

# Lumenate Medical: A Novel, AI-Assisted Bladder Screening Platform



Jack Darbonne, Eleanor Kimbro, Lauren Lee, Haley Slosberg, Anand Vaish, Dr. Youseph Yazdi  
Johns Hopkins University, Center for Bioengineering Innovation and Design

## Problem

Diagnostic cystoscopy is the first-line, gold-standard imaging procedure for patients that have been referred for suspicion of bladder or urethral cancer. The procedure is a direct visualization of the bladder and urethra using a cystoscope. It can be done

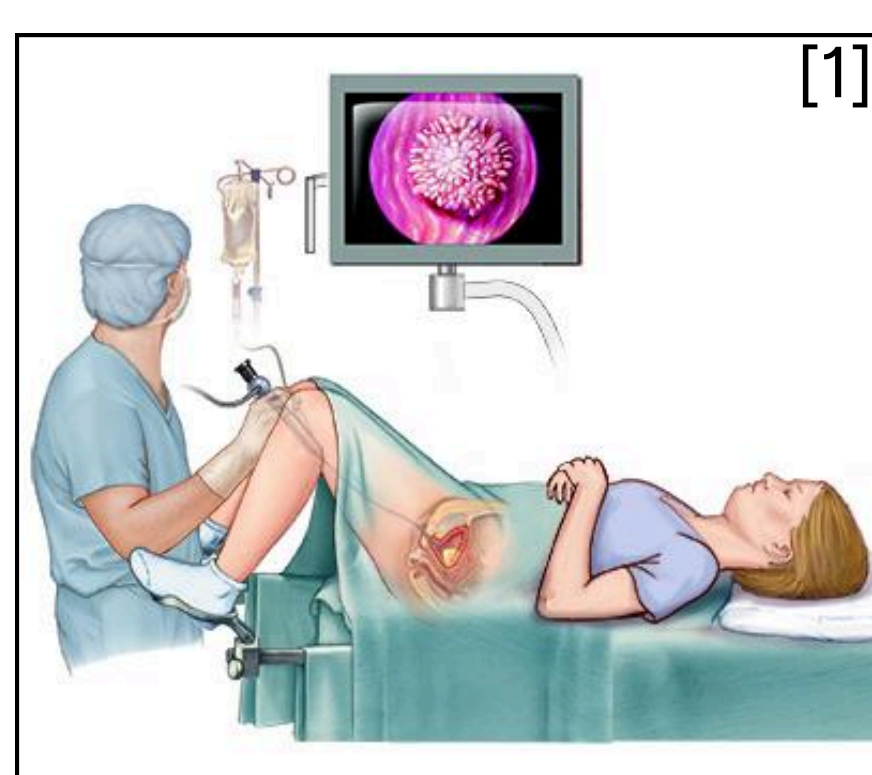


Figure 1: Diagnostic cystoscopy

in-office, outpatient, or inpatient, and patients are referred for a variety of very common indications (such as hematuria, or blood in the urine) [2]. The procedure itself is simple, inserting an endoscope through the urethra into the bladder. However, approximately 20 million patients have indications for bladder screening, yet only about 6 million cystoscopies are performed annually, highlighting a significant gap in access to urological care [3]. This gap stems from the requirement of live urologist evaluation. A urologist needs to be physically present to maneuver the scope to visualize the bladder, ensuring that the entire bladder is scanned.

And though this is a common procedure, a staggering 63% of American counties do not have a practicing urologist [4]. Patients, especially those in

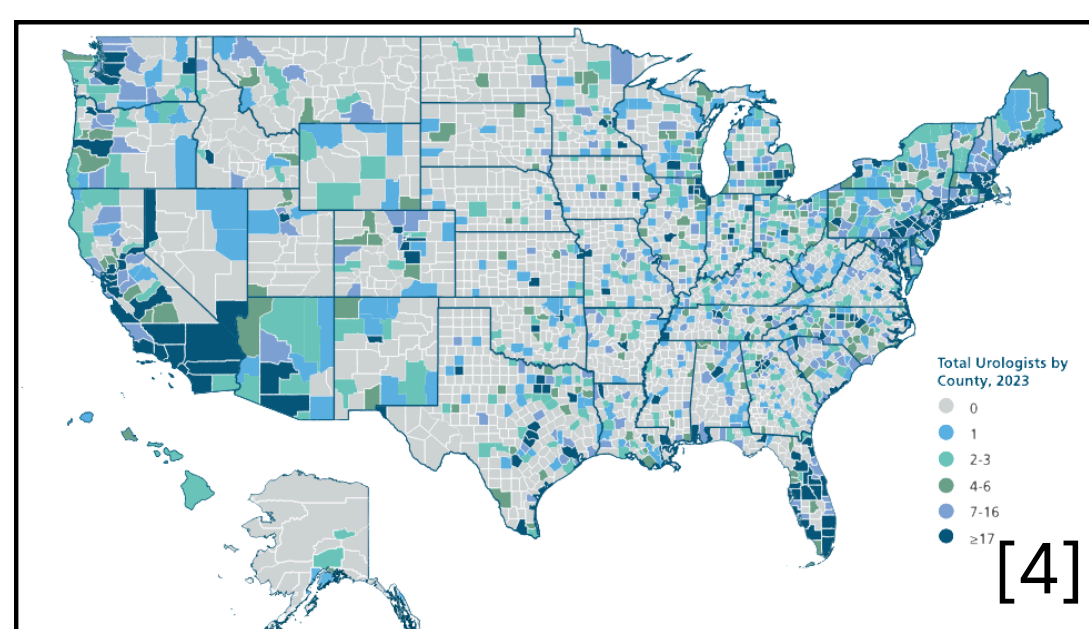


Figure 2: Urologist distribution per county

rural areas, are required to travel long distances to receive critical care or end up being unable to receive care at all [5]. This leads to tangible outcomes: delays of 3 months decrease median bladder cancer survival by almost a year [6], an estimated 20,000 cases of bladder cancer diagnoses are missed annually due to inaccessibility [7], and bladder cancer has the highest per-patient cost of any other cancer at \$150,000 annually [8].

## Our Solution

We are developing a novel, AI-enabled cystoscope that decouples image collection and interpretation, designed for non-urologists to perform imaging. The hardware employs a catheter form factor, is non-articulating, and ensures complete visualization via a multi-camera array. The AI software layer verifies scan completion, detects lesions, and transmits images for asynchronous review by urologists. In this redefined workflow, non-urologists providers — including PAs, NPs, and PCPs — can image the bladder while urologists interpret images asynchronously, unlocking a new workforce and accelerating the time to diagnosis.

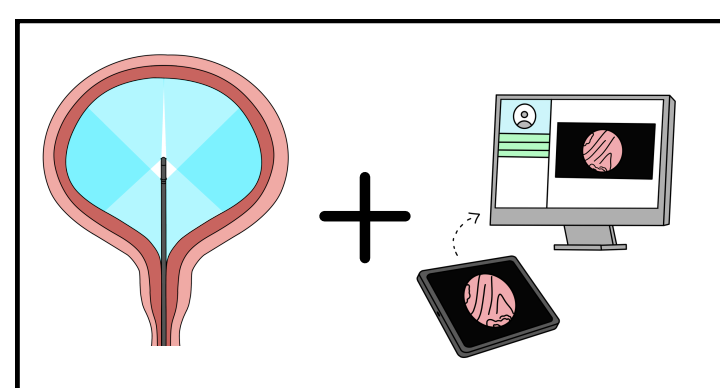


Figure 3: Lumenate Medical workflow

can image the bladder while urologists interpret images asynchronously, unlocking a new workforce and accelerating the time to diagnosis.

## Hardware & Software

Figure 4: Device rendering and expanded view of cameras

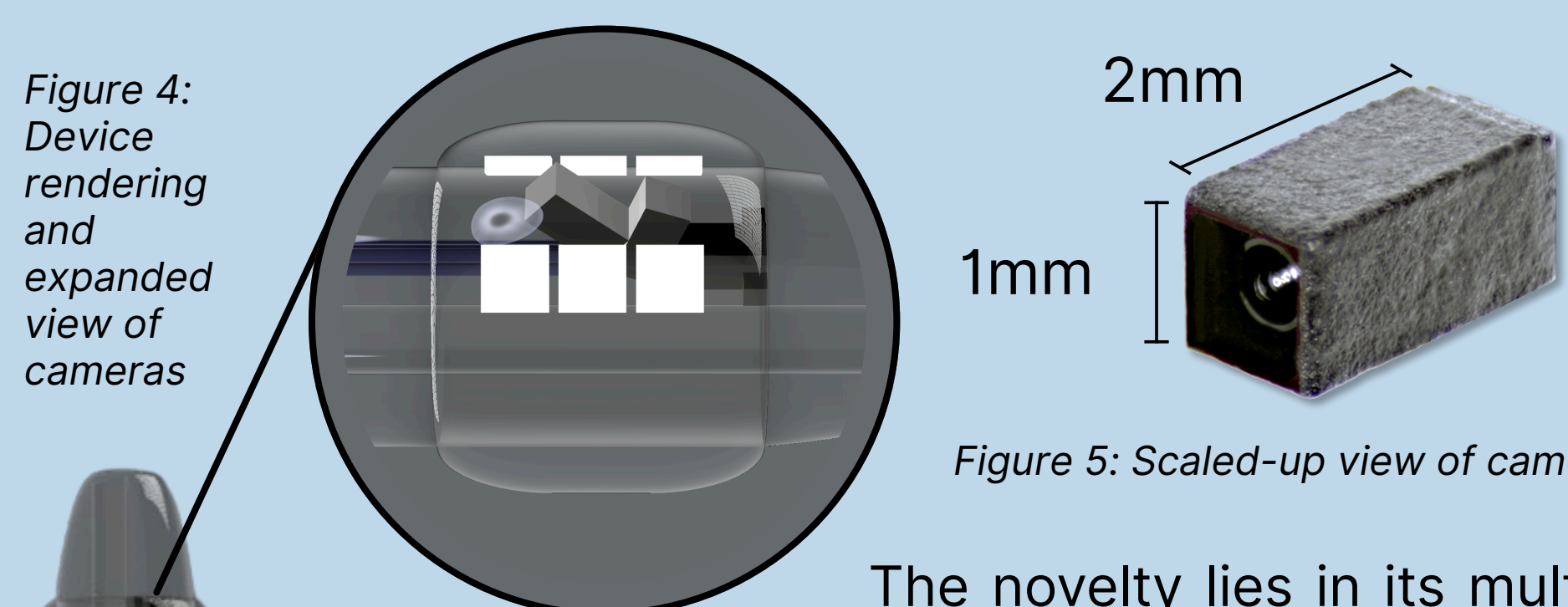


Figure 5: Scaled-up view of camera

The novelty lies in its multi-camera array (Figure 3, 4, 5) and ability to scan the entire bladder without articulation. The cameras are derived from cystoscopes on the market, which are at 400x400 px. This is an established resolution for urologists, which enables the device to slot into existing workflows. With the software, the hardware is able to get a 360° view of the bladder with an image-stitching algorithm

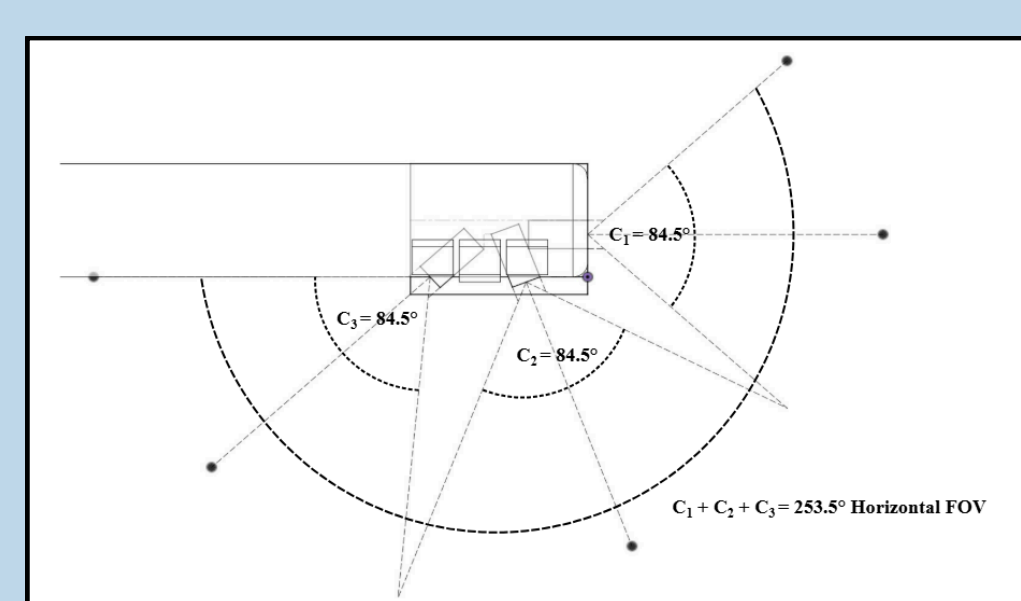


Figure 6: Camera array FOV

(Figure 6) when rotated around its central axis. There is also functionality to indicate when a spin has been completed.

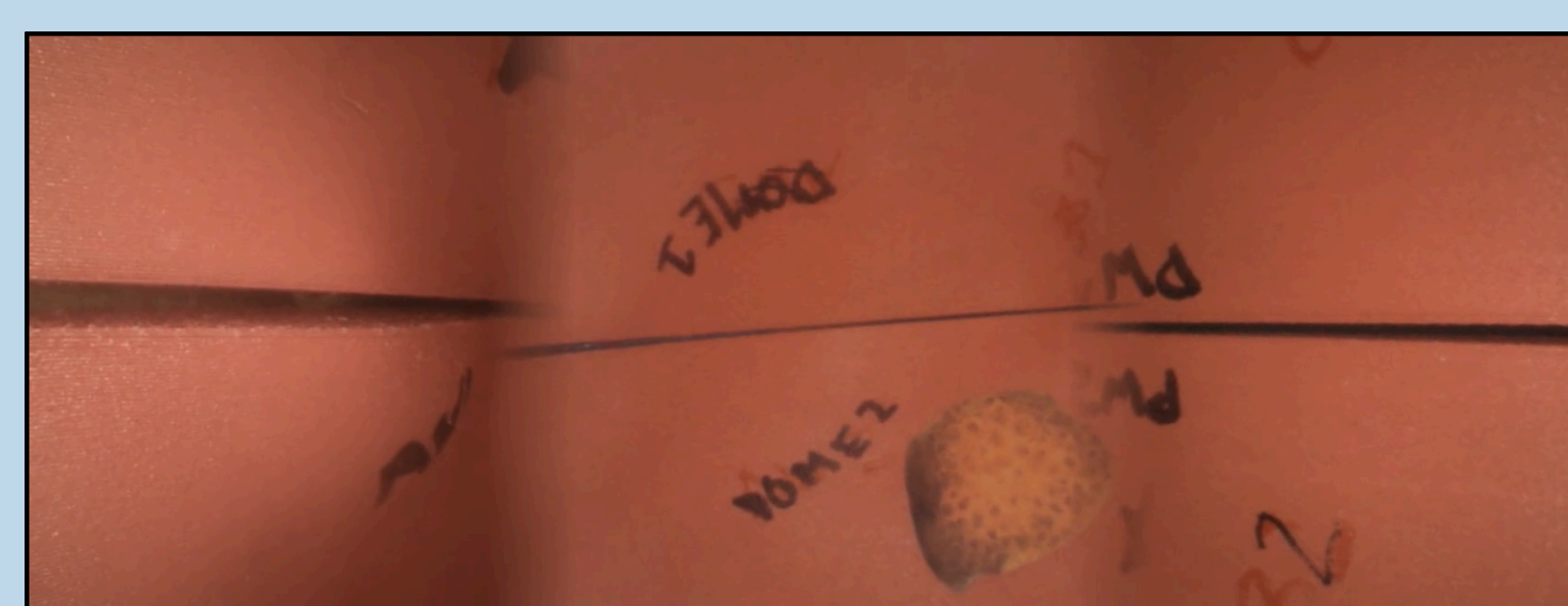


Figure 7: Image-stitching algorithm

## Competitive Analysis

	Existing cystoscopes <b>Ambu</b> <b>STORZ</b> <b>OLYMPUS</b>
✓ Designed for non-urologists	✗ Requires a urologist
✓ Expands access beyond urology clinics	✗ Restricted to urological practices
✓ Ensures complete exam, every time	✗ Risk of incomplete visualization

## Value Proposition

<b>Payers</b>	<b>Practices</b>
<b>\$2B</b> reduction in annual expenditure	<b>\$1.5M</b> in revenue from new procedures
<b>Providers</b>	<b>Patients</b>
<b>350+ hrs</b> freed per year	<b>50%</b> reduction in out-of-pocket costs

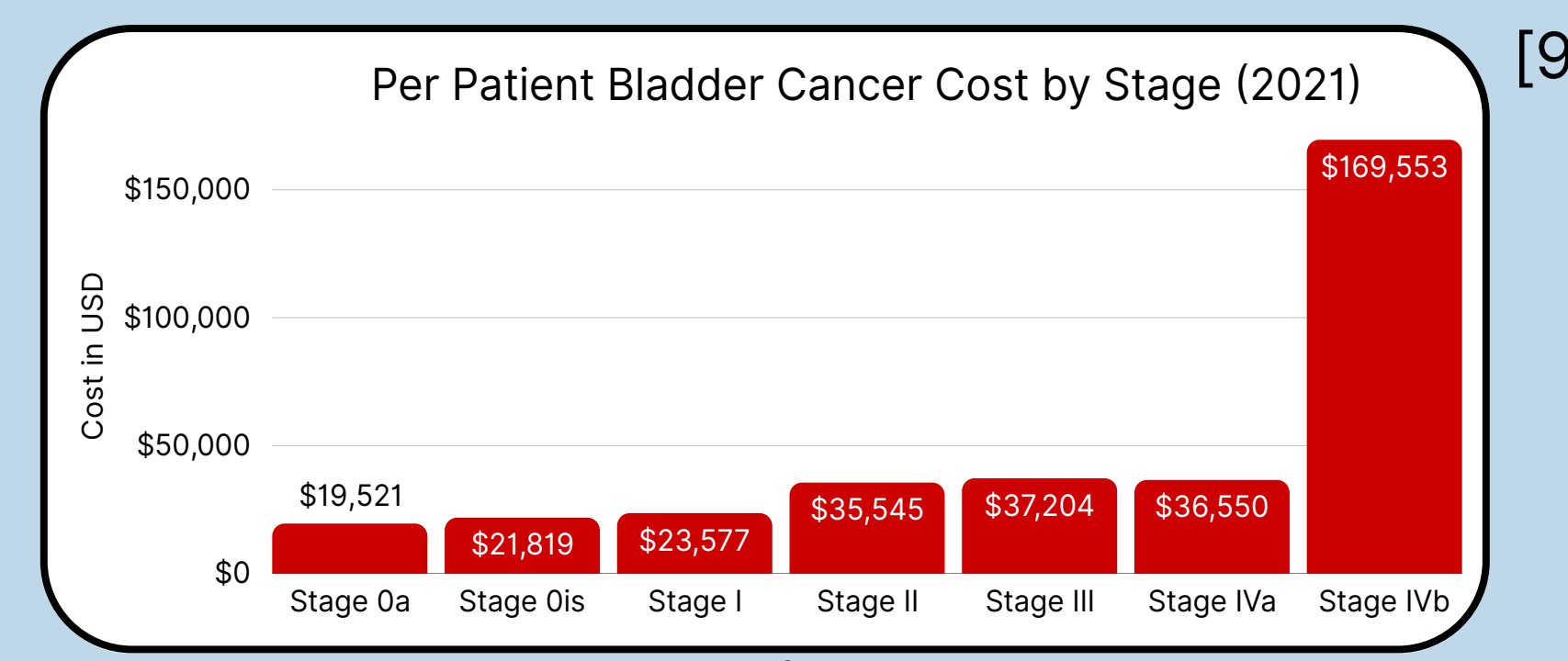
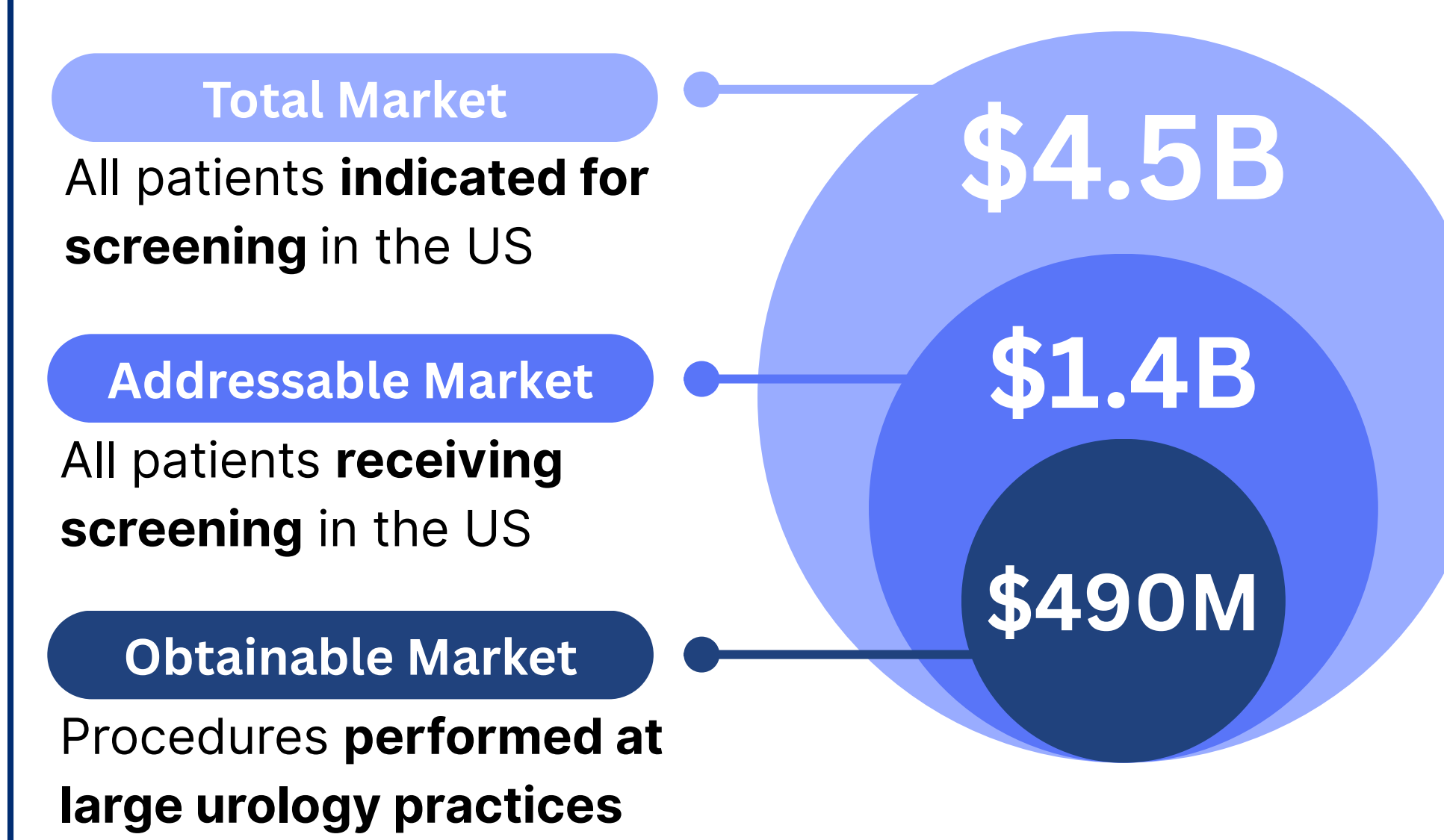
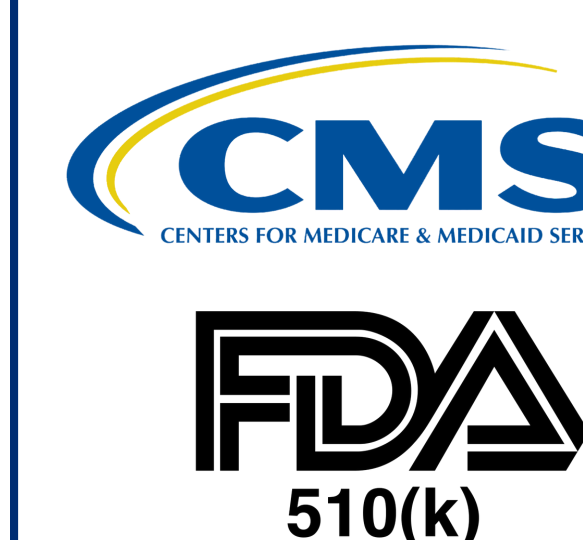
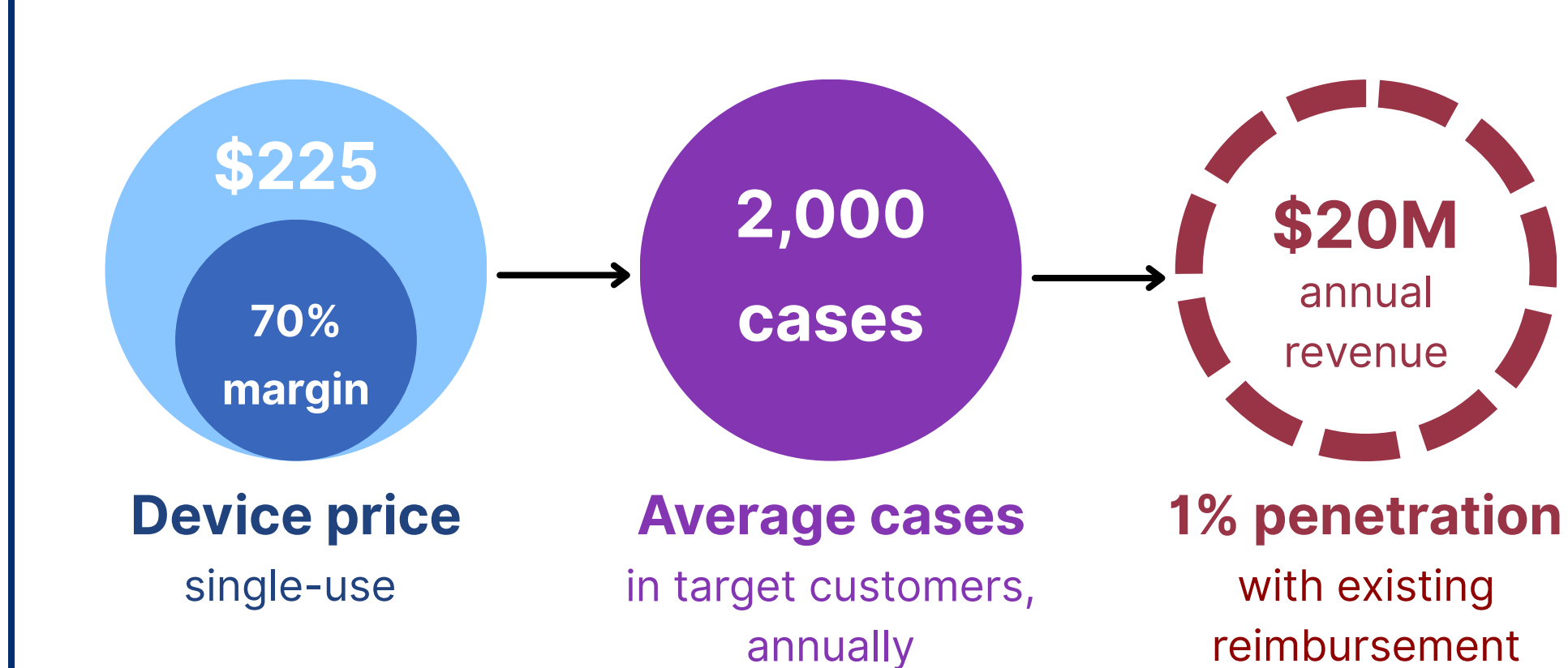


Figure 8: Costs of bladder cancer

## Market Opportunity

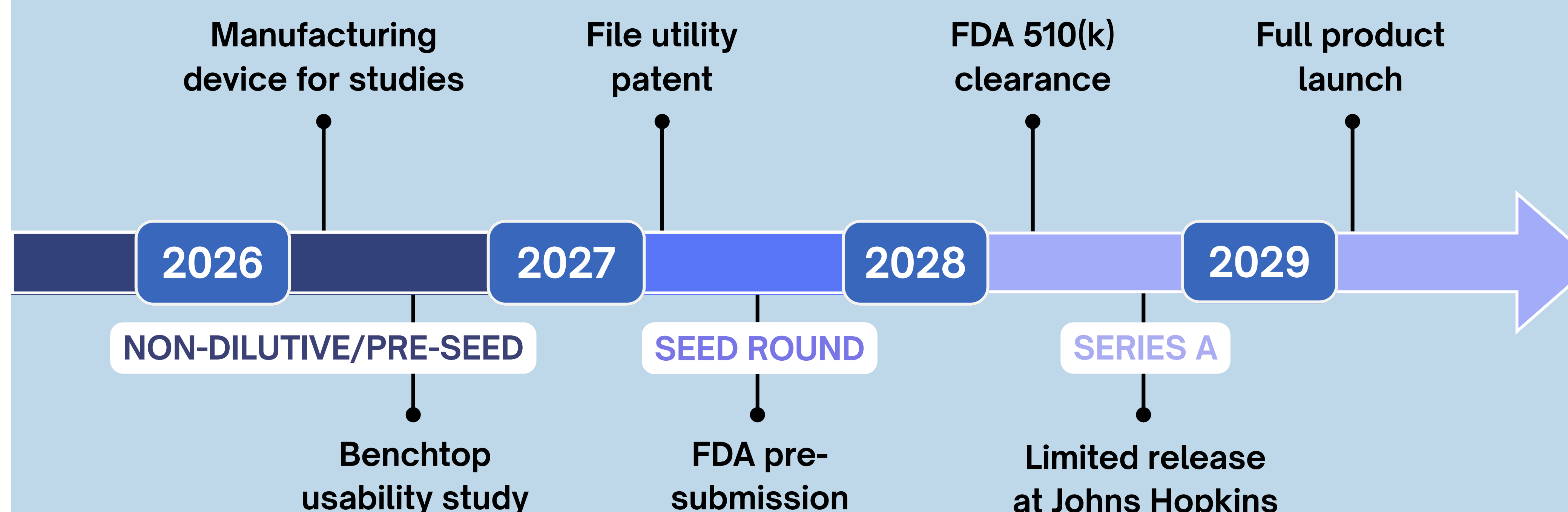


## Business Model



The device will be a Class II designation and follow a 510(k) pathway. The existing code for cystoscopy (CPT 52000) can be billed for reimbursement. The device is priced competitively with existing cystoscopes.

## Future Steps



## Acknowledgements

Special thanks to program advisors Dr. Youseph Yazdi and Dr. Soumyadipta Acharya; clinical mentors Dr. Mohammad Allaf, Dr. Arun Rai, Dr. Mahir Maruf, Dr. Mark Alshak, and Dr. Ashish Nimgaonkar; and Dr. April Zambelli-Weiner, Michelle Zwernemann, Jee Shin, and Susan Crews for their continued and valuable support on the project.

## References

[1] Altru Health System. (2025, October 25). Cystoscopy. <https://www.altru.org/health-library/procedures/cystoscopy>

[2] Engelsberg, J. S., & Delbert, C. M. (2023). Cystoscopy. In StatPearls [Internet]. StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK493180/>

[3] Clark, O., Sarmento, T., Eccleston, A., Brinkmann, J., Picoli, R., Daliparthi, V., Voss, J., Chandrasekar, S., Thompson, A., & Chang, J. (2024). Economic impact of bladder cancer in the USA. *Pharmacoeconomics - Open*, 8(6), 837-845. <https://doi.org/10.1007/s11693-024-00512-8>

[4] Garg, T., Meeks, W. D., Coward, R. M., Merrill, S. B., Huang, W. C., & Burnett, A. L. (2022). Demographic and practice trends of rural urologists in the U.S.: Implications for workforce policy. *Urology Practice*, 9(5), 481-490. <https://doi.org/10.1097/UPJ.0000000000000231>

[5] Note: The ASCO abstract page (abstract #231960) did not render its full content. Please verify the author(s), title, and year directly on the ASCO site and format as: Author(s). (Year). Title of abstract [Abstract]. In [Meeting name]. American Society of Clinical Oncology. <https://www.asco.org/abstracts-presentations/231960/abstracts>

[6] Hollenbeck, B. K., Dunn, R. L., Ye, Z., Hollingsworth, J. M., Skolarus, T. A., Kim, S. P., Montie, J. E., Lee, C. T., Wood, D. P., Jr., & Miller, D. C. (2010). Delays in diagnosis and bladder cancer mortality. *Cancer*, 116(22), 5235-5242. <https://doi.org/10.1092/cncr.25310>

[7] Perez, D., Mamber, A., Pasherstrink, M., Koulikov, D., Natshen, A. E., Shenfeld, O. Z., Zeldin, A., Tzair, B., Cherin, B., & Kalka, I. Z. (2025). Antibiotic prophylaxis in ambulatory cystoscopy: Challenging its role even in high-risk patients—prospective observational study. *Investigative and Clinical Urology*, 66(5), 448-454. <https://doi.org/10.4111/icu.20250221>

[8] Sievert, K. D., Amend, B., Nagle, U., Schilling, D., Beuke, J., Horstmann, M., Heutenlotter, J., Knack, S., & Stenzl, A. (2009). Economic aspects of bladder cancer: What are the benefits and costs? *World Journal of Urology*, 27(3), 295-300. <https://doi.org/10.1007/s00345-009-0395-z>

[9] Clark, O., Sarmento, T., Eccleston, A., Brinkmann, J., Picoli, R., Daliparthi, V., Voss, J., Chandrasekar, S., Thompson, A., & Chang, J. (2024). Economic impact of bladder cancer in the USA. *Pharmacoeconomics - Open*, 8(6), 837-845. <https://doi.org/10.1007/s11693-024-00512-8>