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Operational excellence in healthcare through Artificial Intelligence: A Shingo framework perspective

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Abstract

Healthcare services play a critical role in human health and well-being. All the operations involved in providing healthcare directly influence the efficiency, effectiveness, and quality of the healthcare services. Improving the efficiency of these operations is important for delivering healthcare services to patients. Operational excellence principles, which have been widely adopted across industries, have helped to improve operations. These operational excellence principles have significant potential to optimize healthcare operations as well when applied in the healthcare sector. The healthcare sector has already benefited from these principles, but there remains substantial scope for further improvements. Integrating Artificial Intelligence (AI) with operational excellence principles can significantly improve healthcare operations, resulting in more efficient, data-driven systems. This study explores how AI can be integrated into healthcare operations to achieve operational excellence in healthcare using the Shingo model. This study also highlights the potential benefits and the challenges that need to be addressed for its successful implementation. The study also maps the AI applications in healthcare on the Shingo guiding principles.

Keywords: Artificial intelligence, Operational excellence, Healthcare, Operational excellence in healthcare, Shingo model

Introduction

The World Health Organization (WHO) recognized good health as a fundamental human right in its 1946 constitution. In 2015, when the United Nations established the Sustainable Development Goals (SDGs), ensuring good health and well-being was designated as SDG 3, one of the 17 goals aimed at promoting global development and prosperity. This highlights the global commitment to promote the health and well-being of populations worldwide. However, several challenges obstruct progress toward achieving this goal. These include a lack of health awareness, limited access to healthcare services, a shortage of qualified health workers, higher healthcare costs, and a lack of accountability (Kasthuri, 2018). These challenges are not limited to only developing countries; even in developed countries like the United States of America, the higher cost of healthcare is a significant challenge (Lopes, 2024). Besides these, the quality of healthcare services and medical errors have always been challenges in healthcare (Greiner and Knebel, 2003).

Operational excellence focuses on improving all areas of the business through continuous improvement. It aims to increase productivity, improve quality, optimize processes, and reduce costs (Jäger et al., 2014). A successful organization consistently strives to add value to its customers at every stage of the value chain.

Since operations oversee the production and distribution of goods and services, excellence in operations is crucial for customer satisfaction and for fulfilling the organization's strategic vision. Operational excellence in healthcare refers to implementing best practices in the healthcare sector (KPMG, 2018). It may be in the daily operations of hospitals, such as maintaining the electronic health record (EHR), hospital administration, patient care, diagnostics, and consultation. Operational excellence can be achieved by leveraging innovation and technology to refine the development and distribution processes of products and services (Ojha, 2015).

Computers and digital technologies have revolutionized almost every field and impacted on humanity in numerous ways. The healthcare industry is also a beneficiary of these technologies. Although adoption of these technologies in healthcare was slow at first (around the 1960s) due to several issues with equipment and technology, including cost, reliability, and complexity, medical practitioners remained optimistic about their potential (Ambinder, 2005). As computers and digital technologies improved over time, they became an integral part of the healthcare system. Computers and digital technologies have proven invaluable for maintaining electronic health records (EHRs) for patients, advancing medical research, improving diagnostics, enhancing customer service, enabling telemedicine and online payments, etc. However, the development of computers and digital technologies has not stagnated, nor have their applications in the healthcare industry. In July 2024, a surgeon and his team in China remotely removed a lung tumor from a patient using a 5G-enabled robot. The surgeon, located in Shanghai, performed the operation while the patient was in Xinjiang, approximately 5,000 kilometers away (Clarance, 2024). This example highlights how computers and digital technologies are revolutionizing healthcare systems.

Artificial Intelligence (AI) encompasses a set of technologies focused on creating systems that can think and act like humans. AI systems are developed and trained on diverse datasets using algorithms that range in complexity depending on the tasks they are designed to replicate. In healthcare, where vast amounts of data are readily available, AI has the potential to perform at par with, or even surpass, human abilities in various areas of healthcare (Davenport and Kalakota, 2019).

The challenges faced by the healthcare sector can be addressed through operational excellence, with AI playing a pivotal role in optimizing processes. This study explores how AI is transforming healthcare delivery, driving improvements in efficiency, quality, and patient outcomes.

Operational excellence

Continuous improvement and waste elimination are key strategies for reducing operational costs (Rusev & Salonitis, 2016). Numerous tools exist to facilitate these improvements, but their effectiveness increases significantly when applied with a focus on their core principles rather than as mere mechanical processes. When these tools are integrated into an organization's culture and management practices, they contribute to operational excellence. Operational excellence principles are built on four key pillars: culture, continuous improvement, alignment with enterprise goals, and results (Shingo Institute).



Figure 1: Principles of operational excellence are based on 4 pillars

Operational excellence is a continuous journey that requires the full commitment of an organization's workforce. Achieving it is impossible without fostering a culture of inclusivity, respect, and humility throughout the organization. This journey focuses on processes, identifying faults in them rather than in people. Similarly, organizations must be clear about their guiding principles, and these principles must be aligned to drive organizational behavior. Adherence to these principles impacts the organization's long-term success. Finally, the organizations must focus on creating value for their customers (Shingo institute). These principles have enough scope and could be applied to different business areas to achieve operational excellence.

Operational excellence in healthcare

Operational excellence principles are applied across different areas of healthcare, as in other businesses. This includes customer relationships, product and service development operations, supply chain, and the administration of the organization. Operational excellence principles hold that there is always scope for improvement in processes, which can create higher value for customers, and customers may pay more for this higher value. Figure 2 shows the different areas where operational excellence principles can be applied.

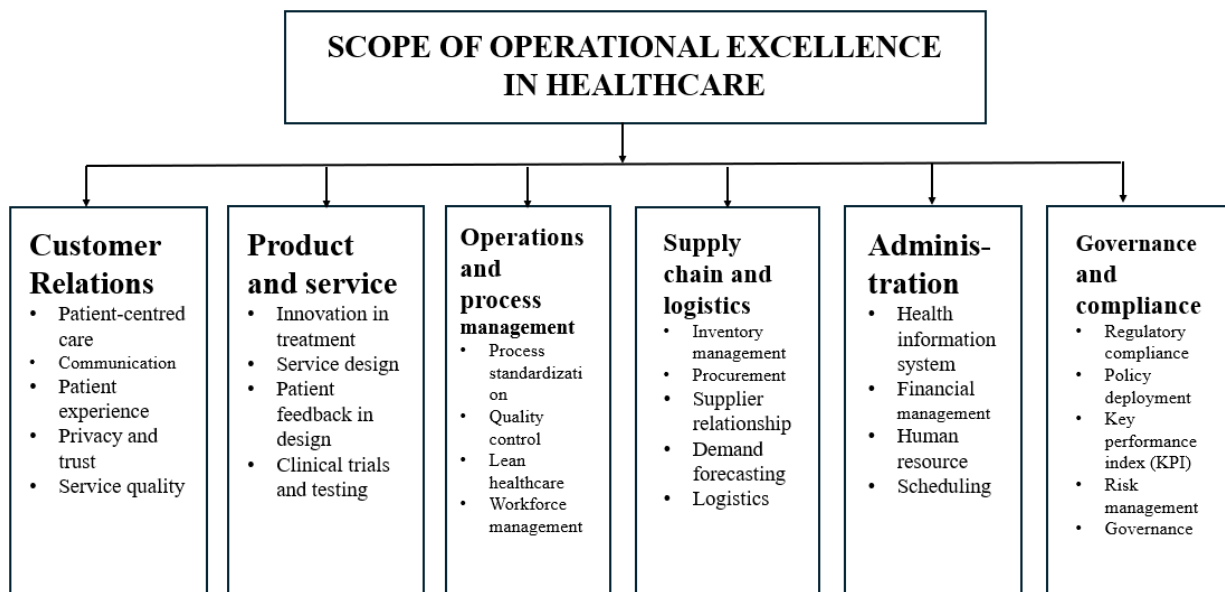


Figure 2: Scope of operational excellence in different areas of healthcare

Building strong relationships with patients is crucial for healthcare professionals. This connection can be nurtured by focusing on patient-centered care, fostering clear and compassionate communication, managing the overall patient experience, and ensuring each individual's privacy and trust. Similarly, operational excellence principles can help to design and improve treatment and services. These principles can also be applied in capturing patient feedback and in clinical trials and testing. Operational excellence principles can transform various processes, quality control, and workforce management. The healthcare sector can benefit from lean management practices, which help in eliminating waste and bring much-needed efficiency to the system. The supply chain is a critical component of healthcare operations (Tiwari et al., 2024). With efficient management of inventory, procurement, and suppliers, healthcare organizations can maintain a seamless flow of essential supplies, ultimately enhancing patient care. Finally, operational excellence is key in healthcare administration, governance, and compliance. It improves the management of health information, ensures regulatory compliance, and streamlines financial and human resource management, leading to a more efficient and responsive healthcare system.

Challenges in healthcare

Healthcare plays an important role in the life of every human being, providing treatment and care. Sometimes, access to good healthcare services can be a matter of life and death for those in need. Healthcare systems have evolved over a long period of time, and individuals, corporations, and governments around the world are working to provide healthcare services to all. This sector faces numerous challenges; a few important challenges have been highlighted here:

Overpopulated hospitals: Hospitals are facing overcrowding; this may be due to a variety of reasons, including outbreaks of certain diseases, uneven access to hospitals, etc. Most hospitals experienced an overwhelming influx of patients during the COVID-19 pandemic (Hu et al., 2022; Khan et al., 2024). Similarly, many Asian countries face this situation during dengue fever outbreaks (Rehan et al., 2022). Certain super-specialty government hospitals face high patient inflow due to the high cost of care in private hospitals (EH News Bureau, 2023). Overcrowded hospitals pose risks to healthcare services, including higher rates of medical errors and longer wait times. This also creates a challenge in managing the facilities, including beds and staff, resulting in patient dissatisfaction and increased inefficiency in the system.

Shortage of trained staff: Many countries, including India, face a significant shortage of qualified staff in the healthcare sector, including not only doctors but also pharmacists, nurses, technicians, and others (Kasthuri, 2018). The shortage of staff gets worse in rural areas due to the concentration of experts in urban areas; the concentration of private hospitals in urban areas further increases the scale of this problem (Rao et al., 2011). This leaves a large portion of the population without access to specialist care (Panagariya, 2014). Often, due to a lack of trained staff, patients are forced to receive treatment from incapable, untrained staff in the informal sector, which carries their own risks (Rahman et al., 2024).

Inefficiencies in the healthcare system: An inefficient healthcare system presents several obstacles to patient treatment in many forms; this may include denying patients the best possible care within the healthcare system's limited resources. The inefficient use of the resources may cause denial to the other patients as well. Resource wastage in the healthcare system is a collective loss to society (Cylus et al., 2016). However, measuring efficiency in healthcare is not easy; still, simple efficiency indicators are useful in the healthcare system for comparing processes (Cylus et al., 2017). Misallocation of resources is considered a cause of inefficiency in the healthcare system (Fuchs, 2018). Other examples include underutilization of resources, unnecessary diagnostic tests, medical errors, poor inventory management, and miscommunication across different departments within a hospital.

High cost of healthcare: Rising healthcare costs are a concern that hampers the ease of availability of healthcare services to all. Sometimes, only physicians are held responsible for the higher cost of healthcare services; however, several factors, including increased use of technology, higher pharmaceutical expenses, and rising administrative costs, contribute to the high cost of healthcare (Norbeck, 2013). The high cost of healthcare makes it difficult for lower-income populations to access quality healthcare services (Timilsina et al., 2024).

Low use of technology in healthcare: Although the use of technology in healthcare has evident benefits, adoption has been quite slow in the past (Greiner and Knebel, 2003). There are several factors that have hampered the adoption of technologies in healthcare; the risk of privacy breach and data security is one of the primary factors (Sittig et al., 2020). High initial costs, interoperability challenges, and limited IT infrastructure have also been significant factors in the slow adoption of technology in healthcare (Cresswell et al., 2015). Sometimes, low personal interaction between doctor and patient due to the use of technology also becomes a reason for patient dissatisfaction and discourages the use of technology.

Quality of care concerns: WHO (WHO, Quality of care) defines quality of care as the likelihood that healthcare services result in the desired health outcome for the patient. The services provided must be effective, safe, and people centric. Healthcare quality also involves the efficient use of resources and the minimization of waste to ensure optimal patient care and operational effectiveness (2019 National Healthcare Quality and Disparities Report). The quality parameters also include timely and equal access to healthcare services for all. Variations in quality are also a major concern for the healthcare sector.

Healthcare systems around the world are struggling with these challenges, but digital technologies and AI can play a transformative role. These technologies can help integrate operational excellence principles into the design and processes of healthcare systems, making them more efficient, effective, and patient-centered. The following section explores the role of digital technologies and AI in healthcare.

Artificial Intelligence (AI)

Artificial intelligence (AI) is a set of technologies that allows computers and machines to think and act like humans. With AI, machines can learn from data, understand and translate languages, make informed decisions, provide recommendations, and much more. These capabilities help AI systems adapt and improve over time, offering solutions that mimic human decision-making and problem-solving. A few of these technologies are shown in Figure 3 and are as follows.

Machine learning (ML): ML technology operates on data and statistics; machine learning algorithms enable computers to learn from it. These are used in drawing inferences and in decision-making.

Data mining: Data mining tools and techniques help uncover useful patterns and relationships in the data. Data mining helps make more accurate estimates and forecasts.

Neural networks: Neural networks are models inspired by the human brain and used in various machine learning techniques. These networks are used in deep learning to recognize patterns and clusters in data, as well as images and speech.

Deep learning (DL): Deep learning is a machine learning technology that uses neural networks to identify complex patterns in data. Deep learning works on much larger data sets and uses more powerful chips than machine learning, and it outperforms machine learning.

Natural language processing (NLP): Natural language processing (NLP) enables computers to understand and respond to human languages. These techniques work with different machine learning and other AI technologies to communicate with humans, either via text or speech.

Generative AI: These AI technologies can generate text, images, or videos and work by learning from data. These technologies learn from the data and can respond to new queries based on their developed intelligence.

Robotics: Although robotics is a distinct field of engineering focused on machines that can operate autonomously, the development of intelligent robots leveraging AI, ML, and DL techniques has revolutionized the field (Soori et al., 2023). These robots can adapt to a changing environment and perform various tasks like humans.

Machine vision: Machine vision enables a computer to see and make decisions using various algorithms and AI techniques. Machine vision uses cameras and other sensors to capture data, and its decisions are based on that data.

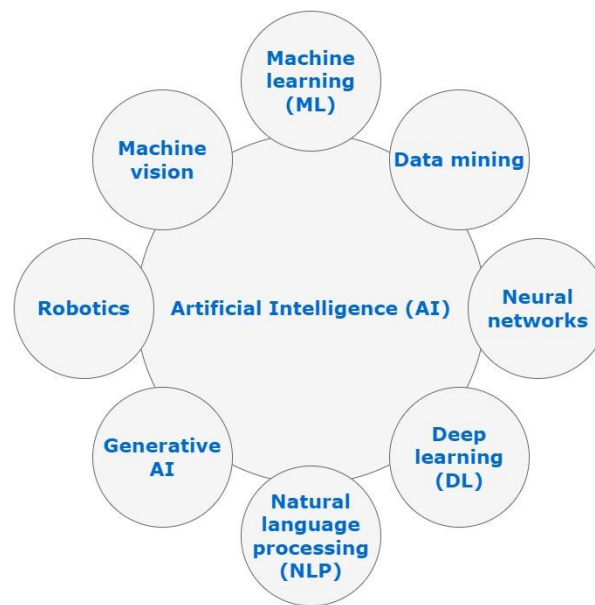


Figure 3: Various technologies of AI

Framework for integrating AI into healthcare using the Shingo model

Modern technologies have significant potential to improve efficiency in the healthcare sector (Narain, 2016). Technologies, in particular AI and robotics, have the potential not only for research but also for providing healthcare services (Mennella et al., 2024). These are also being seen as a potential source of providing cost-effective healthcare services. Technologies, including telemedicine, various health apps, wearable devices, and Artificial Intelligence (AI), can provide personalized treatment at much lower cost (Mumtaz et al., 2023).

Even with such high potential, it is important to fully understand the capabilities, limitations, and risks of the technologies before implementation. This is the foundation for integrating AI in healthcare: once the capabilities are understood, implementation is guided by the Shingo model's guiding principles. These guiding principles are cultural enablers, continuous improvement, and enterprise alignment. The principal objective of the Shingo model is to create value for customers and stakeholders, including quality, responsiveness, and returns to stakeholders. By following the guiding principles of the Shingo model, the successful integration of AI into healthcare could be achieved.

The rise of digital technologies has significantly impacted the healthcare sector in various ways, extending beyond diagnostics and medical equipment (Iyanna et al., 2022). For an innovation to be successful, it must not only solve real-world problems but also create larger societal value while remaining financially viable (Allers et al., 2023). The widespread application of technology across healthcare—ranging from hospital management and administration to service delivery, insurance, and payments—demonstrates its ability to achieve both societal impact and economic sustainability. Several technologies have been proven critical in the healthcare industry.

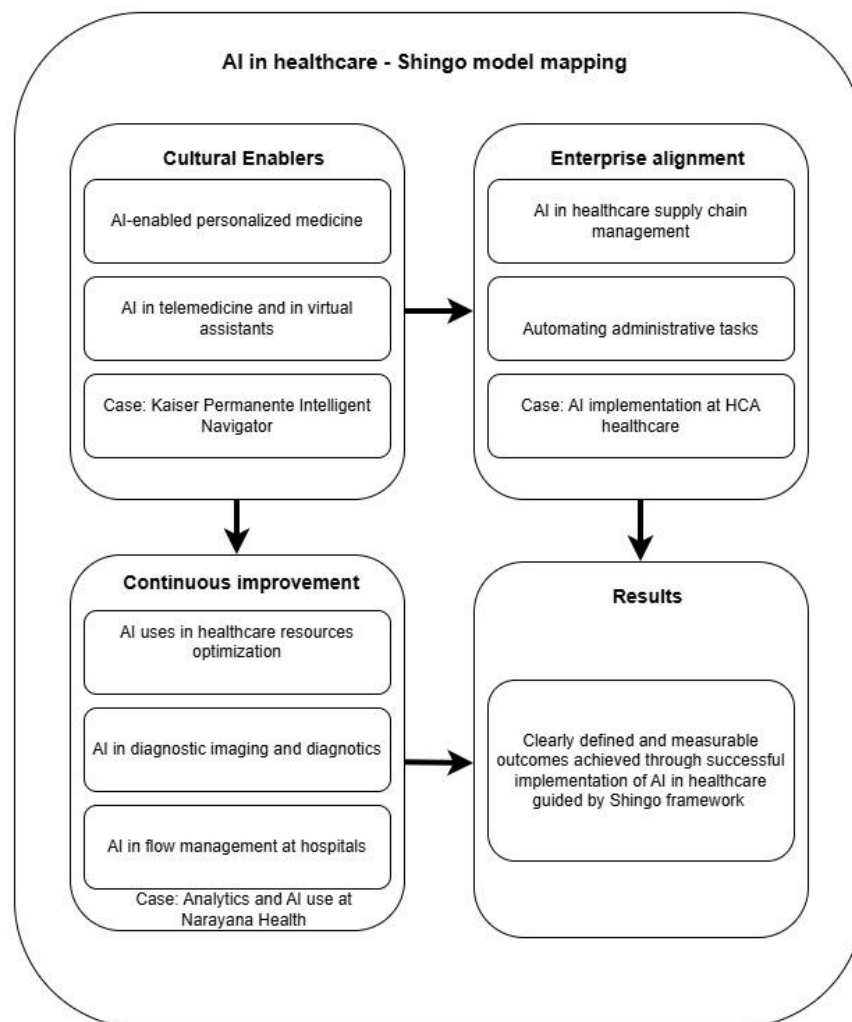


Figure 4 Framework for integrating AI into healthcare using the Shingo model

AI-driven operational excellence in healthcare

AI implementation can help the healthcare organization achieve operational excellence. In fact, the implementation of AI in healthcare aligns seamlessly with the principles of operational excellence. AI implementation brings a culture of continuous improvement, efficiency, and results-oriented approaches. AI involves data-driven predictive analytics, introducing systems that help with decision-making, optimize resources, minimize waste, and improve overall service quality for patients. AI tools also help reduce variability in the services offered to patients by standardizing processes, improving diagnostic accuracy, and facilitating personalized treatment. With real-time, data-driven insights, AI can adjust processes, ensuring responsiveness to patient needs and demands. Overall, AI-driven operational excellence in healthcare focuses on implementing lean processes, continuous improvement, better patient services and experiences, while reducing costs and improving organizational efficiency.

The following are a few AI applications in healthcare that align with the Shingo Principles framework and enhance operational excellence in healthcare:

1. Cultural Enablers: Cultural enablers include the respect for people, individuality, and leading with humility. The people here include not only the patients but also internal employees and external stakeholders. The following are a few examples of AI applications in which respect for individuals' biology, time, safety, and access is evident.

AI-enabled personalized medicine: Every human being is genetically different, which suggests that everyone's body may react differently to diseases and, consequently, to medical interventions. A large amount of medical data is being generated, and AI has significant potential to study it and develop personalized medical interventions (Schork, 2019). Machine learning is helpful in precision medicine, which enables early detection and personalized treatment for various health conditions. Similarly, deep learning and NLP are helpful when useful data are extracted and analyzed alongside health data to accurately detect the illness.

AI in telemedicine and in virtual assistants: Telemedicine is used by healthcare organizations to provide services to remote locations or where the distance or travel is a limiting factor. Medical information is shared through digital communications to avail examination and consultation (Dinya and Tóth, 2013; Pacis et al., 2018). Telemedicine proved helpful during the COVID-19 pandemic, and integrating AI into telemedicine can significantly enhance its capabilities (Sharma et al., 2023). AI allows doctors to make real-time, data-driven decisions in a virtual setting, resulting in a better patient experience (Amjad et al., 2023). AI-enabled virtual assistants can be helpful for common illnesses, where symptoms can be recorded, and patients can be directed to the appropriate level of care. These virtual assistants can also be helpful for medication adherence and related tasks. AI in telemedicine and virtual assistants enhances operational excellence by improving access to care. e-Sanjeevani is an Indian government-run telemedicine service that allows patients to avail follow-up healthcare services without traveling and, for doctors, reduces the physical OPD load.

Case: Kaiser Permanente Intelligent Navigator (KPIN)

Kaiser Permanente is one of the largest healthcare providers in the United States of America, operating more than 40 hospitals and 600 healthcare facilities. Their AI-enabled customer portal, Kaiser Permanente Intelligent Navigator (KPIN), allows users to book appointments simply by typing their issues in their own words rather than going through the pain of selecting multiple redundant options (Permanente, 2025). The KPIN interface allows customers to access personalized, safe, and appropriate care options because it is also integrated with other patient databases. A later study showed that KPIN identified emergency medical

cases with 97.7% accuracy and recommended appropriate care with nearly 88.9% accuracy. KPIN saves time, it is simpler, and makes the services more accessible to the patients.

2. Enterprise Alignment: These are the factors that suggest that the successful deployment of AI shall be strategic and across the organization with system thinking. The integration of AI with the organization's strategy and governance further aligns it with the organization's goals and creates more value for customers.

AI in healthcare supply chain management: Supply chains that deal with medicines and other medical products are referred to as healthcare supply chains (HSCs) and are responsible for their production and distribution. HSC plays a greater role in health services and has implications for the cost, accessibility, and quality of healthcare services (Long et al., 2023). The integration of AI in HSC provides practical solutions to many issues and improves HSC's supply chain efficiency. (Kumar et al., 2023). Several companies are using AI for supplier selection, disruption avoidance, sourcing, and procurement (Van Hoek and Lacity, 2023).

AI, through predictive analytics, can help with several supply chain functions, including inventory management, demand forecasting, and order tracking. This can be helpful in maintaining proper stock levels of various medicines and equipment while considering several factors, including cost, seasonality, and admission patterns. AI can also be helpful in supplier management by analyzing performance and streamlining procurement processes, ensuring timely deliveries and better supplier relationships. This also brings better supply chain visibility in the healthcare sector. Overall, AI-enabled operational excellence brings efficiency, reduced costs, and process improvements in the healthcare supply chain, which lead to greater efficiency and effectiveness in healthcare service delivery.

Automating administrative tasks: AI has impacted how various resources are scheduled in the medical field in recent years. These applications can reduce provider time and help deliver patient-centered care (Knight et al., 2023). Hospitals can be more responsive by adopting AI across various operational and administrative tasks. AI can be integrated with online booking platforms to provide better appointment scheduling, reduce waiting times for patients, and enhance system efficiency (Seyedi et al., 2024). AI also enhances operational excellence in healthcare by automating administrative tasks such as billing and coding, reducing errors. AI-powered tools, such as natural language processing (NLP), can automatically generate and process medical codes for billing based on clinical documentation, eliminating the need for manual data entry. This reduces errors and speeds up the financial transactions. Timely claim submissions enhance the patient experience at hospitals. AI can reduce the administrative burden on staff, allowing them to focus on patient care. This brings operational excellence in healthcare by eliminating waste, improving accuracy, and ensuring smooth process flow.

Case: AI implementation at HCA Healthcare:

Hospital Corporation of America (HCA) is a major for-profit healthcare organization in the United States, operating more than 190 hospitals and 2,400 healthcare centers. HCA has deployed AI tools in clinical, operational, and administrative tasks. They found an opportunity to deploy the AI tool to facilitate a smooth handover of patients during shift changes. The deployed AI tool synthesizes patients' medical and operational records and provides an effective way for nursing teams to conduct shift handoffs (Muioio, 2025). HCA is also using an AI-driven tool for scheduling and staffing operations. On the administrative side, HCA is using AI-driven tools in IT, supply chain, human resource management, and revenue management. Overall, HCA is trying to identify the best cases of AI deployment and bring efficiency and effectiveness to administrative work as well.

3. Continuous Improvement: AI implementation is not a one-time task; rather, it's a continuous process of improving the system iteratively by identifying and eliminating the wastes in the processes. The waste could be in any inefficient use of resources. The goal of AI implementation is to seek perfection through scientific thinking in the use of resources and in ensuring quality at the source.

AI uses in healthcare resources optimization: The healthcare sector has adopted AI in some form or another in recent years. This adoption leads to a twofold benefit for the healthcare organization, helping it not only to optimize resources but also to retain customers (Waldman, 2022). AI can help optimize staff, equipment, and other facilities, enabling more efficient use to meet patient needs. Various AI algorithms can analyze historical, demand, and real-time data to optimize schedules for staff, equipment, and other facilities. This ensures that the right number of healthcare professionals are available at the right times, avoiding staff shortages. AI can also be used to optimize operating rooms, ICU beds, and other resources by predicting patient flow and allocating resources based on needs and availability. Resource optimization becomes critical during emergencies, and AI can better distribute resources in such situations (Wu et al., 2023). Resource planning directly affects patient waiting times, and better planning can reduce them and enhance patient satisfaction (Mizan and Taghipour, 2022). AI helps reduce bottlenecks and improve throughput by minimizing idle time and maximizing equipment utilization. AI-driven tools can also predict equipment maintenance needs, reducing the risk of downtime.

AI in diagnostic imaging and diagnostics: AI can support various diagnostic processes and save critical time required to start treatment (Bajwa, 2021). AI can be used to scan images and reports and predict various diseases at their early stages. Machine learning is widely used in medical diagnostics and treatments, where patient data can be analyzed using various algorithms, enabling early disease detection. Computed tomography (CT) and magnetic resonance imaging (MRI), among others, generate large volumes of data, and AI techniques have significant potential for the efficient analysis of these scans (Pinto-Coelho, 2023). AI improves precision, reducing diagnostic errors and leading to faster, more accurate decisions. AI can improve diagnosis, resulting in better accuracy, speed, and efficiency in identifying diseases. This improves patient outcomes and reduces the need for costly and time-consuming follow-up tests. AI inclusion in diagnosis focuses on efficiency, error reduction, and value-driven care.

AI in flow management at hospitals: AI improves flow management in healthcare facilities by implementing operational excellence principles, optimizing the movement of patients, information, and resources. AI-enabled systems can predict footfall and, with better management of admissions, transfers, readmissions, and discharges, better manage flow. Also support doctors in decision-making regarding discharge, diagnosis, and admission, etc., which leads to better patient flow management in hospitals. AI, with better management of administrative tasks and resource optimization, could improve patient flow in hospitals (Dawoodbhoy et al., 2021). Such an efficient system in place would be especially helpful in emergencies like COVID-19 (Arnaud et al., 2022). In emergency departments, AI can better manage patients by analyzing their clinical data, understanding their specific needs, and directing them to the right care more quickly. This can help minimize crowds in hospitals. AI can minimize delays, enhance coordination, and reduce the length of stay. This aligns with the operational excellence principles of lean process flow and waste reduction, leading to better quality of care and patient experience.

Case: Analytics and AI use at Narayana Health:

Narayana Health has implemented real-time data analytics to improve efficiency across the board. For this purpose, they use operational, financial and patients' records to gain new insights. They spent a significant amount of time on data warehouse architecture, meaningful KPIs and metrics, etc., which greatly facilitated the smooth implementation of Power BI across the system (Agrawal, 2018). Narayana Health used insights across different functions, such as managing nursing staff, achieving faster lab turnaround times,

monitoring the use of consumables, reducing the time patients spend in the ICU, and better predicting costs. Basically, Narayana Health implemented Power BI to increase system efficiency as part of a continuous improvement process.

4. Results In the Shingo framework, the results represent the clearly measurable outcomes achieved through the successful implementation of AI in healthcare, guided by its principles, rather than AI alone. When AI is integrated into an organization's culture that respects people, focuses on continuous improvement, and prioritizes strategic alignment, it can generate measurable benefits across the organization. These benefits may include improved quality of care, shorter service time, enhanced operational efficiency, fewer errors, reduced costs, and improved patient satisfaction. These benefits shall be clearly defined through measurable outcomes for patients, staff, and the system.

Challenges and Considerations for AI in Healthcare

Johnson et al. (2021) have described three principles for the successful adoption of AI in health care: data and security, analytics and insights, and shared expertise. Although AI in healthcare has shown the potential to achieve operational excellence in service delivery, certain challenges must be addressed prior to implementation. This implementation shall take ethical considerations into account to maintain patients' trust and safety. A major challenge concerns data privacy and security. Any system in place must comply with regulations such as HIPAA (Health Insurance Portability and Accountability Act) to prevent breaches and misuse of patient data. Issues such as AI algorithm biases, incomplete or inaccurate datasets, or other data-related problems can produce inaccurate or faulty results, and any decision based on such a report can affect the patient's health. Transparency of the AI algorithms is also an important issue. AI systems can produce results without clear reasoning, making it difficult for healthcare providers to trust and validate these decisions. This lack of interpretability raises concerns about accountability. A complete disclosure of the reasoning and algorithms can bring more trust in the AI systems. AI has shown precise results in medical imaging and diagnosis, but caution is warranted when using these technologies because human intervention is often required (Oren et al., 2020). This intervention can be critical at times. Similarly, validation of methods and ethical considerations are required for the widespread adoption of AI in telemedicine (Kuziemy et al., 2019). There is also the challenge of job losses and workforce displacement. AI systems can automate tasks performed by healthcare professionals, leading to job losses. However, this can be mitigated by designing AI to complement human roles rather than replace them, emphasizing collaboration between AI and healthcare providers. Balancing efficiency and cost savings with ethical considerations such as patient safety and patient-centered care is vital to achieving AI-driven operational excellence in healthcare.

Conclusion

The integration of Artificial Intelligence (AI) in healthcare has shown potential to drive operational excellence by improving efficiency and effectiveness. AI can help schedule resources, improve patient outcomes, and optimize resource utilization, leading to operational excellence. AI-driven solutions can help organizations to meet their operational goals of delivering high-quality care by removing inefficiencies. However, the success of AI in healthcare requires a complete understanding of its opportunities and challenges. While AI has the potential to revolutionize clinical decision-making and operational processes, it also raises significant ethical and practical concerns. Data privacy and security, algorithmic biases, and related challenges are among the issues that need to be addressed to maintain patients' trust and safety. Furthermore, AI must be in the system to complement humans, not replace them. Healthcare professionals

must be trained to work with AI to ensure an efficient and effective system. AI has the potential to drive remarkable advancements in operational excellence in healthcare, but its adoption must be handled carefully. A balanced approach, in which AI and healthcare professionals complement each other, must be followed.

References

- 2019 National Healthcare Quality and Disparities Report . Rockville (MD): Agency for Healthcare Research and Quality (US); 2020 Dec. QUALITY IN HEALTHCARE. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK579353/>
- Agrawal, R. (2018, December 19). Narayana Health uses data analytics and AI to provide affordable, high-quality healthcare. Microsoft News Center India. <https://news.microsoft.com/en-in/features/narayana-health-uses-data-analytics-and-ai-to-provide-affordable-high-quality-healthcare/>
- Allers, S., Eijkenaar, F., van Raaij, E. M., & Schut, F. T. (2023). The long and winding road towards payment for healthcare innovation with high societal value but limited commercial value: A comparative case study of devices and health information technologies. *Technology in Society*, 75, 102405.
- Ambinder, E. P. (2005). A history of the shift toward full computerization of medicine. *Journal of oncology practice*, 1(2), 54.
- Amjad, A., Kordel, P., & Fernandes, G. (2023). A review on innovation in healthcare sector (telehealth) through artificial intelligence. *Sustainability*, 15(8), 6655. A., Kordel, P., & Fernandes, G. (2023). A review on innovation in healthcare sector (telehealth) through artificial intelligence. *Sustainability*, 15(8), 6655.
- Arnaud, E., Elbattah, M., Ammirati, C., Dequen, G., & Ghazali, D. A. (2022). Use of artificial intelligence to manage patient flow in emergency department during the Covid-19 pandemic: a prospective, single-center study. *International Journal of Environmental Research and Public Health*, 19(15), 9667.
- Bajwa, J., Munir, U., Nori, A., & Williams, B. (2021). Artificial intelligence in healthcare: transforming the practice of medicine. *Future healthcare journal*, 8(2), e188-e194.
- Clarance, D. (2024). Chinese doctor removes patient's lung tumor using robot from 5,000 km away. <https://www.indiatoday.in/health/story/chinese-doctor-removes-tumour-from-patients-lungs-while-being-5000-km-away-2575862-2024-08-02>
- Cresswell, K. M., & Sheikh, A. (2015). Health information technology in hospitals: current issues and future trends. *Future Healthcare Journal*, 2(1), 50-56.
- Cylus, J., Papanicolas, I., & Smith, P. C. (2017). Identifying the causes of inefficiencies in health systems. *Eurohealth*, 23(2), 3-7.
- Cylus, J., Papanicolas, I., Smith, P. C., & World Health Organization. (2016). Health system efficiency: how to make measurement matter for policy and management. World Health Organization. Regional Office for Europe.

- Davenport, T., & Kalakota, R. (2019). The potential for artificial intelligence in healthcare. *Future healthcare journal*, 6(2), 94-98.
- Dawoodbhoy, F. M., Delaney, J., Cecula, P., Yu, J., Peacock, I., Tan, J., & Cox, B. (2021). AI in patient flow: applications of artificial intelligence to improve patient flow in NHS acute mental health inpatient units. *Heliyon*, 7(5).
- Detmer, D. E., Steen, E. B., & Dick, R. S. (Eds.). (1997). *The computer-based patient record: an essential technology for health care*.
- Dinya E. and Tóth, T. (2013). *Health Informatics: eHEALTH and TELEMEDICINE*, Presentation, Semmelweis University Institute of Health Informatics.
- EH News Bureau (2023). Government hospitals are overburdened due to lack of health coverage: Expert. <https://www.expresshealthcare.in/news/government-hospitals-are-overburdened-due-to-lack-of-health-coverage-expert/438729/>
- Fuchs, V. R. (2018). Is US medical care inefficient?. *JAMA*, 320(10), 971-972.
- Greiner, A. C., & Knebel, E. (2003). Challenges facing the health system and implications for educational reform. In *Health Professions Education: A Bridge to Quality*. National Academies Press (US).
- Greiner, A. C., & Knebel, E. (2003). Challenges facing the health system and implications for educational reform. In *Health Professions Education: A Bridge to Quality*. National Academies Press (US).
- Hu, F., Qiu, L., Xi, X., Zhou, H., Hu, T., Su, N., ... & Wei, S. (2022). Has COVID-19 changed China's digital trade?—Implications for health economics. *Front Public Health* 10: 831549.
- Iyanna, S., Kaur, P., Ractham, P., Talwar, S., & Islam, A. N. (2022). Digital transformation of healthcare sector. What is impeding adoption and continued usage of technology-driven innovations by end-users?. *Journal of Business Research*, 153, 150-161.
- Jäger, A., Matyas, K., & Sihm, W. (2014). Development of an assessment framework for operations excellence (OsE), based on the paradigm change in operational excellence (OE). *Procedia CIRP*, 17, 487-492.
- Johnson, K. B., Wei, W. Q., Weeraratne, D., Frisse, M. E., Misulis, K., Rhee, K., ... & Snowdon, J. L. (2021). Precision medicine, AI, and the future of personalized health care. *Clinical and translational science*, 14(1), 86-93.
- Kasthuri, A. (2018). Challenges to healthcare in India-The five A's. *Indian Journal of Community Medicine*, 43(3), 141-143.
- Khan, H. U., Ali, Y., Khan, F., & Al-Antari, M. A. (2024). A comprehensive study on unraveling the advances of immersive technologies (VR/AR/MR/XR) in the healthcare sector during the COVID-19: Challenges and solutions. *Heliyon*, 10(15).
- Knight, D., Aakre, C. A., Anstine, C. V., Munipalli, B., Biazar, P., Mitri, G., ... & Halamka, J. D. (2023). Artificial Intelligence for Patient Scheduling in the Real-World Health Care Setting: A Metanarrative Review. *Health Policy and Technology*, 100824.

- KPMG (2018). Operational excellence in healthcare: Getting from good to great. <https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2018/06/a-culture-of-continuous-improvement-operational-excellence.pdf>
- Kumar, A., Mani, V., Jain, V., Gupta, H., & Venkatesh, V. G. (2023). Managing healthcare supply chain through artificial intelligence (AI): A study of critical success factors. *Computers & Industrial Engineering*, 175, 108815.
- Kuziemsky, C., Maeder, A. J., John, O., Gogia, S. B., Basu, A., Meher, S., & Ito, M. (2019). Role of artificial intelligence within the telehealth domain. *Yearbook of medical informatics*, 28(01), 035-040.
- Long, P., Lu, L., Chen, Q., Chen, Y., Li, C., & Luo, X. (2023). Intelligent selection of healthcare supply chain mode—an applied research based on artificial intelligence. *Frontiers in Public Health*, 11, 1310016.
- Lopes, L., Montero, A., Presiado, M. & Hamel, L. (2024). Americans' Challenges with Health Care Costs. <https://www.kff.org/health-costs/issue-brief/americans-challenges-with-health-care-costs/>
- Mennella, C., Maniscalco, U., De Pietro, G., & Esposito, M. (2024). Ethical and regulatory challenges of AI technologies in healthcare: A narrative review. *Heliyon*.
- Mizan, T., & Taghipour, S. (2022). Medical resource allocation planning by integrating machine learning and optimization models. *Artificial Intelligence in Medicine*, 134, 102430.
- Mumtaz, H., Riaz, M. H., Wajid, H., Saqib, M., Zeeshan, M. H., Khan, S. E., ... & Vohra, L. I. (2023). Current challenges and potential solutions to the use of digital health technologies in evidence generation: a narrative review. *Frontiers in Digital Health*, 5, 1203945.
- Muoio, D. (2025, November 12). How AI is already playing a role at the country's largest for-profit hospital chain. *Fierce Healthcare*. <https://www.fiercehealthcare.com/ai-and-machine-learning/ai-already-playing-role-countrys-largest-profit-hospital-chain>
- Narain, J. P. (2016). Public health challenges in India: seizing the opportunities. *Indian journal of community medicine*, 41(2), 85-88.
- Norbeck, T. B. (2013). Drivers of health care costs: a physicians foundation white paper-second of a three-part series. *Missouri Medicine*, 110(2), 113.
- Ojha, S. K. (2015). Operational excellence for sustainability of Nepalese industries. *Procedia-Social and Behavioral Sciences*, 189, 458-464.
- Oren, O., Gersh, B. J., & Bhatt, D. L. (2020). Artificial intelligence in medical imaging: switching from radiographic pathological data to clinically meaningful endpoints. *The Lancet Digital Health*, 2(9), e486-e488.
- Pacis, D. M. M., Subido, E. D., & Bugtai, N. T. (2018, February). Trends in telemedicine utilizing artificial intelligence. In *AIP conference proceedings* (Vol. 1933, No. 1). AIP Publishing.
- Panagariya, A. (2014). The challenges and innovative solutions to rural health dilemma. *Annals of neurosciences*, 21(4), 125.

Permanente (2025)<https://permanente.org/ai-powered-patient-portal-enhances-access-safety-and-patient-satisfaction/>

Pinto-Coelho, L. (2023). How artificial intelligence is shaping medical imaging technology: A survey of innovations and applications. *Bioengineering*, 10(12), 1435.

Rahman, K. M. T., Rayna, S. E., Khan, F. A., Khan, M. M. H., Rahman, F., Ether, S. T., ... & Khalequzzaman, M. (2024). Challenges faced by medical officers in providing healthcare services at upazila health complexes and district hospitals in Bangladesh—a qualitative study. *The Lancet Regional Health-Southeast Asia*, 24.

Rao, M., Rao, K. D., Kumar, A. S., Chatterjee, M., & Sundararaman, T. (2011). Human resources for health in India. *The Lancet*, 377(9765), 587-598.

Rehan, S. T., Asghar, M. S., Ullah, I., Mahmood, H., Lee, K. Y., & Tahir, M. J. (2022). Dengue outbreak and fragile healthcare system: Doctors at the verge of mental and physical stress. *Brain and Behavior*, 12(11).

Rusev, S. J., & Salonitis, K. (2016). Operational excellence assessment framework for manufacturing companies. *Procedia CIRP*, 55, 272-277.

Schork, N. J. (2019). Artificial intelligence and personalized medicine. *Precision medicine in Cancer therapy*, 265-283.

Seyedi, P., Eshghi, K., & Carter, M. W. (2024). A paradigm shift in appointment Scheduling: Introducing a decentralized integrated Online booking system. *Expert Systems with Applications*, 257, 124836.

Sharma, S., Rawal, R., & Shah, D. (2023). Addressing the challenges of AI-based telemedicine: Best practices and lessons learned. *Journal of education and health promotion*, (1), 338.

Shingo Institute. Utah. Shingo Model Handbook. Utah; 2014:7-25

Sittig, D. F., Wright, A., Coiera, E., Magrabi, F., Ratwani, R., Bates, D. W., & Singh, H. (2020). Current challenges in health information technology–related patient safety. *Health informatics journal*, 26(1), 181-189.

Soori, M., Arezoo, B., & Dastres, R. (2023). Artificial intelligence, machine learning and deep learning in advanced robotics, a review. *Cognitive Robotics*, 3, 54-70.

Timilsina, A., Neupane, P., Pandey, J., Subedi, A., & Thapa, S. (2024). Exploring the healthcare access challenges faced by visually impaired young women in Nepal: Navigating sexual harassment and stigma within healthcare settings. *Dialogues in Health*, 4, 100171.

Tiwari, M., Bryde, D. J., Stavropolou, F., Dubey, R., Kumari, S., & Foropon, C. (2024). Modelling supply chain Visibility, digital Technologies, environmental dynamism and healthcare supply chain Resilience: An organisation information processing theory perspective. *Transportation Research Part E: Logistics and Transportation Review*, 188, 103613.

Van Hoek, R., & Lacity, M. (2023). How global companies use AI to prevent supply chain disruptions. *Harvard Business Review*, available at: <https://hbr.org/2023/11/how-global-companies-use-ai-to-prevent-supplychain-disruptions>.

Waldman, Chad. (2022). How Health Systems Can Use AI to Optimize Resources and Maximize Patient Satisfaction. <https://hitconsultant.net/2022/03/04/health-systems-ai-to-optimize-resources-patient-satisfaction/>

WHO. Quality of care. <https://www.who.int/health-topics/quality-of-care>

Wu, H., Lu, X., & Wang, H. (2023). The application of artificial intelligence in health care resource allocation before and during the COVID-19 pandemic: scoping review. *Jmir Ai*, 2(1), e38397.