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HEALTHCARE APPLICATION OF OPERATIONS MANAGEMENT TOOLS AND TECHNIQUES: A REVIEW OF LITERATURE

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Abstract:
This paper undertakes a review of extant literature to examine the outlets in which operations management tools and techniques have been applied for improved healthcare delivery. Just as operations management has found usefulness in many other industrial sectors, this report shows that healthcare has also recorded significant advances as the principles of operations management are continually being utilised. This is evident in areas such as the management and planning of medical capacity like bed space; management of medical inventory, equipment scheduling and assignment of doctors, nurses, and other medical personnel to patience. Moreover, operations management tools have been pivotal in making improvements in such areas as medical logistics, drugs and vaccine distribution, and the management of the health supply chain. The healthcare industry has also seen a couple of successes in implementing sustainable operations management in some aspects of healthcare logistics, ethical healthcare services, and responsible healthcare delivery. However, the major challenges in applying sustainability initiatives in healthcare relate to the disposal of medical wastes, effective application of six-sigma for process improvement, and managing long waiting lines experienced in most developing nations' hospital facilities.

Keywords: healthcare operations management; operations management tools and techniques; healthcare logistics and supply chains, sustainable healthcare operations management

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1. Introduction

Operations management (the management of activities involved in the conversion of input resources into finished products and services delivered for immediate or future postposed consumption) either as a concept, strategy or an academic field of study has come a long way and has made significant in-roads applications in almost all facet of life and livelihood. From the historical beginning during World War II to its modern application, operations management has come to stay. For instance, the application of operations management principles and tools has helped nations set development priorities (Iqbal, 2022; Corinne, Michael, & Nancy, 2016; Hipkin & Bennett, 2004). Many industrial nations, including the United States, the United Kingdom, and other European countries, have used operations management protocols to advance and accelerate the pace of industrialization, economic growth, and comparative advantage (Frakt, 2018; Iqbal, 2022).

In addition, it has helped nations like Japan and China in the development of improvement intervention templates and the development of sustainable growth-targeted policies and principles such as Just-in-Time production, Lean philosophy, and Six Sigma (Dieste, Panizzolo, Garza-Reyes, Anosike, 2019; Caldera, Desha, & Dawes, 2017; Guerrini, & de Castro, 2009; Chan, Samson, and Sohal, 1990). In both advanced and transient economies, the importance and positive impact of operations management are visible in many areas, including manufacturing, transportation, finance and banking, hospitality, small scale enterprises, automobiles, healthcare, and governance, amongst many others (Corinne, Michael, & Nancy, 2016; Slack, Chambers, and Johnston, 2007; Fleury, 1999).

2. Principles and Tools of Operations Management in the Healthcare Industry

Today, knowledge of operations management and the application of its tools and techniques has helped solve man's socio-economic and environmental problems ranging from capacity planning and resource utilisation to location and layout of facilities, waiting lines problems, product and service quality issues, information technology application, facility management, maintenance, and climate change and carbon energy footprint issues. The range of operations management functions in healthcare includes those related to the basic management processes of planning, organising, staffing, leading and controlling. These functions are in the form of clinical activities such as capacity design and hospital capacity planning; workflow; physical network; staffing levels and productivity management, logistics and health supply chain, and the management of medical stocks or inventory (Young, Saunders, & Olsen, 2010). Accordingly, Corinne *et al.,* (2016; 12) defined healthcare operations management as *"the management of the supporting business and clinical systems and processes that transform health resources (inputs) into services (outputs) for the last mile users (patients)."*

The healthcare industry is also an important sector in all nations, whether in developed or developing countries, and has constantly been under huge pressure for efficient performance from regulators, patients, fund providers, and donors. Given the numerous pressure sources and the need for compliance, hospitals and other healthcare providers have, over the years, been productive in using innovative solutions to provide more effective healthcare services to patients and humanity in general. For instance, evidence of breakthroughs in surgical operations abounds in the healthcare industry; medical discoveries in medicine revolution, trans medicine, vaccine manufacturing and preservation, infectious disease control, efficient management of hospital facilities and infrastructure, effective distribution of drugs, pharmaceuticals, and other healthcare services to remote areas, amongst others, are some of the positive stories in the world healthcare system. It might not be inaccurate to state that the deployment of operations management tools and techniques in one form or another has not contributed to these successes.

3. Solving Queues and Waiting Line Problems in Healthcare with Operation Management Tools

Various operations management models have been suggested and some are actually used in healthcare. For instance, a study by Peter & Nsikan (2021) deployed the queuing model in Nigerian hospitals to provide a benchmark for modelling the flow of patients and simulate the required number of doctors based on a multi-server queuing system. A study in a similar context by Nsikan, Eno, Ine & Koko (2021), gave an account of the sustainability factors that are important in selecting healthcare material suppliers and also delineates their effect on healthcare operational performance. They reported that economic sustainability was given consideration above all other factors for selecting emerging economies as suppliers in the healthcare industry.

4. Facility Location and Layout Decision in Healthcare

To enhance hospital competitiveness, its location is an important factor. Thus, selecting and evaluating the most attractive hospital location based on multi-criteria decisions has been the subject of operations management studies. For instance, Muhammet & Guneri (2021) undertook a systematic review of 44 operational management literature in solving hospital location selection problems and found that cost, environment, demand, population, government regulation, and distance to available infrastructure were the most considered criteria. The authors also reported that AHP and GIS-based MCDM models were the most commonly used methodologies for solving hospital location problems.

Beyond hospital location problems, the use of operation management tools also finds significant application in the area of facility layout. Hahn & Krarup (2001; Yucesan & Gul, 2020) argued that finding the optimal solution to hospital facility layout

issues is a major concern for hospital operations managers. However, Tongur, Hacibeyoglu, & Ulker (2020) contended that solving facility layout issues in the healthcare sector has not been deeply ingrained in comparison to the manufacturing industry.

In a similar study, Arnolds & Nickel, (2015) solved the hospital layout planning problem through the application of location analysis in Mexico's tertiary hospitals. A study of medical facility resource scheduling principles in Tanzania (Ileri 2013; Huyen, *et al.,* 2017) showed that resource management is an integral part of healthcare management (Reiling, B., Ronda, D., & Murphy, M., 2021).

5. Facility Scheduling and Assignment Models in Healthcare

Murphy (2021) investigated the impact that the design and assignment of medical facilities and equipment have on patient safety and found the assignment of medical equipment to patients (Muhammet & Guneri, 2021). By evaluating hospital service quality practices, Yucesan & Gul (2020) added a different dimension to how operations management has been applied in healthcare. The authors reported increased use of quality management tools such as fishbone diagram, statistical quality control, value stream mapping, Quality Function Deployment (QFD), and business process reengineering to enhance process quality in the 329 hospitals surveyed.

6. Supply Chain Management Principles in Healthcare

Managing the healthcare supply chain in an efficient and effective manner is central to achieving its goals and objective. To that extent, Nsikan, Ekeins, Tarela, & Affiah (2018) gave an account of the successful strategies that have been applied for the efficient management of healthcare supply chains. Similarly, Okon, Uduak, & Nsikan (2019) sampled the experiences of healthcare supply chain managers to understand the operational management practises that enhance healthcare supply chain performance. Given the above, one would not be entirely wrong to conclude that operations management principles, tools, and practises have had a significant influence on the performance of the healthcare industry.

7. Sustainable Healthcare Operations Management: Contemporary Issues and Challenges

Apart from the fact that the global healthcare industry has seen a remarkable increase in the use of operations management tools and principles, the healthcare industry has recently also been involved in implementing sustainability initiatives, for example in the faculty of medical sciences (FMS) and the National health service (NHS), in the UK. This has come both as a regulatory requirement and as a competitive strategy for patient satisfaction. Evidence abounds of many cases of successful implementation of sustainable

operations management in healthcare logistics, supplies, and distribution of health facilities and medical products and services in a timely and quality manner to the users (Fennigkoh, L., Smith B., 2019; Toba, Tomasini, & Yang, 2011). In addition, the high level of implementation of sustainable operations management tools such as Just-In-Time and lean thinking has also been reported in the healthcare operations management literature (Wang & Levenson, 2016).

However, several challenges and issues still confront the health sector as far as sustainable operation management is concerned. For instance, the healthcare industry, particularly in transient economies, appears to be grappling with issues such as sustainable disposal of medical waste (WHO, 2011; Verónica, William, & Elena, 2019); effective application of Six Sigma for process improvement; hence the long patient waiting lines in most developing nations' hospital facilities.

Today, the sustainable management of healthcare inventory is a serious challenge for many healthcare service providers. This is readily observed in areas such as sustainable capacity planning for spare parts and consumable inventory, development of sustainable policies for equipment maintenance and replacement, effective contract and contractor performance management, automation of procurement and supplies, and identification of healthcare personnel training needs in sustainable behaviour. In addition, other areas that have posed enormous challenges to the industry include managing supply chain sustainability risks, planning and developing resilience tools for emergencies and disasters, poor documentation and weak medical information management systems, and medical equipment standardisation require further research and policy attention (Oyamo & Mburu, 2014; Rao, Mellon, & Sarley, 2006).

According to Shadrack, Dominic, & Lilian (2015), other notable burning healthcare sustainability issues related to the adherence to green packaging of medical products, designing of eco-friendly medical products/materials; efficient warehouse space utilization; ethical concerns in the delivery of care; and management of clinical safety for frontline caregivers. Other management challenges in using operations management tools include scheduling optimization, performance and productivity analysis, process mining, quality improvements and more. Similarly, many rigid and non-learning operational algorithms from the past can be enhanced with healthcare design, making them much more applicable in complex operational environments. As a result, blending domain-optimal algorithms with healthcare data learning opens an extremely promising direction for solving real-life operational problems. In many ways, this ‘learning’ approach to operations management should change the entire management paradigm, and significantly improve healthcare delivery.

8. Conclusion and Future Directions

Operations management and its tools and techniques have been examined in this paper. Hence, it is important to suggest that a concerted effort by practitioners to imbibe operations management philosophy and deploy the tools for making healthcare service

delivery decisions would go a long way towards surmounting the implementation challenges. Although healthcare providers in Nigeria have increasingly made effort toward the philosophy of continuous improvement, many healthcare managers and decision-makers are still struggling with implementing operations management techniques. The incorrect notion about the nature of operations management has created an attitude of apathy towards the use of a specific tool. Thus, there is a somewhat low level of awareness of and usage. Moreover, there is a clear shortage of staff with meaningful knowledge or training in operations management as a basis of knowledge. This imbalance needs to be addressed if meaningful achievement in healthcare managerial decision making is to be optimised. This actually creates a requirement for the development of facilities for the education and training of personnel in the use of operations management tools. Future studies could examine the readiness level of healthcare institutions and the knowledge of healthcare personnel for the implementation of sustainability initiatives in healthcare operations. More studies are also needed to understand the role of new technologies in transforming the management of public health operations.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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