NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Quality in Sport. eISSN 2450-3118.

Journal Home Page
https://apcz.umk.pl/QS/index

KANDEFER, Tomasz, SROKA, Maria Izabela, WASINIEWSKA, Weronika, and BARAŃSKI, Marcin. Nutrition and Urological Disorders: From Nephrolithiasis to Uro-oncology – Practical Implications for Everyday Practice. Quality in Sport. 2026;55:71121. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.55.71121

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 21.04.2026. Revised: 26.04.2026. Accepted: 4.05.2026. Published: 8.05.2026.

Nutrition and Urological Disorders: From Nephrolithiasis to Uro-oncology – Practical Implications for Everyday Practice

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Abstract

Nutrition has become a key determinant across urological disorders, with particularly strong evidence in nephrolithiasis and emerging data in urologic oncology and functional conditions. This narrative review synthesizes current evidence on the role of diet, obesity, and broader dietary patterns in nephrolithiasis and urologic cancers, and translates these findings into practical dietary counselling strategies for everyday clinical practice. A selective review of recent guidelines, systematic reviews, meta-analyses, and key observational and mechanistic studies was performed, focusing on dietary and lifestyle determinants of kidney stone disease and major urologic malignancies, with particular attention to clinically actionable recommendations. For nephrolithiasis, convergent guideline and meta-analytic data support high fluid intake, normal dietary calcium, reduced sodium and animal protein, and plant-rich dietary patterns (DASH- or Mediterranean-like) as first-line preventive strategies rather than optional adjuncts. In urologic oncology, obesity and adverse dietary patterns are consistently associated with increased risk of kidney and bladder cancers and aggressive prostate cancer, while greater adherence to plant-forward, cancer-prevention dietary guidelines appears protective, although high-quality interventional data on survival remain limited. Emerging

evidence suggests that diet, body composition, and the gut microbiome may modulate response to systemic therapies, including immune checkpoint inhibitors, but this area is still in early translational development. Current evidence justifies routine, pattern-based dietary counselling—centered on adequate hydration, plant-forward eating, moderation of sodium and animal protein, and weight management—as a core component of nephrolithiasis prevention and urologic cancer risk reduction. Key research priorities include randomized trials of whole dietary patterns in recurrent stone disease, mechanistically informed studies of diet and treatment response in uro-oncology, and better-quality data on nutrition in functional urology and male reproductive health.
Keywords: Nephrolithiasis, Urology, Urologic cancers, Obesity, Cancer prevention, Nutrition

Introduction

Nutrition has emerged as a clinically meaningful determinant in urological disease, influencing not only disease prevention but also symptom burden, recurrence risk, and long-term outcomes[1]. Among urological conditions, nephrolithiasis offers one of the most established examples of diet-sensitive pathophysiology, with fluid intake, sodium, calcium, animal protein, and broader dietary patterns all affecting urinary supersaturation and stone recurrence[2]. Accordingly, current reviews and clinical guidance consistently recommend adequate fluid intake, moderation of sodium and animal protein, maintenance of normal dietary calcium, and increased consumption of fruits and vegetables as the foundation of kidney stone prevention[3]. The importance of nutrition in urology extends beyond stone disease. Observational and synthesis studies suggest that dietary patterns may also influence the risk and course of selected urologic cancers, including malignancies of the kidney, bladder, and prostate[4,5]. In this context, food-group composition and overall dietary pattern appear more informative than isolated nutrients alone, with Mediterranean-style or plant-forward diets increasingly associated with favorable urologic and cardiometabolic profiles. This issue is particularly relevant in everyday clinical practice, because many patients with urological disorders are older, metabolically complex, and managed across primary care, internal medicine, nephrology, and oncology settings. At the same time, the evidence base is uneven across disease entities: it is robust for nephrolithiasis, suggestive but less definitive for lower urinary tract symptoms and benign

prostatic hyperplasia, and still evolving for uro-oncologic outcomes. The aim of this review is to synthesize current evidence on nutrition and major urological disorders, with particular emphasis on nephrolithiasis and uro-oncology, and to translate that evidence into practical recommendations for everyday practice.

Nutrition and nephrolithiasis

Nephrolithiasis is a paradigmatic example of a urological disorder in which diet and lifestyle critically shape both initial stone formation and subsequent recurrence. Stone formation depends on urinary supersaturation with lithogenic salts such as calcium oxalate, calcium phosphate, and uric acid, modulated by urinary volume, pH, ionic strength, and the presence of inhibitors such as citrate. Diet influences virtually all of these parameters by altering solute excretion (calcium, oxalate, uric acid), urinary pH, and urinary volume, and by interacting with systemic conditions such as obesity, insulin resistance, and metabolic syndrome[6]. Recent umbrella and systematic reviews have further quantified the contribution of modifiable factors, identifying central obesity, type 2 diabetes, dietary sodium, fructose intake, and higher ambient temperatures as suggestive causal risk factors for nephrolithiasis[7]. Conversely, higher fluid intake, adherence to a Dietary Approaches to Stop Hypertension (DASH)-like diet, adequate dietary calcium, and consumption of coffee, tea, fruits, and vegetables emerge as protective factors against incident stones. Taken together, these data support the view that nutrition in stone formers should be considered part of comprehensive metabolic risk management rather than a narrow adjunct to urologic intervention[8,9].

Fluids and beverages

Low urine volume is one of the most consistent modifiable risk factors for kidney stone formation, and increased fluid intake is the single most robustly supported preventive measure[2]. Meta-analytic data suggest that higher total fluid intake is associated with approximately 40–50% reduction in incident stones, with a clear inverse association between daily fluid intake and stone risk. Clinical practice guidelines therefore recommend increasing fluid intake to achieve a urine volume of at least 2–2.5 liters per day in most stone formers, with individualization based on comorbidities such as heart failure or advanced chronic kidney disease. The type of beverage consumed also matters. Observational data indicate that water, coffee, tea, and certain fruit juices—particularly citrus juices rich in citrate—are associated with lower stone risk, whereas sugar-sweetened beverages and sodas appear to increase risk[10]. The mechanism is likely multifactorial, involving not only changes in urine volume but also effects

on urinary pH, citrate excretion, and metabolic parameters such as insulin sensitivity[11]. Recent work has also explored the role of bicarbonate-rich mineral waters, which can alkalinize the urine, increase urinary citrate, and potentially reduce uric acid and calcium stone risk in selected patients[12]. In clinical practice, counseling should therefore prioritize total fluid intake, encourage water and other protective beverages, and limit habitual consumption of sugar-sweetened drinks, especially in patients with concomitant obesity or diabetes.

Calcium, oxalate, and vitamin D

The relationship between dietary calcium and stone risk is nuanced and often misunderstood by patients. Early observational work and subsequent meta-analyses suggest that **low** dietary calcium intake is associated with a higher risk of calcium oxalate stones, whereas normal calcium intake with meals is protective by binding intestinal oxalate and reducing its absorption[13]. In contrast, calcium supplementation - particularly when taken between meals rather than with meals—has been associated with an increased risk of nephrolithiasis in some observational studies, although randomized trials have shown less consistent effects[14]. Vitamin D supplementation alone, especially at higher doses, may modestly increase the risk of stones in observational datasets, possibly through increased calcium absorption and hypercalciuria, but data from randomized controlled trials are less definitive. Current recommendations therefore favor maintaining a normal dietary calcium intake (typically 1,000–1,200 mg/day in adults) from food sources, avoiding unnecessarily restrictive low-calcium diets, and using calcium and vitamin D supplements cautiously in patients with a history of calcium stones. Dietary oxalate is another key contributor, particularly in patients with hyperoxaluria. High-oxalate foods such as spinach, rhubarb, nuts, and certain grains can increase urinary oxalate excretion, but the absolute risk depends on total oxalate load, concurrent calcium intake, and individual absorptive characteristics[3]. Rather than eliminating oxalate-containing foods entirely, many experts recommend moderating intake of the highest-oxalate items while ensuring adequate calcium is consumed with meals to promote intestinal binding. In addition, emerging nutrigenomics research suggests that genetic and microbiome-related factors may modulate oxalate handling and the impact of specific dietary patterns, although this has not yet translated into routine clinical testing.

Animal protein, sodium, and metabolic context

High intake of animal protein is consistently associated with increased stone risk, largely through increased urinary calcium and uric acid, decreased urinary citrate, and acid load–

induced changes in urinary pH[7,10]. Dietary sodium is likewise a major determinant of urinary calcium excretion, with higher sodium intake promoting calciuria and thereby increasing the risk of calcium-based stones, particularly in individuals with other risk factors such as hypercalciuria, hypertension, or obesity[13]. Meta-analytic and umbrella-review data now support dietary sodium as a suggestive causal risk factor for nephrolithiasis, while also reinforcing its broader role in cardiovascular and renal disease, which strengthens the rationale for sodium restriction in stone formers. Obesity and metabolic syndrome further amplify these dietary effects, as they are associated with hyperuricosuria, lower urinary pH, insulin resistance, and systemic inflammation, all of which favor stone formation.[8,15]. Lifestyle-based interventions that combine weight reduction, increased physical activity, reduced sodium intake, and moderation of animal protein may therefore yield synergistic benefits for both stone prevention and cardiometabolic risk reduction[9]. Clinicians should explicitly address high-protein diets (including some popular weight-loss regimens) and high-sodium processed foods with stone-forming patients, framing changes as part of overall cardiovascular and metabolic risk management rather than as isolated "stone diets."

Fruits, vegetables, dietary patterns, and the DASH/Mediterranean model

Higher intake of fruits and vegetables is associated with lower stone risk, largely via increased alkali load, improved acid–base balance, higher urinary citrate and potassium, and beneficial effects on metabolic parameters. Dietary pattern analyses indicate that a DASH-like diet—rich in fruits, vegetables, nuts, legumes, low-fat dairy, and whole grains, and relatively low in sodium and red/processed meat—is associated with a substantially reduced risk of incident nephrolithiasis. Case–control and cohort data also suggest that better adherence to a Mediterranean diet, characterized by high consumption of plant foods, olive oil, moderate fish and poultry, and low red meat and processed food intake, is associated with lower metabolic risk and may reduce susceptibility to nephrolithiasis[16]. These findings support moving beyond single-nutrient advice toward pattern-based recommendations that are easier for patients to implement and align with general cardiovascular and metabolic guidelines. In practice, many patients can be counseled to adopt a DASH- or Mediterranean-like eating pattern, adjusted for their individual comorbidities and cultural preferences, while layering on stone-specific advice such as avoiding very low-calcium diets and maintaining high fluid intake[9].

Guidelines, multidisciplinary care, and patient understanding

Clinical practice guidelines, including those from the American College of Physicians and contemporary urologic/nephrologic reviews, converge on a core set of dietary recommendations for recurrent calcium stone formers: increase fluid intake, maintain normal dietary calcium, limit sodium and animal protein, and individualize further restrictions based on stone composition and 24-hour urine findings[17]. A state-of-the-art review on multidisciplinary stone management further emphasizes that optimal prevention requires coordinated input from urologists, nephrologists, dietitians, and sometimes endocrinologists, particularly in patients with complex metabolic profiles or recurrent, refractory stone disease. Despite this, cross-sectional surveys suggest that public and patient understanding of stone-related dietary factors remains limited, with many patients overestimating the need for extreme restriction of certain foods while underestimating the importance of fluid intake and sodium reduction[18]. Moreover, methods for dietary assessment in kidney stone formers are heterogeneous and often suboptimal, complicating both research and individualized counseling in routine care. For clinicians, this underscores the need for clear, consistent, and realistic dietary messages, ideally supported by written materials or collaboration with dietitians who are familiar with stone-specific recommendations.

Nutrition, obesity, and urologic cancers

Obesity and metabolic syndrome have been increasingly implicated in the etiology of major urologic cancers, particularly kidney, bladder, and advanced prostate cancer[19]. Evidence from meta-analyses and evidence-mapping reviews indicates that excess body mass index (BMI) and central adiposity are associated with higher incidence of kidney and bladder cancer, with more modest and sometimes inconsistent associations for prostate cancer overall but stronger links for advanced disease stages[20]. An evidence mapping of systematic reviews reported relative risks of roughly 1.6–1.7 for kidney cancer and around 1.1 for bladder cancer in individuals with obesity compared with those of normal weight, while the association with prostate cancer incidence was weaker but still suggestive for aggressive phenotypes. A focused review on obesity and urologic cancers further highlighted that obesity confers an increased risk of approximately 20–80% for kidney cancer, 10–20% for bladder cancer, and 6–14% for advanced prostate cancer, consistent with the notion that adiposity-related mechanisms preferentially promote more aggressive disease. Mechanistically, obesity and metabolic syndrome are thought to act through chronic low-grade inflammation, insulin resistance, hyperinsulinemia, altered insulin-like growth factor (IGF) signaling, dysregulated sex hormone metabolism, and

adipokine imbalance, all of which may promote tumor initiation and progression in urologic tissues. From a public health perspective, these relationships are consistent with broader evidence that excess body fatness is a causal risk factor for several obesity-related cancers, including renal and advanced prostate cancer, and that a substantial proportion of cases could theoretically be prevented by maintaining a healthy body weight[21]. The emerging concept of early-onset cancers in younger adults further reinforces concern that obesogenic environments and dietary patterns may contribute to shifting incidence patterns in urologic malignancies, although specific data for younger-onset urologic cancers remain relatively limited[22].

Dietary patterns, food groups, and urologic cancer risk

Beyond body weight alone, dietary composition and overall dietary patterns appear to influence urologic cancer risk, although the strength of evidence varies by tumor type and specific exposures. A recent systematic review and meta-analysis of prospective studies examining food groups and urologic cancers reported that higher intake of fruits and vegetables was generally associated with modestly lower risk of several urologic malignancies, whereas high consumption of red and processed meat, and possibly dairy fat, tended to be associated with higher risk, although heterogeneity across studies was substantial[5]. An earlier narrative review on the impact of nutrition in urogenital cancers similarly concluded that plant-based diets rich in antioxidants, fiber, and phytochemicals may convey protective effects, whereas Western dietary patterns characterized by high energy density, animal fat, and refined carbohydrates may increase risk, particularly for kidney and prostate cancer. Dietary glycemic index and glycemic load have also been investigated, with updated meta-analytic data suggesting that diets with higher glycemic index may be associated with small but statistically significant increases in bladder and kidney cancer risk, though results for prostate cancer are less consistent. These findings are biologically plausible given that high-glycemic diets can exacerbate insulin resistance and hyperinsulinemia, thereby potentially amplifying the IGF axis and downstream proliferative signaling in susceptible tissues. In addition to individual nutrients and food groups, adherence to broader cancer-prevention dietary guidelines—such as those from the World Cancer Research Fund/American Institute for Cancer Research—has been associated with lower risk of total and obesity-related cancers, including kidney and bladder cancer, in large pooled analyses of cohort studies. Although most guideline-focused analyses aggregate multiple cancer sites, their findings support a pattern of moderate energy intake, high consumption of plant foods, limited red and processed meat, and restricted alcohol and sugar-

sweetened beverages as a rational approach to lowering urologic cancer risk alongside other malignancies.

Practical implications for prevention and clinical care

For clinicians, the central implication of this literature is that nutrition and weight management should be considered fundamental components of urologic cancer prevention, especially for kidney and bladder cancer, where the evidence linking obesity and lifestyle factors to risk is strongest[19]. Counseling should prioritize maintenance of a healthy body weight, increased physical activity, and adoption of dietary patterns consistent with cancer-prevention guidelines—namely, plant-forward diets rich in fruits, vegetables, and whole grains, with limited red and processed meat, refined carbohydrates, and sugar-sweetened beverages[23]. In patients already diagnosed with urologic malignancies, nutritional interventions should be framed primarily around cardiometabolic risk reduction, preservation of muscle mass and function, and management of treatment-related adverse effects, while acknowledging that evidence for direct anti-cancer effects of specific diets is still limited and evolving. Given the complexity of obesity-related mechanisms and the heterogeneity of available data, individualized counseling—ideally supported by dietitians and integrated into multidisciplinary urologic oncology clinics—offers the most pragmatic path to incorporating nutrition into comprehensive cancer care[9].

Practical dietary counselling for everyday practice

In clinical practice, dietary counselling for patients with urological diseases should be framed not as a narrow, organ-specific intervention, but as part of integrated cardiometabolic risk reduction and long-term health promotion. A unifying approach is to recommend eating patterns that are broadly consistent with cardiovascular and cancer-prevention guidelines—namely, plant-forward diets rich in fruits, vegetables, whole grains, legumes, and nuts, with limited intake of red and processed meat, refined carbohydrates, and sugar-sweetened beverages. Within this framework, stone formers and patients at risk of urologic cancers can receive tailored advice that modifies specific components—such as fluid intake targets, sodium restriction, or calcium/oxalate handling—without abandoning an overall healthy dietary pattern. Because many patients with urological disease are older, polymorbid, and on complex medication regimens, nutrition counselling should always consider comorbid conditions such as heart failure, chronic kidney disease, diabetes, and frailty when setting fluid and nutrient targets. For patients with a history of calcium nephrolithiasis, counselling should start with

a clear**,** prioritized message: increase fluid intake to achieve a urine volume of at least 2–2.5 liters per day, unless contraindicated. Patients should be advised to distribute fluid intake throughout the day and evening, choose water as the primary beverage, and use adjunctive beverages such as coffee, tea, and citrus juices judiciously, while avoiding or minimizing sugar-sweetened soft drinks[10]. For most calcium stone formers, clinicians should explicitly discourage very low-calcium diets and instead recommend a normal dietary calcium intake (around 1,000–1,200 mg/day) from food sources, ideally consumed with meals to bind intestinal oxalate. Calcium and vitamin D supplements require individualized assessment: they may be necessary for osteoporosis or other indications but should be used cautiously in recurrent stone formers, preferably with monitoring of urinary calcium and, when possible, taken with meals. Patients with suspected or documented hyperoxaluria should receive specific counselling to reduce very high-oxalate foods (e.g., large quantities of spinach, nuts, rhubarb) while avoiding overly restrictive, long-term elimination diets and pairing moderate oxalate intake with sufficient dietary calcium[11]. Counselling on sodium and animal protein should be concrete: reducing processed foods, limiting added salt, and moderating portions of red and processed meat while encouraging plant-based protein sources (legumes, nuts, seeds) and fish where appropriate. For many patients, it is more practical to frame this as a shift toward a DASH-like or Mediterranean-like pattern—high in fruits, vegetables, whole grains, and low-fat dairy, with limited sodium and red meat—rather than as a list of isolated prohibitions. A 24-hour urine evaluation, when available, provides an opportunity to personalize counselling by linking specific abnormalities (e.g., hypercalciuria, hyperoxaluria, low citrate, low volume) to tailored dietary advice, which can improve patient understanding and adherence. Whenever possible, referral to a dietitian familiar with stone-specific recommendations can help translate these principles into culturally appropriate, sustainable eating plans and address common misconceptions identified in population surveys[9,18,24].

For individuals at increased risk of urologic cancers—such as those with obesity, metabolic syndrome, or a family history of kidney, bladder, or prostate cancer—dietary counselling should prioritize weight management and adherence to evidence-based cancer-prevention guidelines[19]. Clinicians can recommend a predominantly plant-based dietary pattern with high consumption of vegetables, fruits, whole grains, and legumes; limited intake of red and processed meats; and restriction of alcohol and sugar-sweetened beverages, consistent with global cancer-prevention frameworks. While the strength of evidence for specific food groups varies by tumor type, meta-analytic data suggest that higher fruit and vegetable intake and lower intake of processed and red meats may modestly reduce risk for kidney and bladder cancers and

possibly aggressive prostate cancer, aligning urologic prevention with broader oncologic advice[5]. In patients already diagnosed with urologic malignancies, particularly those receiving androgen-deprivation therapy or systemic treatments, dietary counselling should emphasize cardiometabolic risk reduction, maintenance of lean body mass, and management of treatment-related metabolic and skeletal complications. A Mediterranean-style pattern rich in extra-virgin olive oil, fish, nuts, and plant foods may be especially attractive in this setting, given its well-documented cardiometabolic benefits and emerging, though not yet definitive, associations with improved outcomes in some cancer populations. Where immunotherapy is used—for example, in urothelial or renal-cell carcinoma—patients may be informed that high-fiber, plant-forward diets and avoidance of unnecessary antibiotics have been associated with more favorable responses in observational studies, while acknowledging that interventional trials are still needed[25]. Because evidence for direct survival benefits of specific diets remains incomplete, clinicians should avoid overpromising anti-cancer effects and instead present dietary modification as a low-risk strategy with clear cardiometabolic and quality-of-life advantages and a plausible, but not yet fully proven, contribution to cancer outcomes.

Communication, behavior change, and implementation

Effective dietary counselling in urology is not only about what to recommend, but also how to communicate and implement changes in a way that patients can sustain[26]. Observational studies and surveys indicate that patients often misjudge the relative importance of different lifestyle factors—for example, overemphasizing specific "stone-forming foods" while underestimating the impact of global dietary patterns, sodium intake, and fluid volume[18]. Simple, prioritized messages (e.g., "your first goal is to drink enough to pass very light-colored urine," or "aim to fill half your plate with vegetables and whole grains at most meals") may be more effective than long lists of prohibited items, especially in older or multimorbid patients. Where available, written handouts, visual aids, or brief, structured dietitian visits can reinforce counselling and address some barriers related to health literacy, cultural dietary norms, and economic constraints[27]. Finally, embedding nutrition into multidisciplinary urology clinics—alongside urologists, nephrologists, oncologists, and primary care physicians—can normalize dietary discussion as part of standard care rather than an optional add-on, improving both uptake and continuity of lifestyle interventions over time.

Conclusion

Nutrition has emerged as a cross-cutting determinant in urology, with particularly strong evidence in nephrolithiasis and increasingly suggestive data in urologic oncology and functional disorders. Across the conditions reviewed, a consistent pattern is that plant-forward dietary habits, adequate hydration, moderation of sodium and animal protein, and maintenance of healthy body weight align stone prevention, cardiometabolic health, and reduction of obesity-related urologic cancer risk. For nephrolithiasis, this evidence is sufficient to justify considering dietary intervention—centered on fluid intake, normal dietary calcium, reduced sodium and animal protein, and plant-rich patterns—as first-line, guideline-supported therapy rather than an optional adjunct. In uro-oncology, data linking obesity and dietary patterns to incident kidney, bladder, and advanced prostate cancer risk are robust enough to support weight management and cancer-prevention dietary counselling, even though high-quality trials on survival and treatment response remain limited. Until more precise, mechanistically informed nutritional strategies are available, clinicians can rely on this shared evidence base to deliver simple, pattern-based dietary advice that is safe, broadly beneficial, and likely underused in routine urologic care.

Disclosure

Author's contribution: Conceptualization: Tomasz Kandefer; Methodology: Weronika Wasiniewska; Check: Tomasz Kandefer; Formal analysis: Weronika Wasiniewska; Investigation: Maria Izabela Sroka; Resources: Tomasz Kandefer; Data curation: : Marcin Barański; Writing -rough preparation: Weronika Wasiniewska; Writing -review and editing: Maria Izabela Sroka; Visualization: Maria Izabela Sroka; Supervision: Marcin Barański; Project administration: Marcin Barański;

Receiving funding: no specific funding

All authors have read and agreed with the published version of the manuscript.

Financing statement: This research received no external funding.

Institutional Review Board Statement Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflict of interest: The authors deny any conflict of interest.

Declaration of the use of generative AI and AI-assisted technologies in the writing process.

In preparing this work, the authors used Perplexity AI for the purpose of checking language accuracy. After using this tool, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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