Micro-cost analysis of single-use vs. reusable cystoscopy in a single-payer healthcare system

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Abstract

Introduction: Single-use flexible diagnostic cystoscopy has recently been developed with comparable functionality to reusable cystoscopes. Prior studies have demonstrated considerable upfront costs of reusable cystoscopy. The objective of this study was to compare costs of reusable cystoscopy to single-use cystoscopy in a single-payer, socialized healthcare system.

Methods: A retrospective micro-cost analysis of reusable cystoscopy in a combined inpatient and outpatient setting at a single institution was performed. The cost analysis was divided into capital, maintenance, reprocessing, and labor. Annual costs were averaged over two fiscal years. Costs were amortized over 5- and 10-year basis as appropriate. The results were compared to theoretical costs of single-use cystoscopes.

Results: There were 3415 annual average cystoscopy cases with 171 cases per reusable cystoscope. The capital, maintenance, reprocessing, and labor costs of reusable cystoscopy are $96 000, $99 867, $247 855, and $65 317, respectively. The total annual costs per case for reusable and single-use cystoscopy are $149.06 and $245.57, respectively. The costs of reusable

Key Messages

- Reusable cystoscopes have significant upfront capital costs compared to single use cystoscopes
- Single use cystoscopes are more cost effective at annual cystoscopy volumes of less than 1265 cases
- Single use cystoscopes are an appropriate alternative to reusable cystoscopes to expand outpatient volume or in less equipped circumstances

cystoscopy decrease with the number of procedures per year and intersect the costs of single-use cystoscopes at 1265 procedures per year. All costs are CAD.
Conclusions: The cost-effectiveness of reusable cystoscopes is dependent on cystoscopy volume due to considerable upfront costs. Single-use cystoscopes are more cost effective if the total number of cases performed is less than 1265 per year. Additional investigation into the cost-effectiveness of single-use cystoscopes as supplements in the outpatient setting or primary endoscopes in inpatient/emergency settings should be performed.

Introduction

Office-based flexible cystoscopy is an essential tool for diagnosis and/or treatment of lower urinary tract conditions since its inception in 1973. (1) It is the most common procedure performed by a urologist in the office. (2) Moreover, its versatility allows for procedures such as intravesical botulinum toxin-A injections, biopsy plus fulguration of superficial bladder tumors as well as retrieval of ureteral stents. (3–6) The standard of care in all Canadian institutions is reusable flexible cystoscopes with sterile reprocessing. One disadvantage of reprocessing is that a single cystoscope can only be used once per day, which limits the number of cystoscopes performed to the reusable cystoscopes available. In addition, there is a risk of improper sterilization leading to cross-contamination and iatrogenic outbreaks. (7) Lastly, flexible cystoscopes require 1 repair every 2-3 years, with the distal tip polymer as the most common culprit due to frequent deflections. (8) Although the rate of repairs is comparatively superior to other endoscopes (i.e. flexible ureteroscopes), there are still maintenance costs (9)

A single-use diagnostic flexible cystoscope, aScope 4 Cysto, was developed by Ambu (Copenhagen, Denmark) with FDA approval in 2020. The aScope 4 Cysto showed comparable benchtop maneuverability and durability to reusable cystoscopes, with higher subjective provider satisfaction for inpatient evaluations. (10) Main advantages of single-use cystoscopes include portability, enhanced sterility, high visual quality, fully digital and recordable procedures for electronic medical records, and avoidance of expensive maintenance and sterilization procedures. (11)

Previously, a single-use flexible cystoscope with integrated grasper (Isiris, Humlebaesk, Denmark) has showed possible cost benefit to reusable stent removal procedure. (12) Kenigsberg et al. has compared single-use versus reusable flexible diagnostic cystoscopy in the United States. (13) They demonstrated that the cost-effectiveness of a single-use cystoscope is dependent on annual cystoscopy volume. Given these findings, it is important to evaluate the economic implications of a single-use flexible cystoscope in the context of the Canadian healthcare system.

Methods

A micro-cost analysis is a detailed review of all costs related to a procedure; this was used to evaluate the per-procedure costs associated with reusable cystoscopy in a combined inpatient and outpatient setting in a tertiary urology referral center in Canada. The data was retrieved from the endoscopy department, which includes reprocessing for both outpatient and inpatient purposes. Annual costs were averaged from two fiscal years (2019-2021). The University Health Network Quality Improvement Review Committee reviewed and approved this project (QI ID 21-0279).

The costs were divided similarly to the study done by Kenigsberg et al., including capital, maintenance, reprocessing and labour. The disposable supply costs were included in the reprocessing costs, since only the disposable supplies in this category account for the cost differences between single-use and reusable cystoscopes. Costs associated with ancillary procedures are not analyzed in this study; for example, stopcocks, stent graspers and fulgurating electrodes.

The capital costs include initial purchases of cystoscopes (Olympus CYF-VH, Tokyo, Japan; 5 year amortization), cystoscope towers (5 year amortization) and sterilization machine (Sterrad, Advanced Sterilization Products, Irvine, CA, USA; 10 year amortization). The maintenance costs include cystoscope repair costs, leak point tester (5 year amortization) and sterilization machine maintenance contract (3 year contract). At this institution, the maintenance of cystoscope repair is not under contract and the total repair per year was used in the calculation. The reprocessing costs include consumables used by sterilization machine and detergent to manually clean the equipment. The labour costs include the wages of the Medical Device Reprocessing Department (MDRD), and calculated by the amount of time that each cystoscope takes to reprocess (41 minutes each). The use of masks, face shields and other personal protective equipment has been omitted from the analysis, since the costs of these will be congruent in reusable and single use cystoscopy procedures.

The reusable cystoscopy per-procedure costs were calculated by dividing the sum of all cost inputs by total cystoscopy volume at the hospital. The theoretical per-procedure costs of single-use cystoscope were then compared based on the cystoscopy volume (aScope Cysto, Ambu, Copenhagen, Denmark). In terms of single-use cystoscopy, the aView2 advance monitor ($4 900) and disposable cystoscope costs ($245) were the only inputs. Two aView2 monitors will be used in the analysis, since the current reusable setup incorporates two cystoscopy towers. In terms of maintenance, the manufacturer replaces the only reusable component, the monitor, for any non-user related damage for the first 5 years. All costs were calculated in Canadian dollars ($CAD).

Results

An average of 3415 cystoscopy procedures were done at a single academic institution per year calculated between 2019 and 2021; the average of two years were included in the analysis based on fiscal year. The total annual cost of reusable cystoscopy was $509 038. (Table 1) The capital,

maintenance, reprocessing and labour costs of reusable cystoscopy are $96 000, $99 867, $247 855 and $65 317, respectively. The fixed costs of reusable and single use cystoscopy were $195 866 and $1 960, respectively. (Table 1 and 2) The variable costs of reusable and single-use cystoscopy were $92 and $245, respectively. The per-procedure cost of reusable cystoscopy was $149.06. The theoretical per-procedure cost of single use cystoscopy was $245.57. At greater than 1265 cases annually, or 63 cases per cystoscope, the reusable cystoscopes were more cost effective to single use cystoscopes (Figure 1).

Discussion

Single use cystoscopes have been designed to counteract the shortcomings of reusable cystoscopes, including enhanced sterility, portability and eliminating the need for reprocessing. There is also no downtime during repairs in contrast to reusable cystoscopes, where the instrument can be out of service for a period of time. Other single use cystoscopes, including NeoFlex (NeoScope, Portsmouth, NH, USA) and Isiris α, have been studied in the literature. (11,14) Small clinical studies have demonstrated that both NeoFlex and Irisis α performs comparably to reusable cystoscopes for routine diagnostic procedures. (11,15,16) Moreover, the sterility of single use cystoscope is attractive given the possibility of uropathogenic infections due to cystoscopy. (17)

According to our analysis, the single use cystoscopes was more cost effective in volumes when cystoscope volumes were less than 1265 cases annually due to lack of upfront capital costs. Therefore, the single use cystoscopes are not economically feasible in the current outpatient volume at this tertiary center. These trends are consistent with previous micro-cost studies performed in other healthcare systems. (13,18,19) The upfront capital costs are justifiable for busy outpatient cystoscopy clinics, where both the procedure and reprocessing is performed systematically in a single setting. Less-equipped areas with inconsistent volume of cystoscopic care are more likely to be suitable for single use cystoscopes. These include satellite clinics, emergency departments and inpatient wards.

Single use ureteroscopes have gained more traction compared to single use cystoscopes, since reusable ureteroscopes have higher frequency of repairs compared to their relative case volume. (9) The cost effectiveness of reusable cystoscopes is related to its durability, as the impact of the initial investment lessens significantly with successive uses. Recent evidence suggest that single use cystoscopy continues to be a more expensive option for dedicated cystoscopy centers despite accounting for reprocessing costs. However, there are other facets of clinical care that are not captured in a micro-cost analysis, which include user/patient satisfaction, efficiency, portability and higher throughput (i.e. more procedures in a single day). Early evidence suggests that single use cystoscopy has equivalent or improved user satisfaction. (10,20) It is important to characterize the role of single use cystoscopes in hospital settings to improve overall urological care.

There are several limitations to this study. Firstly, the retrospective nature of the study is susceptible to biases that may occur without a direct comparison between single use and reusable cystoscopy. For example, the costs of shipping/transporting, other forms of labour (nursing, clinical manager) and disposal (increased solid waste from single use, chemical waste from reprocessing) cannot be adequately captured without real-life use of single use cystoscopy. A prospective collection of data will further strengthen the findings of this study. Secondly, the micro-cost analysis does not include complete replacement of reusable cystoscopes or failures of single use cystoscopy. Assmus et al. demonstrated that the failure rate of single use cystoscopy was 5% in a sample of 91 cases; these cases required reusable cystoscopes. (20) A complete failure of a reusable cystoscope would require complete replacement and may spike the per case cost of reusable cystoscopy significantly. A way to capture these rare events would be to study a longer time interval of cases. Thirdly, this micro-cost analysis may not be extrapolatable to other institutions and healthcare systems. Most procedures were simple outpatient cystoscopy procedures such as hematuria workups, bladder tumour surveillance and lower urinary tract symptom workups. Our institution does not perform complex or prolonged endourological procedures such as percutaneous nephrolithotomy which may carry an increased risk of instrument damage. Although the absolute value of the finances may not reflect other institutions, the authors would like to emphasize the trend where economic feasibility ultimately depends on cystoscopy volume. Finally, these calculations do not capture pricing discounts provided for volume-based usage or institutional contracts. For example, some single use companies may provide cystoscopy monitors for no cost if certain volumes of cystoscopes are purchased.

Conclusions

This retrospective micro-cost analysis determined that reusable cystoscopy becomes more cost effective at large clinical volumes compared to single use cystoscopy. Since single use cystoscopy is more valuable in lower case volumes, it is important to determine their effectiveness in settings that do not have dedicated reprocessing departments, and cases where portability and sterility is prioritized. Moreover, single use cystoscopes may supplement when the availability of reusable cystoscopes are exhausted. Future directions include workflow studies amongst users, environmental impact of single use cystoscopes and prospective data to solidify the role of single use devices in cystoscopy and capture differences in user/patient satisfaction, efficiency, and portability.

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Figures and Tables

Figure 1. Comparing the costs per case for reusable (dotted lines) and single-use cystoscope (solid lines) dependent on case volume. The lines intersect at 1265 cases.

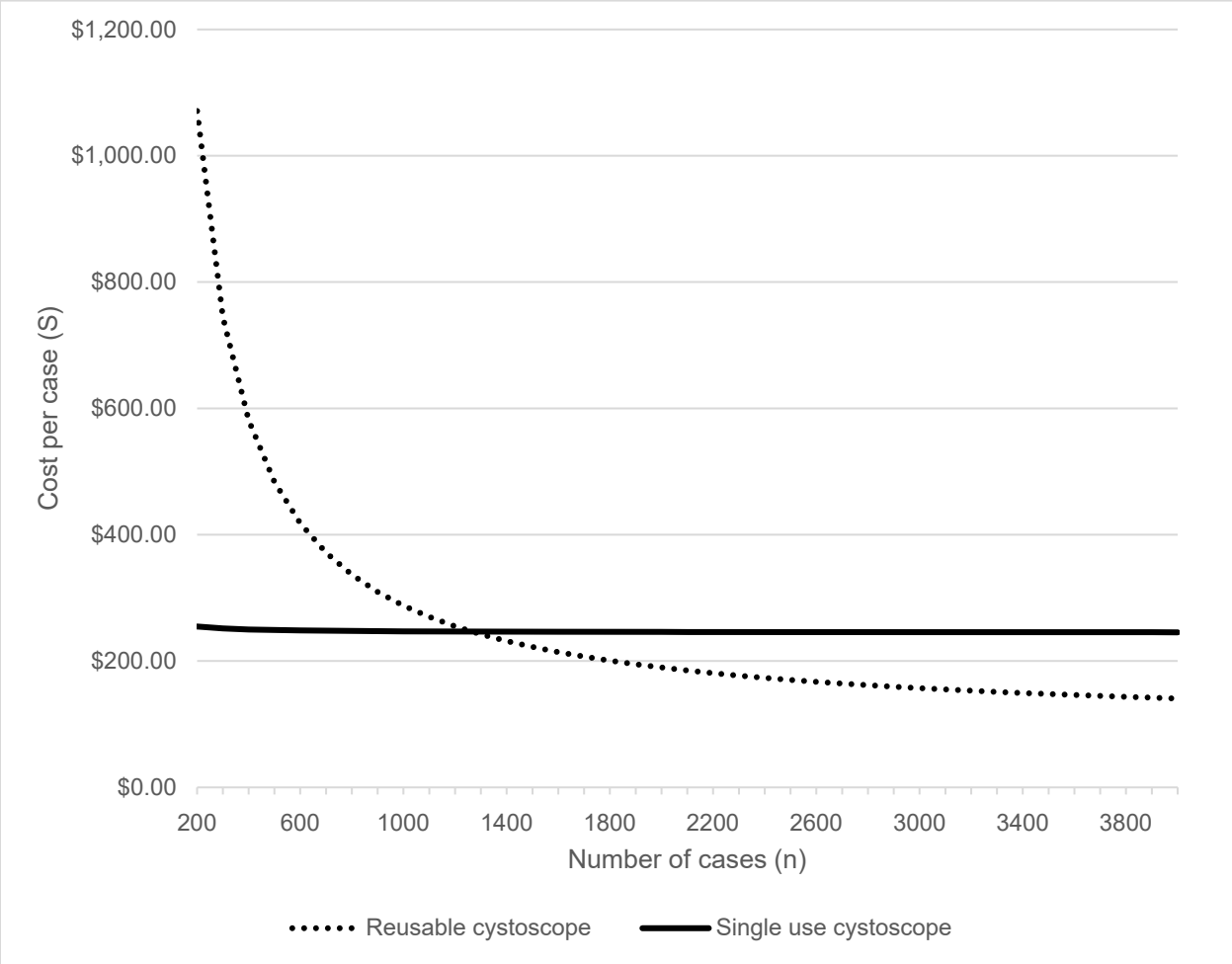

Table 1. The costs associated with reusable cystoscopy in a single institution					
	Quantity	**Cost per unit (CAD)**	**Total cost (CAD)**	**Amortization (in years)**	**Annual cost (CAD)**
Capital					
Cystoscopes	20	$15 000.00	$300 000.00	5	$60 000.00
Cystoscope tower	2	$80 000.00	$160 000.00	10	$16 000.00
Sterilization machine (Sterrad)	1	$200 000.00	$200 000.00	10	$20 000.00
				Total capital	**$96 000.00**
Maintenance					
Cystoscope repairs	7	$8300.00	$85 000.00	1	$85 000.00
Leak point tester			$1500.00	5	$300.00
Sterrad maintenance contract			$43 700.00	3	$14 566.67
				Total maintenance	**$99 866.67**
Reprocessing					
Sterrad consumables*	–		$236 795.00	1	$236 795.00
Cassettes	–		$168 596.09		
Trays	–		$6292.22		
Boosters	–		$23 807.44		
Indicators	–		$31 048.94		
Indicator reader	–		$1920.00		
Sterile tape	–		$229.78		
Endozime detergent	3415	1.19	$4055.31	1	$4055.31
Alcohol swabs	3415	0.02	$57.08	1	$57.08
Gloves	3415	0.67	$2302.73	1	$2302.73
Single-use cleaning brush	3415	1.36	$4644.40	1	$4644.40
Total reprocessing					**$247 854.53**
Labor					
MDRD operator^	3415	19.31	$65 317.00	1	$65 317.00
				Total labour	**$65 317.00**
				Total annual cost for reusable cystoscopy	**$509 038.20**

*The sterilization machine consumables were calculated by annual costs to the department, rather than extrapolating from quantity used. ^The MDRD operator has an average wage of $27.99 and it takes approximately 41 minutes to sterilize a single cystoscope.

Table 2. The theoretical costs associated with single-use cystoscopy in a single institution for the same case volume

	Quantity	Cost per unit (CAD)	Total cost (CAD)	Amortization (in years)	Annual Cost ($CAD)
Capital					
Single use cystoscopes	3415	$245.00	$836 675.00	1	$836 675.00
Monitors	2	$4900.00	$9800.00	5	$1960.00
				Total capital	**$838 635.00**
Maintenance*					
Total maintenance					**$0.00**
Reprocessing*					
				Total reprocessing	**$0.00**
Labor*					
				Total labor	**$0.00**
				Total annual cost for reusable cystoscopy	**$838 635.00**

*The manufacturer allows warranty that replaces monitors in 5 years, which results in no maintenance costs theoretically. There is no costs associated with reprocessing and the labor costs only apply to reprocessing duties, not clinical duties associated with cystoscopy.