Volume 4, No. 8 August 2025 - (1304-1312)
p-ISSN 2980-4868 | e-ISSN 2980-4841
https://ajesh.ph/index.php/gp

The Effectiveness of Reprocessing Single-Use Medical Devices in Improving Cost Efficiency and Hospital Resource Management: A Systematic Review

Lusia Enggar Wijayanti[1], Wiku Bakti Bawono Adisasmito[2]
Universitas Indonesia
Emails: lusiaenggarw@gmail.com

ABSTRACT

The reprocessing of single-use medical devices (SUDs) has emerged as a strategic approach to enhance cost efficiency and sustainability in healthcare systems. This systematic review evaluates the effectiveness of SUD reprocessing in improving hospital resource management while maintaining patient safety standards. The study examines the entire reprocessing cycle, including cleaning, disinfection, sterilization, repackaging, and relabeling, which is conducted under strict protocols supervised by designated hospital committees. Our findings demonstrate that various SUDs—including cardiovascular catheters, laparoscopic instruments, staplers, and energy-based surgical tools—can be safely reprocessed, with clinical outcomes comparable to new devices. Economically, reprocessing yields substantial savings, reducing device costs by up to 50% and potentially saving a 200-bed hospital $600,000 to $1 million annually. In the United States alone, annual cost savings from SUD reprocessing are projected to exceed $2 billion by 2025. Beyond financial benefits, this practice significantly reduces medical waste, contributing to environmental sustainability in healthcare. The review highlights that successful implementation requires robust quality standards, regulatory compliance, and multidisciplinary oversight. While challenges exist, particularly in resource-limited settings, the evidence supports SUD reprocessing as a safe, cost-effective, and environmentally responsible strategy for modern healthcare systems.

Keywords: Reprocessing, single use, medical device, hospital efficiency

INTRODUCTION

The reuse of *single-use devices* is a common practice in most countries worldwide. The primary reason for reprocessing *SUDs* is to reduce costs passed on to patients. If the full cost of each new *SUD* is charged, individuals in low-income or developing countries may not be able to afford medical services. Other aspects to consider in the reuse of *SUD* include the availability of devices, patient safety, availability of equipment, and the time or technique of the reprocessing process. However, the adoption of *SUDs* reprocessing is not without challenges. Concerns about patient safety, clinical effectiveness, and regulatory compliance are major issues. In some developing countries, reprocessing practices are often carried out without adequate regulation, increasing the risk of infection and other complications (Zheng et al., 2022).

Previous studies have explored various aspects of *SUD* reprocessing. For instance, de Sousa Martins et al. (2017) compared the clinical and financial outcomes of reprocessed versus original *single-use devices*, finding no added clinical risks and significant cost savings of up to 50% per device. Similarly, Garay et al. (2017) conducted a cost-comparison analysis in Argentina, demonstrating that reprocessing policies for trocars, endocutters, and harmonic scalpels resulted in substantial cost reductions without compromising safety. Despite these findings, there remains

a notable research gap in comprehensively evaluating the combined economic and environmental impacts of *SUD* reprocessing, particularly in developing countries where regulatory frameworks may be less robust (Siu et al., 2016).

The cost efficiency generated from the *SUDs* reprocessing process is significant. Studies show that reprocessed medical devices can reduce costs by up to 50% compared to new devices. In addition, a 200-bed hospital that fully adopts a reprocessing program can save between $600,000 and $1 million per year. These savings enable greater allocation of funds for core clinical services and improvements in patient care quality (Pollmanns et al., 2024). Conversely, in countries with strict regulations such as Germany and Japan, reprocessing is conducted to high standards to ensure the safety and effectiveness of reused medical devices (Robertson et al., 2021).

A study from a cancer center in India shows that with the right policies, reprocessing can significantly reduce costs for patients without compromising the quality of care. In Indonesia, the implementation of *SUDs* reprocessing is still limited and requires more attention from stakeholders (Bayrak & Soylu, 2021).

Against this backdrop, this study aims to address the research gap by systematically reviewing the economic and environmental benefits of *SUD* reprocessing, while also examining the challenges and regulatory considerations associated with its implementation. The novelty of this study lies in its integrative analysis of cost efficiency and environmental impact, providing a holistic perspective that has not been sufficiently explored in existing literature. By synthesizing evidence from diverse settings, this review seeks to offer actionable insights for policymakers and hospital administrators, particularly in resource-constrained environments (Sağlam et al., 2014).

The objectives of this study are threefold. First, it seeks to evaluate the cost-saving potential of reprocessing *single-use medical devices (SUDs)* in healthcare settings, analyzing how this practice can reduce expenses while maintaining service quality. Second, the study aims to assess the environmental benefits of reprocessing, particularly in terms of reducing medical waste and its ecological footprint. Third, it endeavors to identify best practices and regulatory frameworks that ensure the safety and efficacy of reprocessed devices, addressing concerns about patient safety and compliance. The findings of this research are expected to contribute significantly to the development of sustainable healthcare practices, offering hospitals and policymakers actionable insights into the economic and environmental advantages of *SUD* reprocessing. By bridging the gap between theoretical research and practical implementation, this study aims to inform evidence-based policy decisions and encourage the global adoption of safe, efficient, and sustainable reprocessing programs in healthcare systems.

METHOD

The research method used is a Narrative Review. The literature used includes scientific articles from academic databases, books, reports, and regulations. Data analysis includes articles that have undergone peer review between 2010 and 2025, with a focus on the reprocessing of single-use medical devices. Representative studies from leading journals are prioritized. The search period is from May 12, 2025, to May 17, 2025.

Literature Search Strategy

The PICO framework is used, where the population is focused on hospitals, specifically surgical units and operational management. The intervention targets the implementation of reprocessing processes for single-use medical devices, such as sterilization, revalidation, and standardized reuse. Comparisons are made with the use of single-use medical devices without reprocessing (single-use and disposal) or hospitals that do not adopt reprocessing policies. Expected outcomes include improved hospital operational efficiency, reduced medical waste, enhanced effectiveness of medical device management, and maintenance of safety and quality standards in healthcare services.

Table 1. PICO Formulation (*Population, Intervention, Comparison, Outcome*)

PICO	Keywords
Population	Hospitals, particularly surgical wards and operational management.
Intervention	Implementation of *reprocessing* procedures for single-use medical devices (SUDs), including sterilization, revalidation, and standardized reuse.
Comparison	Use of single-use medical devices without reprocessing (single-use disposal), or hospitals that do not adopt a reprocessing policy.
Outcome	Improved hospital operational efficiency, reduced medical waste, enhanced effectiveness of device management, and maintenance of safety and quality standards in healthcare services.

Source: Adapted from the PRISMA-P framework (Shamseer et al., 2015)

Journal articles were obtained from four electronic journal databases, namely *Scopus, ScienceDirect, Proquest*, and *Pubmed.* The researcher used several keywords for journal searches, including *"reprocessing single-use device," "medical device reuse," "hospital cost efficiency,"* and *"cost-effectiveness*." These four search keywords were selected because they yielded the most relevant search results and effectively filtered articles aligned with the research topic. The literature search was conducted from May 12 to 17, 2025. The search strategy used the keywords (*"reprocessing" OR "reuse") AND ("single-use" OR "disposable") AND ("cost-effectiveness" OR "cost-Efficiency") AND "medical device"* from the *Scopus, Science Direct, Proquest* databases, and other journal articles from PubMed, *Google Scholar,* Theses, regulations, and other relevant references supporting this study.

All journal articles obtained through the search process will undergo the next selection stage, which involves filtering out duplicate articles. Subsequently, the journal articles will be filtered again based on inclusion and exclusion criteria as outlined in Table 2. The evaluation results of the journal articles will be presented in detail according to the PRISMA guidelines, as shown in Figure 1.

Table 2. Inclusion and Exclusion Criteria for Journal Article

Inclusion Criteria	Exclusion Criteria
Research written in Indonesian or English	Research not conducted in the scope of health
Research published over the past 10 years, from 2015 to 2025	Research that has not yet been officially published in scientific journals, research conducted before 2015
Data obtained from primary data	Articles in the form of opinions, editorials, or comments without supporting data
Articles are available in *full* text	

Source: Developed by the authors based on systematic review protocols (Liberati et al., 2009)

Articles relevant to the topic Effectiveness of the reprocessing of single-use medical devices

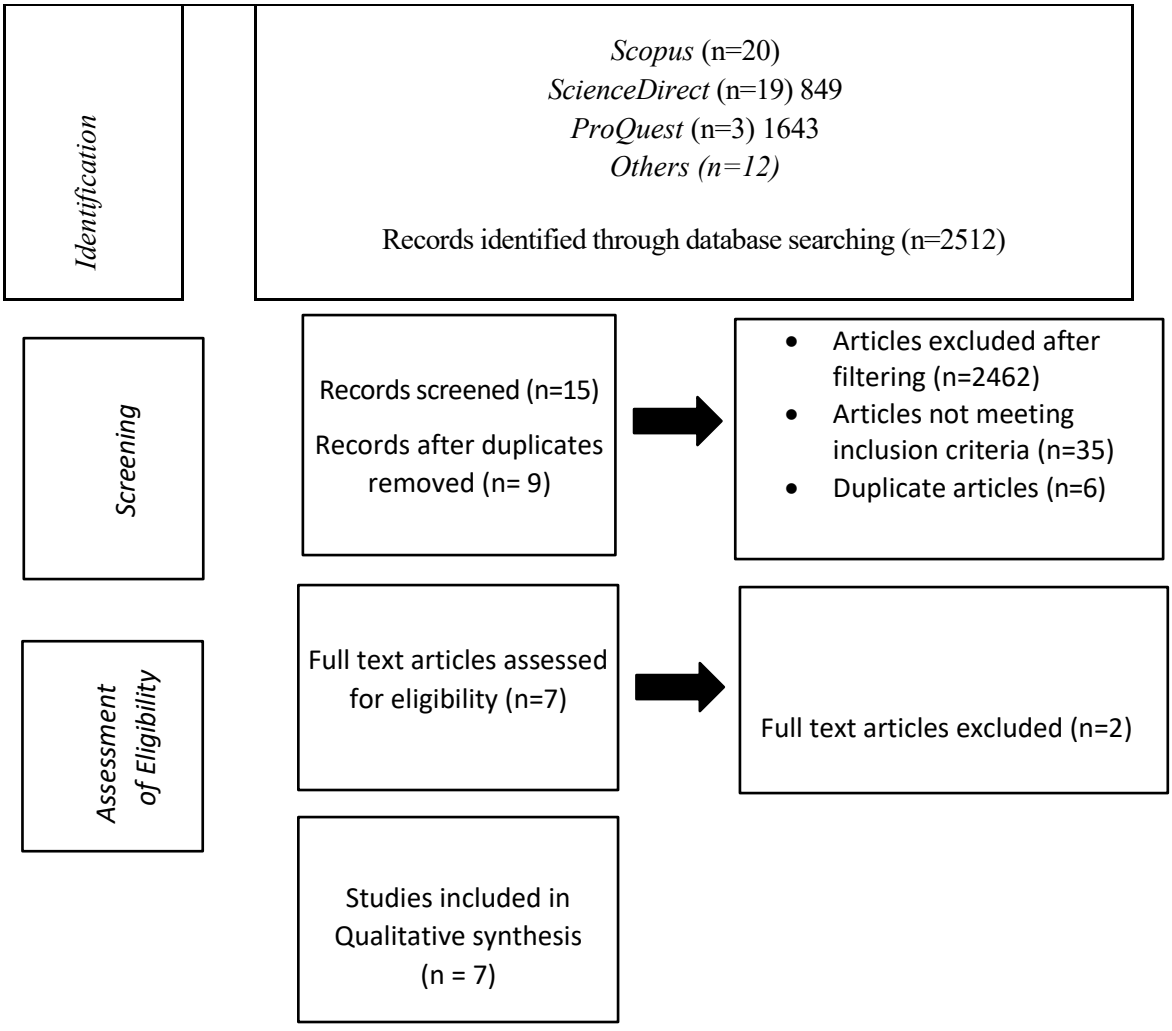

Figure 1. PRISMA Diagram

Source: Adapted from Moher et al. (2009), PRISMA Statement

Table 3. Seven articles reviewed related to the effectiveness of reprocessing single-use medical devices in improving cost efficiency

Author	Year	Title	Main Focus	Findings
Bruno de Sousa Martins, Joao Queiroz e Melo, Joao Logarinho Monteiro, Graça Rente, Pedro Teixeira Bastos	2017	Reprocessing of Single-Use Medical Devices: Clinical and Financial Outcomes	The aim of this study was to compare the clinical results and the financial impact of the use of 2 SUMDs, original and reprocessed, namely the linear suture ma GIA Covidien and Harmonic ACE scissors.	Indicators related to clinical efficacy show that the use of these SUMDs, professionally reprocessed, did not represent any added risk in comparison to the use of original devices. Regarding costs, there is a very significant difference between the use of a new medical device and that of a reprocessed one. In the case of the Harmonic ACE® scissors and the linear suture machine GIA CovidienTM, savings were up to 50% per device
Markus Meissner, Sabrina Lichtnegger, Scott Gibson, Rhodri Saunders	2021	Evaluating the Waste Prevention Potential of a Multi- versus Single-Use Surgical Stapler	Evaluating the waste prevention potential of switching from single-use systems (SUSs) to multi-use systems (MUSs).	Switching from a SUS to MUS facilitates a reduction in total surgical waste and TMR for sleeve gastrectomy, gastric bypass, and VATS lobectomy surgical procedures
Osvaldo Ulises Garay, MSc*, Ezequiel Garcia Elorrio, PhD, Viviana Rodríguez, PhD, Cintia Spira, MD, Federico Augustovski, PhD, Andrés Pichon-Riviere, PhD	2017	Single-Use Devices in Argentina: Cost Comparison Analysis of a "Re-Use" versus a "Single-Use" Policy for Trocars, Endocutters, Linear Cutters, and Harmonic Scalpels	To estimate the average difference per surgery in device-related costs (DRCs) when performed with single-use devices under a single-use policy (SUP) instead of a re-use policy (RP) from the perspective of the private health sector of Argentina	RP was found to be less costly in all devices and scenarios considered. However, the actual frequency of adverse events and their cost implications remain uncertain. Further research is needed to assess the effectiveness and safety of these off-label policies.
Zacharias *et al. International Journal of Retina and Vitreous*	2021	Safety and cost-effectiveness of single-use endolaser probe reprocessing in vitreoretinal surgery	Determine and compare the quality, safety, and costs of reprocessed versus original single-use endolaser probes of a specific brand and model	Single-cycle endolaser probe reprocessing was safe and efficient, not associated with an increase in endophthalmitis rate and proved to be significantly cost-effective, even considering a higher malfunction rate compared to the original devices.

Author	Year	Title	Main Focus	Findings
Aman Khanuja	2020	SUD reprocessing—regulation, environmental impact reduction, and cost savings	The role of the medical device industry in reducing the environmental impact from the healthcare industry	Estimated potential direct cost savings from reprocessing are projected to exceed USD 2 billion per year for the United States by 2025. Reprocessed single-use devices (SUDs) are safe and effective, and SUD reprocessing is a viable option for reducing the environmental impact of the healthcare industry and generating cost savings
Aditya Kapoor, et al	2017	Guidance on the reuse of cardiovascular catheters and devices in India: A consensus document	Reuse single cardiovascular catheters and devices	An appropriate consent should be obtained where necessary and the cost savings should be directly passed on to the patient.
David Renton1 · Peter Denk2 · Oliver Varban3	218	Reprocessed single-use devices in laparoscopy: assessment of cost, environmental impact, and patient safety	A review of RSUDs along with an assessment of their impact on cost, the environment, and patient safety in laparoscopy.	The use of reprocessed single-use devices (RSUDs) plays an important role in reducing the environmental impact of medical waste as well as costs to the healthcare industry

Source: Compiled by the authors from selected studies (e.g., de Sousa Martins et al., 2017; Garay et al., 2017).

RESULTS AND DISCUSSION

The reprocessing and/or reuse of single-use devices (SUDs) is considered a form of "remanufacturing," meaning the original manufacturer is no longer responsible for the performance and safety of the device. Hospitals that reprocess or reuse single-use devices assume full responsibility for their safety and effectiveness.

To determine which single-use devices are reprocessed, hospitals form a committee responsible for making decisions related *to* SUD *reprocessing*. Committee members from administration, infection control, central services, surgical services, logistics, and finance must have sufficient knowledge of the SUD reprocessing process to evaluate related legal, ethical, and economic issues . Factors to consider in determining the reuse of SUD include the availability of equipment, patient safety, availability of reprocessing equipment, time or technique of reprocessing, and supervision of the reprocessing process based on data, hospital needs, and alternatives to reusing the equipment.

Some single-use devices that undergo reprocessing in several countries include *laparoscopic graspers, scissors*, *electrosurgical devices*, *Harmonic Scalpel*, *Harmonic Ace, linear staplers*, *cardiovascular catheters, endolaser probes, endocutters, linear cutters,* and *trocars* In India, the reuse of catheters/devices in cardiology, such as *coronary and vascular catheters, guide*

wires, balloon valvuloplasty catheters, electrophysiology catheters, pacemakers, and defibrillators.

Indicators related to clinical effectiveness in a study conducted in Portugal show that the use of professionally reprocessed Single-Use Medical Devices does not pose additional risks compared to the use of new devices. In terms of cost, there is a significant difference between the use of new medical devices and reprocessed devices. In the case of Harmonic ACE scissors and GIA Covidien linear staplers, savings can reach up to 50% per device. In a study in Argentina, there was a cost difference between the use of new single-use devices and reused SUDs, indicating that reuse practices result in cost savings. Reuse is more cost-effective than single-use.

It is estimated that the potential direct cost savings from reprocessing single-use devices (SUD) in the United States could exceed USD 2 billion per year by 2025. Reprocessed single-use devices have been proven safe and effective, and SUD reprocessing is a viable option for reducing the environmental impact of the healthcare industry while generating cost savings.

The economic benefits of reprocessing are proven, contributing to the development of a culture of economic sustainability in hospitals by reducing costs without compromising the quality of care. Certified reprocessing of single-use medical devices has been proven to be a safe and effective process, and promotes increased hospital efficiency.

The reduction in hospital waste due to fewer single-use devices (SUDs) being discarded, as they are reprocessed and reused, is one of the key benefits of SUD reprocessing and plays a crucial role in reducing the environmental impact of medical waste and lowering costs in the healthcare industry. In *multi-use* applications, the reduction in waste associated with the transition from *single-use* systems will remain monitored across various levels of reuse.

CONCLUSION

The reprocessing and reuse of single-use medical devices (SUDs) provide an effective approach to enhance cost efficiency in hospitals without compromising patient safety or clinical outcomes. While responsibility for ensuring safety shifts from manufacturers to healthcare facilities, this can be managed through dedicated committees and strict policies that uphold high standards. Beyond significant cost savings—both immediate and long-term—SUD reprocessing also plays a crucial role in reducing medical waste and mitigating environmental impact. With appropriate regulatory frameworks, continuous monitoring, and adherence to rigorous protocols, SUD reprocessing represents a sustainable and practical solution, especially valuable in resource-limited healthcare settings. Future research should focus on developing standardized guidelines for implementation and evaluating the long-term environmental benefits and patient outcomes across diverse healthcare systems globally.

REFERENCES

Basu D, Dhara M, Dutta SK. Reprocessing of single-use medical devices and their associated problems: An experience from a cancer center in eastern India. *Infect Control Hosp Epidemiol*. 2020;41(5):625-627. doi:10.1017/ice.2020.54

Bayrak, T., & Soylu, S. (2021). Reprocessing of single use medical devices: A new proposal for a regulation. *Health Policy and Technology*, *10*(3), 100553. https://doi.org/10.1016/j.hlpt.2021.100553

Collier R. Reprocessing single-use devices: an international perspective. *CMAJ*. 2011;183(11):1244. doi:10.1503/cmaj.109-3906

De Sousa Martins B, Melo JQE, Logarinho Monteiro J, Rente G, Bastos PT. Reprocessing of Single-Use Medical Devices: Clinical and Financial Results. *Port J Public Heal*. 2018;36(3):150-156. doi:10.1159/000496299

Development H. Reprocessing Single-Use Medical Devices: A Sustainable Solution. Published online 2020. https://www.magazine.medicaltourism.com/article/reprocessing-aeoe-single-useae-c2-9d-medical-devices-a-sustainable-solution

Garay OU, Elorrio EG, Rodríguez V, Spira C, Augustovski F, Pichon-Riviere A. Single-Use Devices in Argentina: Cost Comparison Analysis of a "Re-Use" versus a "Single-Use" Policy for Trocars, Endocutters, Linear Cutters, and Harmonic Scalpels. *Value Heal Reg Issues.* 2017;14(2017):89-95. doi:10.1016/j.vhri.2017.04.005

Healey N, Sheehan K, Greenhealth P. Is cost-saving and sustainability putting patients at risk through reprocessed single-use medical devices. Published online 2020.

JCI. *Joint Commission International Accreditation Standards for Hospitals.*; 2024.

Kapoor A, Vora A, Nataraj G, Mishra S, Kerkar P, Manjunath CN. Guidance on reuse of cardio-vascular catheters and devices in India: A consensus document. *Indian Heart J*. 2017;69(3):357-363. doi:10.1016/j.ihj.2017.04.003

Meissner M, Lichtnegger S, Gibson S, Saunders R. Evaluating the waste prevention potential of a multi-versus single-use surgical stapler. *Risk Management and Health Policy*. 2021;14:3911-3921. doi:10.2147/RMHP.S325017

Nursalam, Kusnanto, Has Eka Mishbahatul M, et al. *Guidelines for Writing Theses - Literature and Thesis - Systematic Review*.; 2020. file:///C:/Users/MyBook Z Series/Downloads/Pedoman Systematic dan Literature Review (2).pdf

Pollmanns, J., van Wijk, A., Thierens, H., de Bruin, M., & Steenhuijsen Piters, B. (2024). A systematic review comparing the safety, cost and carbon footprint of disposable and reusable laparoscopic devices. *Journal of Visceral Surgery*, *161*(1), 1-11. https://doi.org/10.1016/j.jviscsurg.2023.11.009

Popp W, Rasslan O, Unahalekhaka A, et al. What is the use? An international look at reuse of single-use medical devices. *Int J Hyg Environ Health*. 2010;213(4):302-307. doi:10.1016/j.ijheh.2010.04.003

Renton D, Denk P, Varban O. Reprocessed single-use devices in laparoscopy: assessment of cost, environmental impact, and patient safety. *Surg Endosc*. 2018;32(10):4310-4313. doi:10.1007/s00464-018-6275-0

Robertson, D., Gnanaraj, J., Wauben, L., Huijs, J., Samuel, V. M., Dankelman, J., & Horeman-Franse, T. (2021). Assessment of laparoscopic instrument reprocessing in rural India: A mixed methods study. *Antimicrobial Resistance & Infection Control*, *10*(1), 109. https://doi.org/10.1186/s13756-021-00976-x

Sağlam, F., Çetinkaya, Z., Kocaman, B., Ağalar, C., Aydin, N., & Soyder, A. (2014). Efficacy and safety of reuse of disposable laparoscopic instruments in laparoscopic cholecystectomy: A prospective randomized study. *Surgical Endoscopy*, *18*(4), 727-731. https://doi.org/10.1007/s00464-003-9334-z

Sherman J. SUD reprocessing—regulation, environmental impact reduction, and cost savings. Approved by: Published online 2020.

Siu, J., Hill, A. G., & MacCormick, A. D. (2016). Systematic review of reusable versus disposable laparoscopic instruments: Costs and safety. *ANZ Journal of Surgery*, *86*(11), 906-911. https://doi.org/10.1111/ans.13690

Zacharias LC, da Silva Conci L, Megnis BP, et al. Safety and cost-effectiveness of single-use endolaser probe reprocessing in vitreoretinal surgery. *Int J Retin Vitr*. 2021;7(1):4-9. doi:10.1186/s40942-021-00292-x

Zheng, L., Rodriguez-Barraquer, I., & Sherman, J. D. (2022). The impact of switching from single-use to reusable healthcare products: A transparency checklist and systematic review of life-cycle assessments. *BMJ Open*, *12*(2), e050380. https://doi.org/10.1136/bmjopen-2021-050380