Supplemental Material

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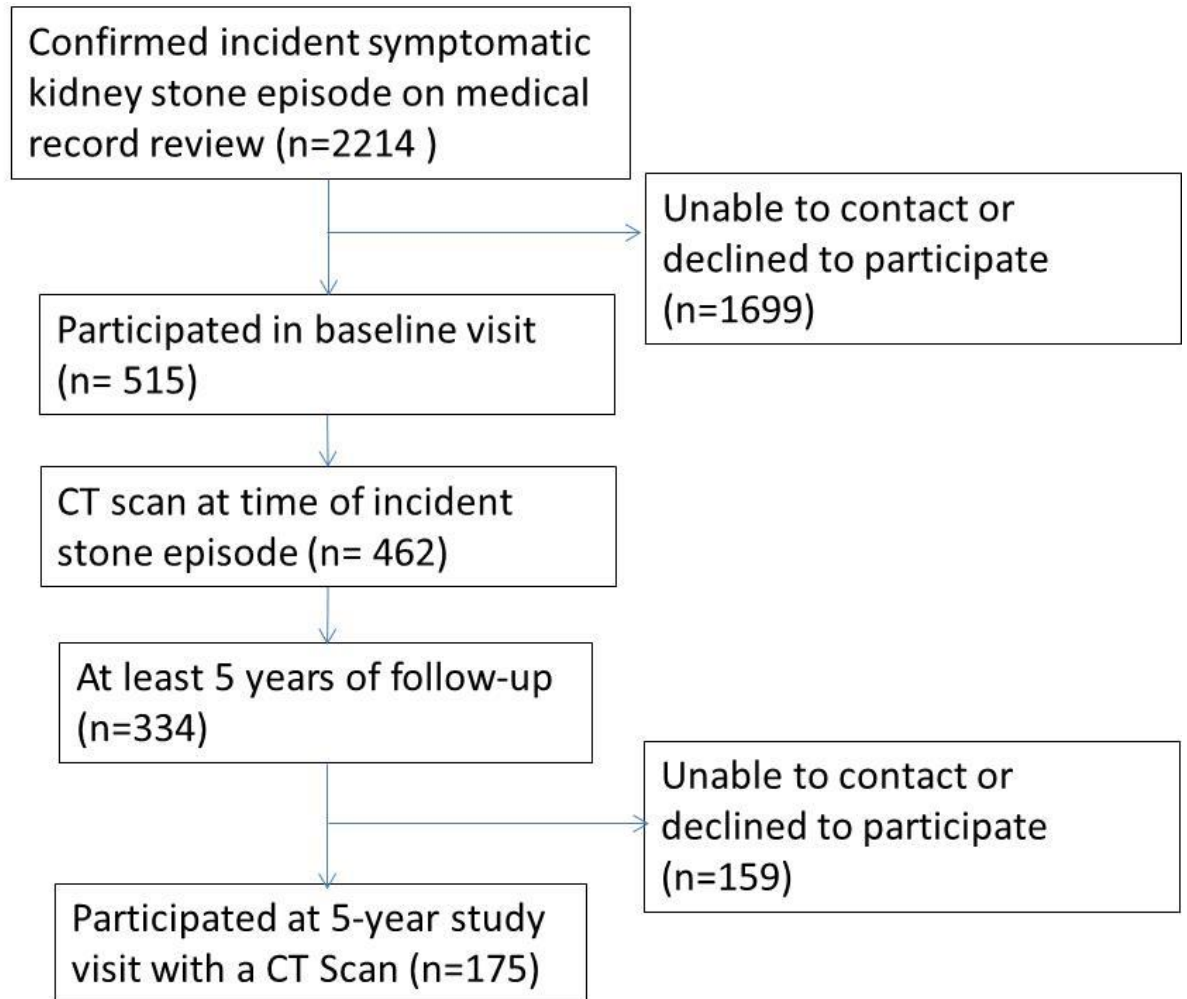
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┌─────────────────────────────────┐
│ Confirmed incident symptomatic  │
│ kidney stone episode on medical │ ──────────────┐
│ record review (n=2214 )         │               │
└─────────────────────────────────┘               ▼
                 │                      ┌──────────────────────────┐
                 │                      │ Unable to contact or     │
                 ▼                      │ declined to participate  │
     ┌─────────────────────────────┐   │ (n=1699)                 │
     │ Participated in baseline    │   └──────────────────────────┘
     │ visit (n= 515)              │
     └─────────────────────────────┘
                 │
                 ▼
     ┌─────────────────────────────┐
     │ CT scan at time of incident │
     │ stone episode (n= 462)      │
     └─────────────────────────────┘
                 │
                 ▼
     ┌─────────────────────────────┐
     │ At least 5 years of         │
     │ follow-up (n=334)           │ ──────────┐
     └─────────────────────────────┘           │
                 │                              ▼
                 │                 ┌──────────────────────────┐
                 │                 │ Unable to contact or     │
                 ▼                 │ declined to participate  │
     ┌─────────────────────────────┐   │ (n=159)              │
     │ Participated at 5-year      │   └──────────────────────────┘
     │ study visit with a CT Scan  │
     │ (n=175)                     │
     └─────────────────────────────┘
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Supplemental Figure 1. Prospective cohort of incident stone formers

Supplemental Table 1. Baseline characteristics of incident symptomatic kidney stone formers in the prospective cohort for this study compared to the historical cohort used to developed the ROKS model.

Baseline characteristics	Prospective Cohort (2009-2017) N = 175	ROKS Cohort[1] (1984-2017) N = 3364	p-value
	N (%) or Mean +/-SD	*N (%) or Mean +/-SD*	
Age (years)	49.6 ± 14	43.9 ± 15.3	<0.001
Male	93 (53.1%)	2045 (60.8%)	0.053
White	168 (96.0%)	2967 (93.9%)	0.25
Body mass index (kg/m^2)	30.5 ± 6.6	29.0 ± 6.6	0.003
Family History of stones	73 (41.7%)	790 (23.5%)	<0.001
Incidental stone on imaging prior to first confirmed episode	15 (8.6%)	180 (5.4%)	0.099
Suspected kidney stone prior to first confirmed stone	6 (3.4%)	205 (6.1%)	0.20
Any stone found to be uric acid, brushite or struvite	8 (4.6%)	115 (3.4%)	0.55
Any stone found to be calcium oxalate monohydrate	78 (44.6%)	1081 (32.1%)	0.001
Gross hematuria	50 (28.6%)	731 (21.7%)	0.042
Stone surgery during first episode	79 (45.1%)	1123 (33.4%)	0.002
Imaging obtained during first episode	175 (100%)	2984 (88.7%)	<0.001
Number of stones in both kidneys			0.002
0	78 (47.3%)	1381 (46.3%)	
1	28 (17.0%)	828 (27.7%)	
2+	59 (35.8%)	775 (26.0%)	
Diameter of largest kidney stone			<0.001
<3mm/no stones	119 (72.1%)	2599 (87.1%)	
3-6mm	29 (17.6%)	263 (8.8%)	
>6mm	17 (10.3%)	122 (4.1%)	
Any pelvic or lower pole kidney stone	27 (16.4%)	339 (11.4%)	0.13
Uterovesical junction stone	66 (40.0%)	1019 (34.1%)	0.38

Supplemental Table 2. Predicting symptomatic and radiographic recurrence over 5 years with the Recurrence of Kidney Stone (ROKS) 2014 score[2] in the full cohort and the subset with or without a baseline asymptomatic kidney stone.

Recurrence manifestation	Full cohort (N=175)			Baseline asymptomatic kidney stone (N=94)			No baseline asymptomatic kidney stone (N=81)		
	5-year Rate(%)	OR* (p-value)	C-Statistic (95% CI)	5-year Rate(%)	OR* (p-value)	C-Statistic (95% CI)	5-year Rate(%)	OR* (p-value)	C-Statistic (95% CI)
Symptomatic recurrence – Clinical care	19%	1.4 (0.067)	0.606 (0.500, 0.712)	24%	1.2 (0.62)	0.551 (0.404, 0.697)	14%	1.5 (0.40)	0.590 (0.402, 0.777)
Symptomatic recurrence – Self-reported	25%	1.8 (0.002)	0.656 (0.562, 0.749)	30%	1.7 (0.055)	0.625 (0.500, 0.751)	19%	2.3 (0.061)	0.651 (0.491, 0.810)
Any symptomatic recurrence	30%	1.9 (<0.001)	0.670 (0.582, 0.757)	38%	1.9 (0.027)	0.638 (0.519, 0.756)	21%	1.9 (0.12)	0.620 (0.470, 0.771)
New stone between CT imaging	35%	1.4 (0.038)	0.592 (0.503, 0.682)	45%	1.2 (0.46)	0.541 (0.422, 0.660)	23%	0.8 (0.50)	0.567 (0.415, 0.719)
Stone growth between CT imaging	24%	2.1 (<0.001)	0.692 (0.611, 0.773)						
Stone passage between CT imaging	27%	2.8 (<0.001)	0.777 (0.707, 847)						
Any radiographic recurrence on CT	59%	3.4 (<0.001)	0.770 (0.700, 0.840)						
Any symptomatic or radiographic recurrence	67%	3.2 (<0.001)	0.759 (0.686, 0.831)						

*OR per standard deviation of ROKS Score[2]

Supplemental Table 3. Prediction of different manifestations of kidney stone recurrence over 5 years by 24-hour urine chemistries (after adjustment for age, gender and urine creatinine) and by serum chemistries (after adjustment for age and gender).

Variable name	Symptomatic recurrence – Clinical care Odds Ratio (95% CI)	Symptomatic recurrence – Self-reported Odds Ratio (95% CI)	New stone between CT imaging Odds Ratio (95% CI)	Stone growth between CT imaging Odds Ratio (95% CI)	Stone passage between CT imaging Odds Ratio (95% CI)	Any symptomatic or radiographic recurrence Odds Ratio (95% CI)
Urine pH (per SD)	0.92 (0.61, 1.39)	0.98 (0.67, 1.43)	1.20 (0.85, 1.69)	0.98 (0.62, 1.54)	1.12 (0.71, 1.75)	1.11 (0.79, 1.57)
Urine volume (per SD)	0.89 (0.59, 1.36)	0.78 (0.52, 1.17)	0.97 (0.70, 1.35)	0.73 (0.46, 1.16)	1.03 (0.69, 1.55)	0.93 (0.67, 1.30)
Urine Osmolality (per SD)	1.12 (0.76, 1.65)	1.19 (0.84, 1.70)	1.03 (0.74, 1.43)	1.02 (0.66, 1.56)	0.70 (0.44, 1.07)	0.90 (0.65, 1.25)
Urine citrate (per SD)	0.99 (0.62, 1.57)	1.15 (0.75, 1.75)	1.06 (0.73, 1.56)	0.87 (0.52, 1.45)	1.26 (0.76, 2.09)	0.96 (0.65, 1.41)
Urine calcium (per SD)	0.98 (0.65, 1.49)	1.00 (0.68, 1.46)	1.26 (0.89, 1.78)	1.18 (0.76, 1.83)	1.29 (0.84, 2.00)	1.06 (0.74, 1.51)
Urine oxalate (per SD)	0.75 (0.41, 1.37)	0.66 (0.36, 1.20)	1.24 (0.83, 1.85)	0.65 (0.33, 1.28)	0.57 (0.27, 1.17)	0.79 (0.52, 1.18)
Urine uric acid (per SD)	1.40 (0.85, 2.31)	1.56 (0.97, 2.51)	1.18 (0.78, 1.78)	1.10 (0.61, 1.98)	0.93 (0.53, 1.65)	1.14 (0.75, 1.74)
Urine sodium (per SD)	1.21 (0.75, 1.96)	0.91 (0.56, 1.46)	1.43 (0.94, 2.18)	0.80 (0.46, 1.41)	1.04 (0.62, 1.76)	1.04 (0.67, 1.59)
Urine potassium (per SD)	0.67 (0.38, 1.17)	0.57 (0.33, 0.98)	1.42 (0.93, 2.17)	1.01 (0.55, 1.86)	0.68 (0.37, 1.26)	0.75 (0.49, 1.15)
Urine phosphate (per SD)	0.70 (0.37, 1.32)	0.77 (0.43, 1.39)	0.64 (0.37, 1.11)	1.57 (0.70, 3.54)	0.63 (0.29, 1.39)	0.54 (0.30, 0.96)
Urine chloride (per SD)	1.16 (0.73, 1.83)	0.84 (0.53, 1.34)	1.40 (0.93, 2.10)	0.77 (0.46 ,1.32)	0.99 (0.61, 1.60)	1.03 (0.68, 1.55)
Urine sulfate (per SD)	1.02 (0.70, 1.48)	0.85 (0.58, 1.24)	1.57 (1.14, 2.17)	0.92 (0.61, 1.39)	0.72 (0.47, 1.09)	1.04 (0.75, 1.43)
Urine magnesium (per SD)	1.11 (0.72, 1.69)	0.97 (0.64, 1.46)	1.12 (0.78, 1.60)	0.89 (0.54, 1.47)	1.35 (0.82, 2.21)	1.03 (0.72, 1.48)
Uric Acid SS (DG)*	1.12 (0.75, 1.68)	1.19 (0.82, 1.73)	0.80 (0.58, 1.09)	1.10 (0.73, 1.66)	0.88 (0.59, 1.32)	0.93 (0.74, 1.19)
CaOx SS (DG) (per SD)*	0.93 (0.65, 1.32)	0.81 (0.58, 1.12)	1.21 (0.90, 1.63)	1.20 (0.81, 1.78)	0.70 (0.47, 1.05)	0.81 (0.59, 1.10)
BR SS (DG) (per SD) *	0.95 (0.64, 1.41)	1.06 (0.73, 1.55)	1.00 (0.72, 1.38)	1.31 (0.83, 2.06)	1.35 (0.86, 2.10)	1.06 (0.76, 1.48)
Na urate SS (DG) (per SD)*	1.17 (0.76, 1.81)	1.34 (0.88, 2.03)	1.10 (0.78, 1.57)	1.09 (0.65, 1.82)	1.05 (0.63, 1.74)	1.09 (0.77, 1.54)
OH Apatite (DG) (per SD)*	0.95 (0.64, 1.41)	1.04 (0.72, 1.50)	1.13 (0.81, 1.57)	1.19 (0.77, 1.84)	1.23 (0.80, 1.88)	1.09 (0.78, 1.51)
Serum bicarbonate (mg/dL)	0.74 (0.47, 1.16)	0.79 (0.52, 1.18)	0.98 (0.68, 1.39)	0.99 (0.56, 1.64)	0.93 (0.57, 1.52)	0.89 (0.62, 1.28)
Serum calcium(mg/dL)	0.81 (0.54, 1.21)	1.01 (0.71, 1.45)	1.19 (0.86, 1.66)	1.18 (0.73, 1.89)	0.82 (0.51, 1.31)	1.06 (0.76, 1.48)
Serum phosphorous (mg/dL)	0.77 (0.40, 1.48)	0.81 (0.47, 1.37)	0.85 (0.57, 1.28)	1.22 (0.55, 2.73)	0.69 (0.29, 1.67)	0.81 (0.58, 1.13)
Serum uric Acid (mg/dL)	1.00 (0.64, 1.54)	0.91 (0.61, 1.36)	0.75 (0.52, 1.09)	1.05 (0.65, 1.69)	1.13 (0.70, 1.83)	0.99 (0.69, 1.41)

*Supersaturation (SS) delta Gibb's free energy (DG) was calculated using EQUIL2[3]

Supplemental Table 4. Comparison of 5-year recurrence rate between the Minnesota and Florida sites

Recurrence manifestation	Minnesota N=148	Florida N=27	p-value
Symptomatic – clinical care	18%	30%	0.15
Symptomatic – self-reported	22%	37%	0.10
Any symptomatic	27%	48%	0.028
Radiographic new stone	37%	26%	0.29
Radiographic stone growth	22%	33%	0.21
Radiographic stone passage	28%	26%	0.84
Any radiographic	60%	56%	0.70
Any symptomatic or radiographic	64%	82%	0.12

References

1. Vaughan, LE, Enders, FT, Lieske, JC, Pais, VM, Rivera, ME, Mehta, RA, Vrtiska, TJ, Rule, AD: Predictors of Symptomatic Kidney Stone Recurrence After the First and Subsequent Episodes. *Mayo Clinic Proceedings,* 94**:** 202-210, 2019.
2. Rule, AD, Lieske, JC, Li, X, Melton, LJ, 3rd, Krambeck, AE, Bergstralh, EJ: The ROKS nomogram for predicting a second symptomatic stone episode. *J Am Soc Nephrol,* 25**:** 2878-2886, 2014.
3. Werness, PG, Brown, CM, Smith, LH, Finlayson, B: Equil2: A Basic Computer Program for the Calculation of Urinary Saturation. *The Journal of Urology,* 134**:** 1242-1244, 1985.