Summer Internship

At

IIHMR, Delhi (April 1st to May 31st 2020)

Sustainable Supply Chain Management Practices and Performance in Hospital

A

Report By

Kumar Saurav

Under the Guidance of

Dr. Preetha GS

Post Graduate Diploma in Hospital and Health Management

2018-2020

International institute of Health Management and Research

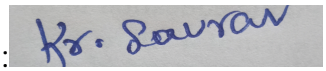
New Delhi

(Completion of Summer Internship from respective organization)

DECLARATION

I, **Kumar Saurav**, hereby declare that this Internship Assignments entitled **Sustainable Supply Chain Management Practices and Performance in Hospital** is the outcome of my own study undertaken under the guidance of **Prof/ Dr Preetha GS, IIHMR-New Delhi**. It has not previously formed the basis for the award of any degree, diploma, or certificate of this Institute or of any other institute or university. I have duly acknowledged all the sources used by me in the preparation of this field internship report.

Date: 25/05/2020

Sign: 

Postgraduate Diploma in Hospital and Health Management

International Institute of Health Management Research

New Delhi

CERTIFICATE OF COMPLETION

The certificate is awarded to

Name: Kumar Saurav (PG/ 18/032)

In recognition of having successfully completed her/ his Internship in the department of

Research

and has successfully completed her/his Project on **Sustainable Supply Chain Management Practices and Performance in Hospital**

Date : 25/05/2020

Organisation : International Institute of Health Management and Research, Delhi

She/ He has found to be a committed, sincere and diligent student who has a strong drive & zeal for learning.

We wish him/her all the best for future endeavors

Dean- Academics & Student Affairs **Mentor Name &Signature**

Certificate of Approval

The following Summer Internship Project titled **"Sustainable Supply Chain Management Practices and Performance in Hospital"** at **"International Institute of Health Management and Research", Delhi** is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of Post Graduate **Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the report only for the purpose it is submitted.

Dr Preetha GS

Associate Professor

IIHMR, Delhi

FEEDBACK FORM

Name of the Student: Kumar Saurav

Summer Internship Institution: International Institute of Health Management and Research ,Delhi

Area of Summer Internship: Research

Attendance:

Objectives met:

Deliverables:

Strengths:

Suggestions for Improvement:

Date: 25/05/2020

Place: IIHMR, Delhi

Signature of the Officer-in-Charge (Internship)

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KUMAR SAURAV

PGDHM (2018-2020)

IIHMR DELHI

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Introduction

1. Background of the Study

Supply chain management is an indispensable part of a business's sustainability. Companies are striving to operate in a more sustainable manner. There's no denying that going green and being environmentally friendly is the way of the future. Knowing the level of environmental, social, and economic impact and viability of your vendors and customers is becoming increasingly common as all industries move towards a more sustainable future

Sustainable supply chain management involves integrating environmentally and financially viable practices into the complete supply chain lifecycle, from product design and development, to material selection, manufacturing, packaging, transportation, warehousing, distribution, consumption, return and disposal. Environmentally sustainable supply chain management and practices can assist organizations in not only reducing their total carbon footprint, but also in optimizing their end-to-end operations to achieve greater cost savings and profitability.

One of the ways a company does this is by looking at their entire manufacturing process (when I say manufacturing, I mean anything from a product to a service), from where the raw materials are obtained, through the entire process within the plant, to the use and ultimately disposal or recyclability of their product or service("life cycle assessment").

As a result, both manufacturing and service organizations must consider the impact of environmental approach on business performance and the economic viability of the firm as well as on the environmental performance. Success at the supply chain level leads to success at the organizational level (Chopra and Meindl, 2004). Since customers and governmental entities have begun to demand that processes, products, and services be environmentally friendly, it is important that managers identify and implement environmental sustainability practices that extend throughout the supply chain.

With ever increasing attention being paid to global environmental issues, customers are beginning to adjust their purchasing habits by increasing their willingness to spend money on eco-friendly products. Increasing stakeholder pressure is one of the

most important factors in the decision-making of companies hence the need for SSCM practices. There are a lot of factors to evaluate the performance of the SC such as customer service, quality, lead time, cost etc.

2. Statement of the Problem

Supply chains, for most of organizations, have a far greater impact on the environment than any other part of their operations. While most corporate and public focus has been on the sustainable profile of a product, there is a need to spotlight and to understand the sustainability issues related to the transportation and distribution of those products.

Beyond reducing energy and resource consumption, there are many other reasons why organizations should care about sustainability in their supply chains:

- The research has shown that sustainability significantly improves financial results.
- Sustainability is equated with corporate social responsibility and stewardship - The positive public relations exposure from identifying and implementing sustainable supply chain practices can yield numerous benefits for companies.
- Suppliers and corporate customers are increasingly requiring sustainable practices of their vendors.
- The elimination of waste in the supply chain is a Hallmark of sustainability.

However, by promoting efficiency in the healthcare supply chain, hospitals and physician practices can create substantial cost-reducing opportunities across their organization.

3. Review of literature

Sustainable supply chain management: A case study of British Aerospace

Sustainability is viewed as possessing environmental, economic and social dimensions. The sustainability approaches adopted by individual businesses and the supply chains to which they belong must include these facets. These three components of sustainability are collectively termed the “triple bottom line” or 3BL.

The economic aspect of the 3BL refers to profit making and attaining and sustaining

competitive advantage through sustainability.

The environmental dimension involves factors relating to climate change, global warming, air, land and water pollution (or preservation) and ozone layer depletion.

The social aspect involves health and safety issues, community well-being, employment opportunities, charities, cultural sensitivities and requirements and organizational behavior(M.Ambursa 2012).

Healthcare logistics and supply chain

Against the background of the complexity of the hospital system, the variability and unpredictability of the patient profile and the high demand for care (Wiser 2011; Bourlakis et al. 2011), logistics is considered as an effective solution in the organization of working time to care staff by offering them the opportunity to concentrate on their core activities and improve patient care conditions (Landry and Beaulieu 2011).

The management of logistics activities goes beyond traditional physical flows, and it considers other flows such as patients throughout the care chain. Patient management incorporates several multidisciplinary and interdependent medical and administrative steps that require controlled interconnection and synchronization to avoid problems with wait times, misuse of medical resources etc.

Reverse Logistics and Outbound Logistics

Reverse logistics has been defined as the term used to refer to the role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials,waste disposal, and refurbishing, repair and remanufacturing. The idea is to eliminate or minimize waste (energy, emissions, chemical/hazardous and solid wastes).Design of products for reuse, recycle, recovery of material, and component parts. (Sarkis 2005).

The initiatives that an organization chooses to follow between the various logistics functions as reverse logistics and environmental considerations will have an impact on the performance of that organization. In an eco-transportation system there are parameters like fuel sources, infrastructure, operational practices and organization of the transport system. These parameters and the dynamics that connect them

determine the environmental impact generated in the transportation logistics phase of the SC (Kam et al., 2003).

Health care operations from a supply chain management perspective

During the last ten years, a considerable amount of studies has emphasized the importance of supply chain management for companies (Croom et al., 2010). Both in theory and in practice it is widely recognized nowadays that by integrating information and materials flows throughout the entire supply chain, both the internal and external performance of supply chain partners can be improved significantly. Many authors have remarked, however, that the supply chain management philosophy not only receives considerable attention from the field of logistics and operations management but also from mother areas (Burgress et al., 2006). Clearly, the origin of supply chain management is of a multidisciplinary nature and stems from different areas such as strategic management, marketing, and organizational behavior (Croom et al., 2010).

Supply Chain Performance Measurements

SCM focuses on how organizations control their suppliers' processes, technology, and capability to improve competitive advantage. It's also based on interactions of manufacturing, logistics, materials, distribution, and transportation functions within an organization. In this regard, for measuring supply chain performance, (SCP) of many characteristics of SCM should be reflected in the SCP measurement system. SCP measurement models are divided into four categories: cost, a combination cost and customer responsiveness, activity time, and flexibility (Cooper et al.).

The performance section of Supply Chain operation references (SCOR) consists of two types of elements: Performance Attributes and Metrics. SCOR Level 1 metrics are strategic, high-level measures that cross multiple SCOR processes. Lower level metrics are associated with a narrower subset of processes. For example, delivery performance is calculated as the total number of products delivered on time and in full based on a commit date. SCOR identifies five core supply chain performance attributes: Reliability, Responsiveness, Agility, Costs, and Asset Management. Consideration of these attributes makes it possible to compare an organization that strategically chooses to be the low-cost provider against an organization that

chooses to compete on reliability and performance.

Sustainable Supply Chain Management Practices

Beyond the previously mentioned economic focus, a recent trend in SCM study points to the consideration of its link to sustainability, which incorporates the environmental and social dimensions, for two reasons. First, global poverty, health, working conditions, and climate change indicators, among others, have aroused worldwide interest in the promotion of sustainable development, defined as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" Second, given that organizations are often responsible for both environmental and social problems including pollution and unacceptable working conditions, they also have a duty to help mitigate such effects, as well as contribute to economic development.

The concepts of the Triple Bottom Line (TBL) and Sustainable Supply Chain Management (SSCM)have become significant. The former was coined by Elkington , and aims to consider the economic, environmental, and social dimensions to be equally important, since the economy is fundamental to support society, but doing business can become unfeasible in a depleted global ecosystem. The latter refers to the inclusion of environmental and social dimensions in the conventional notion of SCM, as proposed by Seuring and Müller, who define SSCM as, "the management of material, information, and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental, and social, into account, which are derived from customer and stakeholder requirements."

Waste Management

How waste is managed. Use of lean methods improves the environmental performance by reducing general wastes and minimizing hazardous waste. SSCM practices since they focus on the elimination of waste that is associated with environmental sustainability this should lead to cost savings and enhance the overall performance of a firm (Rao, 2012). Rao and Holt (2015) demonstrated a link between supply chain and economic performance and they also found that SSCM practices led to competitiveness and better economic performance.

4. Summary of the Literature Review

The SSCM practices have been expounded in detail in the literature as well as the studies done in the area. It has shown that there lacks a comprehensive framework on the SSCM practices and as a result different organizations adopts different practices that they deem suitable to their business context. As such there is lack of universally acceptable SSCM practices. The literature also pointed out the benefits accrued from adoption of GSC practices, this include the positive relationship between SSCM practices and improvement in the SCP as well as economic and environmental performance of the various organizations.

5. Objective

The objectives of the study are:

- To study the sustainable supply chain management practices applied by hospitals
- To study the sustainable performance metrics used by hospitals

Variables

Supply chain practices which is independent variables

Supply chain performance which is dependent variables

6. Methodology

Research Design

This study is based on systemic literature review

Data Collection (Qualitative Data)

The data for the research was sourced mainly from secondary data. Secondary data was sourced from internet, articles and journals.

Data Collection Tool

The data for this study has been collected through web based search. In which two research questions are specifically addressed:

- What are the main SSCM practices applied by hospitals?
- What are the main sustainability performance metrics used by hospitals?

The term "practice and performance" was used for search along with supply chain management, the term "healthcare logistics" was employed, considering that both have been used interchangeably. Regarding the connection between sustainability and hospitals, as keywords cover broad and diverse sustainability subtopics, the search was performed by the title. Publications with direct applicability to hospitals, from a comprehensive perspective, were included.

7. Result and Findings

As a result of the search strategy and review of literature identified hospital SSCM practices and performance metrics are presented, respectively with their categories

SSCM Practices

Different approaches may be found in the literature regarding the concept of Hospital SCM. The SCM can be divided into internal management (material and information flows), and external management (material, information, financial, knowledge flows, and relationships). The external chain composed of manufacturers, distributors, purchasing groups, providers, and users, as well as an internal chain that includes supply management, inventory management, replenishment, and utilization. In addition to medical products, hospital logistics include the management of support services required for care. In fact, the concept of healthcare logistics is also meant to include operations such as care units and operating rooms.

In addressing the first research question: What are the main SSCM practices applied by hospitals? 12 categories emerged from this review for the classification of SSCM

practices, which include

1) Strategic management and leadership
2) Supplier management
3) Purchasing management
4) Warehousing and inventory management
5) Transportation and distribution management
6) Information and technology management
7) Energy management
8) Water management
9) Food management
10) Hospital design
11) Waste management
12) Staff and community behavior

Summary of categories and examples of identified sustainable supply chain management practices in hospitals.

Table 1: SSCM Practices in Hospital

Categories	Examples of Practices
1. Strategic management and leadership	➢ Establishment of a strategic plan for supply chain management ➢ Development of green and healthy policies and plans ➢ Executive support for supply chain management processes ➢ Use of indicators and

	measurement systems to assess total supply chain costs and performance ➢ Involvement of clinical and non-clinical staff in supply chain decision-making
2. Supplier management	➢ Supplier base rationalization ➢ Sharing information with suppliers related to material flow management ➢ Inclusion of environmental, economic, and social dimensions in supplier arrangements. ➢ Selection of ISO 14000-certified suppliers ➢ Work with suppliers to innovate and improve availability of sustainable products
3. Purchasing management	➢ Supply standardization ➢ Use of purchasing groups ➢ Use of the life cycle analysis to assess the environmental impacts of procured items ➢ Considering the environmental and human rights impact of procured products ➢ Purchasing of reusable, rather than disposable, products

4. Warehousing and inventory management	➢ Determination of quantity to order and reorder points based on information systems ➢ Development of collaborative arrangements with trading partners to manage inventory of functional products ➢ Use of hybrid stockless systems (high-volume products are delivered directly to points of care and low-volume products are delivered to the central store) ➢ Store consolidation and deployment of a centralized replenishment system for nursing units. ➢ Deployment of a two-bin system
5. Transportation and distribution management	➢ Consolidation of inter-site transport system. ➢ Consolidation of external transport ➢ Promotion of public transport use ➢ Promotion of shared occupancy vehicle use. ➢ Use of alternative fuels and technologies
6. Information and technology management	➢ Use of information systems and technologies in interactions between hospital departments ➢ Internal joint initiatives regarding product availability improvement

	and logistics cost reduction. ➢ Deployment of an e-commerce system ➢ Use of track-and-trace systems (e.g., barcodes, Radio Frequency Identification) ➢ Collaboration among supply chain partners using pharmacy information systems.
7. Energy management	➢ Implementing initiatives for saving ➢ Use of alternative technologies ➢ Shifting to cleaner fuels ➢ Applying Lean Six Sigma approach to optimize a hospital linen distribution system. ➢ Implementing social marketing interventions (turning off machines, lights out when unnecessary, closing doors when possible)
8. Water management	➢ Implementing initiatives for saving (auditing usage, controlling leaks, installing flow restrictors and dual-flush toilets, use of drought-resistant plants, reclaiming water from services such as dialysis and sterilization, harvesting rainwater)

	➢ Switching from film-based radiology to digital imaging
9. Food management	➢ Serving locally grown and organic food ➢ Integrating the nutritional care pathway, nutritional standards, and regional menu framework ➢ Purchasing sustainable products (BGH-free, cage-free eggs, meat produced without hormones or antibiotics, certified organic food ➢ Identifying and working with small, local vendors to achieve healthy food goals ➢ Limiting meat consumption ➢ Recycling (fat, oil, grease, cardboard, paper, batteries, plastic, aluminum, newspaper, and tin cans)
10. Hospital design	➢ Flow-through design (design for product, information, and people flow). ➢ Integrated nursing workstation ➢ Building and adapting facilities considering sustainability criteria (using safer materials, local and regional materials, locating hospitals near public transportation routes, planting trees on site, incorporating design

	components such as day lighting, natural ventilation, and green roofs). ➢ Application of sustainability healthcare-building assessment tools
11. Waste management	➢ Addressing over treatment and implementing methods like social prescribing. ➢ Development of processes that use less material and improved technology ➢ Proper segregation. ➢ Recycling ➢ Use of alternatives to incineration ➢ Applying Lean Six Sigma
12. Staff and community behavior	➢ Hire/train well-qualified supply chain professionals ➢ Encouraging critical thinking within the community to understand, adopt, and promote sustainability initiatives ➢ Education of staff and community on sustainability ➢ Joint initiatives with the community for disease prevention and environmental health ➢ Collaboration with stakeholders to

	address environmental problems and develop plans to improve sustainability

Strategic management and leadership practices are identified as a starting point to map out and control the resources, responsibilities, and implementation of other practices.

Other categories, such as supplier management, purchasing management, warehousing and inventory management, transportation and distribution management, and information and technology management have traditionally been discussed from operational and economic perspectives.

However, sustainability has contributed to the integration of environmental and social aspects into these topics, such as by considering the environmental and human rights impacts of procured products

SSCM Performance

In addressing the second research question: What are the main sustainability performance metrics used by hospitals?

SSCM performance metrics used by hospitals were identified and split into economic, environmental, and social factors in the SSCM literature, which is in line with the TBL approach.

In this regard metrics were also grouped into categories in which:

Operation, market, and finance metrics as part of the economic dimension

Pollution control and resource utilization metrics as part of the environmental performance

And enterprise and employee perspective metrics as part of the social performance

Performance are divided into competitiveness, environmental, operations, and employee-centered and community social performance, while groups metrics included economic, environmental, and social factors.

The three dimensions and their categories are as follows:

1) ECONOMIC
    - ✓ Purchasing and supplier management
    - ✓ Warehousing and inventory management
    - ✓ Transportation and distribution management
    - ✓ Information and technology management
    - ✓ Market
    - ✓ Processes and capacity
    - ✓ Financial
    - ✓ Procurement
2) ENVIRONMENTAL
    - ✓ Procurement
    - ✓ Energy
    - ✓ Water
    - ✓ Travel
    - ✓ Food
    - ✓ Hospital design and buildings
    - ✓ Waste
3) SOCIAL
    - ✓ Quality of patient care
    - ✓ Employee
    - ✓ Community

Summary of Sustainable supply chain management performance metrics in hospitals identified in the literature.

ECONOMIC

Table 2: SSCM Performance Metrics in Hospital (economic)

Categories	Metrics
1. Purchasing and supplier management	➢ Categories of items handled ➢ percentage of purchases using contracts ➢ percentage of purchases using purchasing groups ➢ percentage of complete orders ➢ percentage of urgent orders ➢ number of indicators used in supply management ➢ percentage of perfect orders delivered by suppliers ➢ quick response, lead time from suppliers, and number of active suppliers
2. Warehousing and inventory management	➢ Space utilization, order sorting, receiving completeness ➢ service levels in the central warehouse ➢ inventory policies (manual/information system), number of Stock Keeping Units (SKU) ➢ number of indicators used in inventory management, inventory visibility, inventory availability

	➢ number of items in inventory, inventory levels ➢ inventory accuracy, inventory turnover, reduction in stock variety, and reduction of time spent by clinical staff on it
3. Transportation and distribution management	➢ Perfect delivery condition, order delivery in full, delivery performance to customer commit date, on-time delivery ➢ service speed, overall average delivery lead times for formal orders ➢ urgent delivery, number of transactions (inputs-outputs), utilization of transport services, and medication delivery trips
4. Information and technology management	➢ e-procurement (extent to which it is implemented), ease of use and usefulness ➢ product identification, accurate and reliable tracking ➢ information availability, information accuracy, information kept up to date ➢ adherence to standards and rules, communication among parties, and amount of information sharing

5. Market	➢ Market share ➢ capacity to develop a unique competitive profile ➢ market growth, market development, and market orientation
6. Processes and capacity	➢ Perceived operation processes standardization ➢ procedure preparation time and waste ➢ Service capacity, and increase in efficiency due to visual work standards.
7. Financial	➢ Purchasing costs for medical devices and pharmaceuticals ➢ value of orders coming from tender processes, value of orders chosen without tender processes ➢ administration costs for medical devices and pharmaceuticals flows ➢ supply expense as a percentage of total hospital expense, supply expense per patient admission ➢ inventory carrying costs and stocking , revenue growth, profitability, net profits, return on investment, profit to revenue ratio, cash flow from operations requirements, transportation costs

ENVIRONMENTAL

Table 3: SSCM Performance Metrics in Hospital (environmental)

Categories	Metrics
1. Procurement	➢ Reduction of material consumption, drugs and packaging ➢ decrease in consumption of hazardous/harmful/toxic materials, ➢ reduction in air emission/pollution from procurement, and reduction in air emission/pollution from anesthetic gases
2. Energy	➢ Reduction in energy consumption, increase in energy efficiency ➢ reduction in air emission/pollution from energy consumption ➢ energy usage per unit area, and increase in the use of clean and renewable energy
3. Water	➢ Water consumption, water footprint
4. Travel	➢ Reduction in air emissions/pollution from business travel, patient transportation services, staff and community travel ➢ increase in fully electric fleet and pool vehicles ➢ reduction in fuel consumption,

	decrease in staff car use, and proportion of journeys made by a car
5. Food	➢ Percentage of locally and sustainably sourced foods procured ➢ reduction in air emission/pollution from food supply ➢ reduction in nutritional waste, and patient and staff satisfaction with healthy food choices provided
6. Hospital design and buildings	➢ Compliance with environmental and social value certification standards
7. Waste	➢ Decrease in waste generation from pharmaceuticals, chemicals, materials (e.g., products and equipment, packaging), and food, perceived waste reduction in processes ➢ avoidance of improper waste mixing and incineration ➢ proper waste disposal ➢ percentage of toxic waste, decrease in incineration waste as a percentage of the total ➢ improvement in ability to reuse/recycle/compost, and a reduction in waste disposal sent to a landfill

SOCIAL

Table 4: SSCM Performance Metrics in Hospital (social)

Categories	Metrics
1. Quality of patient care	➢ Death rate, timely provision of healthcare, length of stay, improvement in patient experience (quality of sleep, level of privacy, thermal comfort, service quality as perceived by customers, overall satisfaction with hospital experience) ➢ perceived care quality compared to other hospitals, service level, and perceived service level compared to other hospitals
2. Employee	➢ Improvement in worker safety and health at work ➢ improvement in employee awareness and education ➢ Improvement in worker efficiency, employee satisfaction, employee work life quality, proportion of working hours to that planned, staff absenteeism, employee privacy, and staff utilization.
3. Community	➢ Job creation ➢ image/reputation among major customer segments ➢ reduction in corruption and bribes

	➢ increase in population well-being, and stakeholder satisfaction

Findings show that most of the identified metrics are economic which is with the prominent attention that this dimension has received in the literature over time. Both recent and older publications that address the effects of SCM on performance without consideration of a holistic sustainability approach, have defined performance through a competitive advantage, operational market, and financial constructs.

The social dimension is that which contains the smallest number of identified indicators, which is consistent with the lesser recognition of this dimension in the literature. On the one hand, social issues are considered difficult to measure, since they involve subjective, complex, and dynamic factors of human nature. On the other hand, the literature shows significant advances in the identification of social issues of interest for supply chain management, but slow progress in their operations.

Environmental indicators are in a halfway position between economic and social indicators, pertaining to quantity. In the reviewed literature, efforts to measure natural resource consumption and waste generation, as well as the economic projection attributable to practice implementation, are evident.

8. Analysis of SSCM Practices and Effects on Sustainable Performance

Strategic Management and Leadership

The SCM strategy has become a prerequisite for practice deployment. However, it appears that strategy and organizational changes are hardly successful if there are no responsible and trained leaders who establish and control SCM priorities, plans, work teams, and performance measurement. From a sustainability perspective, this not only includes economic aspects, certain matters become relevant in advocacy for green and healthy hospitals.

Supplier Management

This is clear that organizational performance depends upon the way in which suppliers are managed. Practices such as supplier rationalization are often suggested in the reviewed literature, as it lends not only the possibility of ordering higher

volumes that generate financial savings, but also of building long-term relationships that enhance trust and enable the implementation of collaborative initiatives. Given that quality of care, health, and hospital reputation can be compromised by problems related to procured products. Hospital sustainability implies supplier sustainability as well.

Purchasing Management

The purchasing management is among the categories with the highest number of practices, as it represents a large portion of hospital budgets. On average, the share of supply expense, in reference to tangible supplies, is 15% and can reach 40% in hospitals with high clinical complexity. Among the most commonly mentioned practices are product standardization, purchasing group use, and creation of alliances with other hospitals. These practices have an essential economic orientation. The use of purchasing groups has also turned out to be a beneficial practice for the achievement of more competitive prices and economies of scale, through the purchasing power acquired by these groups, as a consequence of volume consolidation. In addition to economic and environmental motives, the decision to source from suppliers that offer the most competitive prices must not be at the expense of unethical conditions and human rights violations.

Warehousing and Inventory Management

One-fifth part of healthcare revenue is attributed to inventory management [80], implementation of practices to improve the reception, warehousing, and control of supplies can be more than justifiable. The use of hybrid stockless systems has been recommended. This involves the delivery of high-volume products directly to points of care and low-volume products to central stores. A completely stockless system is ideal for removing central stores and releasing space but may fail in a hospital environment that deals daily with unpredictable emergencies, or in remotely-located hospitals in which response times might be significant. The centralization of replenishment systems for nursing units is a practice that results in reducing surplus inventory, as well as administrative time for nursing, which works in favor of their dedication to delivery of care.

Transportation and Distribution Management

The large number of transport providers and their independent operations create valuable opportunities for capacity and routing optimization, which reduces both time and costs. It is important to mention that a stream of practices pushes toward transport minimization for environmental reasons, given its high impact on CO2 emissions. From this perspective, the avoidance, or at least reduction of travel, is a primary goal, through the encouragement of active travel and the promotion of the use of public transport, shared occupancy vehicles, and electric vehicles. Virtual solutions have proven valuable for the replacement of face-to-face meetings and appointments, since they avoid unnecessary patient and staff travel, both in administrative and clinical environments, through solutions such as tele-conferencing and tele-health, respectively.

Information and Technology Management

Some of the internal practices applied by leading hospitals mention the use of electronic communication tools and information systems, such as Electronic Patient Record (EPR), bar codes, and Enterprise Resource Planning (ERP) systems. The relevance of sharing information regarding forecasts, planning, inventory visibility, and delivery dates, as well as the establishment of cross-functional teams that encourage joint initiatives for product selection and standardization, inventory classification, and the discussion of performance metrics has been acknowledged. A bundle of practices is concentrated on supply, inventory, and transport. These consider the implementation of electronic commerce or e-procurement, Radio Frequency Identification (RFID), the integration of medical and administrative information systems, and automation of warehouses and transportation systems. Some outcomes of e-procurement implementation include the reduction of clerical tasks, errors, use of paper, and associated costs. RFID, along with barcodes, are part of track and trace systems, which identify medicines, individuals, supplies, or equipment. The identification of products, in particular, generates numerous advantages, in terms of a visibility increase and inventory cost reduction, manual task reduction, patient safety improvement, and support for reverse logistics.

Energy Management

This is known that the high amount of energy consumed by hospitals. Identified practices regarding energy mainly point to conservation measures, the use of

alternative energy technologies and fuels, the application of lean six sigma, and behavior change interventions. Some of these refer to the optimization of ventilation systems and replacement of existing lighting with LED, which resulted in quantifiable financial and consumption savings, and improved patient and staff comfort. By applying analytical tools derived from Six Sigma, proposed a future state to optimize a hospital linen distribution system, which led to improvements in communication, demand forecast accuracy, effectiveness, responsiveness, and reliability, which increased energy consumption efficiency. The turning off machines and lights when unnecessary, and closing doors when possible, as part of a social marketing intervention, proved successful not only in the reduction of energy consumption and carbon, but also in the improvement of the work environment and patient experience indicators such as quality of sleep and overall satisfaction.

Water Management

Hospitals use substantial amounts of water, which accounts for approximately 7% of the total water consumed in the tertiary sector in some countries. According to the reviewed literature, auditing, controlling for leaks, and installing more efficient fixtures in both toilets and showers can lead to savings of up to 25% while more complex solutions might imply transformations in clinical services operation. Another focus of practices involves recycling water from sterilization, dialysis, and other processes for use in non-potable needs. In contrast, a 20% water reuse policy leads to a reduction of 16% in the water footprint, savings in the cost of services at 19%, and a population well-being increases from 1.116% to 1.117%. The water footprint denotes water consumption, cost of services refers to daily average cost of resources per patient, and population well-being is measured in terms of patient admittance.

Food Management

High-fat processed food, the use of non-nutritive additives, meat produced using antibiotics and hormones, obesity, antibiotic resistance, diabetes, cancer, food waste, and pollution caused by food transport are among the problems that current food systems face. Hospitals have the potential to impact sustainability by addressing food issues, given their role as intermediaries in the market, their buying power, their responsibility for the promotion of proper nutritional habits, and the large number of people who frequent these organizations, between patients, visitors, employees, and

the community. In the reviewed literature, publications that focus on food sustainability show that recycling and avoiding the sale of bottled water are common practices, in contrast to composting and serving organic and locally grown food. This identifies 12 opportunities through which food practices may be addressed: procurement, catering contracts, menu development, pricing, waste management, infrastructure, staff training, information, education, communication and feedback, partnerships, and special events.

Hospital Design

For any hospital, fluid architecture is desirable to facilitate logistics, which, in turn, assists with people, material, and information flows. One of the practices implemented in some hospitals has been the integration of nursing stations, through a design that groups the elements of information, medicines, and materials required for care, and which not only contributes to ergonomic improvements, but also contributes to reducing the distances travelled by nursing staff. In addition to making flows more effective, sustainability raises challenges that generate the need for more complex planning for future facilities, as well as adaptation of existing facilities. Specific recommendations for building and adapting facilities, considering sustainability criteria, include using safer and local materials, sitting hospitals near public transportation routes, planting on-site trees, and incorporating design components like day lighting, natural ventilation, and green roofs. One limitation of current sustainability demands, however, many of today's hospitals operate in old buildings that consume large amounts of resources, and whose design is not carefully planned to favor aspects such as those mentioned above.

Waste Management

Significant volumes of waste are generated by hospitals. Besides environmental motives, waste management is important for public health reasons. In countries like India, the regulation is still weak while non-hazardous and hazardous waste are often mixed together, and large amounts of waste are unnecessarily incinerated, which causes avoidable toxic air pollution. Even more effective practices refer to avoiding waste generation altogether, which has been made achievable by addressing overtreatment, instigating methods such as social prescribing, development of processes where less material is necessary, waste stream analysis, review of waste-

generation processes, selecting safer chemicals, purchasing environmentally-friendly products, purchasing reusable rather than disposable products, and acquisition of improved technologies. Case studies regarding the application of Lean Six Sigma in medication processes and sterile processing illustrate the way in which it can lead to improved medication availability, fewer missing medications, reduced medication delivery trips, less kit variety for sterile processing, less waste, and financial savings. Similarly, despite the fact that waste cannot be completely avoided, it demonstrates that reverse logistics processes offer significant opportunities for hospitals and healthcare systems as a whole.

Staff and Community Behavior

Several examples show that capabilities, culture, and psychological factors are key determinants for the successful implementation of SCM practices. In other words, lack of training and education of supply chain professionals and executives is a common barrier is proneness to issues like sharing information, which pivots on organizational culture. From an economic perspective, includes the institutionalization of training and development as a best practice for the improvement of hospital supply chains. From the environmental and social perspectives, it asserts that critical thinking needs to be fostered, and employees must be supported in the process of making ethical decisions that they consider to be coherent with their personal beliefs, if indifference toward and myths about sustainability that constrain action are to be dismantled.

9. Conclusions

The analysis shows that both SSCM practices and sustainable performance metrics at once is not an easy task. The concept of practice is difficult to define. Practices take various forms and can represent technologies, processes, ways of doing things, or ways of organizing work. In addition, they can have different meanings or rationales from a sustainability approach and, for this reason, can overlap whichever categories have been established for their classification. In this way, a practice such as serving locally grown food can be conceived to improve food freshness and nutritional quality, favor the environment by avoiding transport activities, or strengthen local economies. Multiple purposes and interconnections among practices are more than visible and demonstrate the massive opportunities for action and

impact that an integrated approach for sustainability provides, as well as its complexity

Regarding performance, the main difficulty is that many effects of practices are not completely clear because there have not been enough empirical studies completed, and even less so regarding the interactions and trade-offs that may arise between dimensions. On one hand, it might be indicative of the exploratory status of current research, and the nascent interest in disclosing the elements that make up hospital SSCM. On the other, this could be interpreted as a symptom of the low level of adopting metrics and measurement systems, to such an extent that it would be more important to learn whether hospitals use indicators to measure performance than to calculate the values of such indicators.

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