

# Contemporary Care Patterns in the Management of Small Renal Masses

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**K**idney cancer accounted for approximately 4% of all new cancer cases in the United States in 2019, and the incidence has been rising for the past 3 decades.<sup>1</sup> In parallel with the increase in cross-sectional abdominal imaging, renal masses are increasingly diagnosed when they are small, localized, and asymptomatic.<sup>2</sup> The rising incidence of small renal masses (SRMs) is reflected in the downward stage migration of renal cell carcinoma.<sup>3-5</sup> Earlier detection results in a substantial proportion of benign lesions or indolent cancers found on resection.<sup>6</sup> Overdiagnosis and overtreatment of clinically indolent SRMs is now an important problem on both the individual and population levels.<sup>7,8</sup> Because most patients with an SRM are older and have preexisting comorbidities, the associated perioperative and late adverse consequences of treatment may affect their health and well-being.<sup>9</sup>

Currently, there are several published guidelines for the initial work-up and management of SRMs,<sup>10-12</sup> offering recommendations on urology referral, initial work-up and staging, selection of therapy, and follow-up (**eAppendix Figure** [available at [ajmc.com](https://ajmc.com)]). Among the options for initial management, active surveillance has emerged as a viable strategy to reduce overtreatment of benign masses and cancers with low malignant potential. However, specific recommendations to guide candidate selection and imaging modality and frequency are lacking.<sup>11</sup> Additionally, frequency of active surveillance as a management strategy varies institutionally, with reports ranging from 2% to 45%.<sup>13,14</sup> Renal mass biopsy (RMB) has also garnered recent interest as a method to risk-stratify patients and attempt to reduce the frequency of overtreatment. However, reports of limited diagnostic sensitivity raise concern for the utility of RMB, and it remains infrequently used (< 10% of all SRMs).<sup>15,16</sup>

A better understanding of the patterns of care after a radiologic diagnosis is necessary to design and implement systems-level reductions in the delivery of low-value care. To this end, we undertook an analysis of patterns of care associated with newly diagnosed SRMs within an integrated health care system in southern California.

## ABSTRACT

**OBJECTIVES:** Incidental small renal masses (SRMs) now account for the majority of new diagnoses of renal cancers. Although there are established management guidelines, referral and management patterns can vary. We aimed to explore identification, practice patterns, and management of identified SRMs in an integrated health system.

**STUDY DESIGN:** Retrospective analysis.

**METHODS:** We identified patients with a newly diagnosed SRM measuring 3 cm or less from January 1, 2013, to December 31, 2017, at Kaiser Permanente Southern California. These patients were flagged at the time of radiographic identification to ensure adequate notification of findings. Diagnostic modality, referral, and treatment patterns were analyzed.

**RESULTS:** Of 519 patients with SRMs, 65% were found on abdominal CT and 22% on renal/abdominal ultrasounds. Within 6 months, 70% of patients consulted with a urologist. Initial management patterns were as follows: active surveillance (60%), partial/radical nephrectomy (18%), and ablation (4%). Among 312 patients on surveillance, 14% eventually received treatment. The majority of patients (69.4%) did not receive guideline-recommended chest imaging for initial staging. Urologist visit within 6 months of SRM diagnosis was associated with increased adherence to staging ( $P = .003$ ) and subsequent surveillance imaging ( $P < .001$ ).

**CONCLUSIONS:** In this contemporary analysis of an integrated health system's experience, referral to a urologist was associated with guideline-concordant staging and surveillance imaging. Frequent utilization of active surveillance with a low rate of progression to active treatment was noted in both groups. These findings shed light on care patterns upstream of urologic evaluation and support the need for clinical pathways to be implemented at the time of radiologic diagnosis.

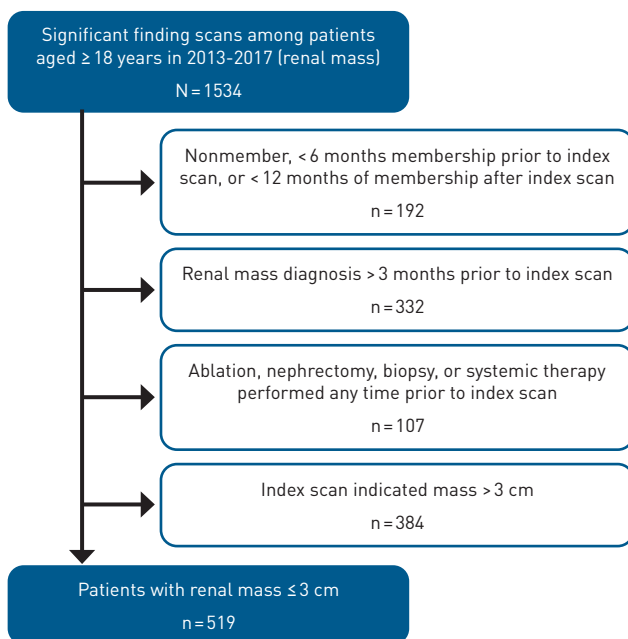
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## TAKEAWAY POINTS

In an integrated health system, early urologist referral of patients with newly identified small renal masses was associated with improved guideline-concordant staging and surveillance imaging.

- ▶ Seventy percent of patients saw a urologist within 6 months of renal mass diagnosis.
- ▶ Patients who saw a urologist were more likely to undergo guideline-recommended chest imaging within 6 months of diagnosis.
- ▶ Sixty percent of patients underwent initial active surveillance, although a urologist visit within 6 months was associated with improved guideline-concordant surveillance imaging.

FIGURE 1. Identification of Study Population



## METHODS

## Study Design

We performed a retrospective observational cohort study to describe care patterns in the management of SRMs, defined as renal masses measuring 3 cm or less, using clinical data from electronic health records. The study was approved by the Kaiser Permanente Southern California (KPSC) Institutional Review Board and a waiver of informed consent was obtained.

## Setting and Patient Identification

KPSC is a large, integrated health care system and insures more than 4.6 million Kaiser Permanente (KP) health plan members. The KPSC population is sociodemographically diverse and largely representative of the general population of southern California.<sup>17</sup> KPSC members receive care from primary care and specialty physicians

at 15 hospitals and more than 200 medical offices throughout southern California. KP HealthConnect, a comprehensive electronic health record system, was fully implemented throughout KPSC by 2007. We identified renal masses and cysts using the significant findings tool, an electronic tool implemented by diagnostic imaging departments systemwide in 2013 to flag significant findings noted on imaging tests that require subsequent follow-up. The tool was embedded in the Radiology

Picture Archiving and Communication System environment and required a simple right mouse click to activate a pop-up window that contained distinct checkboxes for renal cysts and masses, pulmonary nodules, and abdominal aortic aneurysms. Solid renal masses were flagged by interpreting radiologists by checking 1 of 2 boxes based on size ( $\leq 3$  cm or  $> 3$  cm).

## Study Population

We identified eligible scans between January 1, 2013, and December 31, 2017, with small, solid renal masses of 3 cm or less using the significant findings tool described above. We excluded patients who did not have KP membership, had less than 6 months of membership prior to their index scan date, or had less than 12 months of membership after their index scan date. Patients who had a prior renal mass or cyst diagnosis more than 3 months prior to their index scan date or had ablation, nephrectomy, biopsy, or systemic therapy performed any time before their index scan date were also excluded (Figure 1).

## Data Sources

All data were obtained through the KPSC Research Data Warehouse, which includes linked files for membership, demographic characteristics, laboratory tests, diagnostic imaging, pathology, and health care utilization data from both ambulatory visits and hospitalizations.

## Variables and Outcomes

Sociodemographic variables included age, sex, race/ethnicity, insurance type, educational level, and household income. Information about education and income was geocoded at the level of Census block (when available) or block group. Clinical variables such as self-reported smoking behavior were obtained from clinical encounters closest in time to the index scan date.

Procedures were captured using *International Classification of Diseases, Ninth Revision, Clinical Modification*; *International Classification of Diseases, Tenth Revision, Procedure Coding System*; and *Current Procedural Terminology (CPT)* procedure codes. We supplemented our list of standardized codes with KP-internal codes. Procedures of interest included a renal mass biopsy, partial or radical nephrectomy, tumor ablation, additional surveillance scans, chest x-rays, and chest CT scans. Surveillance was defined as undergoing dedicated abdominal imaging within 12 months of initial SRM diagnosis. The full list of codes can be found in the eAppendix.

## Statistical Analysis

Patient characteristics were summarized using means, SDs, frequencies, and percentages. Where appropriate, comparisons of patient characteristics and/or care patterns among various subgroups were made using either *t* tests of Wilcoxon rank-sum tests for continuous variables or  $\chi^2$  or Fisher exact tests for categorical variables.

To ascertain treatment-free survival among those who did not undergo ablation or nephrectomy but had a surveillance scan performed within a year of their index date, we used Kaplan-Meier survival analysis. All statistical tests were 2-tailed and considered statistically significant if *P* was less than or equal to .05. Analyses were conducted using SAS Enterprise Guide 7.1 (SAS Institute Inc).

## RESULTS

### Baseline Characteristics

We identified a final cohort of 519 patients with a new diagnosis of a solid renal mass of 3 cm or less (Figure 1). Baseline characteristics are presented in **Table 1**, with demonstration of the expected older age (median, 63.9 years) and male sex predominance (55.5%) in the cohort. The majority of new renal mass diagnoses were made on abdominal CT (65%), followed by abdominal or renal ultrasound (22%), abdominal MRI (9%), chest CT (4%), and lumbar spine CT or MRI (1%).

Of the 519 patients with a newly diagnosed SRM, 365 (70.3%) were seen by a urologist within 6 months. Characteristics of patients stratified by urologist visit within 6 months are listed in **Table 2**. No significant differences in age, ethnicity, insurance status, or Charlson Comorbidity Index score were noted between groups. However, those seen by a urologist within 6 months of diagnosis were more likely to be men. Eleven patients who were not seen by a urologist had their imaging studies and chart reviewed by a urologist during an electronic “Doctor Advice” consultation.

### Treatment Patterns

Sixty percent of patients had their SRM managed initially with surveillance, 18.5% with partial/radical nephrectomy, 5% with biopsy, and 3.9% with ablation (Table 2). Patients who saw a urologist within 6 months of diagnosis were more likely to undergo surgery or ablation for their SRM (*P* < .001). Among patients seen by a urologist within 6 months, 23 (6.3%) underwent renal mass biopsy within 6 months of diagnosis, of whom 8 (34.7%) underwent ablation or surgery at a later date and 14 (60.1%) were managed with surveillance (**eAppendix Table 1**).

Treatment-free survival for patients initially on surveillance is depicted in **Figure 2**. Over the study period, 14% of patients who initially elected surveillance ultimately underwent definitive treatment (Figure 2 [A]). When stratified by urologist visit within 6 months, those who did see a urologist were more likely to undergo definitive treatment (Figure 2 [B]).

### Imaging Patterns

Only 30.6% of patients had chest imaging within 6 months after SRM diagnosis, but those who saw a urologist in that time period

**TABLE 1.** Cohort Demographics and Clinical Characteristics

Patient characteristics	Renal mass $\leq$ 3 cm (N = 519)
Age in years, mean (SD)	63.9 (13.1)
Male sex, n (%)	288 (55.5%)
Ethnicity, n (%)	
White	261 (50.3%)
Black	52 (10%)
Hispanic	155 (29.9%)
Asian/Pacific Islander	42 (8.1%)
Other/multiple/unknown	9 (1.7%)
Median household income in \$, geocoded, median (SD)	73,275.0 (32,596.7)
Marital status, partnered or married, n (%)	327 (63%)
Area households with education $\leq$ grade 12 (%), geocoded, mean (SD)	17.6 (14.0)
Insurance, n (%)	
Self/commercial	250 (48.2%)
Medi-Cal/Medicaid	24 (4.6%)
Medicare	245 (47.2%)
Smoking status (based on the last measure prior to the index date), n (%)	
Current	50 (9.6%)
Passive	2 (0.4%)
Quit	178 (34.3%)
Never	283 (54.5%)
Unknown	6 (1.2%)
Comorbidities	
CCI score (weighted), mean (SD)	1.8 (2.1)

CCI, Charlson Comorbidity Index.

were more likely to do so (34.5% vs 21.4%; *P* = .003) (**eAppendix Table 2**). Among 124 patients who received treatment with surgery or ablation, 49 (39.5%) had chest imaging. Of the 395 patients who did not receive treatment, 110 (27.8%) had chest imaging. Temporal imaging patterns are displayed in **Figure 3**, showing that a urologist visit within 6 months of diagnosis was associated with a higher rate of abdominal and chest surveillance imaging during follow-up. Compared with patients who had a urologist visit, a higher proportion of patients who did not have a urologist visit within 6 months received no chest imaging during the study period (64.9% vs 41.9%; *P* < .001). In the cohort at large, 38.6% of patients had surveillance abdominal imaging using the same modality (CT, ultrasound, or MRI), whereas 61.4% of patients had multimodal abdominal imaging follow-up.

## DISCUSSION

As the epidemiologic profile of kidney cancer has evolved over the past several decades, so too must our strategies for management. Incidental detection from widespread imaging accounts for the

**TABLE 2.** Clinical Characteristics Stratified by Initial Urology Evaluation

Patient characteristics	Urology evaluation: yes/no			P
	No urology encounter within 6 months of diagnosis (n = 154)	Urology encounter within 6 months of diagnosis (n = 365)	Total (N = 519)	
Age in years, mean (SD)	63.3 (15.0)	64.2 (12.2)	63.9 (13.1)	.751
Male sex, n (%)	69 (44.8%)	219 (60.0%)	288 (55.5%)	.002
Ethnicity, n (%)				.834
White	74 (48.1%)	187 (51.2%)	261 (50.3%)	
Black	16 (10.4%)	36 (9.9%)	52 (10.0%)	
Hispanic	46 (29.9%)	109 (29.9%)	155 (29.9%)	
Asian/Pacific Islander	14 (9.1%)	28 (7.7%)	42 (8.1%)	
Other/multiple/unknown	4 (2.6%)	5 (1.4%)	9 (1.7%)	
Insurance, n (%)				
Self-pay/commercial	75 (48.7%)	175 (47.9%)	250 (48.2%)	.875
Medi-Cal/Medicaid	8 (5.2%)	16 (4.4%)	24 (4.6%)	.688
Medicare	71 (46.1%)	174 (47.7%)	245 (47.2%)	.744
CCI score (weighted), mean (SD)	1.9 (2.3)	1.8 (2.0)	1.8 (2.1)	.807
Initial management, n (%)				<.001
Biopsy	3 (2.0%)	23 (6.3%)	26 (5%)	
Ablation	0 (0%)	20 (5.5%)	20 (3.9%)	
Surgery	0 (0%)	96 (26.3%)	96 (18.5%)	
Surveillance	106 (68.8%)	206 (56.4%)	312 (60.1%)	
None	45 (29.2%)	20 (5.5%)	65 (12.5%)	
Final management, n (%)				<.001
Ablation	2 (1.3%)	39 (10.7%)	41 (7.9%)	
Surgery	3 (2.0%)	129 (35.3%)	132 (25.4%)	
Surveillance	122 (79.2%)	187 (51.2%)	309 (59.5%)	
None	27 (17.5%)	10 (2.7%)	37 (7.1%)	

CCI, Charlson Comorbidity Index.

majority of new diagnoses. The pattern of diagnosis has led to a stage migration to smaller, more localized disease.<sup>3-5</sup> The practice patterns of the urologic community are well documented. However, patterns further upstream at the time of the radiologic diagnosis are less well understood, as the initial imaging is often performed by other providers in the community setting. We set out to better define the downstream practice patterns after radiologic identification.

In our study population, lesions were initially identified on a variety of imaging modalities. The majority were found on either abdominal cross-sectional imaging (CT or MRI) or ultrasound, which may have been performed for symptoms of abdominal pain or renal dysfunction. However, some SRMs were identified on chest and spine imaging, suggesting at minimum a 5% rate of incidental disease in this cohort, although other studies would suggest that this rate is substantially higher.<sup>18</sup>

After initial diagnosis, up to 30% of patients were not seen by a urologist within 6 months of diagnosis. Published guidelines suggest referral to the urology community as an important first

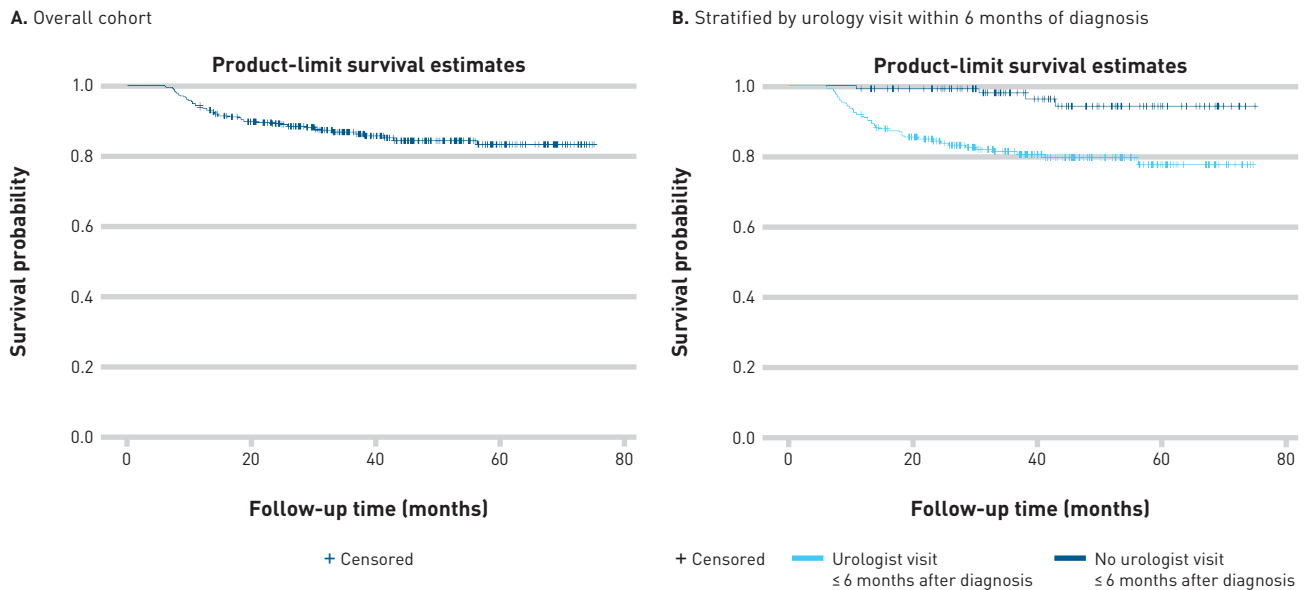
step in the management of SRMs in order to lead the discussion of management options.<sup>10,11</sup> By not receiving a timely referral to a urologist, patients may not have appropriate counseling and management after initial diagnosis, possibly leading to undertreatment of disease. Indeed, only a small fraction of patients who did not receive initial urologist referral ultimately underwent definitive treatment, despite no difference in age or comorbidity index. It is impossible to know whether active treatment would have been recommended for these patients. Although internal practice guidelines at KPSC do recommend a urologist referral after the diagnosis of a renal mass, a mechanism for informal electronic consultant advice known as “Doctor Advice” accounted for 7% of uncaptured urologist input. In addition, patients with life-limiting comorbid conditions may choose to forego referral and subsequent evaluation.

After diagnosis, consistency with guidelines for metastatic work-up was also limited. The American Urologic Association (AUA) recommends chest imaging after diagnosis of any renal mass suspicious for malignancy.<sup>10</sup> Despite this, nearly 70% of patients did not undergo any form of chest imaging within 6 months of identification. Among those who did, 27% underwent chest CT scan with no prior chest x-ray. As the risk of metastasis on presentation is low with renal masses of 3 cm or less,<sup>19,20</sup> the AUA recommends CT scan only for patients with pulmonary symptoms, abnormal x-rays, or high-risk disease. Thus,

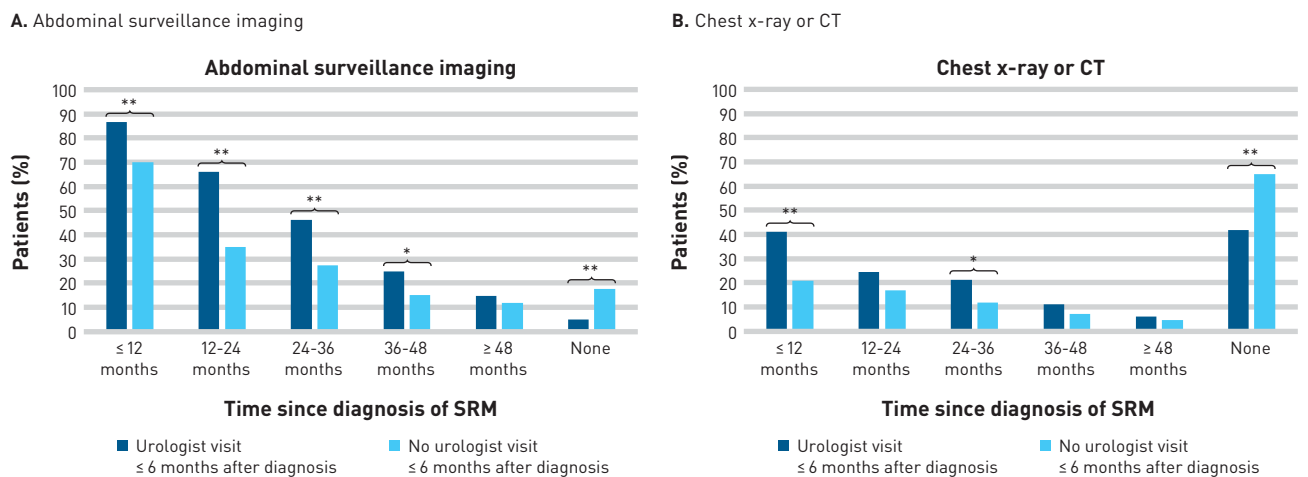
the high frequency of CT rather than chest x-ray utilization may indicate unnecessary cost and radiation exposure. Adherence with chest imaging guidelines was better among patients who saw a urologist within 6 months of diagnosis. Although follow-up chest imaging after initial diagnosis is also recommended, the diagnostic utility may be limited, especially among patients on surveillance.<sup>21</sup> The observed low rate of follow-up chest imaging may be reflective of a perceived low yield. It is also possible that some chest imaging studies (including CT) were performed for another indication during the follow-up period as well.

The frequency of RMB as an initial management strategy in this cohort was 5% overall and 6.3% among patients who had an initial visit with a urologist, similar to other population-based studies.<sup>22</sup> Among patients who were seen by a urologist, there was no significant difference in age or comorbid status between patients who did and did not undergo biopsy. Although this was a small subset of patients and the individual context for each case could not be captured, the final treatment patterns were no different between patients who

**FIGURE 2.** Treatment-Free Survival Among Patients Who Were Initially Managed With Active Surveillance (A) From the Overall Cohort and (B) Stratified by Urology Visit Within 6 Months of Diagnosis



**FIGURE 3.** Comparison of the Number of Patients Receiving (A) Abdominal and (B) Chest Imaging Between Subgroups Who Did and Did Not Have a Urologist Visit Within 6 Months of Initial Diagnosis



SRM, small renal mass.

\* $P \leq .01$ ; \*\* $P \leq .001$ .

did and did not undergo biopsy, suggesting that RMB had limited impact on management selection in this cohort.

Analysis of our large contemporary cohort demonstrated frequent use of surveillance. The low rate of conversion to definitive treatment (14%) is consistent with other series in which surveillance strategies

have been studied.<sup>14</sup> The viability of active surveillance for SRMs has been established through institutional cohort series. Pierorazio et al investigated clinical outcomes of 223 patients who elected active surveillance for SRMs.<sup>14</sup> In 5 years of follow-up, cancer-specific survival was comparable with that among those who elected primary

intervention (99% vs 100%), and only 9% of patients crossed over to delayed intervention. However, on a national level, surveillance utilization appears limited. Daskivich et al reviewed nearly 10,000 patients older than 65 years who received a diagnosis of clinical T1a kidney cancer between 2000 and 2010 who were identified in the Surveillance, Epidemiology, and End Results–Medicare national database.<sup>13</sup> They found that surveillance remained underutilized compared with surgery or ablation, with only 10% to 21% of patients aged 65 to 80 years surveilled. Additionally, although use of surveillance appeared to increase with increasing patient age, utilization appeared more sensitive to age than to comorbid status.<sup>23</sup> In this study, the patients who underwent surveillance without referral to a urologist were no different in terms of age or comorbid status compared with those who were referred, suggesting that surveillance was implemented regardless of candidacy for definitive treatment or associated prognosis.

### Limitations

This study has several limitations. First, cohort identification was based on a retrospective analysis of cases identified using the significant findings tool, which required active flagging of renal masses by radiologists in addition to clinical interpretation of the study. Thus, any newly diagnosed renal masses that were not flagged at the time of study interpretation were left out of the cohort. Second, the capturing of radiology encounters did not include indications for imaging, and therefore inferences were made as to whether the studies were performed for surveillance or metastatic work-up based only on the CPT code. Finally, clinical outcomes as they relate to a urologist referral were not captured. Although assessment of outcomes ultimately has strong implications for the appropriate utilization of resources in the initial SRM diagnosis setting, this was beyond the scope of the current study and would require longitudinal follow-up and more detailed characterization of patient characteristics and disease states. Despite these limitations, this study allows us to characterize longitudinal patterns of care in a large contemporary cohort of patients in an integrated health system and identify patterns of care over a 2- to 4-year period beginning at the time of radiologic diagnosis.

### CONCLUSIONS

In this analysis of a contemporary cohort of patients with newly diagnosed SRMs in an integrated health system setting, there were significant differences seen in guideline-compliant imaging for metastatic evaluation and treatment patterns between patients who did and did not receive a referral to a urologist within 6 months of diagnosis. As expected, surgical or ablative definitive local treatment was significantly more common among those with urology referral, but frequent utilization of active surveillance with a low rate of progression to active treatment was noted in both groups. These findings shed light on care patterns upstream of urologic evaluation and support the need for clinical pathways to be implemented at the time of radiologic diagnosis. ■

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**eAppendix Table 1.** Cohort characteristics and treatment selection of patients who saw a urologist within 6 months of diagnosis, stratified by biopsy.

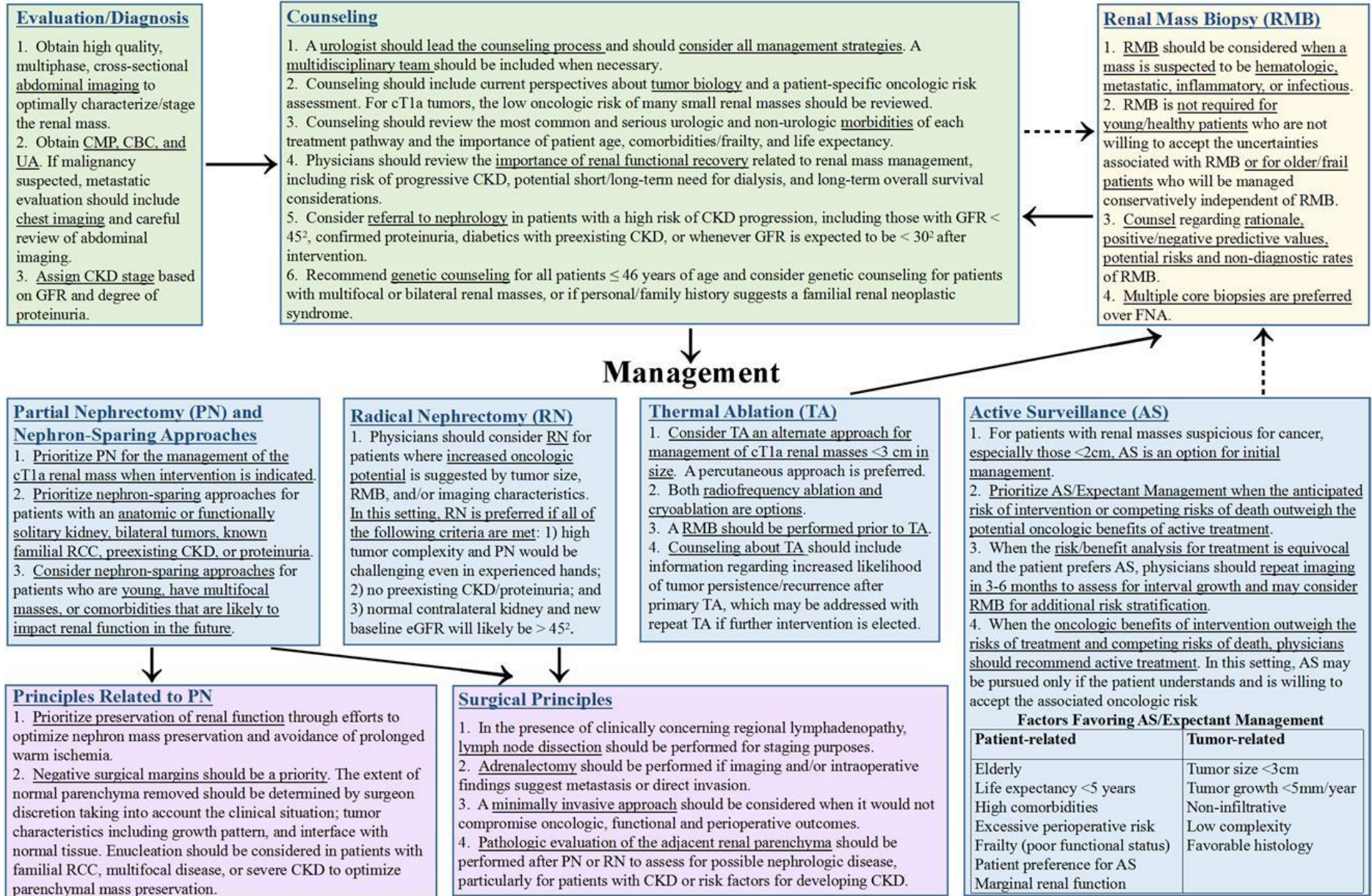
<b>Patient Characteristics</b>	<b>Biopsy within 6 months of index date</b>			
	<b>No (N=342)</b>	<b>Yes (N=23)</b>	<b>Total (N=365)</b>	<b>p-value</b>
<b>Demographics</b>				
Age, years	64.0 (12.4)	67.5 (8.4)	64.2 (12.2)	0.192
Charlson’s comorbidity Index (weighted)	1.8 (2.0)	2.1 (2.0)	1.8 (2.0)	0.328
Treatment (within 6 months of index date)				0.148
Surgery	96 (28.1%)	4 (17.4%)	100 (27.4%)	
Ablation	20 (5.8%)	4 (17.4%)	24 (6.6%)	
Surveillance	206 (60.2%)	14 (60.9%)	220 (60.3%)	
None	20 (5.8%)	1 (4.3%)	21 (5.8%)	

**eAppendix Table 2.** Frequency of chest imaging within 6 months of radiologic SRM diagnosis, stratified by urology visit.

<b>Chest imaging within 6 months of index date</b>	<b>All patients (N=519)</b>	<b>No urology enc. within 6 months of index date (N=154)</b>	<b>Urology enc. within 6 months of index date (N=365)</b>
Chest x-ray	107 (20.6%)	16 (10.4%)	91 (24.9%)
Chest CT	40 (7.7%)	12 (7.8%)	28 (7.7%)
Both	12 (2.3%)	5 (3.2%)	7 (1.9%)
Neither	360 (69.4%)	121 (78.6%)	239 (65.5%)



## Renal Mass and Localized Renal Cancer<sup>1</sup>



1. Focus is on clinically localized renal masses suspicious for RCC in adults, including solid enhanced tumors and Bosniak 3 and 4 complex cystic lesions. 2. ml/min/1.73m<sup>2</sup>.