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**The Business Case for Decarbonization  
of a Healthcare Delivery System—A Case  
Study on Switching from Single Use to  
Reprocessed Medical Devices**

**January 2024**

## **ACKNOWLEDGEMENTS**

This case study was written by Associate Research Scholar Divya Chandra, and Senior Research Lead Chisara Ehiemere, of the NYU Stern Center for Sustainable Business. Funding for its development was provided by The Commonwealth Fund. This case study was developed as the basis for a practical guide to institutions and is not intended to serve as an endorsement, source of primary data, or illustration of either effective or ineffective management.

## **NYU STERN CENTER FOR SUSTAINABLE BUSINESS**

The NYU Stern Center for Sustainable Business (CSB) was founded on the principle that sustainable business is good business. We provide education, conduct research, and influence industry practice by proving the financial value of sustainability for business management and performance. At CSB, we aim to equip future and current corporate leaders with updated business frameworks that embrace proactive and innovative mainstreaming of sustainability, resulting in competitive advantage and resiliency for their companies as well as a positive impact for society. For more information, visit [www.stern.nyu.edu/sustainability](http://www.stern.nyu.edu/sustainability)

## Decarbonization and Industry Action

Climate change is an emergency that affects humanity worldwide, and all players across all industries must take immediate action to keep warming below 2°C targets. Healthcare accounts for 4.5% of greenhouse gas (GHG) emissions globally, and 8.5% of US emissions<sup>1</sup>. The healthcare sector must reduce its emissions, albeit in a safe way that does not undermine its pertinent role to society.

In April 2022, recognizing the impact of health care on GHG emissions, the Department of Health and Human Services (HHS) together with the White House, called upon all health care stakeholders to commit to tackling the climate crisis through a new initiative aimed at reducing emissions across the health care sector. The voluntary HHS pledge asks signatories to, at a minimum, commit to: (1) reducing their organization's emissions (by 50% by 2030 and to net zero by 2050) and publicly reporting on their progress; (2) completing an inventory of Scope 3 (supply chain) emissions; and (3) developing climate resilience plans for their facilities and communities<sup>2</sup>.

In our research, the NYU Stern Center for Sustainable Business (CSB), found numerous large integrated healthcare delivery systems among the early adopters of decarbonization practices. These institutions are sharing their experiences on platforms provided by the Commonwealth Fund, Practice Greenhealth, Health Care Without Harm, National Academy of Medicine, Office of Climate Change and Health Equity, and others. However, there remains an urgent and pressing need to catalyze larger scale action across the industry, particularly to reach those that have not started decarbonization. CSB's study of the [Business Case for Healthcare Delivery System Decarbonization](#), funded by the Commonwealth Fund, is one such effort.

**One decarbonization practice that is broadly available to healthcare systems is using reprocessed medical devices. CSB engaged with Advocate Health to determine the tangible and intangible financial benefits of switching from single use to reprocessed medical devices at Advocate Health's facilities in Illinois and Wisconsin. The ROSI™ Framework was used to quantify those benefits and calculate the return on investment.**

## Introduction to the Medical Device Reprocessing Industry

In the U.S., reprocessing refers to the cleaning, testing, and repackaging of "single-use" medical devices (SUDs) that are regulated by the Food & Drug Administration (FDA) at a facility that is also FDA approved, so they may be returned for reuse safely<sup>3</sup> in healthcare delivery systems.

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<sup>1</sup> [Health Care's Climate Footprint](#) (Health Care without Harm & ARUP, 2019)

<sup>2</sup> Department of Health and Human Services, Office of Climate Change and Health Equity

<sup>3</sup> A report to the Government Accountability Office found that use of reprocessed devices did not indicate an elevated health risk (2008)

**Fig 1: Steps in reprocessing**



Source: The Association for Medical Device Reprocessors

The Association for Medical Device Reprocessors (AMDR), is a global trade association for the regulated, commercial “single-use” medical device reprocessing industry. AMDR serves to protect the interest of its members in legislation, policy and standard setting. Albeit small as a percentage of total medical device industry, the influence of reprocessing within medical devices is growing - a comparison of key performance indicators shows sales of reprocessed devices was up by 4% (31.6 Mn units to 33 Mn units) and waste diverted from landfills was up by 68% (12 Mn lbs to 20 Mn lbs) between 2020 and 2021.

AMDR notes that FDA regulated reprocessing is found to be a key decarbonization strategy by The National Academy of Medicine, the Agency for Healthcare Research and Quality, part of the U.S. Department of Health and Human Services. The United Kingdom’s National Health Service also advocates for the use of “remanufactured” devices (as they are called in Europe) to reduce greenhouse gas emissions<sup>4</sup>.

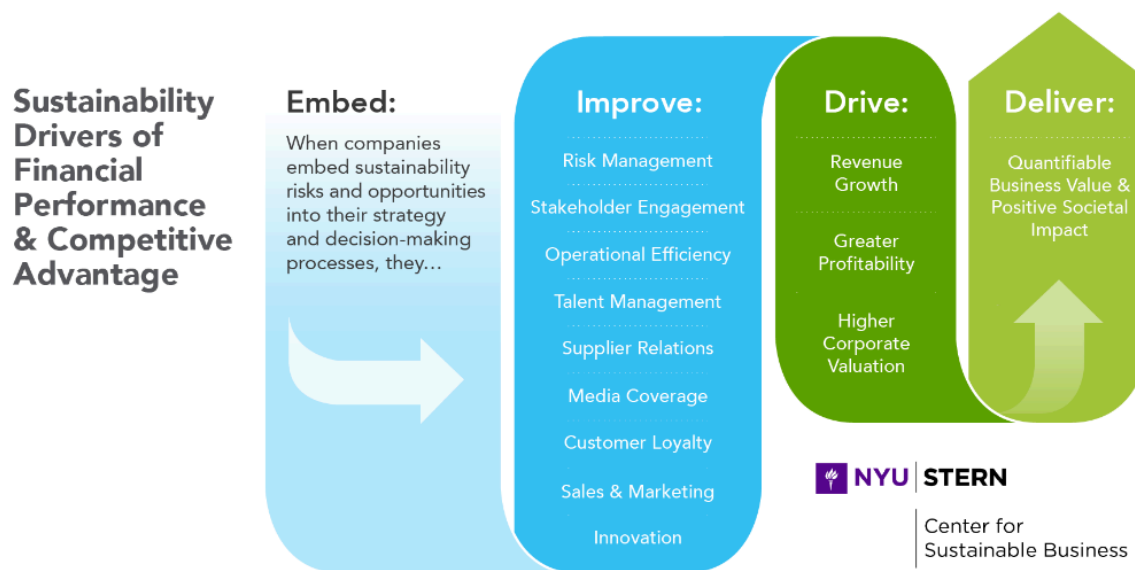
## **The Business Case for Switching from Single Use to Reprocessed Medical Devices: ROSI™ Benefits**

Traditional profit and loss analyses generally do not identify and quantify fully the benefits and costs of doing business in a more environmentally and socially responsible way. Without this analysis, sustainability benefits are not adequately measured and hence not embedded within an organization’s strategic decision making process. The Return on Sustainability Investment (ROSI) framework (refer schematic below) is a way of measuring the benefits and the costs of an organization’s sustainability-conscious initiatives and systematically assigning a financial value to the resultant impacts. The ROSI process helps monetize the benefits and calculate a return on sustainability-related investments using the lens of nine mediating factors namely-risk

<sup>4</sup> [www.amdr.org](http://www.amdr.org)

management, stakeholder engagement, operational efficiency, talent management, supplier relations, media coverage, customer loyalty, sales and marketing, and innovation.

**Fig 2: The ROSI Framework**



Using ROSI, the NYU Stern CSB team created the [Healthcare Delivery Systems Decarbonization Framework](#). The framework identifies strategies to decarbonize, the various benefits and costs that accrue as a result of these activities and provides guidance on how to monetize the impacts. The framework provides new research and analysis that will aid in **increasing the rate of adoption of decarbonization practices by highlighting the financial implications** of the tangible and intangible benefits of the actions that healthcare delivery systems can take.

### Introduction to Research Partner

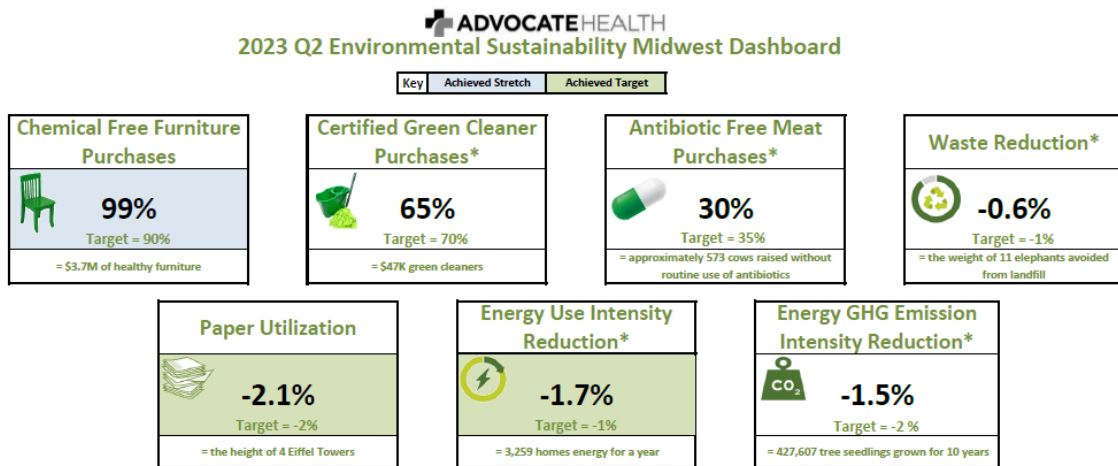
Advocate Health, Inc. ("Advocate Health" or Advocate or the "Organization") was created after a joint operating agreement was entered into between Advocate Aurora Health and Atrium Health. Advocate Health collectively manages 68 hospitals, 3 colleges, over 1000 sites of care including 49 acute care hospitals, an integrated children's hospital, a psychiatric hospital, primary and specialty physician services, outpatient centers, physician office buildings, pharmacies, rehabilitation and home health and hospice care in the U.S.<sup>5</sup>

Advocate Health, a signatory of the HHS Pledge, has committed to environmental goals<sup>6</sup> around energy and resource conservation, increasing green and eco-friendly purchases, and reducing emission intensity of its operations. A snapshot of Advocate Aurora Health's (part of Advocate Health) sustainability dashboard is provided below:

<sup>5</sup> Advocate Health, Annual Report, 2023

<sup>6</sup> Advocate Aurora Health Dashboard on Practice Greenhealth

**Fig 3: Sustainability Dashboard of Advocate Aurora Health**



Using reprocessed medical devices (rSUDs) has benefits of lowering procurement costs and waste generation. The sustainability team was keen to understand the other benefits from reprocessing and how they could be calculated and monetized. For example, there was interest in understanding how using reprocessed devices reduced GHG emissions as they are presently in the process of creating their emissions inventory.

### Methodology: Applying ROSI

The ROSI framework was used to identify tangible and intangible financial benefits for switching from single use to reprocessed medical devices for Advocate Health. Several benefits in operational efficiencies, supplier relations, and stakeholder engagement were assessed across Advocate Health’s operations. Of these, four different benefits in operational efficiency and risk management were monetized by gathering data and building financial models.

**The analysis shows a net positive financial benefit in monetary terms, the 10-year Net Present Value is assessed at \$ 20.3 M (present value of total benefits \$ 20.8 M less present value of program costs \$0.5 M). On an average annual basis, the net benefit is likely to be \$3.5 M over the same period (~ 3 % of annual operating income of Advocate Health in 2023<sup>7</sup>). The emission analysis shows that on an average basis each reprocessed device reduces emissions by 1.5Kg CO<sub>2</sub> equivalent and on an average annual basis, emissions reduce by 857 MT CO<sub>2</sub> equivalent during the 10 year period. A description of the monetized benefits and their relative importance are provided below:**

- Operational efficiencies relate to reduced procurement costs, and waste disposal costs. These account for close to 95% of the total financial benefits

<sup>7</sup> ~\$80 million operating income in 9 months of 2023 reported by AH

- Risk management relates to lower GHG emissions and improved supply resiliency, accounting for the remaining 5% of the total financial benefits

*Additional potential benefits such as lower product failure rate, improved inventory management, lower waste generation overall in operational efficiencies, higher employee productivity in talent management, improved supplier relations, and beneficial financial arrangements in stakeholder engagement were identified, however they were not monetized due to limited information, lack of internal data and/or external research availability that could provide evidence.*

## ROSI Monetization Explained

### Operational Efficiency

Benefits from operational efficiency comprise benefits of reduced procurement costs and reduced waste disposal costs. The results and the monetization process are explained in detail below:

#### Benefit I: Reduced Procurement Costs

##### Description

Switching single use devices (SUDs) to reprocessed devices (rSUDs) can potentially lead to savings in procurement costs

##### Type of Data

- Total volumes of OEM and Reprocessed devices sourced within patient care, surgical and vascular devices
- Prices for OEM and Reprocessed devices
- Rebates and discounts
- Penalties for not meeting volume commitments, tiered pricing levels
- Future growth rates

##### Methodology

Estimated the total number of reprocessed products bought in the past three years by category type. Calculated the price (cost) differential between a new product sourced from an OEM and a reprocessed product. Multiplied the total number of reprocessed products sourced with the cost differential to estimate the total savings, adding any additional rebates given by the reprocessor and/or reducing any penalties imposed by OEMs (due to losing volume discounts etc.).

Projected a scenario of devices likely to be procured in the future by applying growth rates to OEM and reprocessed, forecasting prices of each and calculating the differential as savings associated with switching to reprocessed.

In case of device categories where reprocessed devices are not currently being sourced, estimated a percent of OEM devices that can be switched and then modeled, growing the

portfolio at a projected growth rate. Applied average savings reported by the reprocessing industry (sourced from AMDR) to forecast the total savings from the portfolio.

### **Benefit Value**

This emerged as the largest benefit for Advocate Health-expected average annual benefit is \$3 M with a 10-year Present Value (PV) totaling to \$17.4M.

## **Benefit II: Reduced Waste Disposal Costs**

### **Description**

Collecting used devices and sending them for reprocessing instead of discarding them after use, reduces the amount of waste generated at the hospital site leading to saving in waste disposal costs

### **Type of Data**

- Total volumes of OEM and Reprocessed devices collected within patient care, surgical and vascular devices
- Average costs of waste disposal
- Average weight of products collected
- Average collection credits<sup>8</sup>

### **Methodology**

Calculated the total number of the products/devices collected by the hospital and sent for reprocessing on an annual basis. Multiplied the total number of devices by the average or actual weight per product/device and by the average cost of waste disposal of the suitable category (e.g. medical waste) to calculate the total costs saved. Also, multiplied the number of items collected with the collection credit given by a reprocessor.

### **Benefit Value**

Expected average annual earnings benefit are \$287K with a 10-year PV totaling \$1.7M.

## **Risk Management**

## **Benefit III: Reduced Emissions**

### **Description**

Switching SUDs with rSUDs can potentially lead to lower emissions. Reprocessed devices were found to have a lower footprint than new devices in all categories as per an Life Cycle Assessment (LCA) study conducted by Stryker Solutions

### **Type of Data**

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<sup>8</sup> To encourage collections of used devices by the hospitals, reprocessors generally pay a small fee per unit of item collected and returned to the reprocessors by the hospitals.



- LCA studies
- Internal price of carbon or cost of carbon offsets (present and forecast)
- Total volumes of OEM and Reprocessed devices sourced within patient care, surgical and vascular devices

### **Methodology**

Obtained LCA studies from Stryker Solutions that provide the environmental footprint of the different category of devices. Using the findings, quantified the difference between the environmental footprint per device/category type. Multiplied this difference by the total number of rSUDs purchased to estimate the average emissions quantity avoided on an annual basis. Multiplied the total avoided emissions quantity by an internal price of carbon or price of carbon offsets, if being purchased, to quantify the total cost savings

### **Benefit Value**

Expected average annual earnings benefit is \$187K with a 10-year PV totaling \$1.1M.

## **Benefit IV: Reduced Risk of Supply disruption**

### **Description**

Switching single use devices to reprocessed devices can potentially improve supply chain resiliency as it leads to diversification of supplier base

### **Type of Data**

- Actual data on any past shortage of device supply and the impact on business disruption or external research estimates on the probability and severity of future supply chain disruption
- Average annual total medical device purchases in value and quantity
- Average annual reprocessed medical device purchases in value and quantity

### **Methodology**

Estimated the probability of occurrence and the severity of costs of a device supply chain disruption event. Applying an attribution factor for reprocessing, estimated how much of this risk can be avoided by having an alternate supply source

### **Benefit Value**

Expected average annual earnings benefit is \$87K with a 10-year PV totaling \$0.6M.

## **Additional Lessons Learned**

CSB undertook desktop research, interviewed key staff from the sustainability, supply chain, and the clinical teams at Advocate Health to learn about procurement, and reprocessing practices. Advocate Health implemented its reprocessing program in 2014 and has worked to expand it since then. The sustainability team had to engage with multiple teams across the system to start a reprocessing program. We have captured these considerations/success factors in Appendix 1

as a guidance for hospitals/delivery systems looking to start or expand their reprocessing program.

To create the ROSI financial models, CSB required data on volumes of procurement of OEM and reprocessed purchases, and devices collected at the various hospital sites. However, information was not in a readily usable format as the product category labels recorded in the system could not be matched directly with labels in the reprocessed purchase categories. Further, reprocessed device purchases were not separately identified on the database. We were able to work around this by pulling data from other external sources such as the AMDR and Practice Greenhealth Sustainability Benchmarking Report and extrapolating these data points to create proxies. Rather than highlight this as a shortcoming, we'd like to point out data identification and labelling as a consideration for a hospital shifting to reprocessed devices. *CSB recommends Identifying and labelling the universe of product categories eligible for reprocessing and tracking how much is being purchased as reprocessed.*

Another challenge was navigating procurement contracts with Original Equipment Manufacturers (OEMs) that may contain tiered pricing to drive minimum volume commitments and limitation of liability clauses for non OEM (i.e. reprocessed) products. Often, contracts across device categories can be bespoke and terms vary significantly, thus making it harder to model the impact of not meeting requirements. Advocate was prioritizing products where reprocessor and OEM were the same institution while negotiating with other OEMs to maximize the volumes of reprocessed devices that could be purchased under the contracts. *CSB recommends that hospitals should review existing contracts to determine if there are price penalties. Even with a price penalty on other items, there may be cost saving in buying reprocessed devices.*

CSB learned that collections of used devices to be sent back to the reprocessor varied based on the collection system available on each hospital site. There were certain sites where reprocessors managed the logistics while others where employees were required to ship the items themselves. We understood that on the latter sites- training, signage and reminders on the collection process were helpful to convince staff that managing collections does not add to their workload. *Maintaining high to adequate collections of devices is critical to keep devices in circulation and the reprocessing program viable for the reprocessors. CSB recommends setting high targets for collections as not only does it help to save costs of waste disposal but keep the reprocessing program efficient and viable.*

## **Resources Available to Healthcare Delivery Systems**

CSB has created an Excel based monetization template that captures the benefits explained in the section above. Users are advised to access the template on the CSB webpage and enter data relating to their facility.

Other resources available include Practice Greenhealth and AMDR.

## Partner Feedback: Embedding ROSI into Operations

The Advocate Health team found the ROSI approach to be a very thorough analysis, and something that was never done before for reprocessing items. They consider that the ROSI approach could be helpful for several other initiatives as they seek to decrease their emission footprint and are increasingly asked for NPV and financial analyses. Their sustainability team has not had much of a role in calculating NPVs and quantifying financial value beyond cost savings. The biggest value lies in the structured process, deriving the NPV and determining the emission reduction.

## Conclusion

Using ROSI to measure the value of an expanded reprocessing program found benefits amounting to ~\$20.3 million in 10-year NPV terms and an average net annual Benefit of ~\$3.5 million. While reasonable estimates of operational efficiencies (lower procurement costs and waste disposal costs) and risk management (lower emissions and lower risk of supply disruption) were made, potentially additional benefits may be identified with more data tracking and external research availability. These include lower product failure rate, improved inventory management, lower waste generation overall in operational efficiencies, higher employee productivity in talent management, improved supplier relations, and beneficial financial arrangements in stakeholder engagement.

To enhance gains from the reprocessing program, Advocate Health should consider implementing CSB's recommendations. These including setting targets for reprocessed purchases by category type prioritizing based on device value and availability of the same within the location, navigating procurement contracts and proactively negotiating clauses that can potentially limit the amount of reprocessed purchases in different ways, better data management in terms of Identifying and labelling the universe of product categories eligible for reprocessing and tracking how much is being purchased as reprocessed. Lastly, it should set high targets for collections of used devices as not only does it help to reduce waste disposal costs for Advocate Health but also contributes to keeping the reprocessing program efficient and viable for reprocessors by keeping a sufficient number of devices in circulation.

Given Advocate Health has environmental goals on reducing emission intensity of its operations and waste reduction they can use the ROSI monetization developed as a tool for communicating the value of switching to reprocessed devices internally across business functions. The ROSI analysis showed significant operational efficiency and makes a case for using reprocessed devices to reduce scope three emissions.

## Appendix

### Key considerations while implementing a Reprocessing program

#### User Engagement

- Collaborate with the Supply chain team to understand reprocessed device availability in the location, their prices compared to OEM and any other contractual terms and conditions that will affect annual spend.
- Understand who needs to be involved in the decision-making process to switch the devices (e.g. physicians, surgical staff and clinical staff teams, supply chain procurement teams). Communicate with them to understand and address any concerns that they may have.
- Create a reprocessing committee with diverse (systemwide and function wide) representation and appoint reprocessing champions
- Assess staff educational needs and create a plan to fill the gaps to get their buy-in. List the steps that will help to get their approval

#### Review procurement contracts

- Collaborate with the Supply Chain team to understand the clauses that may restrict outside purchases within Original Equipment Manufacturers (OEMs) contracts. This is important to understand which devices may be easier to prioritize in switching to reprocessed.

#### Setting reprocessing targets and goals

- Set goals and priorities for switching to reprocessed devices based on clinical feasibility for different time durations (1 year, 3 and 5 years)
- Consider prioritizing devices where OEM is both manufacturer and reprocessor as it may be easier to navigate contractual barriers (if any) and logistics
- Another way of prioritizing devices is based on the per unit financial saving and emission reduction potential of devices
- Be consistent in the expansion of the program to switch more types of devices

#### Launch pilot projects

- Shortlist devices and launch pilot projects
- Track performance and identify reprocessed products to adopt

#### Support collection mechanisms

- Place an adequate number of collection bins at convenient places and include appropriate signage
- Outsource the logistics of shipping collected items out of the hospital to the reprocessor at no cost where feasible

#### Collect and share data to demonstrate program's success

- Create dashboards that measure financial savings, environmental footprint, and share success of the program with the decision making staff on an ongoing basis

**NYU Stern CSB acknowledges the Advocate Health Teams for their valuable contributions to the project**

Travis Hawks, Sustainability Manager  
Sydney Nelson, Director, Supplier Diversity

NYU Stern CSB thanks the Commonwealth Fund for providing the financial support

NYU Stern CSB thanks Dr.Cassandra Thiel for consulting support, Dan Vukelich and David Sheon of AMDR for their invaluable insights and data shared during the project

**For questions on this case study and NYU Stern CSB's other research, feel free to contact:**

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