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Reinventing Medical Gowns Sourcing Strategies through Reusability

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INTRODUCTION

H ealthcare providers require a broad array of personal protective equipment (PPE) supplies to perform diagnosis and treatment. After gloves, medical gowns are the second most commonly used PPE items in healthcare settings.¹ Over the last several years, preferences among healthcare providers worldwide have gradually shifted from reusable medical gowns to disposable ones designed to be discarded after a single use. In perspective, the disposable gowns accounted for more than half of the global market revenue in 2023.² This trend is no exception among US healthcare providers, with around 80 percent of medical gowns used are disposable³ and more than 90 percent of the US surgical and isolation gown market are disposable.⁴

The single use nature means that this critical supply needs to be constantly replenished. As witnessed during the COVID-19 pandemic, such requirements had a detrimental effect on healthcare providers' ability to keep up with demand surges and weather the storm of supply shortages that followed. Meanwhile, reuse of PPEs, such as medical gowns and masks, was an effective measure to reduce pressure on supply capacity and helped buffer against supply shortages during the pandemic.⁵

In this paper, we posit that reusability can be an impactful apparatus as part of sourcing strategies that enables not only resilience in times of crisis, but also improvement in on-going supply management. In fact, in healthcare where financial and environmental sustainability pressures are mounting, medical gown sourcing strategies that leverage reusable products can unlock efficiencies in supply costs and improvement in environmental sustainability.⁶

Nevertheless, transitioning from disposable to reusable medical gowns is by no means a simple matter of switching products purchased. After each use, reusable gowns require proper laundering to clean and remove microbicide from the potentially contaminated items before putting them back in an inventory for reuse.⁷ Not all healthcare providers have these reprocessing operations established, especially given the predominant tendency of using

¹ Kaplan 2021; Quito 2020

² Global Market Insights 2024; Grand View Research 2024; Maximize Market Research 2024

³ Kharbat, Mizer, and Zumwalt 2020; Kilinc 2015; Marselas 2020; Ugalmugle and Swain 2021

⁴ David and DeCarlo 2020

⁵ Baker et al. 2020; Hanna and Brown 2020; Zuckerman and Cohen 2020

⁶ Gicewicz 2020; Global Market Insights 2024; Grand View Research 2024; Ugalmugle and Swain 2021

⁷ Alberta Health 2019; Taurasi 2020

disposable gowns. Thus, entirely new supplier relationships, infrastructure, and materials handling and logistics procedures will be required to bring the transition to successful fruitions.⁸ To this end, we present a decision framework that takes an end-to-end supply management perspective to provide a structural thinking lens for healthcare providers embarking on the road to reinvent medical gowns sourcing strategies through reusability.

REUSABILITY: A PAIN RELIEF FOR MEDICAL GOWN MARKET PREDICAMENTS

Global manufacturing of PPE products has been concentrated in Asia over the past several years. China, in particular, is dominating as the top manufacturing country and exporter of several PPE items,⁹ with the exception of medical-grade gloves in which China is second to Malaysia, the top producer and world's largest exporter in 2023.¹⁰ In the case of medical gowns, China accounted for 40 percent of global production share in 2019, followed by United States (20%) and Australia (10%), respectively.¹¹

In the United States, the medical gown manufacturing industry has been highly concentrated, with a small number of large, multinational corporations playing dominant roles. Furthermore, much of the production capacity (60%–70%) and sources of raw materials for these US companies is located overseas. Not surprisingly, despite its status among the top production countries, the United States is also the world largest importers of medical gowns, accounting for 37 percent of global imports in 2019, most of which from China.¹² Indeed, imports supply most of the US surgical and isolation gown market, with import penetration rates as high as 99 percent in 2019.¹³

The foregoing supply market conditions—oligopoly, offshoring, and concentrated supply network—are not likely to change any time soon. Consequently, sourcing managers must contend with relative negotiating power against the oligopolies, intense competition for limited domestic production capacity, long lead times of supply importations, and risks associated with

⁸ Bausch + Lomb 2018; Hanna and Brown 2020; Slack and Pulver 2020; Zotinca 2021

⁹ Drevinskas, Shing, and Verbeet 2023

¹⁰ Silver, Aeppel, and Latiff 2024

¹¹ Hanna and Brown 2020; IFC 2021

¹² David and DeCarlo 2020; Hanna and Brown 2020; IFC 2021; Zuckerman and Cohen 2020

 $^{^{\}rm 13}$ David and DeCarlo 2020

concentrated locations of supply sources in Asia. The COVID-19 pandemic has particularly put all of these vulnerabilities in the glare of media spotlight and public attention.

However, through reusability, sourcing challenges driven by supply market predicaments can be alleviated with added benefits to the environments. Reusable medical gowns can be quickly hygienically cleaned, processed, and replenished back into an inventory, allowing the compression of supply lead time and enabling the stability of supply availability during demand surge and supply capacity constraints.¹⁴ Moreover, reusable gowns present an opportunity to achieve savings in the total cost of ownership by lowering cost per use, decreasing inventory levels, and lowering amount of wastes.¹⁵

LEVERAGING THE ADVANTAGES OF REUSABILITY: A SOURCING DECISION FRAMEWORK

Embarking on medical gown sourcing reinvention to leverage the advantages of reusability necessitates an end-to-end supply management consideration. Based on insights drawn from literature and our experiences in the fields of healthcare linen and supply chain management, we introduce a sourcing decision framework depicted in Figure 1. The framework is structured around key strategic assessment areas, including acquisition, maintenance, on-site materials handling and logistics, and end-of-life management, as further discussed below.

Acquisition: Own or Rent

Healthcare providers can acquire reusable medical gowns by two primary approaches, namely purchasing or renting. Healthcare providers own medical gowns in the former, but do not have ownership of the gowns in the latter. In the case of owning, healthcare providers may purchase medical gowns directly from manufacturers or indirectly from wholesalers. The US surgical apparel manufacturing industry is characterized by a moderate level of market share concentration, with the top two manufacturers, namely Cardinal Health and Medline Industries, accounting for 28.3 percent and 16.7 percent of total \$1.1 billion industry revenue in 2023, respectively.¹⁶ Cardinal Health's brand names include Astound, Barrier, SmartGown; and

¹⁴ Baker et al. 2020; Nixon Medical 2020; ThomasNet 2020; Zotinca 2021

¹⁵ Atay et al. 2021; Baker et al. 2020; Gicewicz 2020; McQuerry, Easter, and Cao 2021; Nixon Medical 2020; Vozzola, Overcash, and Griffing 2020.

¹⁶ Seiler 2023

Medline's brand names include Aloetouch, Sensicare, Aurora. The two leaders' vertical integration equips them with the capability to develop materials, which is usually patent; while larger production capabilities give them greater buying power for inputs.¹⁷ Another notable medical gown manufacturers are 3M (1.6% market share).¹⁸

| END-TO-END SUPPLY MANAGEMENT | STRATEGIC ASSESSMENT AREAS | | |
|---|---|--|--|
| | OWN Direct purchase from manufacturer Indirect purchase from wholesaler RENT Rental contract with healthcare linen rental service providers | | |
| MAINTENANCE (REPROCESSING) | OWNED GOWN LAUNDRY On-premise laundry: Self operated or outsourced operations to a third-party contract management company* Cooperative laundry: Operated by the co-ops or a third party* Third-party laundry: Reprocessing services performed by a third party* for a fee RENTED GOWN LAUNDRY Reprocessing performed by the rental service provider for a fee | | |
| ON-SITE MATERIALS HANDLING AND LOGISTICS | Workflow: Used item collection for reprocessing, restock, and redistribution procedures Usage monitoring and quality control: Tracking tools and inspection procedures Space configuration: Space for storage and used item collection | | |
| END-OF-LIFE MANAGEMENT | Repurpose: Decontamination and inspection requirements Recycle: Decontamination requirements Disposal: Decontamination requirements | | |

* A third-party operator can be a healthcare linen rental service provider or an independent commercial laundry companies

Source: Center for Supply Chain Research®, The Pennsylvania State University

In the case of renting, healthcare providers acquire medical gowns from linen rental service providers. Companies in the linen rental service industry supply laundered items to various industries. Typical clients include industrial, healthcare, food service and hospitality

¹⁷ Diment 2021

¹⁸ Seiler 2023

establishments. Increased outsourcing trend among healthcare providers are making them important customers for linen rental companies.¹⁹ In serving healthcare providers, healthcare linen rental service providers purchased medical gowns and other linen products that, in turn, are provided on a *rental contract* basis to healthcare providers.²⁰ Most key providers such as Unitex Textile Rental Services, Inc., Crothall Laundry Services, ImageFIRST Healthcare Laundry Specialists, Inc., and AmeriPride Services Inc. also offer laundry services along with linen supply.²¹

The majority of linens used by healthcare providers are rented, accounting for an estimate of 80 percent of hospitals and other large institutional linen users, while the other 20 percent purchase it.²² Acknowledged among key benefits of renting medical gowns and other linens are: inclusion of repair or replacement service, elimination of inventory or storage costs, range of product options available, and flexibility of supply volume adjustment, which can be particularly beneficial in high employee and/or patient turnover environment.²³

Maintenance: Reprocessing Operations

Laundering is a very necessary process in the lifecycle of reusable isolation gowns as protective barriers. After each use, they must be laundered following the Centers for Disease Control and Prevention (CDC)'s guidelines that not only clean but also disinfect the gowns with bleaching agents.²⁴ Reusable gowns require labor and facilities for washing and sterilizing. Here, a distinction is noted between *clean* (non-sterile) gowns generally used for isolation, and *sterile* gowns only necessary for performing invasive procedures.²⁵ In all cases, reprocessing medical gowns can be a challenging process that, if done improperly, can increase the risk of cross-contamination, or lead to damages that compromise protective properties or lifespan of the item.²⁶ Depending on how the gowns are acquired, namely own or rent, a range of reprocessing operations models can be considered as follows.

¹⁹ Kanda 2024; Spitzer 2020

²⁰ Colonnade Advisors 2016; Spitzer 2020

²¹ Grand View Research 2018

²² Colonnade Advisors 2016

²³ Crown Health Care Laundry Services 2020; Uniform Nations 2016

²⁴ Sun 2011

²⁵ CDC n.d.

²⁶ Barlow 2021; Gicewicz 2020

Owned Gown Laundry

When a healthcare provider purchases medical gowns, they are responsible for material cleaning between each use. Healthcare providers may implement laundering themselves or outsourced to a third party. However, as healthcare providers recognize that processing linen is not related to their core competency and mission, the trend to outsourcing laundering and management has increased over the last two decades.²⁷ A variety of models can be considered for implementations, including the followings:²⁸

- On-premise laundry. A laundry facility is located on-site at the healthcare facility, and may be managed by the healthcare provider itself or by a third-party contract management company such as Sodexo, ARAMARK, and Crothall through outsourcing. This model can be advantageous for some hospitals as it enables them to directly monitor quality and amount of linen stock.
- Cooperative laundry. The cooperatives are structured as non-profits and are typically managed by a board representing the member hospitals. Co-ops own their linen, equipment and sometimes the facilities. The facility may be managed by the co-ops themselves or by a third party which can be healthcare linen rental companies or independent commercial laundry companies.
- Third-party laundry. Healthcare facilities contract with a third party to wash medical gowns and other linens that are owned by the healthcare providers for a fee on a per pound basis and/or by the piece. Third-party laundry service providers can be healthcare linen rental companies or independent commercial companies. These third-party operators offer advantages both from cost and quality aspects of healthcare laundries. These operators are cost-efficient due to economies of scale, and allow healthcare providers to eliminate the cost of setting up and maintaining an on-site laundry facility. During pandemic, this model also offers healthcare providers a flexibility to quickly expand laundry capacity.

Rented Gown Laundry

Typically, when a healthcare provider rents medical gowns, the rental provider will set up scheduling for routine pickups and deliveries of soiled and sanitized materials on a regular basis,

²⁷ Colonnade Advisors 2016; Crown Health Care Laundry Services 2020; Ricci 2017

²⁸ Colonnade Advisors 2016; Crown Health Care Laundry Services 2020; Livingston, Desai, and Berkwits 2020; Marr 2015; Ricci 2017

sometimes as frequently as several times a day.²⁹ For the laundry services, healthcare providers are charged either on a per pound basis, by the piece basis, or a combination of the two. Also, there is often time a loss charge that will be applied. In addition to laundering services, healthcare linen rental companies may provide an array of additional services and products, such as processing customer-owned linen, on-site linen management and distribution, software to manage linen, and disposable supply delivery and/or distribution. Examples of healthcare linen rental companies offering laundry services in the United States are provided in Table 1.

| Healthcare | | Est. | Number of |
|---------------|--|-------------|-------------|
| Linen Rental | Description | Annual | Healthcare |
| Company | | Pounds | Laundry |
| company | | (Million) | Facilities |
| Alsco Inc. | Over 80 plants providing linen, industrial uniform | n/a | n/a |
| | and healthcare processing. Services to healthcare | | |
| | providers are offered through the HealthAssure | | |
| | brand. | | |
| Crothall | Provides not only healthcare laundry and linen | 630 | 55 |
| Healthcare | services, but also environmental, patient transport, | (including | (including |
| | technology, ambulatory services, and facilities | managed | managed |
| | management. Leader in managing laundry | facilities) | facilities) |
| | facilities for hospitals and cooperatives serving | | |
| | over 550 laundry accounts nationwide in | | |
| | managed facilities and its own. | | |
| Ecotex | Clients are hospitals and medical facilities in the | 150+ | 7 |
| Healthcare | US western and Canada (Washington, Oregon, | | |
| Linen Service | New Mexico, Texas, Oklahoma, British | | |
| Corp. | Columbia). Family-owned company of 500 | | |
| | employees. | | |
| Faultless | Products and services are provided under | 100+ | 4 |
| Healthcare | Faultless, Hamilton Linen & Uniform, and | | |
| Linen | Peerless Medical Laundry. Clients are in | | |

| Table 1 | 1: Example | es of Healthcare | Linen R | lental Compa | nies Offering | Laundry Services |
|---------|------------|-------------------|-----------|--------------|---------------|-------------------|
| 14010 | n znampre | o or ricultileare | 2111011 1 | tentai dompo | | Zaamar j oor mees |

²⁹ Colonnade Advisors 2016; Uniform Nations 2016

| Healthcare | Description | Est. | Number of Healthcare |
|--------------|---|-----------|-------------------------|
| Linen Rental | Description | Pounds | Laundry |
| Company | | (Million) | Facilities |
| | Colorado, Kansas, Missouri, and Illinois. Fifth | | |
| | generation, family-owned company of 525 | | |
| | employees. Owned by ImageFIRST. | | |
| FDR Services | Clients are academic medical centers, hospitals, | 75+ | 3 |
| Corp. | outpatient facilities, and long-term care facilities. | | |
| | Provides rental and customer-owned linen | | |
| | processing. Focuses on mid-Atlantic region with | | |
| | processing facilities in New York, New Jersey, and | | |
| | Virginia. | | |
| Logan's | Provides healthcare linen services for hospitals, | 100+ | 8 |
| Linens / | clinics, and nursing homes. Operates in | | |
| Superior | Wisconsin, Illinois, Kentucky, Tennessee, Indiana, | | |
| Health | and Ohio. Owned by Thompson Street Capital | | |
| Linens | Partners. | | |
| Mission | Provides linen and uniform rental to the | 200+ | 8 |
| Linen Supply | healthcare, hospitality, and industrial markets in | | |
| | California, Arizona, Texas, Oregon, and New | | |
| | Mexico. Family-owned company of 3,000 | | |
| | employees and over 800 vehicles and 43 facilities. | | |
| Paris | Provides linen and uniform rental to the | 50+ | 3 |
| Companies | healthcare and industrial markets in Pennsylvania, | | |
| | New York, Ohio, and West Virginia. Operated as | | |
| | part of NOVO Health Services. | | |
| Unitex | Full range of clients in healthcare industry from | 300+ | 13 |
| Textile | acute care facilities to walk-in medical clinics in | | |
| Rental | Connecticut, New Jersey, and New York. Family- | | |
| Services | owned company. | | |

Source: Colonnade Advisors (2016), ImageFIRST (2019), Paris Companies (2020)

On-Site Materials Handling and Logistics

Use of reusable gowns has a number of on-site materials handling and logistics implications that are not previously the cases for disposable products.

- Workflows. Detailed workflows on how a reusable gown is handled and collected after each use, as well as how the gown is restocked and redistributed after being reprocessed need to be worked out.³⁰
- Usage monitoring and quality control. Reusability also implies the need for procedures to track and monitor the number of usages of each gown so as not to exceed the maximum number of reuses specified by the manufacturer or the Food and Drug Administration (FDA). Inspection and quality control procedures are also essential to ensure that each gown is fit for reuse.³¹
- Space configuration. Equally, space for storage and used item collection may need to be reconfigured to accommodate reusable gowns. Here, it is vital to work with related internal and external partners (e.g., linen renting provider, reprocessor/launder, central supply department) to determine the appropriate space and workflow configurations for the reusable gowns.³²

End-of-Life Management

When medical gowns are no longer suitable for use, a number of end-of-life pathways may be considered depending on the conditions and types of the gowns.

- Repurpose. At their end-of-life, high quality Level 3 or Level 4 surgical gowns can be repurposed for uses as Level 1 or Level 2 non-surgical gowns rather than disposal. The gowns need to be decontaminated and inspected to ensure a fit-for-use quality prior to repurposing.³³
- Recycle. Reusable medical gowns are most commonly made from woven polyester fabric.
 After being taken out of service, reusable gowns can be ragged and recycled for these fibrous

³⁰ Swenson 2017; WFHSS 2019

³¹ ibid

³² AHA n.d.; Frederick 2020; Practice 2011; Zotinca 2021

³³ Gicewicz 2020; Vozzola, Overcash, and Griffing 2020

materials. They need to be safely decontaminated to prevent cross-contamination risk before they could be considered for recycling.³⁴

Disposal. Medical gowns are classified as regulated medical waste that must be carefully managed to avoid heavy penalties for not adhering to the regulatory process. Healthcare facilities can either ship their waste to large, centralized incinerators, or dispose in the standard municipal solid waste stream. The latter practices require that medical gown wastes be decontaminated prior to disposal; whereas the former does not.³⁵

CONCLUSIONS

The COVID-19 pandemic has brought PPE supply chain vulnerabilities into spotlight and served as a resounding reminder that new ways of sourcing are required. The current tendency of predominantly using disposable gowns will no longer be congruous with the growing need for resiliency, and mounting financial and environmental sustainability pressures in the healthcare sector. Reusability can provide an impactful source of leverage in sourcing strategies aimed to provide a cost efficient, sustainability-conscious, and uninterrupted flow of supply so that healthcare personnel are protected and can deliver a quality care to the patients they serve. Crucially, an end-to-end process mindset will be key to pave the way for auspicious transition to reusables. Thus, we proffered a framework that provides a structure for integrating four key elements defined by end-to-end supply management, including acquisition, maintenance, on-site materials handling and logistics, and end-of-life management. The framework is intended to help healthcare organizations understand an initial scope and key areas where refinement can be made to enable strategy, and align the purpose of different processes to the common goals set forth for the organization's reusability initiative.

 $^{^{34}}$ AHA n.d.; Atay et al. 2021; Laird and Owen 2020

³⁵ Laird and Owen 2020; Marr 2015

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