

Occupational Radiation Safety and Stone Analysis Practices Among Urologists in Türkiye: A National Cross-Sectional Survey

Türkiye'deki Ürologlar Arasında Mesleki Radyasyon Güvenliği ve Taş Analizi Uygulamaları: Ulusal Bir Kesitsel Araştırma

Engin Denizhan Demirkıran^{1*} , Serdar Madendere² , Müslim Doğan Değer³ , Hüseyin Alperen Yıldız⁴ 

¹ Department of Urology, Zonguldak Bülent Ecevit University School of Medicine, Zonguldak, Türkiye

² Department of Urology, VKV American Hospital, İstanbul, Türkiye

³ Department of Urology, Tekirdağ City Hospital, Tekirdağ, Türkiye

⁴ Department of Urology Abant İzzet Baysal University Hospital School of Medicine, Bolu, Türkiye

ABSTRACT

Objective: To evaluate real-world occupational radiation-safety and post-procedural stone-analysis practices among urologists in Türkiye, and associated factors.

Materials and Methods: A cross-sectional, web-based survey was e-mailed to 2,305 urologists in Türkiye. The Google Forms questionnaire covered demographic, institutional, radiation-safety, and stone-analysis/metabolic-evaluation practices. Categorical comparisons used the Chi-square or Fisher's exact test, and independent factors were assessed with multivariable logistic regression.

Results: Of 346 respondents, 301 were analysed after excluding incomplete responses (61.5% specialists, 23.6% residents, 14.9% academics). A personal dosimeter was unavailable to 68.1%, regular dosimeter feedback was absent in 62.8%, a statutory radiation leave was not granted to 99.0%, and a periodic medical examination was not performed in 81.4%. Lead aprons (95.3%) and thyroid shields (81.7%) were common, whereas protective eyewear (20.6%) and gloves (9.3%) were rare. Routine stone analysis was performed by 47.5%; an in-house analysis facility was available to only 25.9% (0% of state-hospital respondents), while 78.7% referred specimens to an external institute. Metaphylaxis was applied by 56.1%. Routine analysis was independently associated with academic title (OR 2.85) and an in-house facility (OR 3.07), and inversely with >10 years' experience (OR 0.25); metaphylaxis was associated with university (OR 3.99) and training-and-research (OR 2.40) hospital practice.

Conclusion: Occupational radiation protection and guideline-recommended stone analysis are incompletely implemented and vary widely among urologists in Türkiye. The fact that a statutory radiation leave was granted to only 1.0% of respondents, together with the institution-dependent availability of stone analysis, indicates that systemic and regulatory measures, not individual awareness alone, are needed.

Keywords: metaphylaxis, occupational exposure, radiation protection, stone analysis, surveys and questionnaires, urolithiasis

Cite As: Demirkıran ED, Madendere S, Deger MD, Yıldız HA. Occupational Radiation Safety and Stone Analysis Practices Among Urologists in Türkiye: A National Cross-Sectional Survey. Endourol Bull. 2026;18(3):249–260. <https://doi.org/10.54233/endourolbull-1976766>

Corresponding Author: Engin Denizhan Demirkıran, MD. Department of Urology, Zonguldak Bülent Ecevit University, School of Medicine, Zonguldak, Türkiye

e-mail: eddemirkiran@gmail.com

Received: June 22, 2026

Accepted: August 10, 2026



ÖZET

Amaç: Türkiye'deki ürologların mesleki radyasyon güvenliği ve işlem sonrası taş analizi konusundaki gerçek hayattaki uygulamalarını ve bu uygulamalarla ilişkili faktörleri değerlendirmek.

Gereç ve Yöntemler: Türkiye'deki 2,305 üroloğa e-posta yoluyla kesitsel, web tabanlı bir anket gönderilmiştir. Google Formlar aracılığıyla hazırlanan anket, demografik ve kurumsal özellikleri, radyasyon güvenliği uygulamalarını ve taş analizi/metabolik değerlendirme uygulamalarını kapsamaktadır. Kategorik karşılaştırmalarda ki-kare testi veya Fisher testi kullanılmıştır; bağımsız faktörler ise çok değişkenli lojistik regresyon ile değerlendirilmiştir.

Bulgular: Eksik yanıtlar hariç tutulduktan sonra 346 katılımcıdan 301'i analiz edildi (%61.5'i uzman, %23.6'sı asistan, %14.9'u akademisyen). Katılımcıların %68.1'i kişisel dozimetreye sahip değildi, %62.8'i dozimetre sonuçları hakkında düzenli geri bildirim almıyordu, %99.0'ına yasal radyasyon izni verilmemişti ve %81.4'ü periyodik tıbbi muayeneye tabi tutulmamıştı. Kurşun önlükler (%95.3) ve tiroid kalkanları (%81.7) yaygınken, koruyucu gözlükler (%20.6) ve eldivenler (%9.3) nadirdi. Rutin taş analizi %47.5 oranında gerçekleştirilmiştir; kurum içi analiz imkânı yalnızca %25.9'unda mevcuttu (devlet hastanesi katılımcılarının %0'ında), %78.7'si ise numuneleri harici bir kuruma sevk etmiştir. Metaflaksi %56.1 oranında uygulanmıştır. Rutin analiz, akademik unvan (OR 2.85) ve kurum içi analiz imkânı (OR 3.07) ile pozitif, 10 yıldan fazla deneyim (OR 0.25) ile ise negatif ilişkilidi; metaflaksi ise üniversite (OR 3.99) ve eğitim-araştırma (OR 2.40) hastanelerinde çalışmakla ilişkilidi.

Sonuçlar: Mesleki radyasyondan korunma ve kılavuzlarda önerilen taş analizi, Türkiye'deki ürologlar arasında tam olarak uygulanmamakta ve büyük farklılıklar göstermektedir. Yasal radyasyon izninin katılımcıların yalnızca %1'ine verilmiş olması ve taş analizinin kurumlara bağlı olarak değişkenlik göstermesi, yalnızca bireysel farkındalığın değil, sistematik ve düzenleyici önlemlerin de gerekli olduğunu göstermektedir.

Anahtar Kelimeler: anketler ve soru formları, mesleki maruziyet, metaflaksi, radyasyondan korunma, taş analizi, ürolitiyazis

INTRODUCTION

Urinary stone disease is among the most common urological conditions worldwide, with reported lifetime prevalence ranging from approximately 5–9% in Europe and 7–13% in North America, and an estimated prevalence of around 11–15% in Türkiye (1,2). Its incidence has risen over recent decades, and the recurrence rate approaches 50% within 10-years of an initial episode, making long-term prevention an integral part of management (2,3).

Contemporary management of urinary stones has shifted overwhelmingly towards minimally invasive endourological techniques such as ureteroscopy and percutaneous nephrolithotomy, the majority of which rely on intraoperative fluoroscopy; fluoroscopic guidance also remains the standard imaging modality for extracorporeal shock-wave lithotripsy (SWL) in many centres, despite growing interest in ultrasound-guided alternatives (4). As these procedures have multiplied, so has the occupational ionising-radiation burden borne by urologists and operating-room staff, with documented associations between cumulative exposure and cataract formation and malignancy (5,6). The principle of keeping exposure "As Low As Reasonably Achievable" (ALARA), the dose limits defined by the International Commission on Radiological Protection (ICRP), and the routine use of personal dosimetry and shielding are therefore cornerstones of safe endourological practice (7,8). Yet surveys across several countries have repeatedly shown incomplete adoption of these measures (6,9,10).

The second pillar of stone care that depends heavily on real-world practice is secondary prevention. Current European Association of Urology (EAU) guidelines recommend that an attempt be made to analyse the stone in every patient—ideally by infrared spectroscopy or X-ray diffraction—together with a basic metabolic work-up for all stone formers and an extended evaluation for those at high risk of recurrence (11,12). Stone composition guides targeted metaphylaxis, and reliable analysis is therefore the entry point to recurrence prevention (12,13). Nonetheless, comprehensive metabolic evaluation is reported to be performed in only a minority of stone formers internationally (14).

Real-world data on how urologists in Türkiye approach these two domains -occupational radiation safety and post-procedural stone analysis- are scarce, and the supporting infrastructure (dosimetry services, statutory radiation leave, in-house stone-analysis laboratories) varies between institution types. Both domains are increasingly regarded as quality indicators of comprehensive stone-disease management: unsafe radiation practice exposes the treating team to avoidable long-term risk, while inadequate stone analysis undermines evidence-based secondary prevention; the present survey therefore examined them jointly as complementary markers of endourological care quality. The present national survey was designed to describe these practices, quantify the variation between practitioner and institutional groups, and identify factors independently associated with guideline-concordant behaviour.

MATERIALS AND METHODS

Study Design and Participants

This was a cross-sectional, questionnaire-based study conducted among urologists (residents, specialists, and academic faculty) practising in Türkiye in 2025. An invitation to participate was sent by e-mail to 2,305 urologists. The questionnaire was created in Google Forms and was self-administered; participation was voluntary and anonymous, and informed consent was obtained on the first page of the form before any item was displayed. A total of 346 responses were received (15.0% of those invited); after excluding 45 incomplete or inappropriate responses, 301 responses were included in the analysis (13.1% of those invited). Responses were classified as incomplete if key sections addressing radiation-safety or stone-analysis practices were left unanswered, and as inappropriate if submitted by respondents outside the target population (e.g., trainees or physicians outside urology) or as apparent duplicate entries from the same respondent. Reporting of the web-based survey followed the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) where applicable (15).

Questionnaire

The questionnaire was developed by the study group and pilot-tested among 15 urologists to assess clarity, comprehensibility, item interpretation, and completion time. Minor wording and formatting revisions were made before national distribution. As only minor revisions were required after pilot testing, responses from the 15 pilot participants were retained and included in the final analytic sample (n = 301). The instrument comprised three domains. The first captured demographic and institutional characteristics (academic title, institution type, age group, and years in practice, including residency). The second addressed occupational radiation safety: procedures performed without a safety guidewire or without fluoroscopy, availability and type of a personally allocated dosimeter, regularity of dosimeter measurement and feedback, availability of personal protective equipment, granting of an annual statutory radiation leave, periodic occupational medical examination, and difficulty in accessing a shared fluoroscopy unit. The third domain addressed stone analysis and secondary prevention: routine post-procedural stone analysis, availability of an in-house analysis facility, referral of specimens to an external mineral-research institute for analysis, intraoperative stone-sampling behaviour in semirigid ureteroscopy (URS), flexible URS and mini-percutaneous nephrolithotomy (mini-PNL), application of metaphylaxis, provision of dietary and lifestyle advice, the patient groups selected for metabolic evaluation, and access to specific metabolic tests. Multiple-response options were permitted where indicated. The full survey instrument (English translation) is provided as a Supplementary File (Appendix 1) to facilitate replication and future comparative survey design.

Stone Analysis Referral Pathway

In Türkiye, where dedicated in-hospital crystallographic analysis is frequently unavailable, urologists may refer retrieved stone specimens for compositional analysis to an external public geological institute (the General Directorate of Mineral Research and Exploration). Referral to this institute was recorded as a distinct practice variable.

Ethics

This study was approved by the Ethics Committee for Non-Interventional Clinical Research at Zonguldak Bülent

Ecevit University at its meeting dated May 13, 2020 (No. 2020/10), regarding the research titled “An Investigation of Differences in Clinical Approaches Among Urologists in Turkey: Prostate Biopsy, Urinary Tract Stone Disease, and Interdisciplinary Collaborations,” was unanimously approved as compliant with the ethics committee’s principles.

Approval for the study was obtained from the local ethics committee, and the study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants.

Statistical Analysis

Categorical variables were summarised as frequencies and percentages. For analysis, academic title was grouped as resident, specialist, and academic (assistant professor, associate professor, and professor); institution type as university, training-and-research, state, private, and city hospital; and experience as ≤ 10 versus > 10 years. Selected multi-response items were dichotomised (e.g., any personal dosimeter versus none; any in-house analysis facility versus none). Between-group differences were tested with the Pearson Chi-square test or the Fisher’s exact test as appropriate. Factors independently associated with routine stone analysis, personal-dosimeter availability, and metaphylaxis were examined with multivariable logistic regression, with results expressed as odds ratios (OR) and 95% confidence intervals (CI). $p < 0.05$ was considered statistically significant. All analyses were performed using Jamovi (Version 2.7.31; The Jamovi project, Sydney, Australia).

RESULTS

Participant Characteristics

Of 2,305 invited urologists, 346 responded (15.0%); after excluding 45 incomplete or inappropriate responses, 301 (13.1%) were included in the analysis. Most were specialists (185; 61.5%), followed by residents (71; 23.6%) and academic faculty (45; 14.9%). State hospitals accounted for 107 respondents (35.5%), university hospitals 74 (24.6%), training-and-research hospitals 59 (19.6%), private institutions 51 (16.9%), and city hospitals 10 (3.3%). Most respondents were aged 20–44 years (78.1%). Full characteristics are shown in Table 1.

Table 1. Demographic and institutional characteristics of respondents (n=301).

Characteristic	Category	n (%)
Academic title	Specialist	185 (61.5)
	Resident	71 (23.6)
	Academic (Asst./Assoc./Prof.)	45 (14.9)
Institution	State hospital	107 (35.5)
	University hospital	74 (24.6)
	Training & research hospital	59 (19.6)
	Private institution	51 (16.9)
	City hospital	10 (3.3)
Age, years	20–34	139 (46.2)
	35–44	96 (31.9)
	45–54	42 (14.0)
	55–64	21 (7.0)
	≥ 65	3 (1.0)
Experience, years	0–5	58 (19.3)
	5–10	110 (36.5)
	10–15	48 (15.9)
	15–20	32 (10.6)
	> 20	53 (17.6)

Radiation-Safety Practices

A personally allocated dosimeter was unavailable to 205 respondents (68.1%); where present, it was most often a collar/chest badge (29.2%). Regular dosimeter measurement with result feedback was not performed for 189 respondents (62.8%), and a further 41 (13.6%) were unaware whether it occurred. An annual statutory radiation (“shua”) leave was not granted to 298 respondents (99.0%), and periodic occupational medical examination was not performed for 245 (81.4%). Lead aprons (95.3%) and thyroid shields (81.7%) were widely available, but protective eyewear (20.6%), radiation shields (19.3%), and protective gloves (9.3%) were used by a minority, and 13 respondents (4.3%) reported no protective equipment. A safety guidewire was used in all procedures by 80.7%, whereas fluoroscopy was used in all listed procedures by only 40.5%; semirigid URS was the procedure most often performed without fluoroscopy. Difficulty accessing a shared fluoroscopy unit was reported by 82 respondents (27.2%) (Table 2).

Stone Analysis and Metabolic Practices

Routine post-procedural stone analysis was performed by 143 respondents (47.5%). An in-house analysis facility was available to only 25.9% (biochemical 21.3%; X-ray diffraction 4.7%), and notably to none of the state-hospital respondents. Referral of specimens to the external geological institute was reported by 237 respondents (78.7%). Intraoperative stone-sampling behaviour varied by procedure: the whole stone was retrieved when feasible by 44.5% in semirigid URS, 8.6% in flexible URS, and 60.1% in mini-PNL, whereas no sample was taken by 16.9%, 44.5%, and 9.3%, respectively. Flexible URS represented the procedure with the greatest loss of compositional information, with 44.5% reporting that no sample was taken. Metaphylaxis was applied by 169 respondents (56.1%), dietary and lifestyle advice was given by 291 (96.7%), and metabolic evaluation was performed by 89.7% (directed at high-risk recurrent stone formers in 86.4%). Access to spot urine (95.3%), serum electrolytes (97.3%), urine culture (96.0%), hormonal tests (92.4%), and 24-hour urine (81.4%) was widespread, whereas genetic analysis was available to 36.5%

Table 2. Occupational radiation-safety practices.

Item	Response	n (%)
Personal dosimeter	None	205 (68.1)
	Collar/chest badge	88 (29.2)
	Both badge + ring	6 (2.0)
	Ring/wrist only	2 (0.7)
Dosimeter measurement & feedback	None	189 (62.8)
	Every 6 months	54 (17.9)
	Unaware	41 (13.6)
	Yearly	17 (5.6)
Annual statutory radiation leave	Not granted	298 (99.0)
	Granted	3 (1.0)
Periodic medical examination	Not performed	245 (81.4)
	Performed	56 (18.6)
Protective equipment*	Lead apron	287 (95.3)
	Thyroid shield	246 (81.7)
	Protective eyewear	62 (20.6)
	Radiation shield	58 (19.3)
	Protective gloves	28 (9.3)
	None	13 (4.3)
Fluoroscopy used in all listed procedures	Yes	122 (40.5)
Safety guidewire used in all procedures	Yes	243 (80.7)
Difficulty accessing shared fluoroscopy	Yes	82 (27.2)

*Multiple responses permitted; percentages exceed 100%.

(Table 3). Despite high reported rates of dietary/lifestyle counselling and metabolic evaluation, routine stone analysis and in-house analytical capacity remained substantially lower, indicating a discontinuity in the stone-prevention care pathway (Figure 1).

Table 3. Stone-analysis and metabolic-evaluation practices.

Item	Response	n (%)
Routine post-procedural stone analysis	Yes	143 (47.5)
	No	158 (52.5)
In-house analysis facility	None	217 (72.1)
	Biochemical	64 (21.3)
	X-ray diffraction	14 (4.7)
	Unaware	6 (2.0)
Referral to external geological institute	Yes	237 (78.7)
	No	64 (21.3)
Sampling – retrieves whole stone	Semirigid URS	134 (44.5)
	Flexible URS	26 (8.6)
	Mini-PNL	181 (60.1)
Sampling – takes no sample	Semirigid URS	51 (16.9)
	Flexible URS	134 (44.5)
	Mini-PNL	28 (9.3)
Applies metaphylaxis	Yes	169 (56.1)
Gives diet/lifestyle advice	Yes	291 (96.7)
Performs metabolic evaluation	Yes	270 (89.7)
Metabolic evaluation directed at	High-risk recurrent formers	260 (86.4)
	First-time formers	10 (3.3)
	Not applied	31 (10.3)

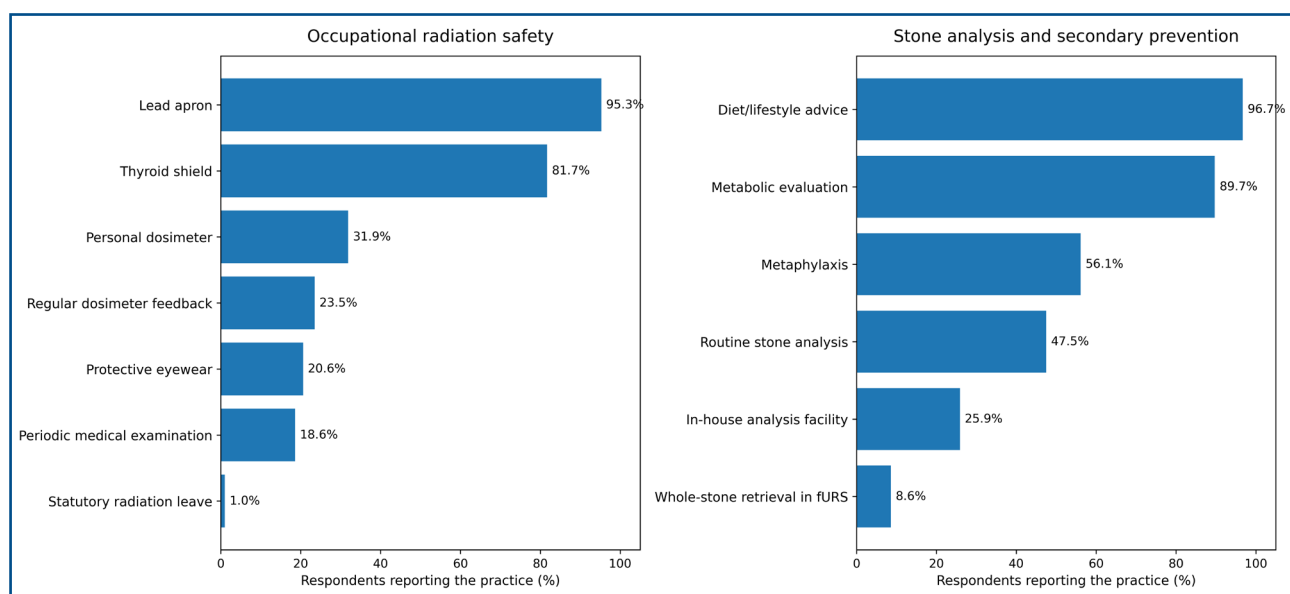


Figure 1. Two parallel care gaps in stone surgery

The left panel shows occupational radiation-safety practices, while the right panel shows stone analysis and secondary-prevention practices.

Factors Associated with Practice

Personal-dosimeter availability differed by academic title (academics 48.9% vs specialists 25.4%; $p = 0.005$). Routine stone analysis differed by institution type ($p = 0.005$), title ($p = 0.009$), and experience ($p = 0.020$), and in-house analysis availability differed strongly by institution type ($p < 0.001$) and title ($p < 0.001$). Referral to the external institute was more frequent among less experienced respondents (≤ 10 years, 87.5% vs > 10 years, 67.7%; $p < 0.001$). Metaphylaxis differed by institution type (university 68.9%, training-and-research 62.7%, state 45.8%; $p = 0.020$) (Table 4). In multivariable analysis, routine stone analysis was independently associated with academic title (OR 2.85, 95% CI 1.16–6.99), availability of an in-house analysis facility (OR 3.07, 95% CI 1.59–5.93), and, inversely, with > 10 years of experience (OR 0.25, 95% CI 0.13–0.50) (Table 5). Personal-dosimeter availability was independently associated with academic title (OR 3.04, 95% CI 1.24–7.42), and metaphylaxis with university (OR 3.99, 95% CI 1.45–10.93) and training-and-research (OR 2.40, 95% CI 1.14–5.05) hospital practice.

DISCUSSION

This national survey of 301 urologists in Türkiye reveals two parallel findings. First, occupational radiation protection is incomplete and, in its regulatory dimension, almost entirely absent: more than 2-thirds of respondents had no personal dosimeter, only about one quarter received regular dose feedback, and a statutory radiation leave and periodic medical examination were essentially unavailable to the vast majority. Second, guideline-recommended post-procedural stone analysis was performed by fewer than half of respondents and was tightly constrained by institutional infrastructure rather than by individual preference alone.

Table 4. Selected subgroup comparisons (proportion answering “yes”).

Outcome	Subgroup (rates)	p
Personal dosimeter	Academic 48.9% / Resident 38.0% / Specialist 25.4%	0.005
Dosimeter monitoring	Academic 42.2% / Resident 25.4% / Specialist 18.4%	0.003
Routine stone analysis	By institution (City 10.0% – Training&Res. 57.6%)	0.005
Routine stone analysis	Academic 66.7% / Resident 50.7% / Specialist 41.6%	0.009
Routine stone analysis	≤ 10 yr 53.6% / > 10 yr 39.8%	0.020
In-house analysis facility	State 0% / others 39–45%	< 0.001
In-house analysis facility	Academic 55.6% / Resident 26.8% / Specialist 18.4%	< 0.001
Referral to external institute	≤ 10 yr 87.5% / > 10 yr 67.7%	< 0.001
Metaphylaxis	University 68.9% / Training&Res. 62.7% / State 45.8%	0.020

Pearson chi-square or Fisher exact test.

Table 5. Multivariable logistic regression for selected practices.

Outcome / predictor	OR (95% CI)	p
Routine stone analysis (ref: State / Specialist / ≤ 10 yr / no facility)		
Academic title	2.85 (1.16–6.99)	0.022
In-house analysis facility	3.07 (1.59–5.93)	< 0.001
> 10 years of experience	0.25 (0.13–0.50)	< 0.001
Personal dosimeter (ref: State / Specialist / ≤ 10 yr)		
Academic title	3.04 (1.24–7.42)	0.015
Metaphylaxis (ref: State / Specialist / ≤ 10 yr)		
University hospital	3.99 (1.45–10.93)	0.007
Training & research hospital	2.40 (1.14–5.05)	0.021

Only statistically significant predictors are shown; each model also included institution type, title and experience as covariates. OR, odds ratio; CI, confidence interval.

The pattern of protective-equipment use mirrors international surveys, in which lead aprons and thyroid shields are nearly universal, while eyewear, shielding, and gloves lag far behind (6,9,10). Similar gaps have been reported in surveys from Türkiye, the United States, Egypt, and Saudi Arabia, where awareness of radiation hazards did not consistently translate into dosimeter use, protective eyewear adoption, or formal radiation-safety training (16–19). However, the figures for personal dosimetry and statutory monitoring observed here are substantially lower than those reported among European and other cohorts, where personal dosimeter use, although still suboptimal, is more established (6,9). Notably, the proportion of respondents without a personal dosimeter (68.1%) is almost unchanged from the 73.9% of Turkish urologists who reported not using a dosimeter nearly a decade earlier in a similarly designed national e-mail survey, indicating that this gap has persisted despite the intervening expansion of endourological practice (20). Given the documented relationship between cumulative ocular exposure and cataract formation and the relatively high eye-lens doses recorded during endourology, the rarity of protective eyewear and eye dosimetry is of particular concern (5,6). This is clinically relevant because the eye lens has become a specific focus of occupational radiation protection after the reduction of recommended occupational lens-dose limits, and experimental as well as clinical studies suggest that eyewear design, operator position, and C-arm geometry substantially influence lens exposure (21,22). The near-complete absence of statutory radiation leave and periodic examination is best interpreted not as a failure of individual awareness but as a gap in institutional and regulatory implementation, since these provisions are administered at the level of the employing institution. Consistent with this, the only practitioner-level factor independently associated with dosimeter availability was academic title, plausibly reflecting better-resourced academic centres rather than differing attitudes. Although radiation-safety education is necessary, the magnitude of dosimetry and occupational-health gaps observed in the present study suggests that education alone is unlikely to be sufficient without institution-level monitoring, mandatory feedback systems, and enforceable occupational-safety policies (8,9,23).

On the stone-analysis side, the EAU guidelines recommend that stone composition be determined in every patient, preferably by infrared spectroscopy or X-ray diffraction, as the basis for targeted prevention (11–13). The observation that routine analysis was performed by under half of respondents is in keeping with the recognised international gap between guideline recommendations and practice (14). The most striking structural finding was that an in-house analysis facility was available to only about a quarter of respondents and to no state-hospital respondent, which explains the heavy reliance (78.7%) on referral to an external geological institute as a pragmatic substitute. However, such external referral pathways can only replace in-house analysis if the analytical method, reporting format, turnaround time, and quality-control standards are clearly defined. Multicentre European data have shown that the accuracy of urinary stone analysis varies across laboratories and analytical methods, supporting the need for standardized, quality-assured pathways (24). The independent association of routine analysis with an in-house facility (OR 3.07) confirms that access, more than intent, drives this behaviour. This mismatch was further illustrated by the stone-prevention cascade. Although dietary/lifestyle counselling and metabolic evaluation were frequently reported, routine stone analysis and in-house analytical capacity were much less common. This suggests that secondary prevention is often initiated without robust compositional confirmation, particularly in centres without local stone-analysis infrastructure. The inverse association with experience -more senior urologists performing analysis less often and referring less frequently to the external institute- may reflect entrenched habits formed before analysis pathways became widely promoted and represents a potential target for continuing education.promoted and

Procedure-specific sampling patterns also deserve attention. In the present survey, no stone sample was obtained in nearly half of flexible URS cases, whereas this was uncommon during mini-PNL. This may partly reflect the increasing use of dusting strategies in flexible ureteroscopy, where an intact fragment is not routinely retrieved. However, dusting alone is unlikely to fully explain this pattern: true dusting to fragments of only a few millimetres is often incomplete, particularly for lower-pole stones with narrow infundibula, where residual fragments may not pass spontaneously and could in principle still be retrieved for analysis; procedural time and cost considerations may therefore also contribute

to the decision not to sample. The finding that no sample was taken in 9.3% of mini-PNL cases is more difficult to reconcile with the technique itself, since an intact or fragmented stone is typically extracted through the nephrostomy tract; this pattern may instead reflect variability in respondents' endourological experience or engagement with stone-analysis practice, and it underscores that self-reported survey data cannot fully capture the reasons underlying non-sampling behaviour. Biochemical analysis of dust or small retrieved fragments has been proposed as a pragmatic route to preserve compositional diagnosis when intact stones are unavailable (25). Nevertheless, visual endoscopic recognition is not sufficiently reliable to replace formal stone analysis (26).

Encouragingly, dietary and lifestyle advice was almost universal, and metabolic evaluation was reported by nearly 90% of respondents, appropriately concentrated on high-risk recurrent stone formers, with broad access to the relevant biochemical tests. This high self-reported rate contrasts with claims-based and patient-level studies showing low uptake of 24-hour urine testing and follow-up metabolic monitoring, suggesting that survey-based physician reports may capture intent or selected high-risk practice rather than universal implementation (27,28).

The higher likelihood of metaphylaxis in university and training-and-research settings suggests that academic environments more readily translate guideline recommendations into routine practice. Taken together, the findings argue that improving secondary prevention in Türkiye depends less on changing attitudes than on widening access to reliable stone analysis—whether by equipping more centres or by formalising and quality-assuring external referral pathways.

Limitations

This study has several limitations. Its cross-sectional, self-reported design is subject to recall and social-desirability bias. Although the number of invited urologists was defined (2,305), the response rate was modest (13.1%), which raises the possibility of non-response bias and limits generalisability. This response rate is consistent with the generally low and often declining rates reported for non-incentivized, single-mailing e-mail surveys of physicians, in which web-based invitations without reminders or incentives typically yield lower participation than mailed or mixed-mode approaches (29). Because respondents with a specific interest in endourology, radiation safety, or stone prevention may have been more likely to participate, the observed adherence rates may overestimate national practice. This selection effect is particularly relevant to personal-dosimeter availability (31.9%), which may overestimate true coverage among the broader population of Turkish urologists, including those in general urological practice with less focus on endourology and radiation safety. The instrument recorded sampling behaviour for semirigid URS, flexible URS, and mini-PNL but not for standard PNL or bladder-stone surgery, and the analytical validity and turnaround time of external referral were not assessed. Data on institutional stone-surgery case volume were not collected, precluding comparison of practice patterns between high-volume and low-volume centres; this represents an additional limitation. Finally, associations are observational and cannot establish causation.

CONCLUSION

Occupational radiation protection and guideline-recommended stone analysis are incompletely implemented among urologists in Türkiye. The very low rates of dosimetry feedback, occupational surveillance, and in-house stone-analysis access suggest that improvement requires institutional and regulatory interventions, in addition to individual education.

Acknowledgments: The manuscript's language and structure were enhanced using artificial intelligence (Claude Opus 4.8; Anthropic). The author has thoroughly examined and verified the content, taking full responsibility for the scientific accuracy and integrity of the completed document.

Funding: This research received no external funding.

Informed Consent: Electronic informed consent was obtained on the first page of the form before any item was displayed.

Conflict of Interest: The authors declare no competing interests.

Ethics Approval: This study was approved by the Ethics Committee for Non-Interventional Clinical Research at Zonguldak Bülent Ecevit University at its meeting dated May 13, 2020 (No. 2020/10), regarding the research titled "An Investigation of Differences in Clinical Approaches Among Urologists in Turkey: Prostate Biopsy, Urinary Tract Stone Disease, and Interdisciplinary Collaborations," was unanimously approved as compliant with the ethics committee's principles.

Author contributions

Conceptualization: EDD, SM, MDD, HAY

Methodology: EDD, SM, MDD, HAY

Formal Analysis: EDD

Investigation: EDD, SM, MDD, HAY

Resources: EDD

Data Curation: EDD, SM, MDD, HAY

Writing – Original Draft: EDD

Writing – Review & Editing: EDD, SM, MDD, HAY

Visualization: EDD

REFERENCES

1. Yao W, Wei X, Jing Q, Yuan X, Liu F, Zhang X. Epidemiological trends of urolithiasis in working-age populations: findings from the global burden of disease study 1990-2021. PLoS One. 2025;20(7):e0327343. <https://doi.org/10.1371/journal.pone.0327343>
2. Muslumanoglu AY, Binbay M, Yuruk E, Akman T, Tepeler A, et al. Updated epidemiologic study of urolithiasis in Turkey. I: Changing characteristics of urolithiasis. Urol Res. 2011;39(4):309–14. <https://doi.org/10.1007/s00240-010-0346-6>
3. Siener R. Nutrition and kidney stone disease. Nutrients. 2021;13(6):1917. <https://doi.org/10.3390/nu13061917>
4. Sihotang RC, Rasyid N, Birowo P, Situmorang GR, Atmoko W. The comparison of totally ultrasound-guided versus fluoroscopy-guided shockwave lithotripsy in renal stone treatment: a systematic review and meta-analysis [version 2; peer review: 2 approved, 1 approved with reservations, 1 not approved]. F1000Res. 2025;14(181). <https://doi.org/10.12688/f1000research.157981.2>
5. Hartmann J, Distler F, Baumüller M, Guni E, Pahernik S, et al. Risk of radiation-induced cataracts: investigation of radiation exposure to the eye lens during endourologic procedures. J Endourol. 2018;32(10):897–903. <https://doi.org/10.1089/end.2018.0324>
6. Vassileva J, Zagorska A, Karagiannis A, Petkova K, Sabuncu K, et al. Radiation exposure of the surgical team during endourological procedures: International Atomic Energy Agency-South-Eastern European Group for Urolithiasis Research Study. J Endourol. 2021;35(5):574–82. <https://doi.org/10.1089/end.2020.0630>
7. López PO, Dauer LT, Loose R, Martin CJ, Miller DL et al. ICRP Publication 139: Occupational Radiological Protection in Interventional Procedures. Annals of the ICRP. 2018;47(2):1-118. <https://doi.org/10.1177/0146645317750356>
8. Söylemez H, Sancaktutar AA, Silay MS, Penbegül N, Bozkurt Y, et al. Knowledge and attitude of European urology

residents about ionizing radiation. Urology. 2013;81(1):30–5. <https://doi.org/10.1016/j.urology.2012.07.097>

9. Ong K, Warren H, Nalagatla S, Kmietek E, Obasi C, et al. Radiation safety knowledge and practice in urology theaters: a collaborative multicenter survey. J Endourol. 2021;35(7):1084–9. <https://doi.org/10.1089/end.2020.0955>
10. Fontanet Soler S, Bravo-Balado A, Skolarikos A, Seitz C, Traxer O, et al. Trends in the use of radiation protection and radiation exposure of European endourologists: a prospective trial from the EULIS-YAU Endourology Group. World J Urol. 2024;42(1):163. <https://doi.org/10.1007/s00345-024-04854-0>
11. Türk C, Petřík A, Sarica K, Seitz C, Skolarikos A, et al. EAU guidelines on diagnosis and conservative management of urolithiasis. Eur Urol. 2016;69(3):468–74. <https://doi.org/10.1016/j.eururo.2015.07.040>
12. Skolarikos A, Somani B, Neisius A, Jung H, Petřík A, et al. Metabolic evaluation and recurrence prevention for urinary stone patients: an EAU guidelines update. Eur Urol. 2024;86(4):343–63. <https://doi.org/10.1016/j.eururo.2024.05.029>
13. Kourambas J, Aslan P, Teh CL, Mathias BJ, Preminger GM. Role of stone analysis in metabolic evaluation and medical treatment of nephrolithiasis. J Endourol. 2001;15(2):181–186. <https://doi.org/10.1089/089277901750134548>
14. Pearle MS, Goldfarb DS, Assimos DG, Curhan G, Denu-Ciocca CJ, et al. Medical management of kidney stones: AUA guideline. J Urol. 2014;192(2):316–24. <https://doi.org/10.1016/j.juro.2014.05.006>
15. Eysenbach G. Improving the quality of web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res. 2004;6(3):e34. <https://doi.org/10.2196/jmir.6.3.e34>
16. Altintas E, Bahceci T, Batur AF, Kaynar M, Kilic O, et al. A survey analysis of knowledge levels of urologists about radiation safety and fluoroscopy use. Int J Clin Pract. 2021;75(4):e13862. <https://doi.org/10.1111/ijcp.13862>
17. Harris AM, Loomis J, Hopkins M, Bylund J. Assessment of radiation safety knowledge among urology residents in the United States. J Endourol. 2019;33(6):492–7. <https://doi.org/10.1089/end.2019.0133>
18. Omar M, Desoky EEA, Elmohamady B, El-Shaer A, Noureldin YA. Awareness and implementation of ionizing radiation safety measures among urology community in Egypt: nationwide survey. Afr J Urol. 2021;27(1):13. <https://doi.org/10.1186/s12301-020-00110-0>
19. Alshahrani S, Alqunais M, Alkhaldi M, Alqasem S, Al-Gonaim A, et al. Radiation safety knowledge and practices among urologists in Saudi Arabia: a cross-sectional survey analysis. Medicine (Baltimore). 2025;104:e44551. <https://doi.org/10.1097/MD.00000000000044551>
20. Söylemez H, Altunoluk B, Bozkurt Y, Sancaktutar AA, Penbegül N, et al. Radiation exposure: do urologists take it seriously in Turkey? J Urol. 2012;187(4):1301–05. <https://doi.org/10.1016/j.juro.2011.11.110>
21. Barnard SG, Ainsbury EA, Quinlan RA, Bouffler SD. Radiation protection of the eye lens in medical workers: basis and impact of the ICRP recommendations. Br J Radiol. 2016;89(1060):20151034. <https://doi.org/10.1259/bjr.20151034>
22. Akahane M, Yoshioka N, Kiryu S. Radiation protection of the eye lens in fluoroscopy-guided interventional procedures. Interv Radiol. 2022;7(2):44–8. <https://doi.org/10.22575/interventionalradiology.2022-0006>
23. Kyei KA, Addo HB, Daniels J. Radiation safety: knowledge, attitudes, practices and perceived socioeconomic impact in a limited-resource radiotherapy setting. Ecancermedicalscience. 2025;19:1855. <https://doi.org/10.3332/ecancer.2025.1855>
24. Siener R, Buchholz N, Daudon M, Hess B, Knoll T, et al. Quality assessment of urinary stone analysis: results of a multicenter study of laboratories in Europe. PLoS One. 2016;11(6):e0156606. <https://doi.org/10.1371/journal.pone.0156606>

25. Ray ER, Rumsby G, Smith RD. Biochemical composition of urolithiasis from stone dust: a matched-pair analysis. *BJU Int.* 2016;118(4):618–24. <https://doi.org/10.1111/bju.13448>
26. Henderickx MMEL, Stoots SJM, de Bruin DM, Wijkstra H, Freund JE, et al. How reliable is endoscopic stone recognition? A comparison between visual stone identification and formal stone analysis. *J Endourol.* 2022;36(10):1362–70. <https://doi.org/10.1089/end.2022.0217>
27. Crivelli JJ, Yan PL, Shahinian V, Hsi RS, Hollingsworth JM. Associations between provider specialty and use of follow-up testing among patients on preventive pharmacological therapy for urinary stone disease. *Urol Pract.* 2023;10(4):400–6. <https://doi.org/10.1097/UPJ.0000000000000414>
28. Song S, Thomas IC, Ganesan C, Sohlberg EM, Chertow GM, et al. Twenty-four hour urine testing and prescriptions for urinary stone disease-related medications in veterans. *Clin J Am Soc Nephrol.* 2019;14:1773–80. <https://doi.org/10.2215/CJN.03580319>
29. Harrap B, Taylor T, Russell G, Scott A. A randomised controlled trial of email versus mailed invitation letter in a national longitudinal survey of physicians. *PLoS One.* 2023;18(8):e0289628. <https://doi.org/10.1371/journal.pone.0289628>