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Global Status of SWL in the Era of Contemporary Urinary Stone Management – a snapshot analysis amongst 3761 urologists

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Abstract

Aim/Objective: To study the global practice of SWL, its comparative results with other treatment options, and potential future advances that may boost its clinical relevance.

Methodology: A global cross-sectional survey was conducted amongst members of Société Internationale d'Urologie (SIU). The survey was distributed amongst urologist and urology trainees and captured data on demographics of participants, the use of Shock Wave Lithotripsy (SWL), Ureteroscopy (URS), and Percutaneous Nephrolithotomy (PCNL) in the management of urinary stones. The survey was translated into seven languages. The survey was conducted through the SurveyMonkey platform. We used descriptive statistics where all analyses were conducted using SAS Version 9.4 (Cary, North Carolina, USA).

Result: 3,761 urologists across 108 countries replied to the survey. Most participants were from Asia (50.1%), general urologists with over 20 years of clinical practice (61.5%) and coming from High Income countries (84.6%). Most hospitals were equipped with SWL equipment from Dornier (28.1%) or Siemens (17.7%). While 62.7% of the SWL providers received specific SWL training during residency, SWL treatment is usually performed by specialized technicians (48.1%). Higher volume stone centers perform equally SWL and URS while lower volume stone centers balance between SWL, URS and PCNL.

Conclusion: Shockwave lithotripsy (SWL) remains widely available but its position in urinary stone management has transformed in favor of ureteroscopy (URS). Advances in robotics, artificial

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intelligence, and improved training programs may strengthen SWL's position as a valuable treatment option in the future.

Ethics Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. It involved a voluntary and anonymous online survey distributed to members of the Société Internationale d'Urologie (SIU). No patient information or personally identifiable data were collected. Participation was entirely optional, and completing the survey indicated informed consent. Formal Institutional Review Board (IRB) approval was provided by Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee, reference number E-10840098-50.04-3324. All data were treated with care and confidentiality, and analysis was performed using only aggregated responses to ensure privacy and integrity.

Introduction

Urinary tract stones, or urolithiasis, are a common condition with the majority found in the upper urinary tract. With a global prevalence of up to 15% and a recurrence rate approaching 50% within 10 years, urolithiasis poses an escalating challenge for patients and healthcare systems worldwide [1,2]. Alongside conservative treatment, urinary stones can be managed with various interventions, including shockwave lithotripsy (SWL), ureteroscopy (URS), and percutaneous nephrolithotomy (PCNL).

Forty years ago, engineers at Dornier observed how shockwaves affected biological tissues. This phenomenon prompted experimental research into their medical application, and in February 1980 the first kidney stone was successfully treated with SWL [3,4]. Since then, SWL has transformed the treatment landscape of urolithiasis. The earliest SWL device, the Dornier HM3, achieved a stone-free rate (SFR) of nearly 90% and was rapidly accepted as the first-line noninvasive therapy for urinary stones [5]. The urological community initially responded with great enthusiasm, expecting SWL to make the world stone-free.

However, over time SWL faced several challenges that limited its indications. Patient-related factors—including renal anatomy, skin-to-stone distance, stone density, abdominal fat distribution, and renal function—combined with technology-related factors such as firing rate, shockwave intensity, and patient positioning contributed to decreased success rates and increased complication rates [6,7]. Despite numerous efforts to improve equipment and delivery techniques, newer generation SWL machines did not always lead to better outcomes and in some cases performed worse than earlier devices, fueling skepticism about the future of SWL [8,9].

As SWL technology plateaued in the 1990s, alternative treatment approaches such as URS and PCNL rose to prominence [9,10]. Today, management of kidney stones smaller than 2 cm is increasingly shifting from SWL to URS, while PCNL is favored for stones larger than 2 cm [11,12]. Although the indications for SWL have narrowed, it still retains a defined role in international guidelines, including those of the American Urological Association (AUA) and the European Association of Urology (EAU) [4,13].

Importantly, the decision to offer SWL in clinical practice often appears to depend less on robust evidence than on surgeon preference, center expertise, device availability, and economic considerations [14, 15, 16]. Against this background, it is timely to revisit the current role of SWL within the armamentarium of urinary stone management and explore future directions that

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may restore its position. The present study therefore aims to investigate the global use of SWL, its comparative outcomes with other treatment modalities, and potential future developments that may enhance its clinical relevance.

Material and Methods

A worldwide cross-sectional online survey was carried out between June - July 2022. The survey design was consistent with the Consensus-Based Checklist for Reporting of Survey Studies (CROSS). The survey was sent to the 10,320 Société Internationale d'Urologie (SIU) members worldwide. National Societies delegates and Group Membership Societies to SIU announced the survey amongst their membership. The survey was open for 6 weeks and weekly follow-up reminders were sent to improve participation.

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. It involved a voluntary and anonymous online survey, and the aims of the survey were explained in an invitation letter, and the participants were informed that by taking part in this survey, they were given consent and agreed to convey the proprietorship of the data to the SIU. No patient information or personally identifiable data were collected. Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee provided post-hoc IRB approval reference number E-10840098-50.04-3324). All data were treated with care and confidentiality, and analysis was performed using only aggregated responses to ensure privacy and integrity.

The survey was addressed to urologist and urology trainees to evaluate the current role of Shock Wave Lithotripsy (SWL) in the management of urinary stones, with a comparative analysis of treatment outcomes between SWL, Ureteroscopy (URS), and Percutaneous Nephrolithotomy (PCNL) globally. Treatment protocols included SWL using a specific SWL Device Model, URS using semi-rigid or flexible ureteroscopy, and PCNL using percutaneous nephrolithotomy.

The principal investigation team reached a consensus throughout the formulation and formatting of the questions to ensure its replicability and comprehensibility. To better capture the global practices related to urinary stone management, the survey was offered in multiple languages. Once the English version was finalized, it was translated to Chinese, French, Portuguese, Russian, Spanish, and Turkish by native bilingual urology specialists to facilitate participation, and conserve data reliability. The survey was accessible through a secure single-access link sent via email, offering respondents with the option to participate at their convenience.

The survey comprised of 22 main questions with sub-questions if needed in the form of multi-select matrix, Likert scale, slider, and as multiple-choice questions. Responses were grouped based on demographics of the participants, baseline urinary stone characteristics, treatment modality, and outcomes.

The survey was conducted through the SurveyMonkey platform (Momentive Inc. San Mateo, California, USA www.momentive.ai). Participation was made voluntary with no prerequisites. Data were anonymized to protect the participants' confidentiality.

Statistical Analysis

Categorical variables were described as frequencies and percentages and continuous variables as median and interquartile range. Association between any two factors of interest was

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assessed through Chi-Square tests. All analyses were conducted using SAS Version 9.4 (Cary, North Carolina, USA).

Results

A total of 3,761 participants, representing a 36.4% response rate, from 108 countries responded to the survey. The participants were mostly male (92.1%), with a mean age of 46.1 and 39.0 years for males and females respectively. Figure 1 presents the continent-wise participation rates, showing that most participants were from Asia (50.1%), followed by Europe (25.4%) and Latin America (15.8%).

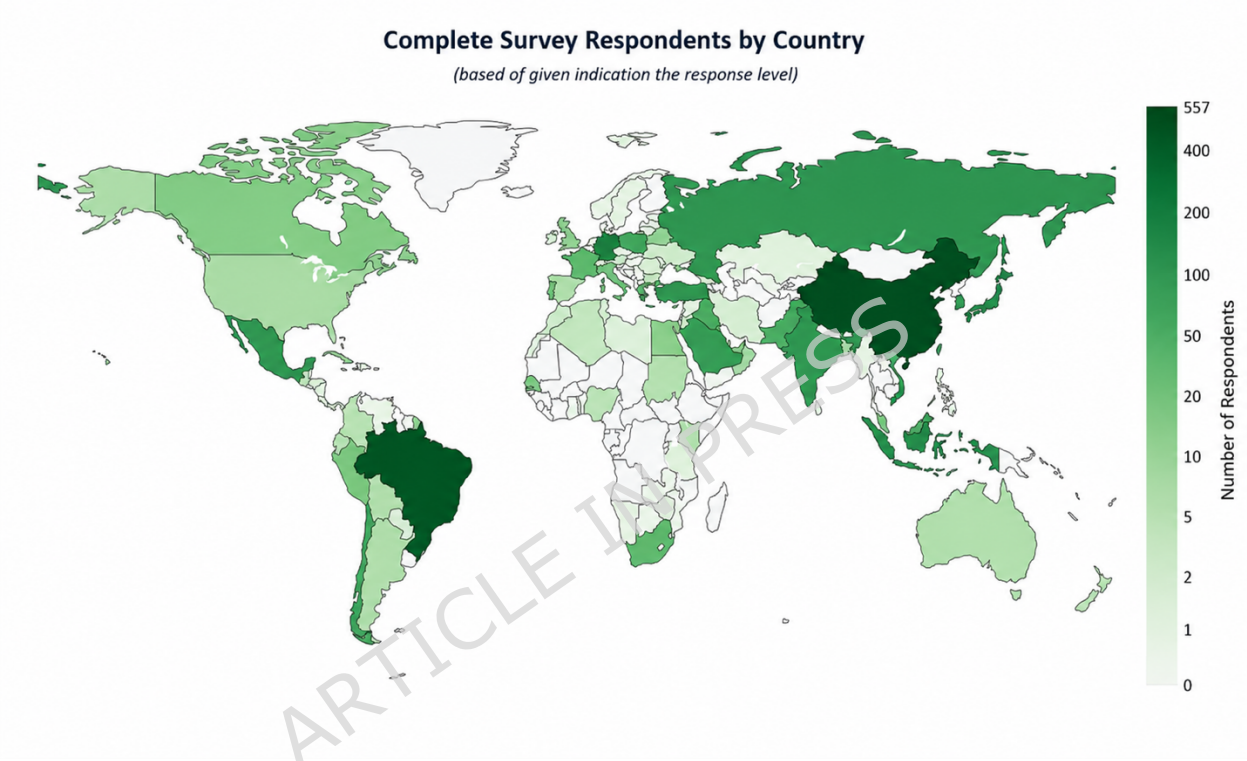


Figure 1: Geographical representation of survey respondents around the globe.

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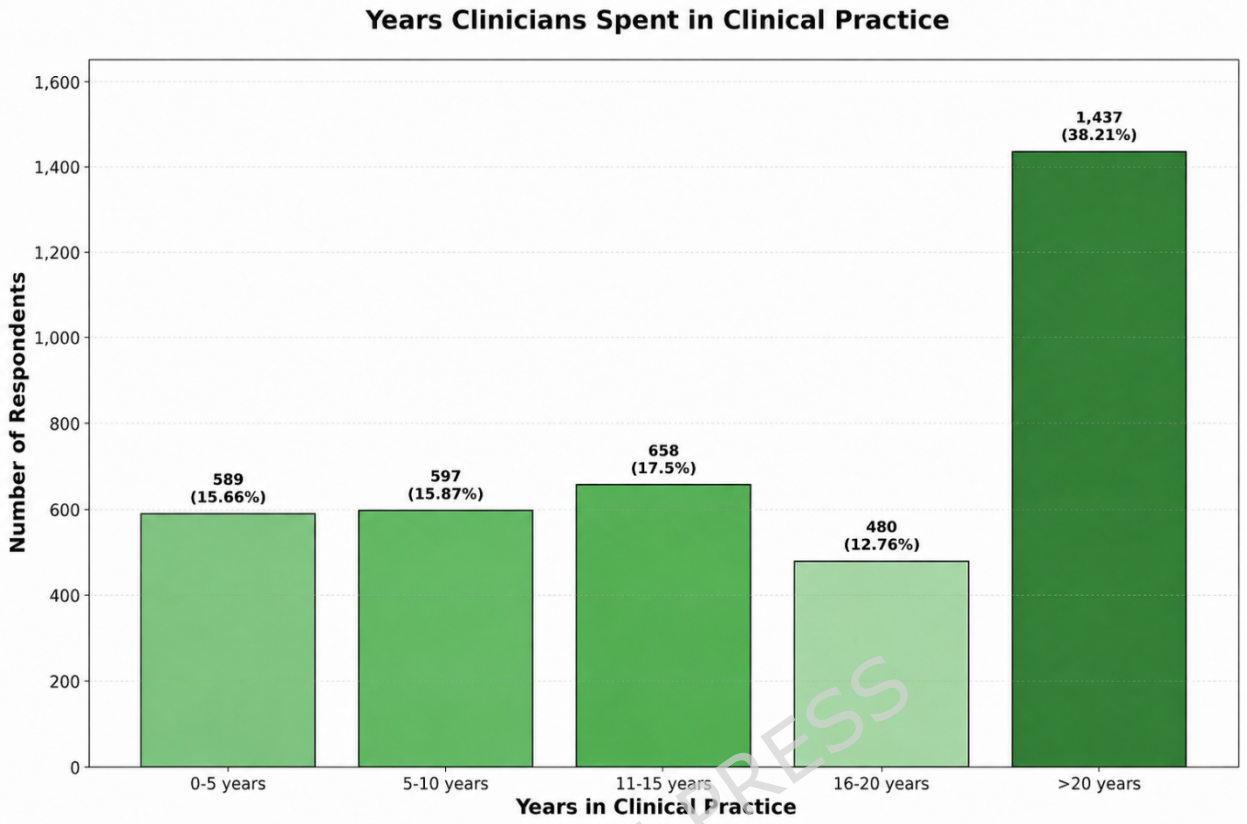
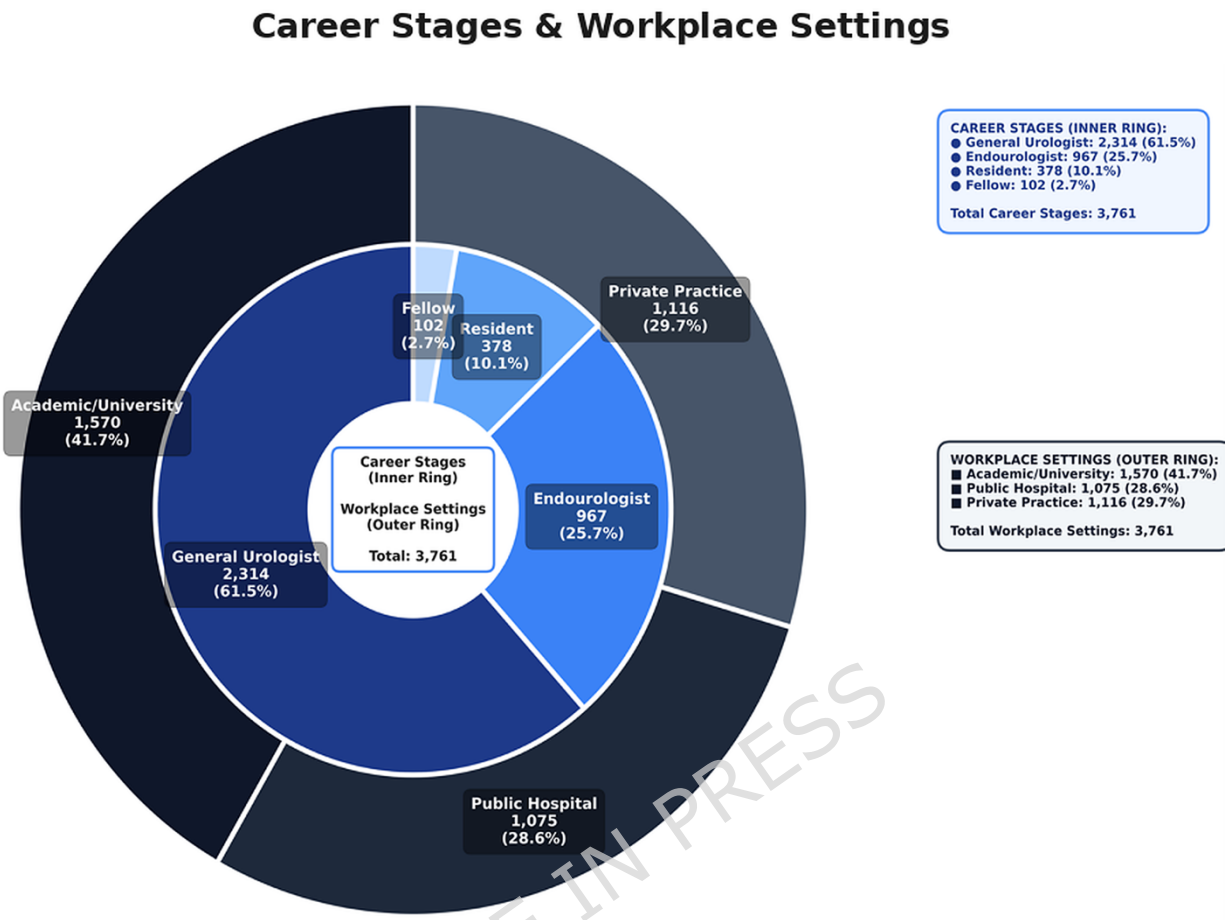


Figure 2: Years spent in clinical practice by respondents.

Figure 3 presents the career stages (inner circle) as residents, fellows, general urologists and endourologists. The outer circle presents the workplace setting including private, Academic/University or Public hospital setting. Most participants (61.5%) were general urologists with over 20 years of clinical practice (38.2%) and, predominantly employed in academic hospitals [fig 2-3]. Age distribution is significantly different by practice setting with participants working in private practice being significantly older ($p<0.0001$). Various methods are offered to treat urolithiasis, including SWL, URS and PCNL. A minority offers open surgery or laparoscopic/robotic assisted procedures.

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Figure 3: Career stages and workplace settings of respondents.

Most participants were from High Income countries (84.6%) followed by Middle Income (15.0%) and Low-Income countries (0.4%). There is a significant difference amongst continents ($p=0.0003$) as well as the WHO income regions ($p<0.0001$) in terms of distribution of general urologists vs. endourologists. Qualified endourologist are most often working within an Academic setting when compared to general urologists ($p<0.0001$). The urolithiasis SWL treatment load is significantly different by years of experience ($p<0.0001$) and qualification of specialization ($p<0.0001$). More years of experience results in a higher SWL treatment load as well as being general urologist.

Most hospitals were equipped with SWL machines (62.7%) or refer patients for SWL to another hospital (22.2%). Some make use of a mobile SWL service (4.5%) while 10.6% does not offer any SWL service to their patients. Most SWL machines installed are from Dornier (28.1%) or Siemens (17.7%). The Storz, Wolf and Edap SWL installments cover together 27.0% and is followed by other providers comprising 27.2% [fig 4]

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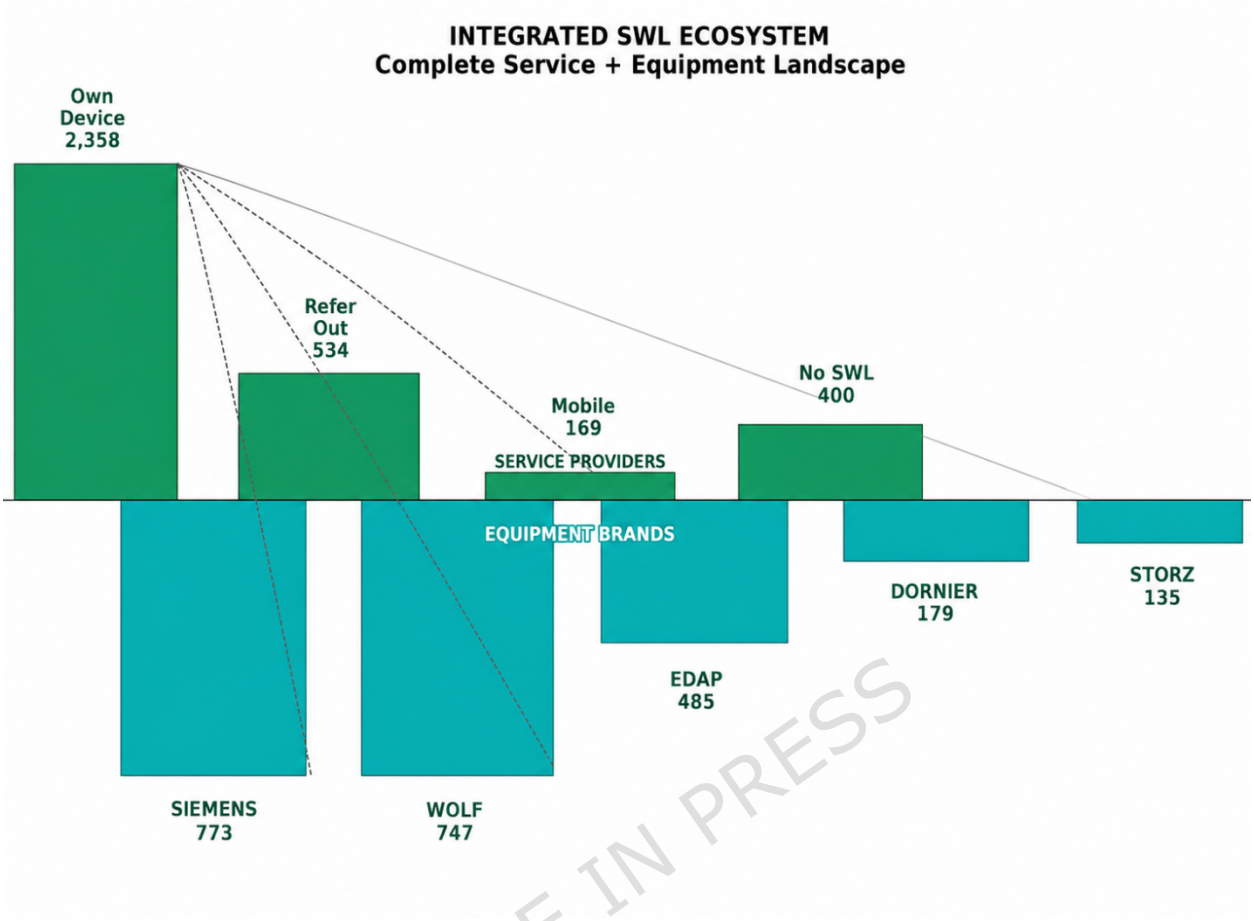


Figure 4: Distribution of equipment utilization by service providers in Shock Wave Lithotripsy Therapy

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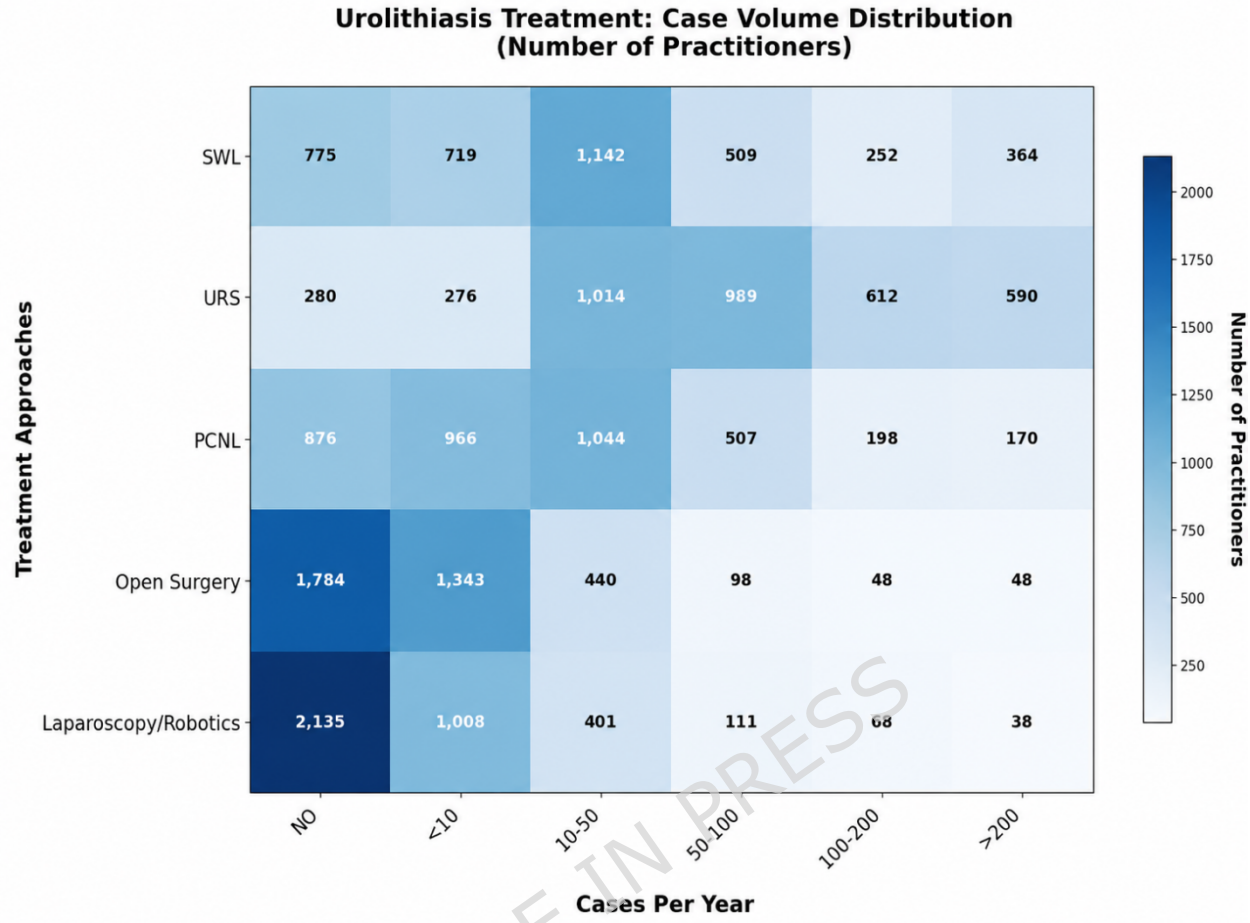


Figure 5 : Urolithiasis Treatment heat map according to case volume distribution.

Treatment is usually performed by specialized technicians (48.1%), the urologists themselves (41.3%), or radiology nurses (5.3%). Some reply that they do not know who is performing the SWL treatment (5.21%). Few participants do not offer SWL treatment and are identified as being mostly general urologists ($p<0.0001$) or working in an Academic setting ($p<0.0001$) and active in Asia ($p<0.0001$). Conversely most Asian participants have a SWL unit installed in their hospital ($p<0.0001$). 62.7% indicated having received specific SWL training during residency while others received this during a (short) fellowship (18.2%), or during in person training courses (17.4%). Only 16.6% presented that they did not receive any specific training. Those not receiving any training also often do not offer SWL treatment to their patients ($p<0.0001$). The same finding related to training is confirmed for URS and PCNL treatment.

In supplement table 1-2 we capture practice patterns and training characteristics per continent. While some regional variations in clinical practice may be observed, this showcases that the global status on SWL treatment and training are presenting a consistent overall picture.

Discussion

This global survey, with responses from 3,761 urologists across 108 countries, represents the largest contemporary dataset on shockwave lithotripsy (SWL). Three major findings emerge. First, SWL remains widely available, with 85% of respondents reporting access to a

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lithotripter—either locally, through referral networks, or via mobile services. Second, delivery of SWL is often delegated to non-physicians: 48% of treatments are performed by specialized technicians and 5% by radiology nurses, while only 41% are delivered by urologists themselves. Third, training in SWL is inconsistent. Although 62.7% of respondents received training during residency, 16.6% reported never having received formal instruction, a finding with direct implications for outcome variability.

Regional and practice-level differences further contextualize these results. Respondents from Asia accounted for half of all participants, with Europe (25.4%) and Latin America (15.8%) also contributing substantially. High-income countries were most represented (84.6%), but disparities were evident: low- and middle-income regions reported fewer endourologists, lower access to training, and a higher reliance on referral-based SWL services. These differences may contribute to the uneven global distribution of stone management modalities and highlight resource-related constraints.

A clear pattern also emerged regarding years of experience, institutional volume and specialization. More years of experience results in a higher SWL treatment load and is maybe fueled by better training access during residency when compared to the current generation of urologists. Also being general urologist is in favor of higher SWL treatment volume. Endourologists may have a preference of the readily available endoscopes they have been trained with over SWL treatment. Urologists in high-volume centers reported a greater SWL treatment load, often accompanied by parallel high-volume URS and PCNL practices. These centers are better positioned to generate outcome data, optimize patient selection, and provide structured training opportunities [table 1]. Hence many high-volume stone centers may use SWL as an initial treatment strategy ("sieve") to optimize institutional logistics, reduce waiting times for endoscopy and optimize operating room utilization. By contrast, respondents in smaller or private centers often relied on technicians for SWL delivery and lacked consistent training pathways, reinforcing perceptions of SWL as inconsistent, or outdated.

Together, these findings underscore a paradox: although SWL remains globally accessible and technically feasible, its clinical utilization is declining relative to URS and PCNL [table 1]. This decline is not solely due to limitations in efficacy but is strongly influenced by practice organization, training gaps, and professional ownership of the procedure [13,16, 17, 18, 19, 20]. Conversely, the recent COVID epidemy showcased elegantly that the short waiting time for treatment and no need for anesthesia encouraged many to embrace SWL again as a most viable treatment option for (acute) intervention for urinary stones [table 1]. Hence the lower complication rates of SWL when compared to endoscopic procedures makes it attractive to reduce in and/or outpatient admissions.

Also, regional differences in patient and economic characteristics may influence treatment preferences. For example, BMI distributions differ substantially between Asian and Western populations, potentially affecting SWL outcomes. Likewise, stone composition and stone density vary geographically and may influence treatment selection. Regional differences may also be related to economic factors including purchase of the equipment, the annual maintenance cost and reimbursement rates. These aspects are therefore potential confounders in the position of SWL for stone treatment [table 1].

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Several opportunities exist to reposition SWL. The initial triumphalism that heralded ESWL as the “end of the stone age” has over time given way to skepticism [8, 21, 22]. Nonetheless, technological refinements have opened avenues for optimization. Coupling quality, for example, is now recognized as a crucial determinant of shockwave transmission. Poor acoustic coupling between the lithotripter’s cushion and the patient’s skin can significantly reduce treatment efficiency, whereas modern monitoring systems—such as camera-assisted or real-time imaging devices integrated into Dornier platforms—allow direct assessment and correction, thereby improving fragmentation efficiency by up to 25% [2,7,16,23,24,25].

Respiratory-induced kidney movement represents another source of treatment inefficiency. During SWL, stone motion can reduce targeting accuracy and lead to incomplete fragmentation. Novel adjuncts, such as abdominal compression plates, have been introduced to stabilize renal motion and improve targeting precision, thereby reducing the total number of shocks required and minimizing unnecessary renal tissue injury [26,39]. Expanding the focal zone of the shockwave is another promising development. A broader focal zone exposes a larger portion of the stone to effective energy, thereby improving fragmentation efficiency while simultaneously lowering the risk of parenchymal injury. Clinical studies have demonstrated that lithotripters designed with wider focal zones can achieve comparable or superior stone-free rates while reducing complications [27,40]

The Burst-SWL technique is one of the most promising recent innovations. Unlike conventional delivery, which uses shockwaves at a steady frequency, Burst-SWL delivers rapid high-frequency shocks in clusters. Experimental and early clinical studies have shown that this approach improves fragmentation efficiency, reduces treatment time, and minimizes renal tissue trauma compared to standard protocols [28,29,37] The Dornier Delta III lithotripter is one example of next-generation systems designed to deliver shockwaves in bursts, achieving faster stone disintegration with potentially fewer complications.

Another key challenge in SWL is the precision of stone targeting. Traditional lithotripters rely heavily on manual alignment, which is vulnerable to operator variability and human error [30]. Robotic-assisted lithotripters are now being developed to automate patient positioning and continuously track stone movement. By maintaining real-time alignment, robotic systems enhance accuracy, reduce the number of missed shocks, and improve stone-free rates [31,32]. These technologies hold particular value in anatomically challenging cases, such as stones in atypical locations or in patients with unfavorable body habitus, where manual alignment is more difficult.

Artificial intelligence (AI) has the potential to further revolutionize SWL by standardizing targeting and individualizing treatment. AI-based image analysis can differentiate stone type and density, optimize shockwave settings, and provide real-time feedback on stone position [33,34]. This may significantly contribute to improvement in Efficacy, resulting in higher SFR and lower retreatment rates comparable to URS and PCNL [table 1]. Machine learning algorithms trained on large datasets can predict the number of shocks required, thus minimizing overtreatment and unnecessary renal exposure [35,36]. In addition, AI-driven robotic systems may dynamically adjust lithotripter alignment during the procedure, automatically compensating for patient or stone movement to ensure energy is consistently focused on the target [33,37].

Beyond improving efficiency, AI integration offers the opportunity for precision medicine in stone management. Predictive algorithms that incorporate patient-specific variables—such as

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stone composition, BMI, skin-to-stone distance, and renal anatomy—can generate personalized treatment protocols. Such approaches not only increase treatment efficacy but also decrease complication rates and retreatment needs [table 1] [38]. Early evidence suggests that combining robotics with AI provides a reproducible and standardized approach to SWL, reducing the variability historically associated with operator skill [30,32]

Despite their potential, the widespread adoption of robotics and AI faces practical barriers, particularly cost and training. Robotic lithotripters and AI systems require substantial investment in both equipment and operator education [table 1]. These obstacles may limit accessibility in resource-constrained regions, where the prevalence of urolithiasis is nonetheless high. Furthermore, robust multicenter clinical trials are still required to confirm the safety, generalizability, and cost-effectiveness of these innovations across diverse patient populations [41,42]

To optimize SWL outcomes, appropriate training and expertise remain critical. Historically, outcomes were heavily influenced by operator variability, with experienced practitioners achieving significantly higher success rates than novices [17,18]. Dedicated SWL training programs have therefore been developed in several regions, typically lasting one to three months depending on prior surgical experience. These programs emphasize not only technical skills—such as optimizing shockwave frequency, coupling quality, and focal zone adjustments—but also patient selection, preoperative imaging interpretation, and complication management [17,18]. However, our survey highlights that in many institutions SWL is still performed by non-physicians, raising questions about ownership of treatment decisions. While technicians can competently deliver SWL once trained, the ultimate responsibility for treatment choice should remain with the urologist.

This study has several limitations. Although response rates were high, geographical distribution was uneven, with greater representation from Asia and Europe compared to Africa and the Americas. Furthermore, reported outcomes were based on perception rather than objective clinical data, introducing potential recall and reporting bias. Nevertheless, the large sample size and broad international representation provide a reliable reflection of contemporary global practice.

Beyond technological advances, broader global factors are expected to further shape the role of SWL. Rising worldwide incidence of urolithiasis, driven by dietary changes, obesity, and climate-related dehydration, highlights the ongoing need for non-invasive and accessible treatment options [42]. At the same time, recent meta-analyses confirm that while URS offers superior stone-free rates for ureteral stones, SWL continues to provide competitive outcomes in selected cases with the advantages of lower invasiveness and outpatient feasibility [table 1] [18,21]. Incorporating these perspectives reinforces the importance of SWL within a diversified global armamentarium for stone management.

In conclusion, SWL continues to occupy an important—though narrowing—position in urolithiasis management. While URS has become the dominant modality for smaller-sized stones and PCNL for larger stones, SWL retains clear advantages in non-invasiveness, recovery, and in a selected patient population feasibility [table 1]. Advances in Burst-SWL, robotic targeting, and AI integration, combined with improved training and rigorous patient selection, could revitalize SWL as a competitive and complementary option in the modern armamentarium of stone

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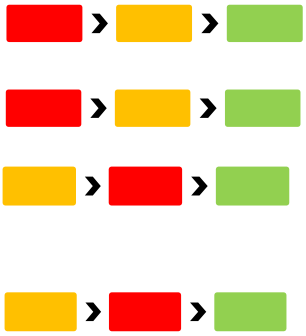
management. The future of SWL depends not only on technological innovation but also on the collective willingness of the urological community to reinvest in its potential.

Table 1 Comparing position of SWL, URS, PCNL based on the performance per 'index' center. The 'Position' column presents the decline in favor of each treatment modality (SWL= 🟩 URS= 🟨 PCNL= 🟥).

Item	SWL	URS	PCNL	Position
Number of procedures annually within index center (10,18.19)	20–40%	35–60%	10–30%	🟨 › 🟩 › 🟥
Waiting time for treatment (18,49)	1-3 weeks	2-4 weeks	3-6 weeks	🟥 › 🟨 › 🟩
Need for anesthesia (17,18)	No*	Yes	Yes	🟩 › 🟨 = 🟥
COVID proof (30)	Yes	No	No	🟩 › 🟨 = 🟥
Efficacy favorable response				
-HU Units Renal stones (44-45)	<750–1000 HU	< 1200 - 1500 HU	< 1200 - 1500 HU	🟥 = 🟨 › 🟩
-HU Units Ureter stones (13,47)	< 1000 HU	Up to 1500 HU	Up to 1500 HU	🟥 = 🟨 › 🟩
-BMI (kg/m2) (16,18)	< 25-30	< 40	< 35	🟨 › 🟥 › 🟩
-Pregnancy (20,21)	Contraindicated (despite the location and the trimester)	Safe (for renal and ureteral stones, especially in 2nd trimester)	Contraindicated (may be considered in the 2nd trimester, especially in large renal stones)	🟨 › 🟥 › 🟩

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Stone free rate (SFR): -Renal stone > 2cm -Renal stone < 2cm -Ureter stone (22,23,24,25)	40-60% 50–70% 75-85% for upper stones. 60-80% for lower stones.	60-75% 70-90% >85–95% for upper stones. 90-100% for lower stones.	75-95% 85-95% 80-95% for upper stones. 75-95% for lower stones.	
Retreatment rate (18,43,47)	10–35%	5–15%	20-30%	
Complications: -Bleeding -Sepsis -Infection -Organ injury (11,17,18,20,21,48, 49)	0.2-0.5% <1% 1-2% <0.1%	1-2% 0.3-2.5% 2-4% 0.1-1%	5–10% 0.5–5% 10-25% <1%	
Cost per procedure (€): (19,50) -Europe -Asia -US -Africa	1,300 - 3,240 800 - 1,000 4,500 - 9,000 1,500 - 2,500	1,334 - 2,979 1,000 - 1,200 5,000 - 7,200 2,000 - 3,000	2,760 - 5,783 2,000 - 3,000 10,000 - 15,000 3,500 - 5,000	
Purchase equipment (€): (19,50)	250,000-500,000	-rigid scope: 5,000-15,000 -flexible scope: 25,000-40,000	30,000-80,000	
Maintenance cost annually (€): (50)	10,000-30,000	-rigid scope: 1,000-3,000 -flexible scope: 5,000-10,000	5,000-15,000	
Reimbursement rates (€): (19,50) -Europe -Asia -US -Africa	1,000 - 2,500 500 - 1,500 2,700 – 4,500 1,000 - 2,000	1,500 - 3,000 700 - 2,000 3,600 – 6,300 1,500 - 2,500	3,000 - 6,000 2,000 - 4,000 7,200 – 10,800 2,500 - 5,000	
Training (17,18, 50,51)	Weeks (operator dependence)	Weeks-months	Years (extended hands-on training; fellowship, etc.)	

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Learning curve (number of cases) (17,18,51,52)	30-50	-rigid scope: 30–100 -flexible scope: 50-100	50–60	

*= except for pediatric or high-risk cases

Key: SWL= URS= PCNL=

Disclosures

Author contribution:

Abdulrahman Alwani - Methodology, Investigation, Writing, Visualization

Abdullah Hamdullah - Methodology, Investigation, Writing, Visualization

Sleiman Alhajj - Methodology, Investigation, Writing, Visualization

Samih Abdurehim - Methodology, Investigation, Writing, Visualization

Mehmet Kocak – Methodology, Formal Analysis, Review & Editing, Supervision

Pilar Laguna Pes - Conceptualization, Writing – Review & Editing

Jean de la Rosette - Conceptualization, Methodology, Writing – Review & Editing, Supervision

Conflict of Interest Statement:

The authors declare that they have no conflicts of interest relevant to this manuscript.

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Data Availability Statement:

The data underlying this article were collected through an anonymized international survey distributed to members of the Société Internationale d'Urologie (SIU). Due to privacy and confidentiality agreements with the SIU, the data are not publicly available. However, the dataset can be made available from the corresponding author upon reasonable request and with permission from the SIU.

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This study did not receive any external funding. All activities related to the design, data collection, analysis, and manuscript preparation were conducted without financial support from public, commercial, or not-for-profit funding bodies.

Ethics Approval and Consent to Participate:

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The survey was conducted under the governance of the SIU and in accordance with relevant guidelines and regulations. The survey was communicated with the Ethics Committee of the International School of Medicine, Istanbul Medipol University, and given the nature of the project was post-hoc approved by the Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee (Approval No. 715; Decision Date: 30 April 2026). The official ethics committee correspondence was issued under document number E-10840098-50.04-3324 (12 May 2026). The Ethics Committee determined that the research was ethically and scientifically appropriate. Participation was anonymized and upon taking part the participants were giving consent to take part in the survey and use the data for scientific purposes.

Human Ethics and Consent to Participate declarations:

Not applicable.

Consent for Publication:

Not applicable — this manuscript does not contain individual-level or identifiable human data.

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Supplementary table 1 - Practice characteristics by Continent.

Supplementary table 1 - Practice characteristics by Continent.

Characteristic	Response	Overall	North America	Latin America	Europe	Africa	Asia
1. Who performs SWL?							
	A radiology nurse	5.32%	0.00%	9.17%	4.62%	7.41%	4.68%
	A specialized technician	48.14%	55.29%	27.75%	36.71%	61.73%	58.54%
	I do not know	5.21%	7.06%	11.01%	6.65%	4.94%	2.69%
	Myself	41.33%	37.65%	52.06%	52.02%	25.93%	34.09%
2. Collecting stone fragments							
	No	15.70%	14.12%	28.21%	4.77%	18.52%	17.08%
	Yes	84.30%	85.88%	71.79%	95.23%	81.48%	82.92%
3. Using coupling gel							
	I do not know	12.82%	16.47%	9.40%	11.13%	13.58%	14.39%
	No	8.41%	12.94%	9.63%	5.49%	7.41%	9.23%
	Yes	78.77%	70.59%	80.96%	83.38%	79.01%	76.38%
4. Alpha blockers							
	No	26.37%	18.82%	28.44%	33.67%	25.93%	22.73%
	Yes	73.63%	81.18%	71.56%	66.33%	74.07%	77.27%
5. Antibiotic prophylaxis							
	No	48.36%	25.88%	42.20%	67.34%	33.33%	43.32%
	Yes	51.64%	74.12%	57.80%	32.66%	66.67%	56.68%
6. JJ stent							
	No	78.22%	40.00%	83.49%	78.61%	62.96%	79.55%
	Yes	21.78%	60.00%	16.51%	21.39%	37.04%	20.45%

Darker shades indicate higher values.

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Supplementary Table 2. Training Characteristics by Continent.

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Supplementary Table 2. Training Characteristics by Continent

Characteristic	Response	Overall	North America	Latin America	Europe	Africa	Asia
1. Training received							
	No formal training	15.24%	12.26%	7.03%	15.90%	18.25%	17.73%
	Only during residency	40.34%	54.19%	31.72%	48.01%	48.41%	37.69%
	Only during fellowship	10.72%	3.87%	14.53%	5.65%	3.97%	13.00%
	Only during residency and fellowship	2.50%	3.23%	2.34%	2.20%	0.79%	2.76%
	Other training combinations	31.22%	26.45%	44.38%	28.24%	28.57%	28.82%
2. Training during my residency							
	No	46.16%	33.55%	55.47%	34.83%	40.48%	50.16%
	Yes	53.84%	66.45%	44.53%	65.17%	59.52%	49.84%
3. Training during a (short) fellowship							
	No	81.76%	90.97%	78.28%	88.08%	92.86%	78.24%
	Yes	18.24%	9.03%	21.72%	11.92%	7.14%	21.76%
4. Training with in-person instructional courses							
	No	82.96%	77.42%	73.91%	81.90%	85.71%	86.84%
	Yes	17.04%	22.58%	26.09%	18.10%	14.29%	13.16%
5. Training with online instructional courses							
	No	93.57%	96.13%	94.38%	95.19%	94.44%	92.20%
	Yes	6.43%	3.87%	5.63%	4.81%	5.56%	7.80%
6. Training by reading about specific treatments							
	No	85.35%	93.55%	76.72%	87.76%	87.30%	86.25%
	Yes	14.65%	6.45%	23.28%	12.24%	12.70%	13.75%
7. Training by watching surgical recordings on demand							
	No	94.02%	95.48%	95.16%	94.04%	95.24%	93.42%
	Yes	5.98%	4.52%	4.84%	5.96%	4.76%	6.58%
8. Any training							
	No	16.56%	14.19%	7.34%	17.68%	20.63%	19.06%
	Yes	83.44%	85.81%	92.66%	82.37%	79.37%	80.94%

Darker shades indicate higher values.

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