INDERSCIENCE PUBLISHERS
Linking academia, business and industry through research

International Journal of Behavioural and Healthcare Research

ISSN online: 1755-3547 - ISSN print: 1755-3539
https://www.inderscience.com/ijbhr

Inter-relationship of operational factors in hospitals

Saibal Kumar Saha, Sucheta Bhattacharya

DOI: 10.1504/IJBHR.2024.10063017

Article History:

Received:	03 August 2023
Last revised:	04 August 2023
Accepted:	09 February 2024
Published online:	26 March 2024

Inter-relationship of operational factors in hospitals

Saibal Kumar Saha* and
Sucheta Bhattacharya

School of Business and Management,
Christ University,
Bangalore, Karnataka, India
Email: saibal115@yahoo.co.in
Email: suchetabhatt08@gmail.com
*Corresponding author

Abstract: The success of any healthcare organisation is largely dependent on the crucial and difficult task of managing hospital operations. This research aims to find the inter relationship of operational factors in hospitals with the help of Decision Making Trial and Evaluation Laboratory analysis. Seven factors were identified which affect the management of hospital operation. Using judgement sampling method 15 responses were collected from senior medical staffs from Agartala, Tripura, India by personal interview. A self-designed questionnaire was designed using paired comparison method to capture the responses. It was found that the factors Inventory, Supplier timeline, collaboration with supplier and green technology were the causes and the factors standard of services, flexibility, and waste treatment are the effects. The factor standard of services had the highest priority.

Keywords: hospital operations; DEMATEL; Tripura; supply chain; inventory; waste treatment.

Reference to this paper should be made as follows: Saha, S.K. and Bhattacharya, S. (2024) 'Inter-relationship of operational factors in hospitals', *Int. J. Behavioural and Healthcare Research*, Vol. 9, No. 2, pp.149–163.

Biographical notes: Saibal Kumar Saha (UGC NET Qualified) holds his PhD degree in Management Studies, a first-class Master's degree in MBA and a first-class Bachelor's degree in Electronics and Communication Engineering. He has over 13 years of experience and has worked in MNCs like Cognizant Technology Solutions and Tata Aig Life. He has served National Institute of Technology, Silchar, Jyotirmoy School of Business, Kolkata, University of Technology and Management, Shillong, Sikkim Manipal Institute of Technology and is currently working as an Associate Professor at Christ University, Bangalore. He has published more than 60 research articles in reputed international journals, book chapters and conference proceedings. He has published three books and has three patents. He has obtained three copyrights and has worked in consultancy and government sponsored projects. He is also a reviewer in several international journals and part of Editorial Advisory Boards.

Sucheta Bhattacharya is an MBA Graduate from Christ University, Bangalore, India. She has specialised in Lean Operations and Systems.

1 Introduction

Healthcare encompasses the activities involved in promoting and preserving good health and wellness by diagnosing, preventing and treating physical and mental ailments. On the other hand, healthcare logistics refer to the management and distribution of essential healthcare items, including pharmaceuticals, medical and surgical supplies and devices, that healthcare professionals like doctors, nurses and administrators require. The prompt and precise delivery of these items is crucial to achieve favourable outcomes in healthcare (Arora and Gigras, 2018). Operations management plays a vital role in all industries, including healthcare. Its core responsibilities involve the strategic planning, coordination and supervision of internal processes to facilitate the smooth functioning of a business. The importance of operations management in healthcare cannot be overstated, given the industry's wide-ranging nature. Effective operations management is imperative for delivering quality care in diverse healthcare settings, from hospitals and residential facilities to nursing homes, doctor's offices and home healthcare organisations. In this dynamic field, it is critical to implement efficient operations management practices to enhance and preserve people's health and well-being.

The management of hospital operations is an indispensable and challenging task that determines the success of any healthcare organisation. By effectively implementing Operations Management (OM) practices, patient care quality and safety can be improved and profits can be increased (Kim and Kwon, 2015). OM is a process that governs the creation of products or services in an organisation. In the healthcare sector, efficient and high-quality care to patients can only be provided through effective OM. The four primary functions of OM in hospitals are quality management, resource management, process improvement and patient safety (Graban, 2018). Quality management is an indispensable component of providing secure and high-quality care. It entails establishing and monitoring standards, evaluating performance and taking corrective measures when required. To meet the dynamic needs of modern healthcare and ensure that patients receive the best possible care, quality must be maintained. Resource management is critical to ensuring that patients receive timely and appropriate care.

Different healthcare operations have unique resources that must be managed accordingly. Process improvement involves implementing changes aimed at enhancing the quality and efficiency of services. Operations managers usually lead these efforts in collaboration with other healthcare professionals. They also ensure patient safety by ensuring that the hospital is free of hazards and clean and by developing policies and procedures to prevent errors or accidents. Additionally, they collaborate with staff to ensure that they receive adequate training in safety protocols.

There are several gaps in hospital management operation that can negatively impact patient care and overall hospital performance. Some common gaps include: *Communication*: Poor communication between hospital staff, departments and with patients and their families can result in errors, delays and misunderstandings that can compromise patient care (Ahmed et al., 2019; Alvarez and Coiera, 2006). *Staffing*: Inadequate staffing levels, high turnover rates and a lack of training and development opportunities can lead to burnout, low morale and suboptimal performance among hospital staff (Carayon and Gurses, 2008; Morse et al., 2012; Osaro and Chima, 2014). *Technology*: Outdated or poorly integrated technology can impede efficient operations and limit the ability of hospital staff to provide high-quality care (Ding, 2014; Hariharan et al., 2004; Moons et al., 2019; Wu et al., 2016). *Data management*: Poor data

management practices, including inadequate documentation and record-keeping, can compromise patient safety, hinder clinical decision-making and lead to compliance issues (Endriyas et al., 2019; Lubis et al., 2018). *Supply chain management*: Inefficient or unreliable supply chain management practices can result in shortages of critical supplies, equipment and medications, leading to delays and suboptimal patient care (Saha, 2022; Saha and Jha, 2018). *Quality control*: Inconsistent or inadequate monitoring and evaluation of quality control processes can result in missed opportunities for improvement and compromised patient safety (Ghazanfari et al., 2021; Nieva and Sorra, 2003; Parand et al., 2014).

Supply chain management is a critical component of hospital management operation. When gaps exist in supply chain management, it can have a significant impact on patient care, hospital finances and overall performance. Some common gaps in supply chain management in hospital management include *Inadequate inventory management*: Inefficient inventory management practices can lead to stockouts of critical supplies and medications, leading to delays and suboptimal patient care (Friday et al., 2021; Kaupa and Naude, 2021; Mbonane et al., 2023; Olutuase et al., 2022). *Lack of visibility*: A lack of visibility into the supply chain can lead to missed opportunities to optimise procurement, reduce waste and improve operational efficiency. *Poor supplier performance*: Poor supplier performance, including delays in delivery and inadequate product quality, can impact the hospital's ability to provide high-quality care and can result in financial losses. *Ineffective contract management*: Poor contract management can lead to missed opportunities to negotiate favourable terms and conditions, resulting in higher costs and reduced operational efficiency.

The effects of these gaps in supply chain management can be significant. i) *Increased costs*: Poor inventory management, supplier performance and contract management can result in higher costs for hospital supplies and medications, impacting the hospital's finances (Fox et al., 2009; Gebicki et al., 2014; Langabeer, 2008). ii) *Reduced operational efficiency*: Inefficient supply chain management practices can lead to delays, wasted time and resources and sub-optimal performance among hospital staff (Carter et al., 2012; Peck, 2005; Piggott et al., 2011). iii) *Compromised patient care*: Stockouts of critical supplies and medications, as well as delays in delivery and poor product quality, can compromise patient care and safety (Olutuase et al., 2022). iv) *Compliance issues*: Poor supply chain management practices can result in compliance issues, including regulatory violations and quality control problems.

Since there is lack of literature on the inter relationship of operational factors in hospitals, the cause and effect of these factors can help to identify challenges and opportunities in hospitals. Hence, this research aims to find the inter relationship of operational factors in hospitals with the help of Decision-Making Trial and Evaluation Laboratory – DEMATEL analysis.

2 Literature review

The supply chain is a comprehensive network of resources that is essential for providing goods or services to customers. Consequently, healthcare supply chain management involves acquiring resources, controlling supplies and delivering products and services to providers and patients (Baltacioglu et al., 2007). To accomplish this, physical commodities and information related to medical products and services go through various

stakeholders, such as manufacturers, insurance firms, hospitals, physicians, group purchasing organisations and various governmental departments. Healthcare supply chain management is typically a complex and fragmented process (Privett and Gonsalvez, 2014). However, efficient healthcare supply chain management can provide significant cost-reducing advantages throughout hospitals and doctor offices. Healthcare supply chain managers are responsible for stocking organisations with necessary products and managing inventory (Kovács and Falagara Sigala, 2021). The supply chain begins at the medical product manufacturer, where items are produced and dispatched for distribution. Depending on the product, hospitals can purchase their inventory directly from the manufacturer or distributor, or they can utilise the services of a group purchasing organisation, which establishes a purchasing contract between the manufacturer and hospital.

Vishnu et al. (2020) examined the various operational risk factors that affect public hospitals in the Indian state of Kerala. The authors highlighted several operational risk factors that impacted public hospitals in Kerala, including *Poor infrastructure* – Many public hospitals in Kerala have inadequate infrastructure, which can impact the quality of care provided to patients. *Staffing shortages* – Many public hospitals in Kerala suffer from a shortage of qualified medical staff, which can impact the quality of care and lead to increased workload for existing staff. *Inadequate training* – Many medical staff in public hospitals in Kerala do not receive adequate training, which can impact their ability to provide quality care. *Poor communication* – Communication between medical staff, patients and their families is often inadequate in public hospitals in Kerala, which can lead to misunderstandings and errors in care. *Inadequate resources* – Public hospitals in Kerala often suffer from a lack of resources, including medical supplies and equipment, which can impact the quality of care provided to patients. *Inefficient processes* – Many public hospitals in Kerala have inefficient processes and systems in place, which can lead to delays and errors in care. The article concludes that operational risk factors are a major challenge for public hospitals in Kerala, and that addressing these factors is essential to improving the quality of care provided to patients. The article suggests that addressing these factors requires a multi-faceted approach, including investment in infrastructure and resources, staff training and development, improved communication and the implementation of more efficient processes and systems.

Another article that examines the relationship between operational flexibility and hospital performance in Jordanian hospitals, highlights several factors that contribute to operational flexibility in hospitals. It includes i) *Technology adoption* – The adoption of new technologies, such as electronic health records and telemedicine, can enhance operational flexibility by enabling hospitals to adapt quickly to changes in patient demand and other external factors. ii) *Organisational structure* – Hospitals with flexible organisational structures, including decentralised decision-making and cross-functional teams, are better equipped to respond quickly to changes in patient demand. iii) *Staffing levels and skill mix* – Hospitals with sufficient staffing levels and a diverse skill mix are better equipped to manage fluctuations in patient demand and provide high-quality care. iv) *Supply chain management* – Effective supply chain management, including the ability to quickly source and distribute medical supplies and equipment, is critical to operational flexibility. v) *Financial management* – Hospitals with strong financial management practices, including the ability to quickly adjust budgets and allocate resources, are better equipped to respond to changes in patient demand and other external factors. The article concludes that operational flexibility is an important driver of hospital performance, and that hospitals that are more flexible are better equipped to respond to changes in patient

demand and other external factors. The article suggests that hospitals can enhance operational flexibility by adopting new technologies, implementing flexible organisational structures, optimising staffing levels and skill mix, improving supply chain management and enhancing financial management practices (Alolayyan et al., 2011).

Supply Chain Management (SCM) is a critical aspect of healthcare delivery, as it involves the coordination and management of resources, materials and information to ensure that healthcare services are delivered efficiently and effectively. SCM encompasses all activities involved in the production and delivery of healthcare products and services, including procurement, inventory management, transportation and distribution (Dobrzykowski, 2019; Jahantigh and Malmir, 2015).

In countries with developing economies where healthcare systems are typically inadequate in terms of resources and funding, SCM becomes increasingly vital to guarantee access to necessary medicines and medical equipment while also enhancing health results. By implementing effective SCM techniques, it is possible to ensure that appropriate products are accessible in the right quantities, at the right time and at reasonable prices. Additionally, effective SCM can minimise product waste and prevent occurrences of stockouts, which could otherwise result in the discontinuation of treatment and negative health consequences (Dobrzykowski, 2019; Jahantigh and Malmir, 2015).

The literature on SCM in healthcare of third world countries suggests that there are several challenges associated with implementing effective SCM systems, including inadequate funding and resources, weak infrastructure, limited access to information and communication technologies and a lack of skilled personnel. However, there are also several strategies that can be employed to overcome these challenges, including the use of innovative technologies, public-private partnerships and capacity building programs for healthcare workers (Chandrasekhar and Ghosh, 2001; Oleribe et al., 2019). Overall, the importance of SCM in healthcare of third world countries cannot be overstated, as it is essential for improving the availability, accessibility and affordability of healthcare products and services, and ultimately, improving health outcomes for the most vulnerable populations (Arora and Gigras, 2018).

Hence, the following seven factors concerned with the operations in hospital have been selected for this study.

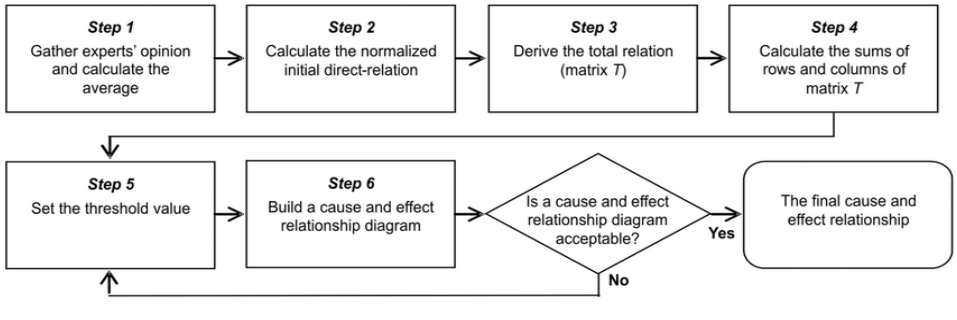
Sl. No.	*Factors*	*Variable*	*Citations*
1	Inventory	VA	Kovács and Falagara Sigala (2021); Kumar and Kumar (2015); Tang and Anane (2023)
2	Standard of services	VB	Vishnu et al. (2020); Gopi et al. (2019); RiyazhKhan and Haq (2019)
3	Flexibility	VC	Alolayyan et al. (2011); Alolayyan et al. (2013)
4	Supplier timeline	VD	Dobrzykowski (2019); Jahantigh and Malmir (2015); Mohammady Garfamy (2011)
5	Waste treatment	VE	Moura and Silva (2016); Faisal et al. (2011); Raj and Samuel (2023)
6	Collaboration with supplier	VF	Saha and Jha (2018); Chakraborty (2019); Mandal et al. (2022)
7	Green technology	VG	Chakraborty and Kalepu, (2019); Rezali et al. (2021); Priyan et al. (2024)

3 Methodology

The method of DEMATEL (Mangla et al., 2016) was used to analyse the interdependencies among the set of factors and determine their relative importance. In this case, the survey was conducted to determine the impact of one factor on another factor using paired comparison method. 15 responses were collected from senior medical staffs from Agartala, Tripura, India by personal interview. The judgemental sampling method was used to select the physicians for the survey. Respondents were asked to evaluate the dependence of one factor on the other by assigning a score between '1' to '5'. The scores ranged from '1' (no effect) to '5' (extreme effect).

DEMATEL: Decision-Making Trial and Evaluation Laboratory is a method used for analysing complex systems by identifying the interrelationships and interdependencies among the different elements or factors within the system (Sharma et al., 2020). The DEMATEL method was developed in the 1970s by the Korean Management Scientist, Professor Bernard G.J. Lee. The method involves a systematic approach to analysing a problem, which includes breaking down the problem into smaller components and identifying the relationships between these components. The DEMATEL method uses a matrix-based approach to identify the causal relationships between the different components of a system (Mathiyazhagan et al., 2020). The method involves constructing a matrix that captures the relationships between each component of the system, including both direct and indirect relationships. The matrix is then analysed using graph theory to identify the most important factors within the system and to understand how the different components of the system are interconnected (Saha et al., 2022). DEMATEL is a useful method for analysing complex systems by identifying the interrelationships and interdependencies among the different elements or factors within the system. The method can help decision-makers to identify the most important factors within the system and to develop effective strategies to improve the system's overall performance (Jha et al., 2020). The steps for DEMATEL is shown in Figure 1.

Figure 1 Steps of DEMATEL



4 Results and discussion

1 The factor 'Inventory' VA affects both 'Flexibility' VC and 'Collaboration with supplier' VF equally.

2 The factor 'Standard of services' VB affects VA 'Inventory', 'Flexibility' VC and 'Waste treatment' VE.

3 The factor 'Flexibility' VC affects 'Standard of services' VB highest.

4 The factor 'Supplier timeline' VD affects 'Standard of services' VB highest.

5 The factor 'Waste Treatment' VE affects 'Standard of services' VB highest.

6 The factor 'Collaboration with suppliers' VF affects 'Green technology' VG highest.

7 The factor 'Green technology' VG affects 'Waste treatment' VE highest.

From the Table 1, maximum values of all the rows and columns are calculated (shown in Table 2).

Table 1 Original impact matrix (OIA)

OIA	*VA*	*VB*	*VC*	*VD*	*VE*	*VF*	*VG*	*Σaij*
VA	0	3.75	**3.85**	3.7	3.45	**3.85**	3.5	22.1
VB	**3.8**	0	**3.8**	3.6	**3.8**	3.35	3.25	21.6
VC	3.6	**3.75**	0	3.35	3.6	3.65	3.45	21.4
VD	3.75	**3.85**	3.45	0	3.4	3.55	3.55	21.55
VE	3.3	**3.7**	3.5	3.45	0	3.55	3.65	21.15
VF	3.5	3.6	3.55	3.7	3.55	0	**3.85**	21.75
VG	3.85	3.7	3.75	3.5	**3.9**	3.6	0	22.3
Σaji	21.8	22.35	21.9	21.3	21.7	21.55	21.25	

Table 2 Calculation of *K*

maxΣaij	*1/Σa*	*K*
22.3	0.044843	0.044743
	0.044743	
maxΣaji		
22.35		

From the matrix of direct impact ash shown in Table 3, one can deduce which factors are causing the most significant impact on the system and how they are related to one another. It helps in prioritising the factors for improvement and identifying which factors to focus on first. Based on the matrix of direct impact a priority ranking is set amongst the identified factor (shown in Table 4).

Table 3 Matrix for direct impact (DI)

*DI=K*QIA*	*VA*	*VB*	*VC*	*VD*	*VE*	*VF*	*VG*	*Σaij*
VA	0	0.1677	0.1722	0.1655	0.1543	0.1722	0.1566	0.9888
VB	0.1700	0	0.1700	0.1610	0.1700	0.1498	0.1454	0.9664
VC	0.1610	0.1677	0	0.1498	0.1610	0.1633	0.1543	0.9574
VD	0.1677	0.1722	0.1543	0	0.1521	0.1588	0.1588	0.9642
VE	0.1476	0.1655	0.1566	0.1543	0	0.1588	0.1633	0.9463
VF	0.1566	0.1610	0.1588	0.1655	0.1588	0	0.1722	0.9731
VG	0.1722	0.1655	0.1677	0.1566	0.1744	0.1610	0	0.9977
Σaji	0.9753	1	0.9798	0.9530	0.9709	0.9642	0.9507	

Table 4 Priority ranking

Variables	*Σaij*	*Σaji*	*Addition of row sum & column sum*	*Priority*
VA	0.988814	0.975391	1.964206	2
VB	0.966443	1	1.966443	1
VC	0.957494	0.979866	1.93736	5
VD	0.964206	0.95302	1.917226	6
VE	0.946309	0.970917	1.917226	7
VF	0.973154	0.964206	1.93736	4
VG	0.997763	0.950783	1.948546	3

From the matrix we can see that VB Standard of services is the highest priority amongst all the factors and plays a crucial role in the operation of hospital management. VA Inventory comes second and is followed by VG Green technology. However, VE Waste treatment comes to the last amongst the factors influencing the hospital management operations. Following the steps of DEMATEL (I-M) Matrix is calculated (as shown in Table 5) where 'I' is the identity matrix. Next inverse of (I-M) is calculated (as shown in Table 6).

Table 5 I-M

I-M	*VA*	*VB*	*VC*	*VD*	*VE*	*VF*	*VG*
VA	1	–0.16779	–0.17226	–0.16555	–0.15436	–0.17226	–0.1566
VB	–0.17002	1	–0.17002	–0.16107	–0.17002	–0.14989	–0.14541
VC	–0.16107	–0.16779	1	–0.14989	–0.16107	–0.16331	–0.15436
VD	–0.16779	–0.17226	–0.15436	1	–0.15213	–0.15884	–0.15884
VE	–0.14765	–0.16555	–0.1566	–0.15436	1	–0.15884	–0.16331
VF	–0.1566	–0.16107	–0.15884	–0.16555	–0.15884	1	–0.17226
VG	–0.17226	–0.16555	–0.16779	–0.1566	–0.1745	–0.16107	1

Table 6 (I-M) inverse

(I - M) inverse	*VA*	*VB*	*VC*	*VD*	*VE*	*VF*	*VG*
VA	5.6777	4.922606	4.844477	4.727384	4.793545	4.777885	4.709502
VB	4.729738	5.683829	4.749296	4.632672	4.712271	4.669164	4.610007
VC	4.688366	4.791826	5.569028	4.590305	4.671134	4.644541	4.582665
VD	4.722526	4.824809	4.731961	5.488385	4.69335	4.66993	4.614249
VE	4.632902	4.7436	4.658579	4.548864	5.487088	4.595983	4.544735
VF	4.750655	4.853776	4.771743	4.666048	4.734707	5.568937	4.660006
VG	4.860853	4.958032	4.877677	4.756271	4.844681	4.805595	5.609573

As shown in Table 7, the matrix of Total Impact (T) is calculated as M * (I-M) inverse

Table 7 Matrix of total impact

T	*VA*	*VB*	*VC*	*VD*	*VE*	*VF*	*VG*	*R*
VA	4.6777	4.922606	4.844477	4.727384	4.793545	4.777885	4.709502	33.4531
VB	4.729738	4.683829	4.749296	4.632672	4.712271	4.669164	4.610007	32.78698
VC	4.688366	4.791826	4.569028	4.590305	4.671134	4.644541	4.582665	32.53786
VD	4.722526	4.824809	4.731961	4.488385	4.69335	4.66993	4.614249	32.74521
VE	4.632902	4.7436	4.658579	4.548864	4.487088	4.595983	4.544735	32.21175
VF	4.750655	4.853776	4.771743	4.666048	4.734707	4.568937	4.660006	33.00587
VG	4.860853	4.958032	4.877677	4.756271	4.844681	4.805595	4.609573	33.71268
C	33.06274	33.77848	33.20276	32.40993	32.93678	32.73204	32.33074	

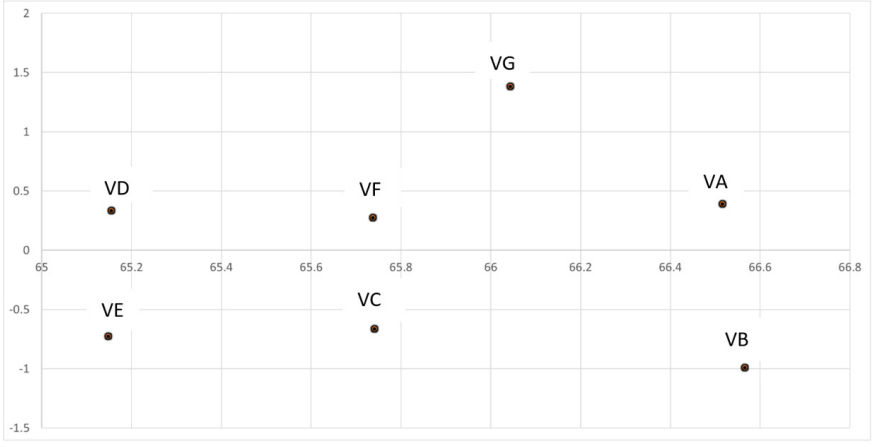
The matrix of Total Impact provided the row sum vector (R) and column sum vector (C), which were utilised to determine the interrelated effects of the factors. When (R + C) (row and column sum vector) values are higher, it indicates that the mutual impact of the factors is greater. The (R–C) (row and column difference vector) determines the net impact of the Total Impact Matrix. If (R–C) value is greater than zero, the factor is considered as the 'cause' because it has a higher impact on other factors. Conversely, if (R–C) value is less than zero, the factor is named an 'effect' because its impact on other factors is smaller. These are shown in Table 8.

Table 8 Relationship of cause and effect

Sl. No.	*Factors*	*C*	*R+C*	*R-C*	
VA	Inventory	33.06274	66.51584	0.39036	Cause
VB	Standard of services	33.77848	66.56546	–0.9915	Effect
VC	Flexibility	33.20276	65.74063	–0.6649	Effect
VD	Supplier timeline	32.40993	65.15514	0.335281	Cause
VE	Waste treatment	32.93678	65.14853	–0.72502	Effect
VF	Collaboration with supplier	32.73204	65.73791	0.273836	Cause
VG	Green technology	32.33074	66.04342	1.381945	Cause

The diagram that illustrates the cause-effect relationship is formed by utilising the values of the 'row and column difference vector' and 'row and column sum vector'. This diagram is split into two quadrants, with the factors having positive values of (R+C) being designated as the 'cause', while those with negative values are classified as the 'effect'. By examining the total impact matrix table, the connection between the various factors was determined. To validate the results, the participating physicians were once again approached to confirm if the outcomes align with their comprehension. The majority of them concurred and provided justifications for their agreement, which was also supported by the literature review.

Figure 2 Diagram of cause and effect relationship



By analysing the average/impact matrix, we can observe the individual effects of each factor. This allows us to determine which factor has the most significant impact on hospital management quality and medical staff. After performing calculations, we can identify the cause-and-effect relationship. Among the seven operational factors studied in literature, the standard of services was found to be the most crucial factor in hospital management, and it can be effectively managed by maintaining proper inventory, supplier timing, collaboration and implementing green technologies. These operational factors are critical for efficient hospital management and for ensuring optimal performance by medical staff. Complying with hospital guidelines and government policies to maintain the standard of services can lead to improved service quality for patients. Improvements in operational factors, such as the use of green technologies and better waste management, can further enhance hospital management. In the future, innovation and sustainable technologies are expected to have a significant impact on hospital service quality and the work environment for medical staff.

Several studies have emphasised the importance of operational factors in healthcare management. For instance, a study by Jabbour et al. (2018) shown that the implementation of green practices in healthcare organisations could improve their operational performance and reduce costs, while also enhancing environmental sustainability. Similarly, other researchers have highlighted the significance of waste management in healthcare, as improper waste disposal can pose significant health and environmental risks (Letho et al., 2021). In addition, the standard of services has been

identified as a critical operational factor that affects patient satisfaction and loyalty (Abu-Rumman et al., 2021). The study found that patients are more likely to return to a hospital if they are satisfied with the quality of care and services provided. Therefore, improving the standard of services in hospitals can have a significant impact on patient retention and loyalty.

Moreover, the role of innovation and technology in healthcare management has been widely recognised in recent years. The use of innovative technologies such as telemedicine and Electronic Health Records (EHRs) can improve the efficiency and effectiveness of healthcare delivery, as well as facilitate communication and collaboration among healthcare professionals (Halamka and Cerrato, 2021). Furthermore, the use of sustainable technologies can help reduce environmental impacts and promote sustainable development in healthcare organisations (Jabbour et al., 2018). Hence, it is evident the importance of operational factors such as waste management, green technologies, standard of services and innovation in healthcare management. These factors are critical for enhancing hospital management and improving the quality of services provided to patients.

5 Conclusions

The management of operational factors is critical for the successful running of hospitals, and their impact on the quality of care offered to patients cannot be underestimated. After conducting an extensive literature review and analysing the collected data, several operational factors were identified as having a significant impact on hospital management. These factors include standard of services, inventory management, supplier timing, collaboration, green technologies, flexibilities and waste treatment. To ensure optimal performance of hospitals, it is necessary to adhere to the government and hospital guidelines regarding service standards. Improving operational factors such as green technologies, waste management and collaboration can improve the efficiency and effectiveness of hospital management. In the future, innovation and sustainable technologies will be instrumental in influencing the service quality in hospitals and the working environment of medical staff. Managing operational factors effectively is crucial for hospitals to provide high-quality care to patients. By implementing futuristic solutions, hospitals can improve their efficiency and effectiveness, leading to better patient outcomes and a more positive work environment for medical staff.

Furthermore, it is important to note that the identified operational factors are interrelated and should be managed in a coordinated manner. For instance, proper inventory management can lead to reduced waste and efficient use of resources, which in turn can enhance the overall performance of hospitals. Collaboration among different departments and suppliers can also improve the quality of services provided to patients. In addition to the recommendations, hospitals can also invest in training and development programs for their staff to improve their skills and knowledge. This can lead to better decision-making and problem-solving abilities, which can positively impact hospital management. Hospitals can explore the use of technology to streamline their operations and reduce errors. The effective management of operational factors is a continuous process, and hospitals should regularly evaluate their performance and identify areas for improvement. This can be done using Key Performance Indicators (KPIs) and benchmarking against other hospitals or industry standards. These can also be areas of future research.

References

Abu-Rumman, A., Mhasnah, A. and Al-Zyout, T. (2021) 'Direct and indirect effects of TQM on the patients' satisfaction and loyalty in the Jordanian health care sector', *Management Science Letters*, Vol. 11, No. 2, pp.493–502.

Ahmed, Z., Saada, M., Jones, A.M. and Al-Hamid, A.M. (2019) 'Medical errors: healthcare professionals' perspective at a tertiary hospital in Kuwait', *PloS One*, Vol. 14, No. 5. Doi: 10.1371/journal.pone.0217023.

Alolayyan, M.N., Ali, K.A.M. and Idris, F. (2011) 'The impact of operational flexibility on hospital performance in Jordanian hospitals: some empirical evidences', *Journal of Global Management*, Vol. 2, No. 1, pp.39–52.

Alolayyan, M.N., Ali, K.A.M. and Idris, F. (2013) 'Total quality management and operational flexibility impact on hospitals performance: a structural modelling approach', *International Journal of Productivity and Quality Management*, Vol. 11, No. 2, pp.212–227.

Alvarez, G. and Coiera, E. (2006) 'Interdisciplinary communication: an uncharted source of medical error?', *Journal of Critical Care*, Vol. 21, No. 3, pp.236–242.

Arora, M. and Gigras, Y. (2018) 'Importance of supply chain management in healthcare of third world countries', *International Journal of Supply and Operations Management*, Vol. 5, No. 1, pp.101–106.

Baltacioglu, T., Ada, E., Kaplan, M.D., Yurt, O. and Kaplan, Y.C. (2007) 'A new framework for service supply chains', *The Service Industries Journal*, Vol. 27, No. 2, pp.105–124. Doi: 10.1080/02642060601122629.

Carayon, P. and Gurses, A.P. (2008) 'Nursing workload and patient safety – a human factors engineering perspective', *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*.

Carter, P.M., Desmond, J.S., Akanbobnaab, C., Oteng, R.A., Rominski, S.D., Barsan, W.G. and Cunningham, R. M. (2012) 'Optimizing clinical operations as part of a global emergency medicine initiative in Kumasi, Ghana: application of lean manufacturing principals to low-resource health systems', *Academic Emergency Medicine*, Vol. 19, No. 3, pp.338–347.

Chakraborty, S. (2019) 'Exploring the antecedents of co-creation in hospital-supplier relationship: an empirical study on private sector hospitals in India', *International Journal of Business Information Systems*, Vol. 32, No. 4, pp.393–424.

Chakraborty, S. and Kalepu, R. (2019) 'IT and green practices as enablers of service-oriented capabilities and patient-focused care in healthcare industry', *International Journal of Innovation and Sustainable Development*, Vol. 13, No. 2, pp.220–244.

Chandrasekhar, C.P. and Ghosh, J. (2001) 'Information and communication technologies and health in low income countries: the potential and the constraints', *Bulletin of the World Health Organization*, Vol. 79, pp.850–855.

Ding, D.X. (2014) 'The effect of experience, ownership and focus on productive efficiency: a longitudinal study of US hospitals', *Journal of Operations Management*, Vol. 32, Nos. 1/2, pp.1–14.

Dobrzykowski, D. (2019) 'Understanding the downstream healthcare supply chain: unpacking regulatory and industry characteristics', *Journal of Supply Chain Management*, Vol. 55, No. 2, pp.26–46.

Endriyas, M., Alano, A., Mekonnen, E., Ayele, S., Kelaye, T., Shiferaw, M., Misganaw, T., Samuel, T., Hailemariam, T. and Hailu, S. (2019) 'Understanding performance data: health management information system data accuracy in Southern Nations Nationalities and People's Region, Ethiopia', *BMC Health Services Research*, Vol. 19, No. 1, pp.1–6.

Faisal, M.N., Khan, S. and Farooqi, I.H. (2011) 'Prioritising factors for selection of infectious waste management contractors using fuzzy analytic hierarchy process', *International Journal of Applied Management Science*, Vol. 3, No. 3, pp.275–293.

Fox, E.R., Birt, A., James, K.B., Kokko, H., Salverson, S. and Soflin, D.L. (2009) 'ASHP guidelines on managing drug product shortages in hospitals and health systems', *American Journal of Health-System Pharmacy*, Vol. 66, No. 15, pp.1399–1406.

Friday, D., Savage, D.A., Melnyk, S.A., Harrison, N., Ryan, S. and Wechtler, H. (2021) 'A collaborative approach to maintaining optimal inventory and mitigating stockout risks during a pandemic: capabilities for enabling health-care supply chain resilience', *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 11, No. 2, pp.248–271.

Gebicki, M., Mooney, E., Chen, S-J. and Mazur, L.M. (2014) 'Evaluation of hospital medication inventory policies', *Health Care Management Science*, Vol. 17, pp.215–229.

Ghazanfari, F., Mosadeghrad, A. M., Jaafari Pooyan, E. and Mobaraki, H. (2021) 'Iran hospital accreditation standards: challenges and solutions', *The International Journal of Health Planning and Management*, Vol. 36, No. 3, pp.958–975.

Gopi, D., Pandi, A.P., Sethupathi, P.R., Paranitharan, K.P. and Jeyathilagar, D. (2019) 'An integrated conceptual model for achieving global quality service in healthcare establishments', *International Journal of Services and Operations Management*, Vol. 33, No. 1, pp.49–68.

Graban, M. (2018) *Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement*, Productivity Press.

Halamka, J. and Cerrato, P. (2021) 'Understanding the role of digital platforms in technology readiness', *Regenerative Medicine*, Vol. 16, No. 3, pp.207–213.

Hariharan, S., Dey, P.K., Moseley, H.S.L., Kumar, A.Y. and Gora, J. (2004) 'A new tool for measurement of process-based performance of multispecialty tertiary care hospitals', *International Journal of Health Care Quality Assurance*, Vol. 17, No. 6, pp.302–312.

Jabbour, J., Robey, T. and Cunningham, M.J. (2018) 'Healthcare disparities in pediatric otolaryngology: a systematic review', *The Laryngoscope*, Vol. 128, No. 7, pp.1699–1713.

Jahantigh, F.F. and Malmir, B. (2015) 'Development of a supply chain model for healthcare industry', *International Conference on Industrial Engineering and Operations Management (IEOM)*, pp.1–5.

Jha, A., Dheer, A., Mehta, V.K. and Saha, S.K. (2020) 'Inter-relational dynamics of various HR aspects in high altitude illness attrition', *Innovative Management and Business Practices in Asia*, IGI Global, pp.114–132.

Kaupa, F. and Naude, M.J. (2021) 'Critical success factors in the supply chain management of essential medicines in the public health-care system in Malawi', *Journal of Global Operations and Strategic Sourcing*, Vol. 14, No. 3, pp.454–476.

Kim, S-H. and Kwon, I-W.G. (2015) 'The study of healthcare supply chain management in United States: literature review', *Management Review: An International Journal*, Vol. 10, No. 2, pp.34–56.

Kovács, G. and Falagara Sigala, I. (2021) 'Lessons learned from humanitarian logistics to manage supply chain disruptions', *Journal of Supply Chain Management*, Vol. 57, No. 1, pp.41–49. Doi: 10.1111/JSCM.12253.

Kumar, D. and Kumar, D. (2015) 'Modelling hospital inventory management using interpretive structural modelling approach', *International Journal of Logistics Systems and Management*, Vol. 21, No. 3, pp.319–334.

Langabeer, J.R. (2008) *Health Care Operations Management: a Quantitative Approach to Business and Logistics*, Jones & Bartlett Learning.

Letho, Z., Yangdon, T., Lhamo, C., Limbu, C.B., Yoezer, S., Jamtsho, T., Chhetri, P. and Tshering, D. (2021) 'Awareness and practice of medical waste management among healthcare providers in National Referral Hospital', *PloS One*, Vol. 16, No. 1. Doi: 10.1371/journal.pone.0243817.

Lubis, M., Ridho, L.A., Lubis, B. and Lubis, A. (2018) 'Incremental innovation towards business performance: data management challenges in healthcare industry in Indonesia', *MATEC Web of Conferences*, Vol. 218. Doi: 10.1051/matecconf/201821804015.

Mandal, S., Nair, S., Sreedhar, A. and Vijeshwari, U. (2022) 'Exploring the impact of orientations on hospital-supplier collaboration: an empirical study', *International Journal of Services and Operations Management*, Vol. 42, No. 1, pp.52–74.

Mangla, S.K., Kumar, P. and Barua, M.K. (2016) 'A fuzzy DEMATEL-based approach for evaluation of risks in green initiatives in supply chain', *International Journal of Logistics Systems and Management*, Vol. 24, No. 2, pp.226–243.

Mathiyazhagan, K., Nangia, S., Senthilkumar, A., Elangovan, K. and Sugathan, S.K. (2020) 'Modelling the interrelationship of risks for green supply chain management adoption: a DEMATEL approach', *International Journal of Logistics Systems and Management*, Vol. 36, No. 3, pp.414–440.

Mbonane, H., Sibanda, M., Godman, B., Meyer, J.C. and Matlala, M. (2023) 'Knowledge, attitudes and practices of healthcare professionals on the use of an electronic stock visibility and management tool in a middle-income country: implications for access to medicines', *Exploratory Research in Clinical and Social Pharmacy*, Vol. 9. Doi: 10.1016/j.rcsop.2023.100233.

Mohammady Garfamy, R. (2011) 'Supplier selection and business process improvement: an exploratory multiple case study', *International Journal of Operational Research*, Vol. 10, No. 2, pp.240–255.

Moons, K., Waeyenbergh, G. and Pintelon, L. (2019) 'Measuring the logistics performance of internal hospital supply chains–a literature study', *Omega*, Vol. 82, pp.205–217.

Morse, G., Salyers, M.P., Rollins, A.L., Monroe-DeVita, M. and Pfahler, C. (2012) 'Burnout in mental health services: a review of the problem and its remediation', *Administration and Policy in Mental Health and Mental Health Services Research*, Vol. 39, pp.341–352.

Moura, L.D.L. and Silva, R.F.D. (2016) 'Waste management of health services: a study on the situation in the Brazilian hospital sector', *International Journal of Business Innovation and Research*, Vol. 11, No. 2, pp.295–309.

Nieva, V.F. and Sorra, J. (2003) 'Safety culture assessment: a tool for improving patient safety in healthcare organizations', *BMJ Quality and Safety*, Vol. 12, No. Suppl. 2, pp.ii17–ii23.

Oleribe, O.O., Momoh, J., Uzochukwu, B.S.C., Mbofana, F., Adebiyi, A., Barbera, T., Williams, R. and Taylor-Robinson, S.D. (2019) 'Identifying key challenges facing healthcare systems in Africa and potential solutions', *International Journal of General Medicine*, pp.395–403.

Olutuase, V.O., Iwu-Jaja, C.J., Akuoko, C.P., Adewuyi, E.O. and Khanal, V. (2022) 'Medicines and vaccines supply chains challenges in Nigeria: a scoping review', *BMC Public Health*, Vol. 22, pp.1–15.

Osaro, E. and Chima, N. (2014) 'Challenges of a negative work load and implications on morale, productivity and quality of service delivered in NHS laboratories in England', *Asian Pacific Journal of Tropical Biomedicine*, Vol. 4, No. 6, pp.421–429.

Parand, A., Dopson, S., Renz, A. and Vincent, C. (2014) 'The role of hospital managers in quality and patient safety: a systematic review', *BMJ Open*, Vol. 4, No. 9. Doi: 10.1136/bmjopen-2014-005055.

Peck, H. (2005) 'Drivers of supply chain vulnerability: an integrated framework', *International Journal of Physical Distribution and Logistics Management*, Vol. 35, No. 4, pp.210–232.

Piggott, Z., Weldon, E., Strome, T. and Chochinov, A. (2011) 'Application of Lean principles to improve early cardiac care in the emergency department', *Canadian Journal of Emergency Medicine*, Vol. 13, No. 5, pp.325–332.

Privett, N. and Gonsalvez, D. (2014) 'The top ten global health supply chain issues: perspectives from the field', *Operations Research for Health Care*, Vol. 3, No. 4, pp.226–230. Doi: 10.1016/J.ORHC.2014.09.002.

Priyan, S., Matahen, R., Priyanshu, D. and Mouqdadi, M. (2024) 'Environmental strategies for a healthcare system with green technology investment and pandemic effects', *Innovation and Green Development*, Vol. 3, No. 1. Doi: 10.1016/j.igd.2023.100113.

Raj, A. and Samuel, C. (2023) 'A study of barriers in healthcare waste management sector', *International Journal of Environment and Waste Management*, Vol. 32, No. 2, pp.165–183.

Rezali, N., Ali, M.H., Idris, F., Yunus, Y.M. and Yunan, Y.S.M. (2021) 'Exploration of institutional theory in green supply chain initiatives for healthcare industries in Malaysia', *International Journal of Business Continuity and Risk Management*, Vol. 11, Nos. 2/3, pp.126–141.

RiyazhKhan, A.M. and Haq, A.N. (2019) 'Role of service quality measurements in in-patients satisfaction in corporate hospitals', *International Journal of Business Excellence*, Vol. 18, No. 3, pp.410–433.

Saha, S.K. (2022) 'Bibliometric analysis of published literature on the pharmaceutical supply chain', *International Journal of Applied Logistics (IJAL)*, Vol. 12, No. 1, pp.1–18.

Saha, S.K. and Jha, A. (2018) 'Role of information technology on supply chain management of pharmaceutical industry', *International Journal of Applied Logistics (IJAL)*, Vol. 8, No. 2, pp.39–68.

Saha, S.K., Adhikary, A., Jha, A. and Mehta, V.K. (2022) 'DEMATEL analysis of medication non-adherence behavior of patients: a study based on the perspective of physicians', *International Journal of Reliable and Quality E-Healthcare (IJRQEH)*, Vol. 11, No. 1, pp.1–22.

Sharma, B., Saha, S.K. and Jha, A. (2020) 'Understanding inter-relational dynamics of different factors impacting the cymbidium orchids-based economy in Sikkim, India using DEMATAL', *Handbook of Research on Managerial Practices and Disruptive Innovation in Asia*, IGI Global, pp.282–299.

Tang, J.Z. and Anane, A. (2023) 'Examine the effects of inventory management practices on operational performance in war memorial hospital and Wedam Medical Center, Ghana', *International Journal of Procurement Management*, Vol. 18, No. 3, pp.340–356.

Vishnu, C.R., Sridharan, R., Ram Kumar, P.N. and Regi Kumar, V. (2020) 'Analysis of the operational risk factors in public hospitals in an Indian state: a hybrid DEMATEL–ISM–PROMETHEE approach', *International Journal of Health Care Quality Assurance*, Vol. 33, No. 1, pp.67–88.

Wu, J-H., Kao, H-Y. and Sambamurthy, V. (2016) 'The integration effort and E-health compatibility effect and the mediating role of E-health synergy on hospital performance', *International Journal of Information Management*, Vol. 36, No. 6, pp.1288–1300.