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ASP Advanced Sterilization Products

2024 WEBINAR SERIES #5
MEDICAL DEVICES BACK TO THE REPROCESSING: FUTURE

SUSTAINABILITY AND ECONOMIC CONSIDERATIONS BEHIND MEDICAL DEVICE REPROCESSING TECHNOLOGIES

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5th WEBINAR

INTRO

WHEN MAKING DECISIONS ABOUT INVESTMENT IN NEW TECHNOLOGY OR SERVICES IN HEALTHCARE, IT IS IMPORTANT TO CONSIDER A RANGE OF FACTORS. MAKING A DECISION BASED ONLY ON WHAT IS "CHEAPEST" OR "BEST" MAY BE SHORT-SIGHTED. OFTEN THERE IS MORE TO A PRODUCT OR SERVICE THAN WHAT YOU SEE UP FRONT.

Economic evaluation allows both costs and outcomes including effectiveness and environmental impacts to be considered together. Modelling can account for different time frames or uncertainty, to enable comprehensive understanding of the impact of different choices.

THE PRINCIPLES CAN BE APPLIED TO QUANTIFYING ASPECTS OF THE CARBON FOOTPRINT SUCH AS ENERGY, WATER USE AND WASTE.

IMAGE SOURCE:https://pixabay.com/photos/pills-tablets-s-tethoscope-ecg-1961431/

THE EVALUATION OF BOTH THE ONGOING COSTS AND OUTCOMES RELATED TO A NEW PRODUCT OR SERVICE IS IMPORTANT AS MANY COUNTRIES ARE NOW SPENDING CLOSE TO 10% OF GDP ON HEALTH. SPENDING MORE MEANS LESS MONEY FOR OTHER PUBLIC SERVICES INCLUDING EDUCATION, AND INFRASTRUCTURE SUCH AS ROADS. SPENDING MORE DOES NOT GUARANTEE BETTER OUTCOMES.

IF WE FAIL TO CONSIDER BOTH COSTS AND EFFECTS WHEN INVESTING IN NEW TECHNOLOGY, WE MAY INADVERTENTLY DRAW RESOURCES AWAY FROM OTHER SERVICES WHICH GENERATE GOOD OUTCOMES FOR PATIENTS OR THE HEALTH SYSTEM. A COMPREHENSIVE EVALUATION SHOULD ASSESS LONGER-TERM COSTS AND BENEFITS OF DIFFERENT OPTIONS, INCLUDING ENVIRONMENTAL CONSIDERATIONS, IN DIFFERENT SETTINGS.

THE PRINCIPLES BEHIND HEALTH ECONOMIC EVALUATION OF TREATMENTS AND SERVICES CAN BE APPLIED TO OTHER DECISIONS TO HELP UNDERSTAND THE COSTS AND CONSEQUENCES OF CHOOSING DIFFERENT TYPES OF STERILIZATION SYSTEMS.

01. Addressing the climate impact of healthcare

THE CLIMATE FOOTPRINT OF HEALTHCARE HAS BEEN ESTIMATED TO BE EQUIVALENT TO 4.4% OF GLOBAL NET EMISSIONS[1]. FIGURES VARY ACROSS COUNTRIES BUT ARE ESTIMATED TO BE 5.4% OF EMISSIONS IN THE UK, 5.1% FOR AUSTRALIA, AND 7.6% FOR THE USA(1). THE IMPACTS OF CLIMATE CHANGE ARE NOW BEING SEEN GLOBALLY. TRADITIONALLY, EVALUATION OF HEALTHCARE SERVICES AND TECHNOLOGY HAS NOT INCLUDED INFORMATION ABOUT CARBON EMISSIONS OR OTHER ENVIRONMENTAL FACTORS.

SUSTAINABILITY MEASURES SHOULD BE INCLUDED IN TECHNOLOGY ASSESSMENT BECAUSE EMISSIONS FROM HEALTHCARE HAVE A NEGATIVE EFFECT ON THE ENVIRONMENT AND THEREFORE ON HEALTH. LIFE CYCLE ASSESSMENT OF CARBON EMISSIONS WHICH INCLUDES RAW MATERIAL ACQUISITION (E.G., MINING), MANUFACTURING, USE AND DISPOSAL OR RECYCLING OF ITEMS, IS THE BEST APPROACH. WHILE THIS TYPE OF ASSESSMENT IS NOT ROUTINELY CARRIED OUT FOR HEALTH TECHNOLOGIES, WE DO HAVE SOME ESTIMATES OF CARBON EMISSIONS ASSOCIATED WITH KEY CONTRIBUTORS SUCH AS WATER AND ELECTRICITY USE.

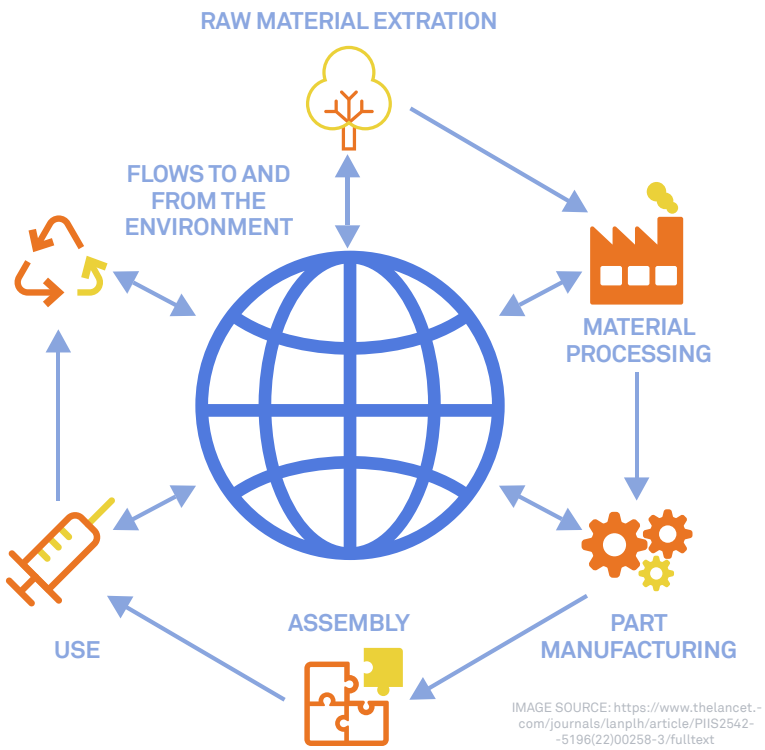

IMAGE SOURCE: https://www.thelancet.-com/journals/lanplh/article/PIIS2542--5196(22)00258-3/fulltext

The climate footprint of healthcare has been estimated to be equivalent to 4.4% of global net emissions.

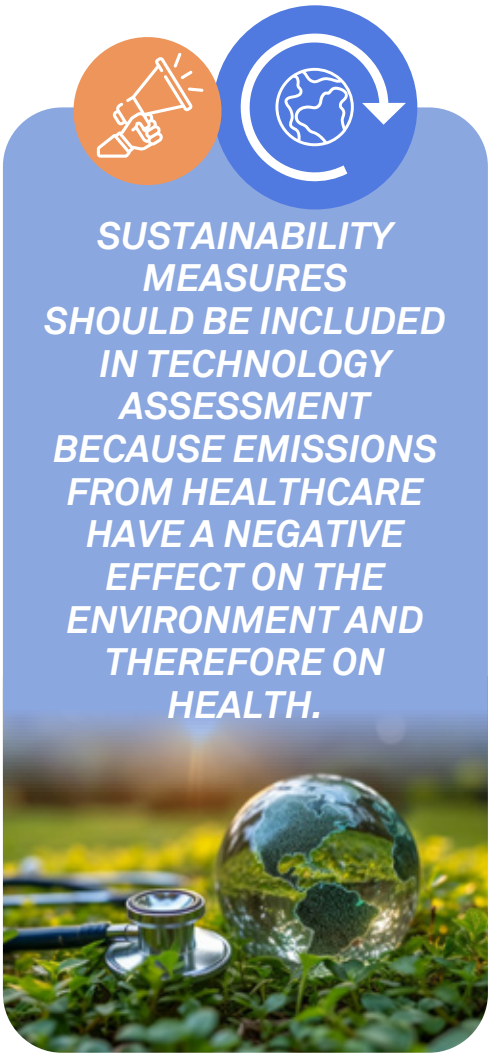

IMAGE SOURCE: https://www.freepik.com/free-ai-image/earth-day-celebration-concept_144428085.htm#fromView=search&page=1&position=2&uuid=0b8c1eee-cc23-4673-a080-a15d6a367dc0

02. Introduction to health economic evaluation

MANY COUNTRIES NOW SPEND 10% OR MORE OF GPD ON HEALTHCARE. SPENDING ON HEALTHCARE CANNOT CONTINUE TO INCREASE WITHOUT LIMIT, AND MUST BE CONSIDERED IN THE CONTEXT OF SPENDING ON OTHER IMPORTANT PUBLIC SERVICES. **FAILING TO CONSIDER BOTH COSTS AND OUTCOMES MAY MEAN WE ALLOCATE SCARCE HEALTHCARE RESOURCES IN WAYS THAT ARE INEFFICIENT AND INEQUITABLE.**
HEALTH ECONOMIC EVALUATION ENABLES THE CONSIDERATION OF BOTH COSTS AND HEALTH OUTCOMES.

Key factors in economic evaluation:

- **Benefits** of each option – effectiveness
- **Costs** related to each option
- Appropriate **timeframe**
- **Uncertainty** in estimates of costs and benefits – enables a more complex decision analysis

COMPARING BOTH EFFECTIVENESS AND COSTS OF DIFFERENT TREATMENTS, SERVICES, TECHNOLOGIES.

WHY NOT JUST USE THE "BEST" OR THE "CHEAPEST"?

WHAT YOU SEE UP-FRONT MAY ONLY BE PART OF THE STORY.

Failing to consider both costs and outcomes may mean we allocate scarce healthcare resources in ways that are inefficient and inequitable.

MANY COUNTRIES NOW SPEND 10% OR MORE OF GPD ON HEALTHCARE.

03.Sterilizer factors

THE KEY FACTORS TO CONSIDER WHEN EXAMINING THE COSTS AND CARBON FOOTPRINT ASSOCIATED WITH DIFFERENT STERILIZERS ARE: ENERGY CONSUMPTION, WATER CONSUMPTION, EFFECT ON OR DAMAGE TO INSTRUMENTS, DISPOSABLE OR SINGLE USE CONSUMABLE ITEMS.

WHEN THINKING ABOUT THE CARBON FOOTPRINT RELATED TO CONSUMABLES, IT IS IMPORTANT TO CONSIDER THE IMPACT OF THEIR PRODUCTION AND DISPOSAL, THE CHOICE OF REUSABLE VERSUS SINGLE-USE WRAPS, POUCHES AND TRAYS.

Increasing costs of electricity and water

THERE HAVE BEEN DRAMATIC INCREASES IN THE COST OF ELECTRICITY DUE TO THE WAR IN THE UKRAINE. USE OF ELECTRICITY IS THEREFORE ALSO COSTLY FROM A FINANCIAL PERSPECTIVE, AS WELL AS CONTRIBUTING TO THE CARBON FOOTPRINT. THE COSTS OF WATER ARE ALSO INCREASING AND IN SOME PLACES RESTRICTIONS ARE IN PLACE DUE TO DROUGHT CONDITIONS.

IN A WORLD AFFECTED BY CLIMATE CHANGE AND DROUGHT, AS WELL AS INCREASING ENERGY PRICES DUE TO WAR AND OTHER FACTORS, IT IS IMPORTANT TO MODERATE USE OF THESE RESOURCES WHERE POSSIBLE.

IMAGE SOURCE:https://justenergy.com/blog/how-to-calculate-your-carbon-footprint/

Electricity (€/MWh) 2020 vs 2022 (%)

ITALY 47,46€ - 441,74€ (931%)	GERMANY 34,98€ - 315,26€ (901%)	FRANCE 37,97€ - 400,95€ (1056%)

(MONTHLY ELECTRICITY PRICES IN SELECTED EU COUNTRIES 2020-2022; PUBLISHED BY BRUNA ALVES; AUG 23, 2022)

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The key factors to consider when examining the costs and carbon footprint associated with different sterilizers are: energy consumption, water consumption, effect on or damage to instruments, disposable or single use consumable items.

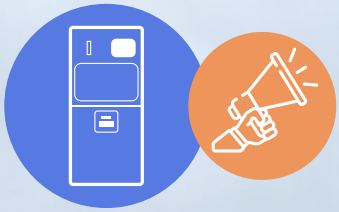

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IMAGE SOURCE:https://www.freepik.com/free-photo/earth-planet-hour-glass-global-warming-concept_17573717.htm#fromView=search&page=1&position=38&uuid=778a2a4f-ac43-4e41-9e16-f5ca94f433ec

04. Instrument factors

DIFFERENT STERILIZATION METHODS HAVE DIFFERENT EFFECTS ON MEDICAL INSTRUMENTS. IN PARTICULAR, INSTRUMENTS MADE OF PLASTICS, CORROSION-SUSCEPTIBLE METAL ALLOYS AND ELECTRICAL DEVICES ARE AFFECTED BY HIGH TEMPERATURE AND HUMIDITY. STEAM STERILIZATION MAY DAMAGE SUCH INSTRUMENTS MEANING THEY NEED TO BE REPAIRED OR REPLACED MORE FREQUENTLY. REPAIRS AND REPLACEMENT ALSO HAVE AN EFFECT ON CARBON FOOTPRINT BECAUSE OF THE ENERGY AND OTHER RESOURCE REQUIREMENTS NEEDED TO REPAIR INSTRUMENTS, MAKE NEW PARTS OR DEVICES.

Case studies in damage to endoscopes and cost of repairs:

A CASE STUDY ON THE FREQUENCY OF DAMAGE TO RIGID ENDOSCOPES WHEN A HOSPITAL CHANGED FROM USING STEAM TO A LOW-TEMPERATURE SYSTEM, SHOWED A **33% REDUCTION IN THE NUMBER OF REPAIRS AND A 58% REDUCTION IN THE NUMBER OF REPAIRS PER PROCEDURE.**[3,4]

Across 7 different studies of endoscope repairs, the average cost was $US 3,749.35 per repair. Substantial savings can be made by reducing the frequency of damage to instruments like endoscopes.[5,6,4,7–11]

- (LANDMAN J, LEE D, LEE C, MONGA M. EVALUATION OF OVERALL COSTS OF CURRENTLY AVAILABLE SMALL FLEXIBLE URETEROSCOPES. UROLOGY 2003;62:218-22.
- MAHAWONGKAJIT P, TECHAGUMPUCH A, AUKSORNCHAT K. EFFECTS OF BASIC ENDOSCOPIC HANDLING AND CARE TRAINING ON GASTROINTESTINAL ENDOSCOPY LOGISTICS. ENDOSC INT OPEN. 2022 JAN 14;10(1):E56-E61. DOI: 10.1055/A-1630-6403.
- SKOGAS J, MARVIK R. MEASURES TAKEN TO REDUCE DAMAGE AND REPAIR COSTS OF RIGID ENDOSCOPES DURING THEIR HANDLING AND PROCESSING IN SURGICAL PRACTICE. MINIM INVASIVE THER ALLIED TECHNOL 2003;12:76-81.
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- SUNG J, SPRINGHART W, MARGUET C, L'ESPERANCE JO, TAN YH, ALBALA DM, ET AL. LOCATION AND ETIOLOGY OF FLEXIBLE AND SEMIRIGID URETEROSCOPE DAMAGE. UROLOGY 2005;66:958-63
- CANALES B, GLEASON J, HICKS N, MONGA M. AN INDEPENDENT ANALYSIS OF FLEXIBLE CYSTOSCOPE REPAIRS AND COST. J UROL 2007;178:2098-102.
- STATHAM M, WILLGING JP. AUTOMATED HIGH-LEVEL DISINFECTION OF NONCHANNELED FLEXIBLE ENDOSCOPES: DUTY CYCLES AND ENDOSCOPE REPAIR. LARYNGOSCOPE 2010;120:1946-9
- INFLATION CALCULATOR: HTTPS://WWW.BLS.GOV/DATA/INFLATION_CALCULATOR.HTM)

33% reduction in the number of repairs and a 58% reduction in the number of repairs per procedure.

INSTRUMENTS MADE OF PLASTICS, CORROSION-SUSCEPTIBLE METAL ALLOYS AND ELECTRICAL DEVICES ARE AFFECTED BY HIGH TEMPERATURE AND HUMIDITY

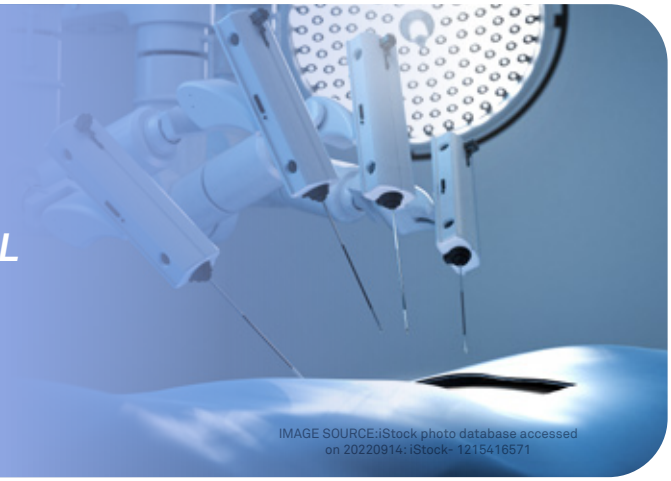

IMAGE SOURCE:iStock photo database accessed on 20220914: iStock- 1215416571

05. How to evaluate the economics in your context

WHEN EVALUATING DIFFERENT STERILIZATION OPTIONS, **IT IS IMPORTANT TO THINK ABOUT WHAT FACTORS ARE RELEVANT TO THE CONTEXT**.

MODELS CAN BE FLEXIBLE TO DIFFERENT INPUTS AND TIMEFRAMES AND INCLUDE MULTIPLE RELEVANT COSTS AND OUTCOMES. THEY CAN ALSO BE RUN MULTIPLE TIMES WITH NEW VALUES, TO INCORPORATE UNCERTAINTY IN ESTIMATES OF, FOR EXAMPLE, ELECTRICITY USAGE AND COSTS.

It is important to think about what factors are relevant to the context, for example, budgetary requirements for capital expenditure v. ongoing, local considerations – renewable energy, waste disposal, water.

Key context-specific factors:

- Relevant timeframe
- Instruments used
- Inflation – changing costs over time
- Budgetary requirements for capital expenditure v. ongoing
- Local considerations – renewable energy, waste disposal, water

MODELS CAN BE FLEXIBLE TO DIFFERENT INPUTS AND TIMEFRAMES AND INCLUDE MULTIPLE RELEVANT COSTS AND OUTCOMES

Carbon emissions from water and electricity

Category	Emission Factor	Source
WATER CONSUMPTION	0.132 KG CO_2/M^3	PARIS HOSPITALS[12]
ELECTRICITY CONSUMPTION	64.7KG CO_2/MWH	PARIS HOSPITALS[12]
	440.8 KG CO_2/MWH	GERMANY[13]
	256.2 KG CO_2/MWH	ITALY[13]
WASTEWATER TREATMENT	0.26 KG CO_2/M^3	PARIS HOSPITALS[12]

EXAMPLE MODEL EXAMINING COST AND CARBON EMISSIONS FROM WATER AND ELECTRICITY ONLY (OTHER FACTORS MAY BE IMPORTANT IN YOUR CONTEXT). IN THIS EXAMPLE, LOW TEMPERATURE REFERS TO HYDROGEN PEROXIDE GAS PLASMA STERILIZERS.

THIS EXAMPLE SHOWS THE HOW TO CALCULATE THE DIFFERENCE IN WATER AND ELECTRICITY CONSUMPTION PER M^3 BETWEEN A STANDARD 600L STEAM STERILIZER AND A 100L HYDROGEN PEROXIDE GAS PLASMA STERILIZER, AS WELL AS ASSOCIATED COSTS AND CARBON EMISSIONS.

SOURCE:Graphics: courtesy PhD Victoria McCreanor, Newcastle – Australia, 2024

References for the calculations

35. Cost of electricity in Germany. Electricity: https://www.statista.com/statistics/1267500/eu-monthly-wholesale-electricity-price-country/. **36.** Carbon emissions: Germany Climate impact checkup tool v3.3 https://healthcareclimateaction.org/checkup **37.** Waste water carbon emissions: https://www.eahp.eu/content/carbon-footprint-sterilisation-unit | **38.** Water cost in Germany: https://waterstatistics.iwa-network.org/graph/VG90YWwgQ2hhcmdlcyBmb3IgQ2FwaXRhbHMgKFVTJCk/100/2023 **39.** Currency conversion: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.htm **40.** Frequency and cost of repairs: Skogas J, Marvik R. Measures taken to reduce damage and repair costs of rigid endoscopes during their handling and processing in surgical practice. Minim Invasive Ther Allied Technol 2003;12:76-8 **41.** Cost of repairs: Schafer B. Decreased number of repairs of rigid scopes as a result of low-temperature sterilization with H2O2 gas plasma. A field report form the Barmherzige Bruder Hospital in Trier, Germany. Central Serv 2009;17:194-6. **42.** Cost of repairs: Sung J, Springhart W, Marguet C, L'Esperance JO, Tan YH, Albala DM, et al. Location and etiology of flexible and semirigid ureteroscope damage. Urology 2005;66:958-63

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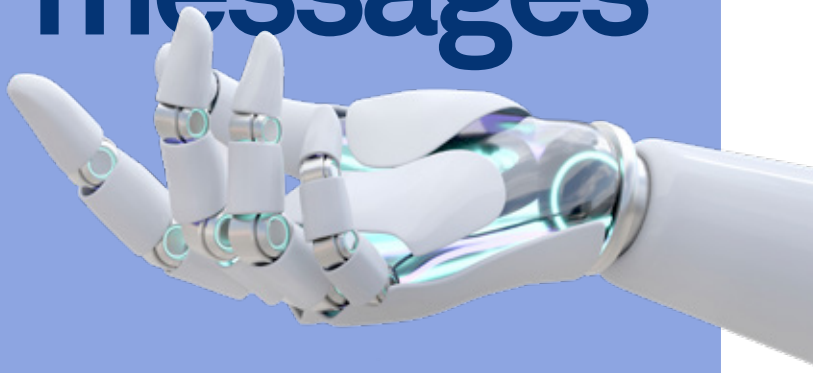
Resume

THERE ARE MANY FACTORS TO CONSIDER WHEN ASSESSING DIFFERENT STERILIZATION TECHNIQUES, THEIR COSTS AND IMPACT ON CARBON FOOTPRINT.

THESE FACTORS INCLUDING ONGOING ENERGY AND WATER REQUIREMENTS, COSTS AND IMPACT OF CONSUMABLES, STERILANT, TESTING AND MAINTENANCE, REQUIRE GREATER THOUGHT THAN WHAT MIGHT BE EVIDENT IMMEDIATELY. THE PRINCIPLES USED IN HEALTH ECONOMIC EVALUATION CAN BE APPLIED TO EVALUATE DIFFERENT OPTIONS IN DIFFERENT CONTEXTS TO ALLOW A MORE HOLISTIC DECISION-MAKING APPROACH AND MORE COMPREHENSIVE UNDERSTANDING OF THE ENVIRONMENTAL IMPACTS AND COSTS OF DIFFERENT OPTIONS.

Take home messages



1. Important to look beyond the up-front costs of the steriliz-er.
2. There are large differences in energy and water consumption: important in current environment.
3. Effect of different sterilizing processes on instruments important consideration (affects costs & carbon footprint).
4. Consumables/disposable items also contribute to carbon footprint.
5. Economic evaluation can be used to assess decisions your context.

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1. Health Care Without Harm, ARUP. Healthcare's Climate Footprint. 2019. 2. Statista. Average monthly electricity wholesale prices in selected countries in the European Union (EU) from January 2020 to September 2023 [Internet]. 2023. Available from: https://www.statista.com/ 3. McCreanor V, Graves N. An economic analysis of the benefits of sterilizing medical instruments in low-temperature systems instead of steam. Am J Infect Control. 2017 Jul 1;45(7):756–60. 4. Skogås JG, Mårvik R. Measures taken to reduce damage and repair costs of rigid endoscopes during their handling and processing in surgical practice. Minim Invasive Ther Allied Technol. 2003 Mar;12(1):76–81. 5. Landman J, Lee DI, Lee C, Monga M. Evaluation of overall costs of currently available small flexible ureteroscopes. Urology. 2003 Aug;62(2):218–22. 6. Mahawongkajit P, Techagumpuch A, Auksornchat K. Effects of basic endoscopic handling and care training on gastrointestinal endoscopy logistics. Endosc Int Open. 2022 Jan;10(1):E56-e61. 7. Schäfer B. Decreased number of repairs of rigid scopes as a result of low-temperature sterilization with H2O2 gas plasma: A field report from the Barmherzige Brüder Hospital in Trier, Germany. 2009 01;17:191–6. 8. Sung JC, Springhart WP, Marguet CG, L'Esperance JO, Tan YH, Albala DM, et al. Location and etiology of flexible and semirigid ureteroscope damage. Urology. 2005 Nov;66(5):958–63. 9. Canales BK, Gleason JM, Hicks N, Monga M. An independent analysis of flexible cystoscope repairs and cost. J Urol. 2007 Nov;178(5):2098–101; discussion 2102. 10. Statham MM, Willging JP. Automated high-level disinfection of nonchanneled flexible endoscopes: duty cycles and endoscope repair. Laryngoscope. 2010 Oct;120(10):1946–9. 11. U. S. Bureau of Labor Statistics. CPI Inflation Calculator [Internet]. 2023. Available from: https://data.bls.gov/cgi-bin/cpicalc.pl 12. Lemonnier J, Bottois C, Talon D. Carbon Footprint of a Sterilization Unit [Internet]. EAHP Congress 2021; 2021. Available from: https://eahp.eu/congress_poster_walk/carbon-footprint-sterilisation-unit 13. Climate impact checkup tool v3.3 [Internet]. Available from: https://healthcareclimateaction.org/checkup

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