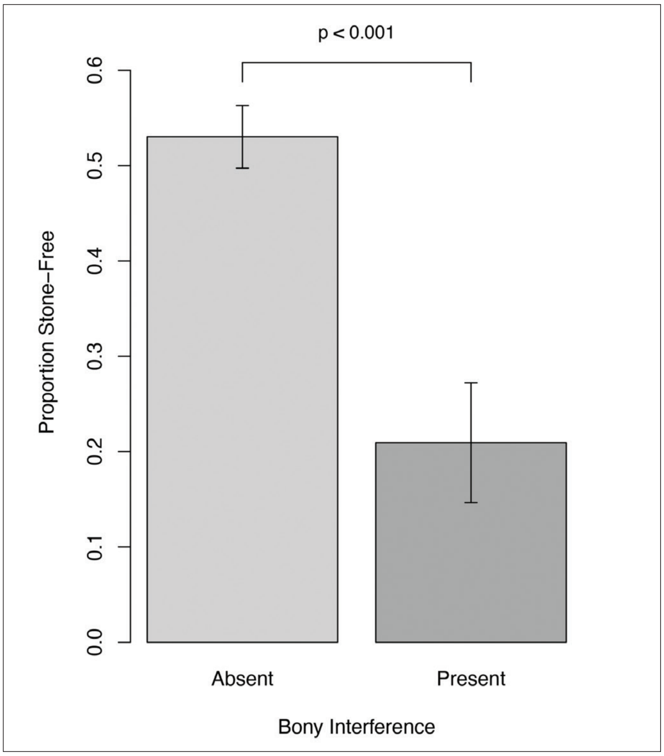
stone density was 1058 HU (Ho:YAG) vs. 1168 HU (TFL). The TFL group demonstrated a statistically significantly faster median ablation speed (1.39 vs. 1.03 mm^3/s, p=0.039). This increase in laser ablation speed was also reflected in total laser-on time, laser efficacy, laser energy consumption, and laser time consumption trending in favor of the TFL, the latter being statistically significant (p=0.020). At three months, the absolute stone-free rate (grade A) was 74.1% for Ho:YAG and 80% for TFL (p=0.832).
Conclusions: The TFL demonstrated superior ablation speed compared to the Ho:YAG laser for dense renal stones in a clinical setting; however, the increased speed did not translate into a statistically significant reduction in total operative time or improved stone-free rates in this cohort.

MP 3.9

Bony interference is associated with reduced extracorporeal shockwave lithotripsy efficacy: Implications for patient selection and positioning

Eric Liu[1], *Anna M. de Waal*[1], *Ryan F. Paterson*[1], *Ben H. Chew*[1], *Connor M. Forbes*[1]
[1]Department of Urologic Sciences, University of British Columbia, Vancouver, Canada

Introduction: In extracorporeal shockwave lithotripsy (ESWL), bony structures between the therapy head and the stone can attenuate shockwave energy. The clinical importance of this is well-known for pelvic bones, but not for other sources of interference. We assessed the effect of bony interference on the probability of ESWL success to determine if this should impact patient positioning or selection.
Methods: We performed a retrospective review of patients with renal or ureteric calculi treated with ESWL at Vancouver General Hospital in 2022. In addition to standard stone parameters, preoperative (X-ray) and intraoperative (fluoroscopy) images were reviewed for bony interference. This included interference from the ribs, spine, or bony pelvis. Successful treatment was defined as stone fragments smaller than 2 mm on followup CT or X-ray. Univariable logistic regression was performed for all variables, and those with p<0.2 were included in multivariable logistic regression (RStudio V2025.05).
Results: Of the 275 patients included, 253 (92%) were treated supine. In total, 132 patients (48%) had successful treatment after one ESWL session. Bony interference was present in 43 patients (15.6%) intraoperatively despite positioning, most commonly by the ribs (Table 1). Patients with intra- and preoperative bony interference had significantly lower ESWL success on univariable analysis (20.9% success (p<0.001 and 29.2% success, p=0.005) (Figure 1). Intraoperative bony interference remained significant on multivariable analysis (p=0.008), while preoperative bony interference did not (p=0.3).
Conclusions: The presence of bony interference on intraoperative fluoroscopy significantly decreased the probability of ESWL success. Bony interference cannot be determined by preoperative X-ray alone — intraoperative fluoroscopy is a better predictor of ESWL success. Measures in the operating room to minimize bony interference, such as slightly tilting the patient for stone targeting, may improve ESWL outcomes.



MP 3.9. Figure 1. ESWL procedures with intraoperative bony interference had a significantly lower success rate than procedures without intraoperative bony interference on univariable and multivariable logistic regression.

MP 3.10

A multicenter, randomized controlled trial of antimicrobial prophylaxis to prevent urinary tract infections after shockwave lithotripsy for urolithiasis: The APPEAL trial

Kari A.O. Tikkinen[1], *Borna Tadayon Najafabadi*[2], *Sakineh Hajebrahimi*[3], *Farhad Tondroanamag*[1,3], *Arto Mikkola*[4], *Saana Horstia*[4], *Le Mai Tu*[5], *Sara V. Tornberg*[4], *Thomas Tailly*[5], *Farzin Soleimanzadeh*[3], *Hanieh S. Pourmehr*[3], *Mari Saalasti*[4], *Jani Ruotsalainen*[4], *Patrick O Richard*[5], *Hassan Razvi*[6], *Negar Pourjamal*[4], *Stephen E. Pautler*[6], *Niko Nordlund*[4], *Sanna Myrskysalo*[4], *Andrei O. Morozov*[7], *Mohsen Mohammadrahimi*[3], *Murilo de Almeida Luz*[8], *Samuel Lagabrielle*[5], *Pauliina Kuutti*[4], *Tuomas P. Kilpeläinen*[4], *Petrus Järvinen*[4], *Alex L.E. Halme*[4], *Alireza Farshi Haghro*[3], *Salam A. Hussain*[9], *Agus Rizal A.H. Hamid*[10], *Dmitry Gorelov*[11], *Pramila Gaudel*[4], *Nariman K. Gadzhiev*[12], *John Denstedt*[6], *Kathrin Bausch*[13], *Raed A Azhar*[14], *Khalid Al-Rumaihi*[9], *Mohamed Abdelkareem*[9], *Sameer Parpia*[15], *Gordon H Guyatt*[15], *Philippe D. Violette*[6,13]
[1]Department of Urology and Clinical Epidemiology, University of Helsinki and Helsinki University Hospital, Helsinki, Finland; [2]Urology, University of Toronto, Toronto, Canada; [3]Urology, Tabriz University of Medical Sciences, Tabriz, Iran; [4]Urology, University of Helsinki, Helsinki, Finland; [5]Surgery, Centre Hospitalier Universitaire de Sherbrooke, Sherbrooke, Canada; [6]Surgery, Western University, London, Canada; [7]Urology, Sechenov University, Moscow, Russian Federation; [8]Urology, Rede D'Or São Luiz, Sao Paulo, Brazil; [9]Urology, Hazm Mebaireek General Hospital, Doha, Qatar; [10]Surgery, Universitas Indonesia, Cipto Mangunkusumo Hospital, Jakarta, Indonesia; [11]Urology, Pavlov First St. Petersburg State Medical University, Saint Petersburg, Russian Federation; [12]Urology, Saint Petersburg State University Hospital, Saint Petersburg, Russian Federation; [13]Surgery, University Hospital Basel, Basel, Switzerland; [14]Urology, King Abdulaziz University, Jeddah, Saudi Arabia; [15]Health Research Methods Evidence and Impact, McMaster University, Hamilton, Canada

Introduction: Shockwave lithotripsy (SWL), a widely used treatment for urolithiasis, carries a risk of post-procedural infections. Clinicians use antibiotic prophylaxis variably, and international guidelines provide conflicting recommendations reflecting current low-certainty evidence.
Methods: APPEAL was a randomized, blinded trial across 12 centers in nine countries that compared a single dose of ciprofloxacin or placebo for adults undergoing SWL. The primary outcome was a composite of bacteriuria or symptomatic cystitis, pyelonephritis or urosepsis, within 7–14 days post-SWL. Other outcomes included pyelonephritis or urosepsis.
Results: Of the 1722 randomized patients, 28 underwent post-randomization exclusions (mostly due to non-visualizable stones). Among the analysis population (n=1694; mean age 50 years; 30% female; 74% with kidney stones and 26% with ureteral stones; 11% with ureteral stent), 10% were lost to followup. Bacteriuria or symptomatic UTI occurred in 20 (2.7%) in the ciprofloxacin group and in 30 (3.9%) in the placebo group (RR 0.68, 95% CI 0.41–1.15). Symptomatic UTI occurred in 10 (1.3%) in the ciprofloxacin group and in 21 (2.7%) in the placebo group (RR 0.49, 95% CI 0.19–1.23). No patients in the ciprofloxacin group and nine (1.2 %) in the placebo group developed pyelonephritis (RR 0.05, 95% CI 0.003–0.93). No patients developed urosepsis, and no serious adverse events occurred.
Conclusions: A single dose of ciprofloxacin likely reduces post-SWL infections. The patient-importance of this reduction depends on individual preferences, weighing small absolute risk reductions against potential harms and wider implica-

MP 3.9. Table 1. Summary of patient and stone parameters, with the results of statistical analyses

	Overall	Successful treatment	Unsuccessful treatment	p_u	p_m
Total patients	275	132	143	-	-
Patient parameters					
Age (years)	57.3±14.9	55.1±14.7	59.2±14.8	**0.02**	0.09
Sex					
Male	201 (73.1%)	93 (70.5%)	108 (75.5%)		
Female	74 (26.9%)	39 (29.5%)	35 (24.5%)	0.3	–
BMI	26.9±4.9	26.5±4.7	27.3±5.1	0.2	0.9
Stone parameters					
Side					
Right	124 (45.1%)	53 (40.2%)	71 (49.7%)		
Left	151 (54.9%)	79 (59.8%)	72 (50.3%)	0.1	0.1
Location					
Kidney	122 (44.4%)	48 (36.4%)	74 (51.7%)		
Ureter	153 (55.6%)	84 (63.6%)	69 (48.3%)	**0.01**	**0.01**
Size (mm)	7.8±2.8	7.0±2.6	8.5±2.9	**<0.001**	0.06
CT attenuation (HU)	828.9±291.2	748.6±276.1	903.1±285.9	**<0.001**	**0.002**
Skin-to-stone distance (cm)	11.4±2.3	11.2±2.1	11.6±2.4	0.2	0.1
Patient position					
Supine	253 (92%)	117 (88.6%)	136 (95.1%)		
Prone	22 (8%)	15 (11.4%)	7 (4.9%)	0.05	0.6
Preoperative bony interference					
Present	48 (17.5%)	14 (10.6%)	34 (23.8%)		
Absent	227 (82.5%)	118 (89.4%)	109 (76.2%)	**0.005**	0.3
Intraoperative bony interference					
Present	43 (15.6%)	9 (6.8%)	34 (23.8%)		
Absent	232 (84.4%)	123 (93.2%)	109 (76.2%)	**<0.001**	**0.008**

p_u is for univariable analysis and p_m is for multivariable analysis. Bolded values indicate statistical significance.

tions of antibiotic use. The APPEAL trial will inform global practice and support evidence-based decision-making for patients undergoing SWL.

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MP 3.11

Computer vision to predict urinary stones composition: A systematic review

Abbas Guennoun[1], Ibrahim Moussa[2], Othmane Zekraoui[2], Tarek Kharfaoui[2], Tomas Cordoba[2], Ghali Harti[2], Bilal Chughtai[3], Dean Elterman[4], Naeem Bhojani[1]

[1]Division of Urology, University of Montreal Hospital Center, Montreal, Canada; [2]Faculty of Medicine, University of Montreal, Montreal, Canada; [3]Department of Urology, Northwell Health, New York, United States; [4]Division of Urology, University of Toronto, Toronto, Canada

Introduction: We conducted a systematic review examining the use of computer vision (CV) to predict urolithiasis composition.

Methods: We searched MEDLINE, EMBASE, Web of Science, and Cochrane Central (inception to October 2025). We included human studies applying CV to predict urinary stone composition. Keywords related to machine learning (ML), urolithiasis, and different types of images were included. Two reviewers screened titles and abstracts, and performed full-text reviews, with a third reviewer resolving discrepancies. Five reviewers performed data extraction from 29 included studies; each study was extracted by one reviewer and verified by a second. Captured data was verified by a machine learning expert.

Results: From 874 unique citations identified, 29 articles were retained for data extraction (Figure 1). Studies were primarily retrospective (n=15) and single-center (n=24). Tasks included multiclass classification (>2 stone types) (n=17) and binary classification (e.g., uric acid stones versus non-uric acid stones) (n=9). A large variety of stone compositions were explored, mostly calcium oxalate, uric acid, and cystine. Most studies used infrared spectroscopy (n=21) as the ground truth. Training models included computed tomography (CT scan) (n=14), endoscopic urolithiasis images and videos (n=6), and CT scans combined with clinical data (n=4). Convolutional neural networks were the main ML algorithm (n=14), with 19 articles testing multiple algorithms. Validations strategies predominantly consisted of internal validation (n=26), with only three studies using hybrid (internal and external) validation. Only one article described a clinical implementation of the model trained.

Conclusions: Our findings suggest limited clinical generalizability resulting in low implementation in routine practice. Future multicenter studies including all known types of urolithiasis and large populations, in addition to guidelines standardizing data acquisition, would significantly improve models' generalizability and performance.

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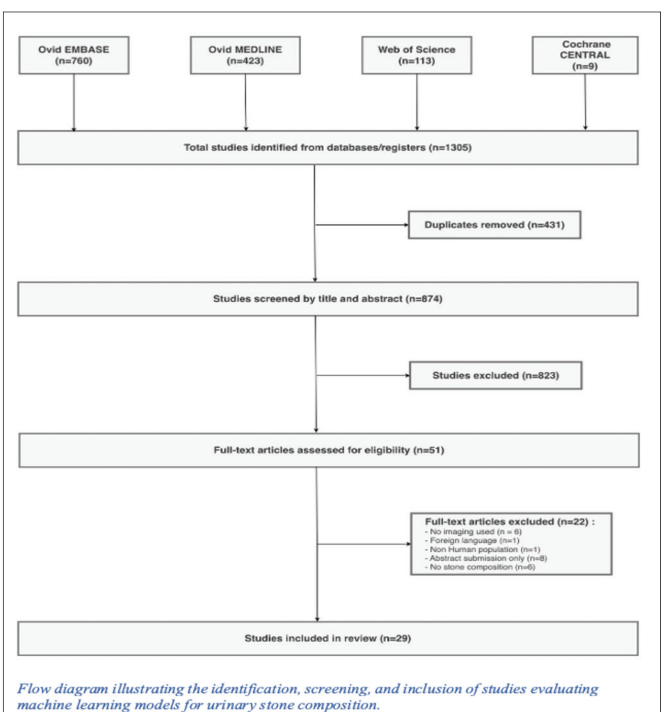

MP 3.11. Figure 1. Preferred reporting items for systematic reviews and meta-analyses flow diagram.

MP 3.12

The impact of mineral porosity on kidney stone density and mechanical hardness: A micro-computed tomography analysis

Gavin Hughes[1,2], Abbas Hammoud[3], Jonguk Lee[4], Rachel Wong[3], Kiran Iyer[5], Panagiotis Leonidas Papalazarou[6], Kate Hardman[7], Rory Shan[3], Yu Zou[7], Nikhile Mookerji[3], Mohamad Baker Berjaoui[3], Kyra White[8], Brian Carillo[9], Monica Farcas[3]

[1]Temerty Faculty of Medicine, University of Toronto, Toronto, Canada; [2]Graduate Department of Biomedical Engineering, University of Toronto, Toronto, Canada; [3]Division of Urology, Department of Surgery, St. Michael's Hospital, University of Toronto, Toronto, Canada; [4]Department of Medicine, Faculty of Health Sciences, McMaster University, Hamilton, Canada; [5]Department of Biomedical Engineering, McMaster University, Hamilton, Canada; [6]Department of Interdisciplinary Sciences, McMaster University, Hamilton, Canada; [7]Materials Science and Engineering, University of Toronto, Toronto, Canada; [8]Faculty of Medicine, Royal College of Surgeons, Dublin, Ireland; [9]WellSpring Research, Toronto, Canada

Introduction: Porosity, or the proportion of void space within a kidney stone, may influence fragmentation susceptibility. Micro-computed tomography (mCT) uses identical imaging principles as conventional CT but offers a resolution capable of quantifying stone porosity.

Methods: Fifty-six kidney stones (22 pure calcium oxalate monohydrate, 13 mixed calcium, 12 uric acid, seven mixed uric acid-calcium [>20% of both], and two struvite) were obtained from patients undergoing percutaneous nephrolithotomy at St. Michael's Hospital, Toronto. Stones were epoxy-embedded and mCT imaged at a 26.6 μm isotropic voxel size with 7680 projections at 145.6× geometric magnification. Beam alignment and gain calibrations were applied. Stone segmentation to define pores was performed using adaptive thresholding. Vickers' hardness testing was executed on each stone (12 indents/cross-section), after grinding and polishing to 1 μm. Hounsfield units (HUs) were obtained by aggregating preoperative axial CT slices. Stones were weighed, and volume was determined from mCT segmentation to calculate mineral density.

Results: Porosity was low overall (mean 1.98%) and correlated negatively with mineral density (r=-0.31) and Vickers hardness (r=-0.34), indicating that stones with more internal voids tend to be less dense and mechanically softer. Between stones of identical composition, those with higher porosity were more likely to have lower HU (Pearson r=-0.32, p=0.04). Uric acid stones were expectedly less dense than calcium-predominant stones (1.50 vs. 1.73 g/cm³, p=0.003), given known isolated mineral densities; however, they also exhibited a higher mean porosity (2.77% vs. 1.06%), although not statistically significant (p=0.11).

Conclusions: Although pores represent a small proportion of total stone volume, they contribute to a reduction in density, HUs, and Vickers hardness. This has implications for interpreting HUs as a proxy for stone fragmentation susceptibility in CT renal colic assessments.

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MP 3.13

Radiologic and mechanical characterization of renal stones: Identifying limitations in Hounsfield units as a fragmentation proxy

Gavin Hughes[1,2], Jonguk Lee[3], Abbas Hammoud[4], Monica Farcas[4], Brian Carillo[5], Leo Chen[4], Rachel Wong[4], Nikhile Mookerji[4], Kiran Iyer[6], Panagiotis Leonidas Papalazarou[7], Rory Shan[8], Kate Hardman[8], Yu Zou[8], Mohamad Baker Berjaoui[4]

[1]Temerty Faculty of Medicine, University of Toronto, Toronto, Canada; [2]Graduate Department of Biomedical Engineering, University of Toronto, Toronto, Canada; [3]Medicine, Faculty of Health Sciences, McMaster University, Hamilton, Canada; [4]Surgery, Division of Urology, St. Michael's Hospital, University of Toronto, Toronto, Canada; [5]Wellspring Research, Toronto, Canada; [6]Faculty of Health Sciences, Engineering, McMaster University, Hamilton, Canada [7]Interdisciplinary Sciences, McMaster University, Hamilton, Canada; [8]Materials Science and Engineering, University of Toronto, Toronto, Canada

Introduction: Higher Hounsfield units (HUs) predict higher energy requirements in shockwave lithotripsy of renal stones; however, it is unclear how HUs relate to mechanical stone hardness, a variable many believe is an important stress-strain mechanical proxy in the context of laser lithotripsy and percutaneous nephrolithotomy (PCNL).

Methods: Fifteen PCNL-derived stones from St. Michael's Hospital, Toronto, met inclusion criteria as 100% calcium oxalate monohydrate (COM) (n=8) or 100% anhydrous uric acid (UA) (n=7), as determined by Fourier Transform

Infrared spectroscopy. Mixed stones were excluded to remove compositional confounding. Postoperatively, the primary surgeon provided a global fragmentation-difficulty rating of ultrasonic lithotripter use. All stones underwent ultrasonic cleaning, air-drying, resin embedding, and sequential grinding and polishing to 1 μm to expose an internal cross-section. Vickers hardness (HV) measurements were performed at 0.5 kgf load for 10 seconds per indentation. HUs were obtained by aggregating preoperative CT axial slices.

Results: No association was found between HUs and HV in UA stones (r=0.10, p=0.82); however, in COM stones, HUs correlated inversely and strongly with HV (r=-0.91, p=0.002). Further, we found a positive (r=0.37) but non-statistically significant (p=0.21) correlation between perceived fragmentation difficulty and mean HV.

Conclusions: Using HUs as a proxy for mechanical hardness should not be done in isolation and must be interpreted in the context of stone composition. For COM stones, higher HUs reflect denser, preferentially oriented crystallites with reduced organic matrices, conditions that promote cleavage-controlled microcracking under indentation. Consequently, HUs (a volumetric voxel average) can increase as HV (a localized, defect-sensitive measure) decreases. More critically, our results indicate that Vickers hardness does not, in practice, reliably align with surgeon-perceived fragmentation difficulty.

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MP 3.14

Exploring the ability of multimodal large language models to determine the presence of renal calculi in non-contrast CT scans from a de-identified, publicly available dataset.

Abbas Hammoud[1], Brian Carrillo[2], Monica Farcas[1], Tiange Li[1], Mohamad Baker Berjaoui[1]

[1]Division of Urology, St. Michael's Hospital, University of Toronto, Toronto, Canada; [2]Wellspring Research, Toronto, Canada

Introduction: In the past two years, large language models (LLMs) have found increasing applications in all branches of industry and research. They have demonstrated remarkable utility in medical research, ranging from the automation of many research tasks to the powering of modern patient counseling and decision-support tools. Recently, the best LLMs (Gemini, ChatGPT, Claude) began to offer image-processing capabilities, allowing users to submit images/videos with their questions. This raises a question about the ability of these LLMs to answer patient questions about medical scans. In this study, we aimed to evaluate the accuracy of two state-of-the-art models — Gemini 3 Flash and GPT 5 Mini — in determining the presence of kidney stones in axial images from abdominal non-contrast CT scans (NCCTs).

Methods: This study employed a fully de-identified, publicly available research dataset containing 2D axial images (slices) of abdominal NCCTs.1 A total of 3154 axial slices from 201 patients were included. One or more stones were present in 48% of the slices. In our prompt to the LLM, we stated the purpose of the study, assured that none of the responses would be used to diagnose patients, and asked if there is at least one renal stone in the image. Responses of the two LLMs were compared to the ground truth (stone vs. no stone). Performance metrics for each LLM were computed, including sensitivity, specificity, NPV, and PPV. To automate this process for thousands of images, Python 3.13 was used, in addition to each company's application programming interface (API).

Results: Gemini 3 Flash achieved a sensitivity of 100%, specificity of 50%, PPV of 72.3%, and NPV of 99.7%. GPT 5 Mini achieved a sensitivity of 89%, specificity of 94.4%, PPV of 94.8%, and NPV of 90%. Although GPT 5 Mini had slightly lower sensitivity than Gemini 3 flash, its specificity was superior.

Conclusions: Although Gemini 3 Flash correctly identified all positive scans, its performance on negative scans was no better than a coin toss. On the other hand, GPT 5 Mini did slightly worse on positive scans but was much better at identifying negative scans. These findings suggest that multimodal LLMs may provide false reassurance or unnecessary alarm due to imbalanced sensitivities and specificities, underscoring important limitations in the reliability of LLM-generated interpretations of medical imaging when used outside a clinical context.