

The background features a large, semi-transparent watermark of the NASA logo, which includes the word "NASA" in its characteristic font, a red chevron, and a blue circular field with white stars.

Screening and Management of Asymptomatic Renal Stones in Astronauts

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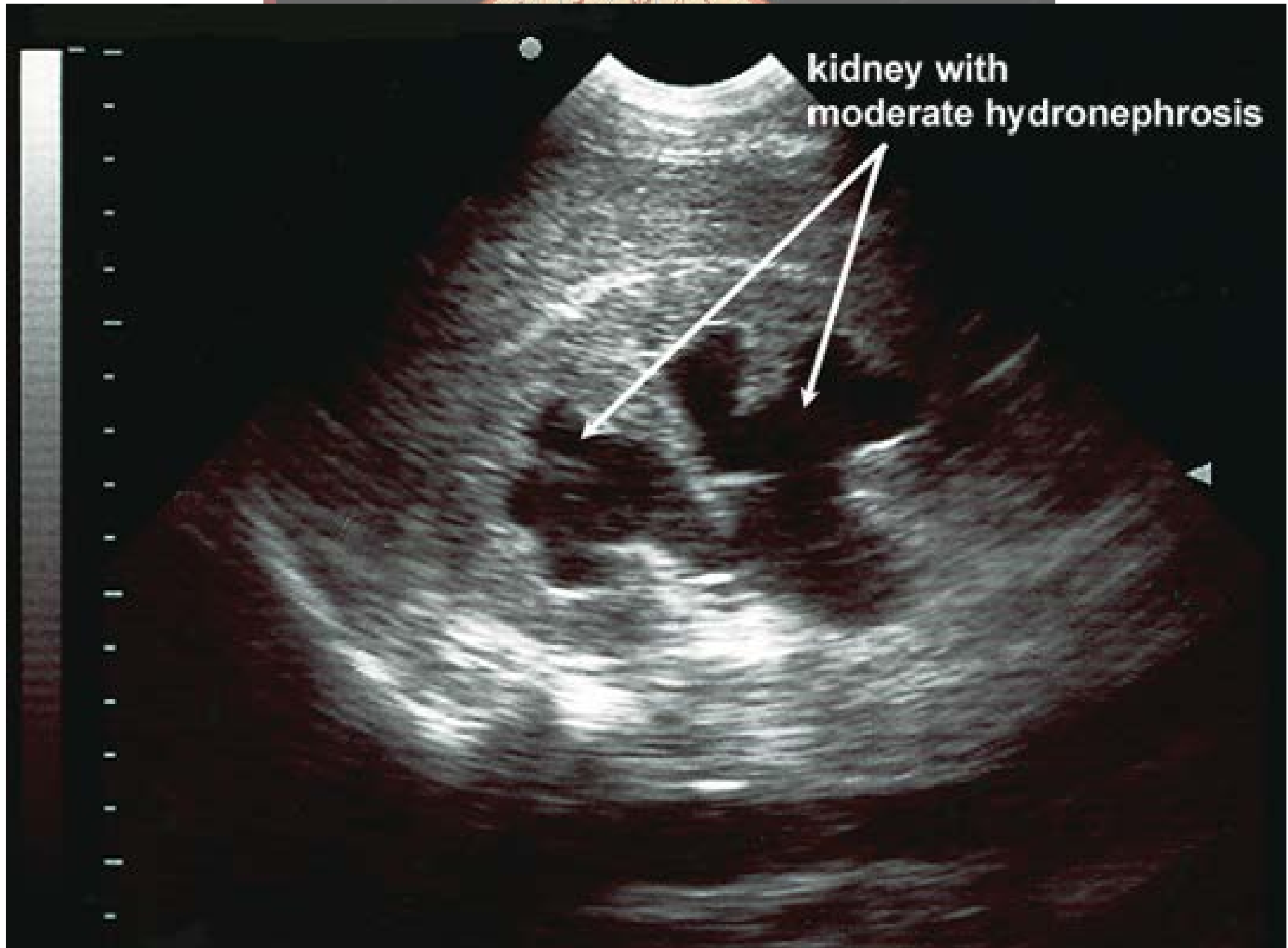
88th Annual Aerospace Medical Association Meeting, 2017 – Denver, Colorado

Disclaimer

- No off label uses
- No conflicts of interest

Overview

- Anatomy and pathology
- Epidemiology
- Screening
- Management
- Waiver



General Population

- Lifetime prevalence 10% male, 5% female
 - Increasing incidence (20 - 74 y.o.)
- 3.7% to 4.6% of commercial aviation pilots²

1. Hall, P. (2009) **Nephrolithiasis: Treatment, causes and prevention**, Clev Clin J Med, 76(10):583-591

2. Hyams, E., et al. (2011) **The incidence of urolithiasis among commercial aviation pilots**, J Urol, 186:914-916.

Mineralized Renal Material (MRM)

- Small areas of calcification found incidentally
- Of uncertain significance
- We need to characterize **MRM**
 - How common?
 - Do they turn into stones or disappear with time?
 - Is spaceflight a risk factor for clinical stones?

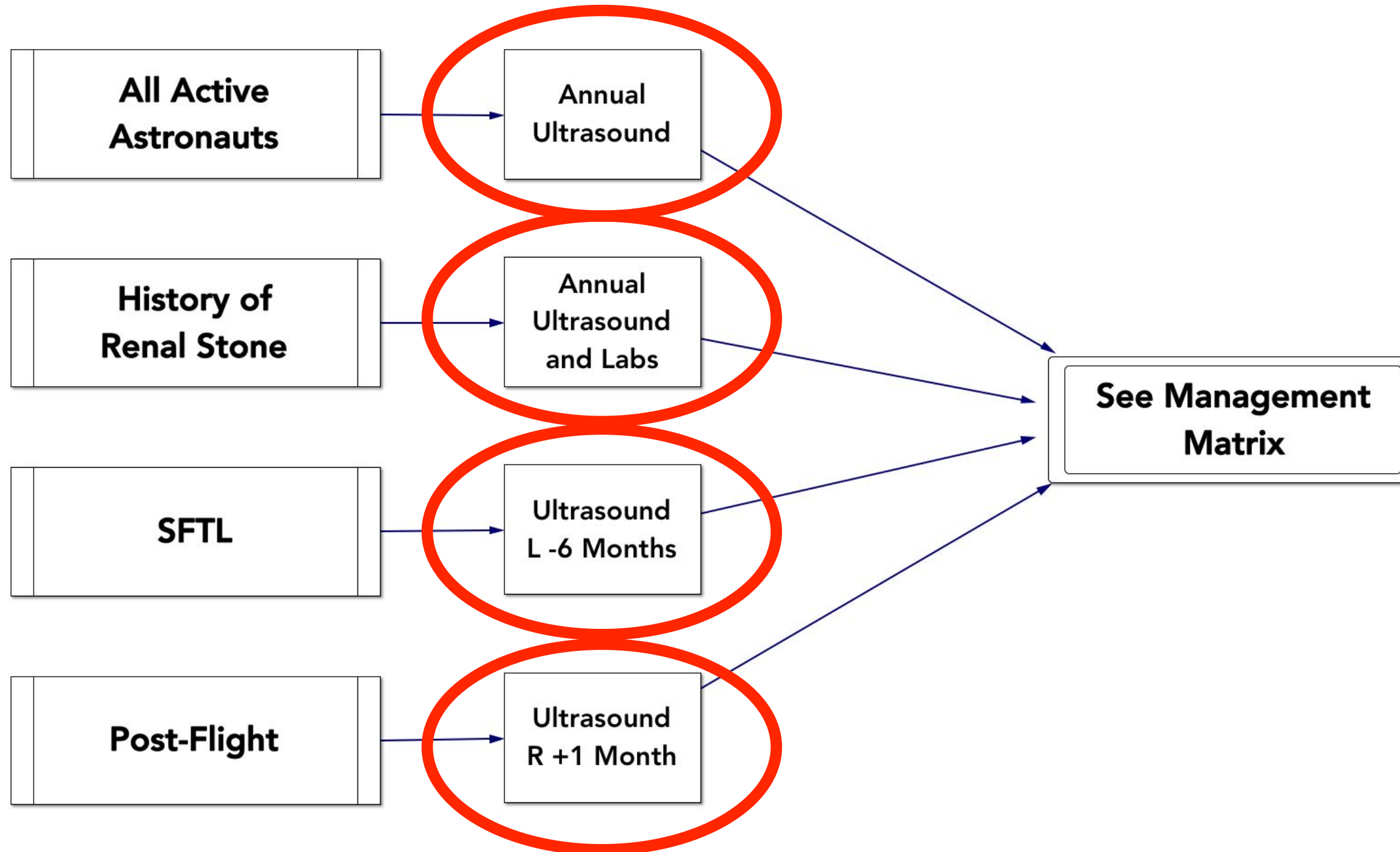
Screening Needs

- Management of MRM/stone has varied widely
- Unknown how many astronauts have MRM
- Understanding is important for future missions

Screening Needs

- Periodic screening → **Annual exams**
- Low or no radiation → **Ultrasound**
- Standardized methodology → **Ultrasound review panel**
- Standardized management → **A clinical practice guideline**

When to Screen?



Ultrasound Benefits

- Low cost
- No radiation
- Easy to do
- Easy to repeat
- Minimal time commitment for astronauts

PHILIPS

MI 1.3

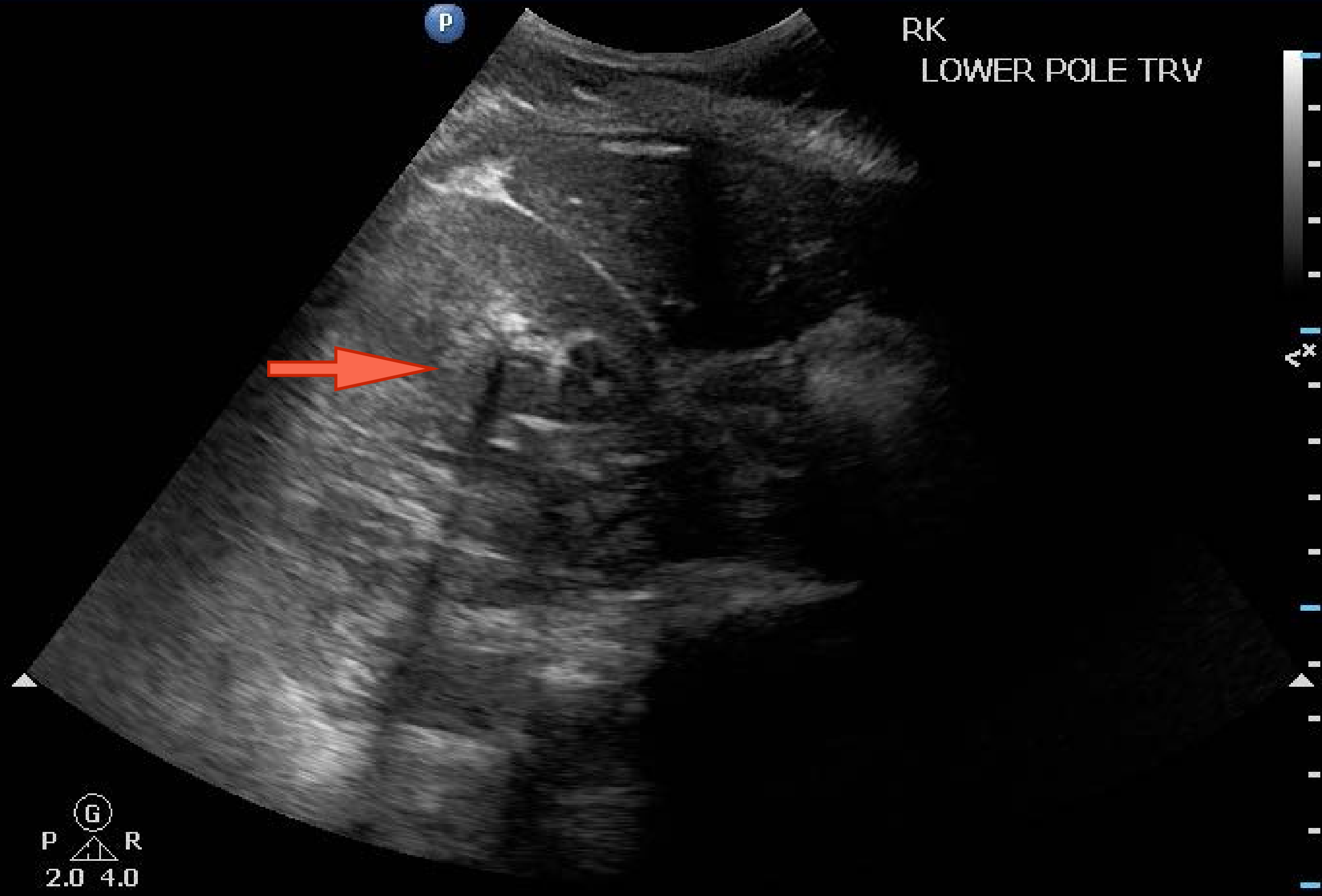
TIS 0.3

Abd Gen
C5-2
33Hz
15cm

2D

HGen
Gn 59
56
3 / 3 / 3

RK
LOWER POLE TRV



PHILIPS

MI 1.2

TIS 0.5

Abd Gen

C5-2

33Hz

15cm

2D

HGen

Gn 59

56

3 / 3 / 3

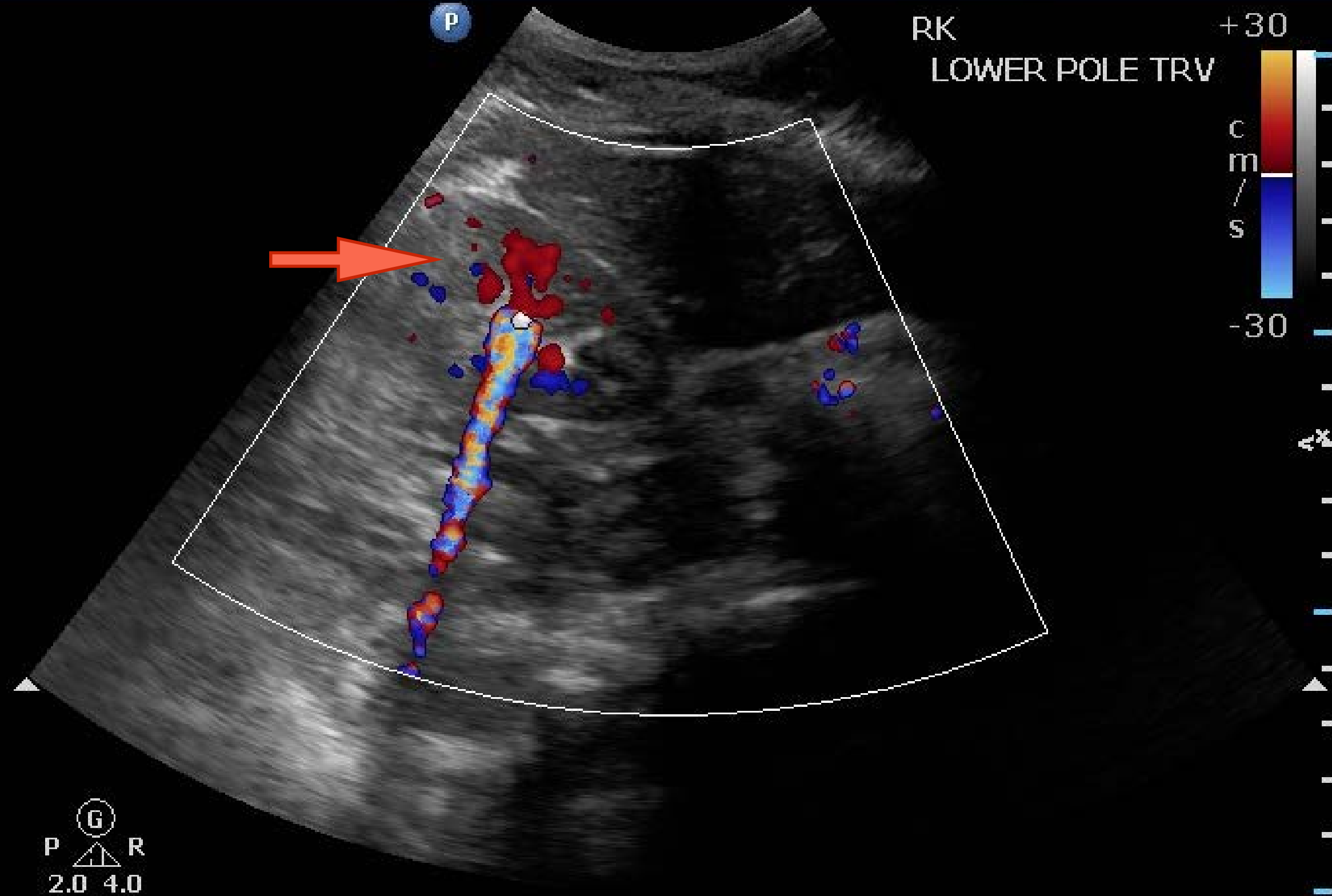
Color

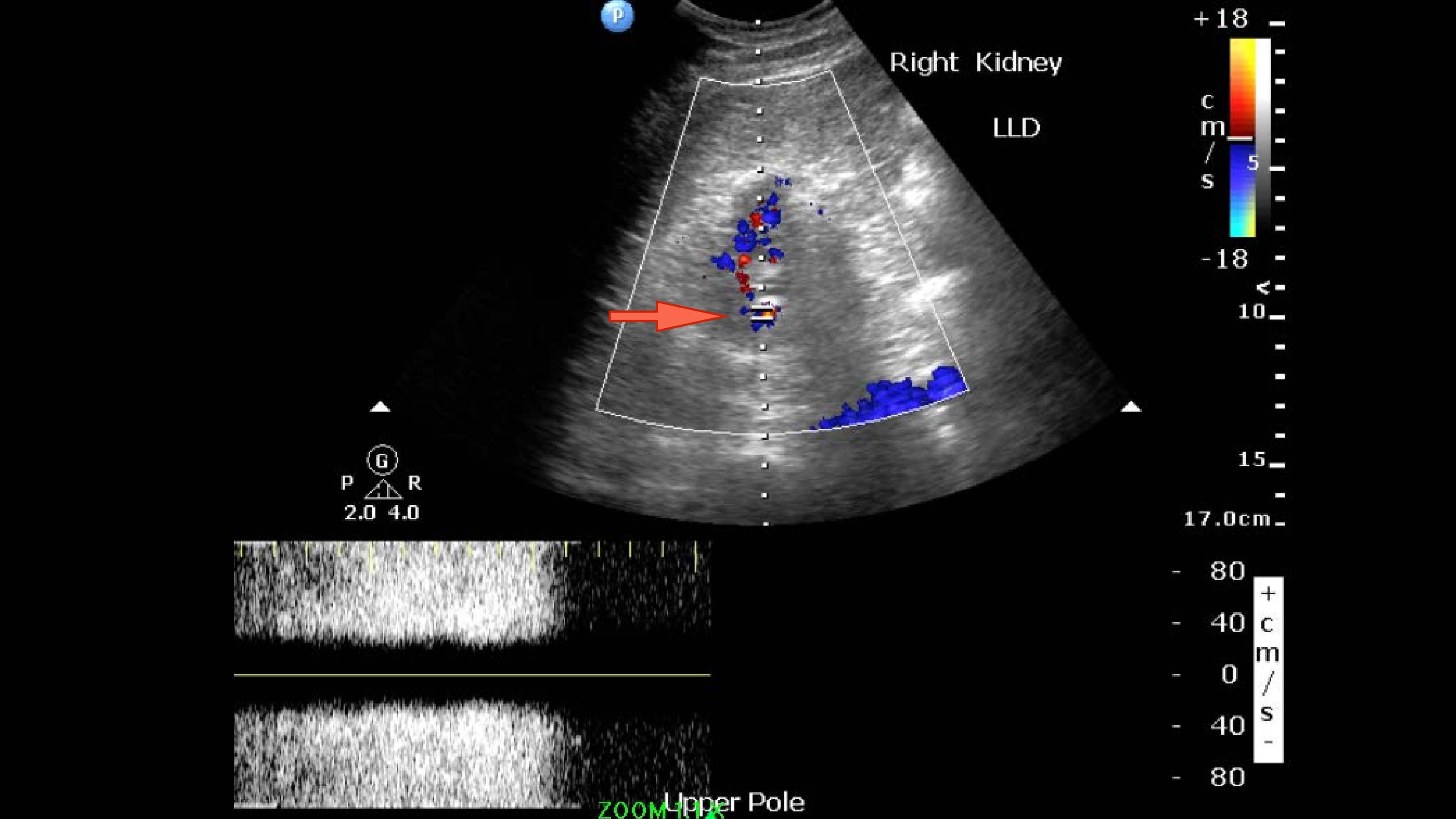
2.2 MHz

Gn 66

3 / 5 / 6

Fltr Med





Natural History

Size (mm)	Stone Free	Progression	Intervention
≤ 5	28%	40.4%	5.3%
5 - 10	4.8%	52.4%	9.5%
≥ 10	0%	71.4%	14.3%

Spontaneous Passage vs. Stone Size



Enhanced U/S Protocol

1. **Echogenic** → seen from 2 or more angles
2. **Shadowing** → opaque to ultrasound
3. **Twinkling** → twinkling in Doppler mode
4. **Dispersion** → spectral frequency dispersion
5. **Measurable** → >3 mm
6. **Location** → parenchymal, papillary or collecting system

Enhanced U/S Protocol

- Standardized and systematic screening
- Multiple scanning positions
- Multiple probe views
- Various ultrasound modes

Clinical Practice Guideline

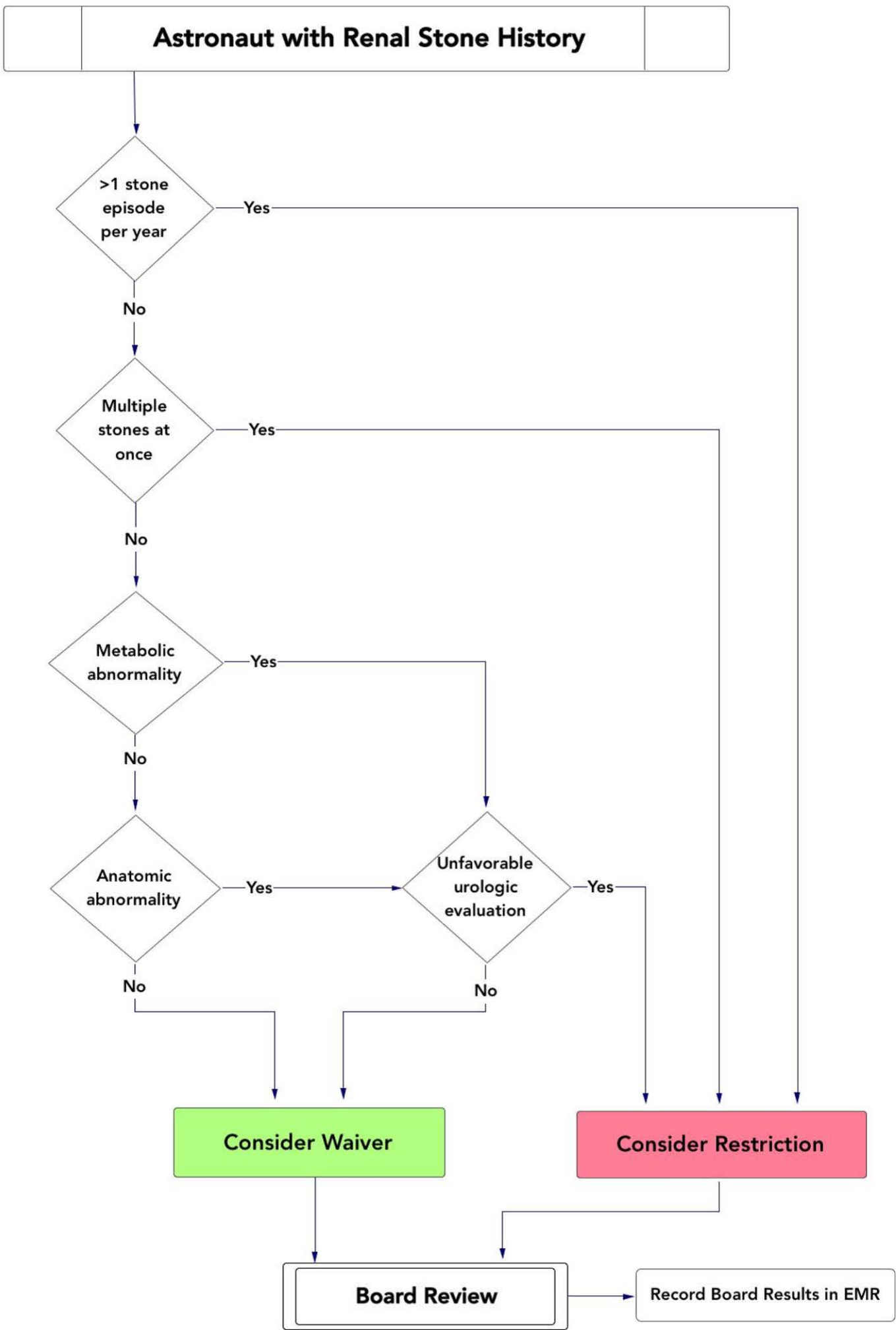
- **Annual ultrasound** for all active astronauts
- Use of **specialized ultrasound** protocol
- Suspicion for stone → Low-dose, high resolution **CT**
- Stone by CT → **Flexible Ureteroscopy** preferred
- **Mission assignment** affects treatment method
- **Potential waivers** for very small, stable MRM

US Navy Standards

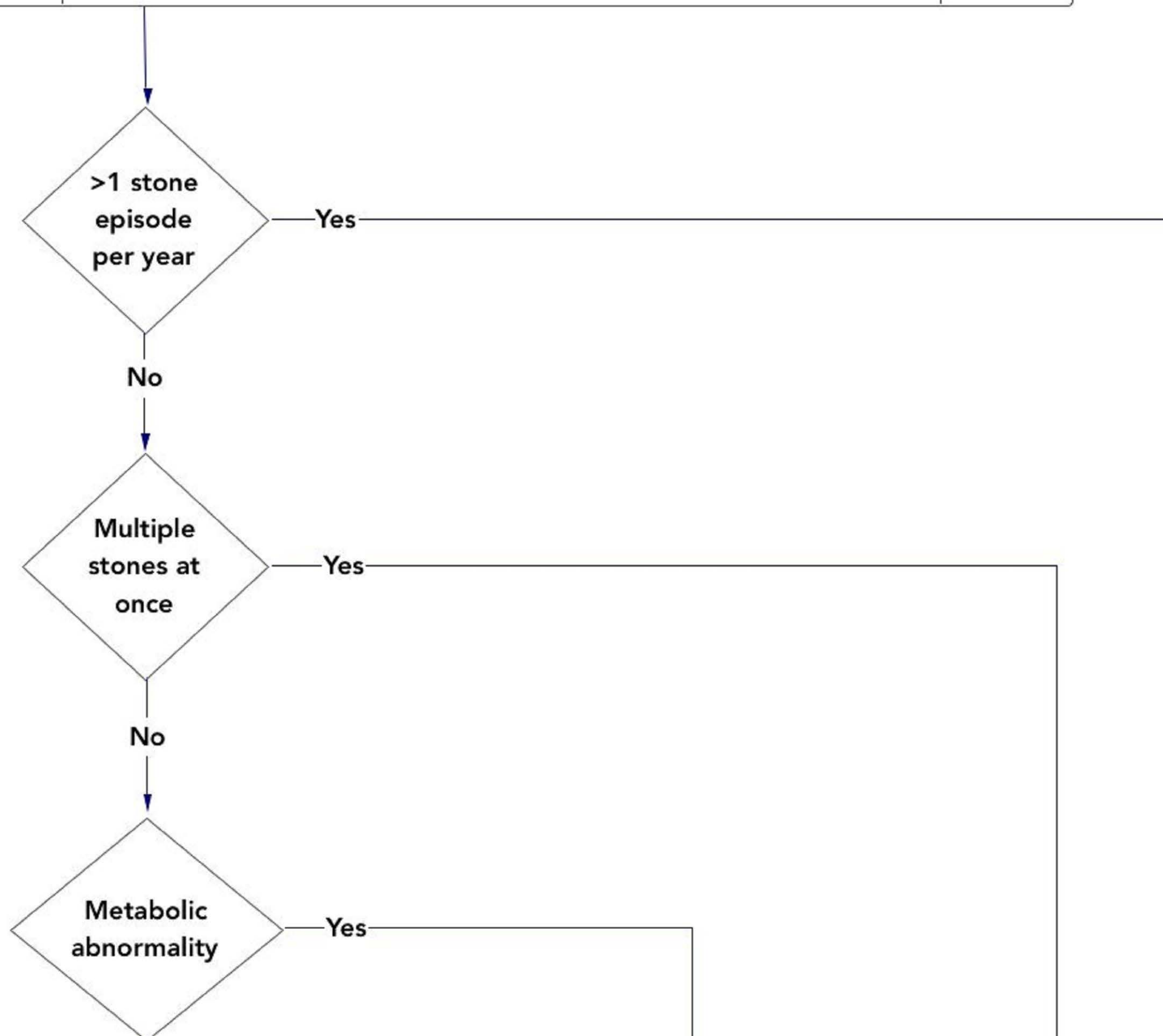
- **Waivers** given for...
 - calcium oxalate, calcium phosphate, uric acid and struvite;
 - retained stones in the renal parenchyma;
 - recurrent stones > 12 months apart.
- Medical evaluation & urology consult required

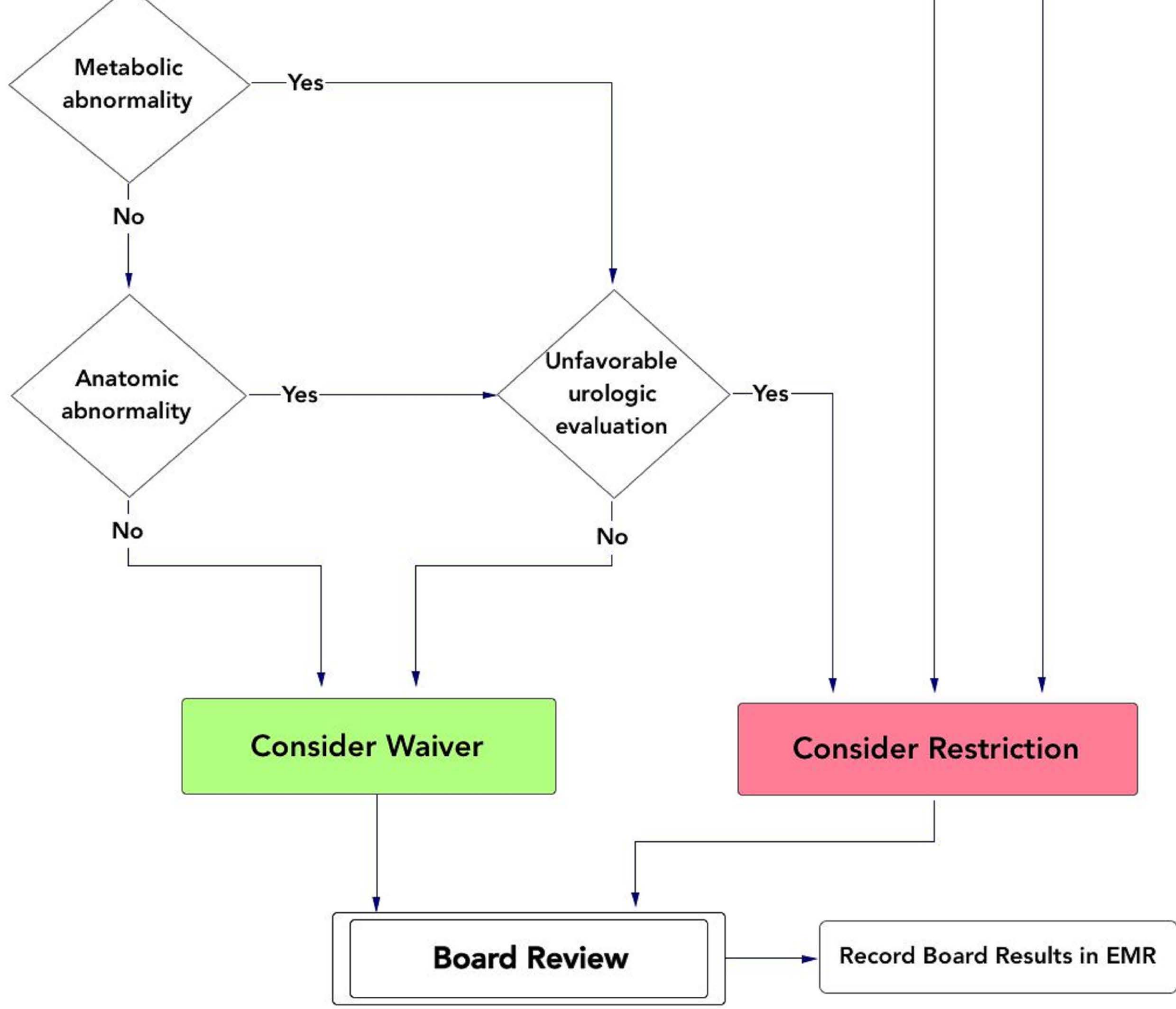
US Navy Standards

- Waivers **NOT** given for...
 - recurrent stones within one year
 - cysteine stones
 - hypercalcuria
 - stones retained in the collecting system



Astronaut with Renal Stone History



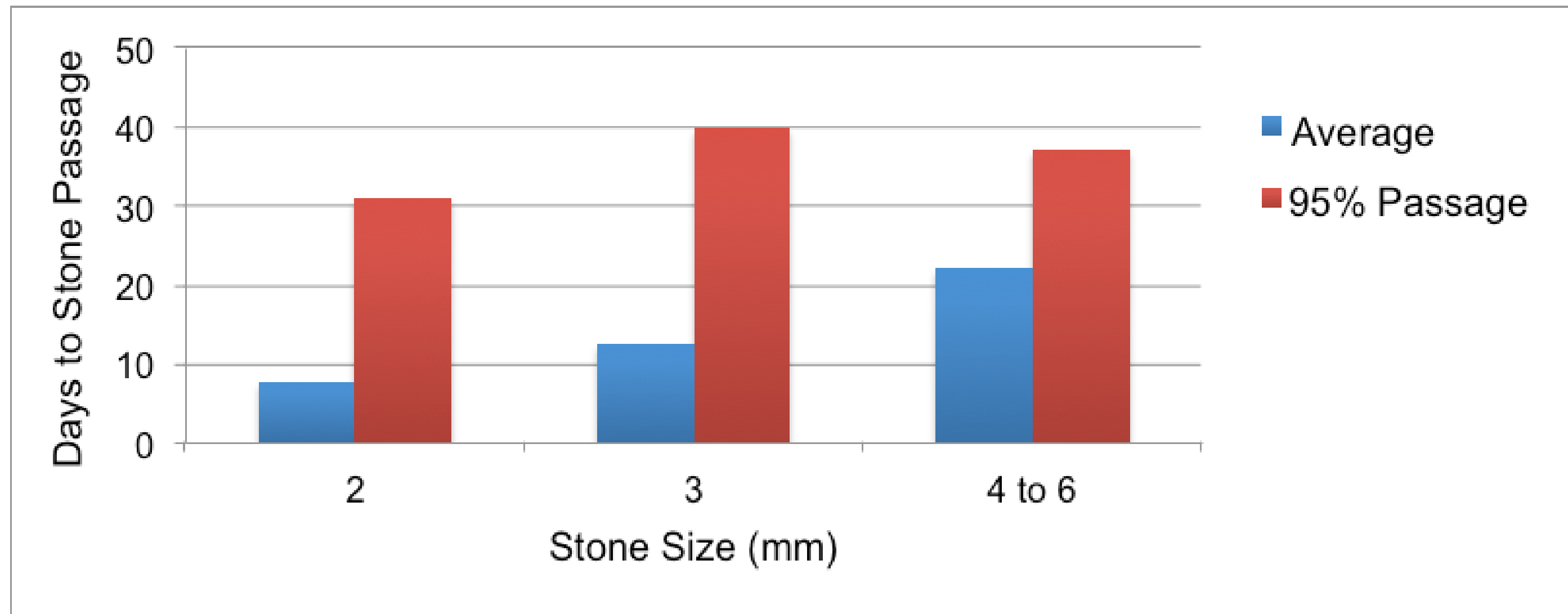


Where we are...

- All active astronauts have been screened
 - 4 were post-flight
- Seven renal panel meetings done
- Prelim results to NASA-AMB Summer 2017

Treatment During a Mission?

Ureteral Stone Size and Time to Passage



Reyes, D, Garcia, K, Sargsyan, A, & Locke, J, *Screening and Management of Asymptomatic Renal Stones in Astronauts*, in preparation, to be submitted to AMHP, May 2017.

Thank you.

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	Sensitivity (%)	Specificity (%)	Dose (mSv)
Ultrasound			
<i>Average 2.6 mm (1 – 9 mm, SD 1.15), n = 51 pts, 114 stones [17]</i>			
Shadowing alone	65 (PPV 90)	-	0
Twinkling alone	81 (PPV 94)	-	0
Shadowing + Twinkle	88 (PPV 96)	-	0
<i>Average 3.9 mm (1-20 mm), n = 105 pts, 65 stones, CT as reference [18]</i>			
Shadowing alone	48 (PPV 81)	99	0
Shadowing + Twinkle	55 (PPV 67)	99	0
X-Ray			
KUB	45 - 58	69 - 77	0.7
IVP	85	90	3
CT			
Low-dose, non-con.	97	95	3
Non-contrast	95 – 98	96 - 98	10
MRI			
	93 - 100	95 - 100	0