

Background

Cystoscopy is one of the most common diagnostic endoscopic examinations in the field of urology.<sup>1</sup> While the first cystoscope can be traced to the early 1800’s, the flexible cystoscope for visualizing the urinary bladder via the urethra did not emerge until 1973.<sup>2</sup> The adoption of disposable, or single-use, endoscopy rests largely on the cost-effectiveness of a disposable, or single-use, platform relative to a reusable system.<sup>3</sup> Organizations contemplating the utilization of single-use devices must consider their costs against the costs associated with reusable devices as well as the environmental impact of both. An economic and environmental analysis may be useful for advising organizations on the various costs and carbon footprint associated with reusable flexible cystoscopes.



Objective

Analyze the various costs and carbon footprint associated with reusable flexible cystoscopes.

Methods

A comprehensive literature review of the various costs and environmental impact associated with reusable flexible cystoscopes was undertaken. When available, comparisons with single-use cystoscopes were employed. The costs analyzed included the amortized capital cost of the reusable flexible cystoscope, repair costs per case, reprocessing costs, incremental operating room time, and the incremental cost associated with postoperative infections.

Results

Four studies were found that examined each of capital, repair, and reprocessing costs; three were found that analyzed procedure time; one study was found that compared infection risk; two were found for the carbon footprint analysis. The median per-procedure cost for utilizing a reusable flexible cystoscope was found to be \$595/€541 (mean cost: \$689/€626). The mean per-procedure carbon footprint associated with reusable flexible cystoscopes was found to be 3.66 kg CO<sub>2</sub> – slightly higher than the 2.24 kg CO<sub>2</sub> value found for single-use flexible cystoscopes.

Limitations

The limitations of this model include but are not limited to:

- The cost analyses studies cited are from multiple countries and primarily from academic medical centers. Those results may not be extensible to all geographies and to smaller tertiary care organizations.
- Although large (N=1,000 cystoscopies), only a single study evaluated infection risk.
- The carbon footprint analyses were single-center studies – results are limited to the waste produced, sterilization processes, and equipment at those specific centers. Organizations employing more environmentally friendly processes and equipment may observe different results.

Discussion

In addition to intra-case analyses, organizations may also wish to consider longitudinal economic effects when evaluating cystoscope options. Geldmaker et al. found that procedures performed with single-use cystoscopes were less likely to result in unplanned post-procedure encounters.<sup>11</sup>

KEY FINDINGS

- When considering amortized capital costs, repair costs, reprocessing costs, cost of incremental procedure time, and incremental costs associated with postoperative infections, the median total per-procedure cost associated with reusable flexible cystoscopes was found to be \$595 (€541).
- Two studies report that the carbon footprint associated with reusable flexible cystoscopes may be greater than that of single-use flexible cystoscopes.
- Organizations should consider this model as a template; adjusting the parameters based on their costs, history, and experience; to determine the total per-procedure costs specific to their facilities.

Model

Per-Procedure Costs of Reusable Flexible Cystoscopes

Amortized Capital Cost			Mean	Median	Min	Max
Kenigsberg (2021) <sup>4</sup>	(Note A)	\$25.74	\$55.60	\$63.47	\$25.74	
Boucheron (2022) <sup>5</sup>	€ 55.56	\$61.12				
Su (2021) <sup>6</sup>	(Note B)	\$65.83				
Bertolo (2024) <sup>1</sup>	€ 63.37	\$69.71				\$69.71
Repair Cost						
Su (2021) <sup>6</sup>	(Note B)	\$13.24	\$32.78	\$31.78	\$13.24	
Kenigsberg (2021) <sup>4</sup>	(Note A)	\$27.33				
Boucheron (2022) <sup>5</sup>	€ 32.94	\$36.23				
Wong (2021) <sup>2</sup>	£41.79	\$54.33				\$54.33
Reprocessing Cost						
Su (2021) <sup>6</sup>	(Note B)	\$53.72	\$83.22	\$80.65	\$53.72	
Assmus (2022) <sup>3</sup>		\$70.87				
Bertolo (2024) <sup>1</sup>	€ 82.20	\$90.42				
Boucheron (2022) <sup>5</sup>	€ 107.15	\$117.87				\$117.87
Incremental Procedure Time Cost						
Haislip (2024) <sup>7</sup>	2.52 min (Note C)	\$90.95	\$394.13	\$296.35	\$90.95	
Johnson (2023) <sup>8</sup>	8.2 min (Note C)	\$296.35				
Medeiros (2024) <sup>9</sup>	22 min (Note C)	\$795.08				
Incremental Infection Risk Cost						
Geldmaker (2023) <sup>10</sup>	3.2% (Note D)	\$123.10	\$123.10	\$123.10	\$123.10	\$123.10
Total Cost Per Procedure			\$689 (€626)	\$595 (€541)	\$281 (€255)	\$1,160 (€1,055)

Notes

Conversion rates: €1.00 = \$1.10 and £1.00 = \$1.30

- A. Kennigberg<sup>4</sup> reported an amortized capital cost and repair cost of \$21.00 and \$22.70, respectively (2019 dollars). Being more than 5 years old, they were adjusted to 2024 dollars, using US BLS inflation data (Jun. 2019 to Sept. 2024).<sup>11</sup>
- B. Su<sup>6</sup> reported these values for 10 cystoscopes and 1000 procedures.
- C. The incremental cost of procedure time was found by multiplying the incremental procedure time in minutes by \$36.14 – the cost of operating room time in the outpatient setting.<sup>12</sup>
- D. The incremental infection risk cost was found by multiplying the incremental risk of positive urine culture with symptoms 3.2% (3.4% for reusable vs. 0.2% for single-use) from Geldmaker<sup>10</sup> by the \$3,847 unadjusted cost of a post-operative UTI from Merkow.<sup>13</sup>
- E. Compared a reusable Cysto-Nephro Videoscope CYF-VA2 (Olympus) to a single-use aScope™ 4 Cysto (Ambu) across device manufacture, transport, sterilization, landfill, and incineration.<sup>14</sup>
- F. Compared high-level disinfection of reusable cystoscopes with peracetic acid to the complete lifespan including raw material extraction, material formulation, component production, product assembly, distribution, transportation after use, and final disposal of a single-use aScope™ 4 Cysto (Ambu).<sup>15</sup>

Per-Procedure Carbon Footprint Analysis

	Reusable Flexible Cystoscope	Single-Use Flexible Cystoscope
Hogan <sup>14</sup> (2022) Note E	4.23 kg CO <sub>2</sub>	2.41 kg CO <sub>2</sub>
Baboudjian <sup>15</sup> (2023) Note F	3.08 kg CO <sub>2</sub>	2.06 kg CO <sub>2</sub>
	3.66 kg CO <sub>2</sub>	2.24 kg CO <sub>2</sub>

Conclusions

Organizations should consider this analysis and adjust parameters based on their costs, history, experience with reusable flexible cystoscopes, and extensibility of the environmental factors cited. Those self-derived, facility-specific findings may advise on the selection of single-use digital flexible cystoscopes as potentially cost-effective alternatives, with possibly a lower carbon footprint, compared to reusable devices.

Disclosures and Funding

Timothy Kelly is an employee of Becton Dickinson and Company, a distributor of single-use flexible cystoscopes. Reference reprints and poster printing costs were funded by Becton Dickinson and Company.

BD-138336

References

- <sup>1</sup>Bertolo R, Gilioli V, Vecchia A, Malandra S, Dal Corso L, Fenzi D, Mazzetto F, Antonelli A. Institutional Micro-Cost Comparative Analysis of Reusable vs Single-use Cystoscopes With Assessment of Environmental Footprint. *Urology*. 2024 Jun;188:70-76.
- <sup>2</sup>Wong A, Phan YC, Thursby H, Mahmalji W. The First UK Experience with Single-use Disposable Flexible Cystoscopes: An In-depth Cost Analysis, Service Delivery and Patient Satisfaction Rate with Ambu® aScope™ 4 Cysto. *J Endoluminal Endourology*. 2021;4(1):e29-e44.
- <sup>3</sup>Assmus MA, Krambeck AE, Lee MS, Agarwal DK, Mellon M, Rivera ME, Large T. Cost-Effectiveness of 90-day Single-use Flexible Cystoscope Trial: Single Center Micro-Costing Analysis and User Satisfaction. *Urology*. 2022 Sep;167:61-66.
- <sup>4</sup>Kenigsberg AP, Gold S, Grant L, Lotan Y. The Economics of Cystoscopy: A Microcost Analysis. *Urology*. 2021 Nov;157:29-34.
- <sup>5</sup>Boucheron T, Lechevallier E, Gondran-Tellier B, Michel F, Bastide C, Martin N, Baboudjian M. Cost and Environmental Impact of Disposable Flexible Cystoscopes Compared to Reusable Devices. *J Endourol*. 2022 Oct;36(10):1317-21.
- <sup>6</sup>Su ZT, Huang MM, Matlaga BR, Hutfless S, Koo K. A micro-costing analysis of outpatient flexible cystoscopy: implications for adoption of single-use flexible cystoscopes. *World J Urol*. 2021 Nov;39(11):4275-4281.
- <sup>7</sup>Haislip I, Rindorf D, Cool C, Tester B. Workflow efficiencies for flexible cystoscopy: comparing single-use vs reusable cystoscopes. *BMC Urol*. 2024 Mar 6;24(1):53.
- <sup>8</sup>Johnson BA, Raman JD, Best SL, Lotan Y. Prospective Randomized Trial of Single-Use vs Reusable Cystoscope for Ureteral Stent Removal. *J Endourol*. 2023 Oct;37(10):1139-1144.
- <sup>9</sup>Medeiros R, Soto-Palou F, Barquin DL, Margolin EJ, Locascio R, Antonelli J, Preminger G, Lipkin M. The Impact of Single-Use Cystoscopes on Clinical Time Workflow in an Outpatient Setting. *Urology*. 2024 Jun;188:7-10.
- <sup>10</sup>Geldmaker LE, Baird BA, Lyon TD, Regele EJ, Wajswol EJ, Pathak RA, Petrou SP, Haehn DA, Gajarawala NM, Ball CT, Broderick GA, Thiel DD. Conversion to Disposable Cystoscopes Decreased Post-procedure Encounters and Infections Compared to Reusable Cystoscopes. *Urol Pract*. 2023 Jul;10(4):312-317.
- <sup>11</sup>U.S. Bureau of Labor Statistics. CPI Inflation Calculator. <https://data.bls.gov/cgi-bin/cpi/calc.pl>. Accessed October 12, 2024.
- <sup>12</sup>Childers CP, Maggard-Gibbons M. Understanding Costs of Care in the Operating Room. *JAMA Surg*. 2018 Apr 18;153(4):e176233.
- <sup>13</sup>Merkow RP, Shan Y, Gupta AR, Yang AD, Sama P, Schumacher M, Cooke D, Barnard C, Bilimoria KY. A Comprehensive Estimation of the Costs of 30-Day Postoperative Complications Using Actual Costs from Multiple, Diverse Hospitals. *Jt Comm J Qual Patient Saf*. 2020 Oct;46(10):558-64.
- <sup>14</sup>Hogan D, Rauf H, Kinnear N, Hennessey DB. The Carbon Footprint of Single-Use Flexible Cystoscopes Compared with Reusable Cystoscopes. *J Endourol*. 2022 Nov;36(11):1460-1464.
- <sup>15</sup>Baboudjian M, Pradere B, Martin N, Gondran-Tellier B, Angerri O, Boucheron T, Bastide C, Emiliani E, Misrai V, Breda A, Lechevallier E. Life Cycle Assessment of Reusable and Disposable Cystoscopes: A Path to Greener Urological Procedures. *Eur Urol Focus*. 2023 Jul;9(4):681-687.