HEALTHCARE 4.0 AS AN ESSENTIAL SOLUTION TO HOSPITAL OPERATING MANAGEMENT IN THE 4.0 INDUSTRY ERA

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Abstract: The rapid development of science and technology today has touched various aspects of people's lives, from household chores to working methods and studying, which are made more accessible by technology. This situation is also discussed by innovations developed by the industry to answer challenges or demands from society and new opportunities to conduct in-depth research and technological development to facilitate human work, especially now that the development and sophistication of technology have also entered the medical world when artificial intelligence (AI) plays an essential role in hospital operations or also known as health care 4.0, where the healthcare delivery process becomes a cyber-physical system complete with IoT or internet of things and radio-frequency identification or RFID, wearables, all types of medical equipment, intelligent sensors medical robots, and others that are all integrated with cloud computing, extensive data analysis, and decision support techniques to achieve intelligent and interconnected health care delivery.

Keyword: healthcare, operation management, internet of things, artificial intelligence, big data, service management

INTRODUCTION

The rapid development of technology today has touched various aspects of people's lives, from household chores to working methods and studying, which are made more accessible by technology. This situation is also discussed by innovations developed by the industry to answer challenges or demands from society and new opportunities to conduct in-depth research and technological development to facilitate human work, especially now that the development and sophistication of technology have also entered the medical world when artificial intelligence (AI) plays an essential role in hospital operations or also known as health care 4.0.

If we look back, the healthcare system has undergone quite a long revolution and revolution in which this development is to provide the best service to the community. In the era of health care 1.0, hospital operations were limited to doctor and patient appointments. During the meeting, the patient visits the intended clinic to meet doctors and other medical teams, conduct consultations and tests, and receive a doctor's diagnosis. Then, the patient is given a prescription by the doctor or undergoes hospitalization according to the doctor's recommendation or the next appointment plan. This activity has been

going on for hundreds of years (Li & Carayon, 2021: 2).

Healthcare 2.0 is characterized by the emergence of medical equipment such as imaging tools, ultrasonography (USG), CT scan, and magnetic resonance imaging (MRI); monitoring devices such as pulse oximeters and arterial lines; as well as da Vinci robots and chest tubes which began to be used as surgical tools and patient life support tools. In addition, developments in the health sector in this era increased, and biotechnology became known. More and more equipment is being used by hospitals in the health care 2.0 era to support diagnosis, treatment, and monitoring by the medical team (Li & Carayon, 2021: 3).

Healthcare 3.0 is characterized by using information systems in hospital operations, such as electronic medical records (EMR), which summarize patient health data stored electronically in digital form, facilitating hospital operations. Not only that, this EMR is regulated to manage patient care whose data can be used by all units and departments in the hospital, and hospital work procedures can also be accessed by medical personnel through this system. In this era, remote health and telehealth have replaced face-to-face appointments with doctors. Especially during the COVID-19 pandemic, which limited face-to-face appointments between patients and doctors, causing requests for telehealth and virtual visits to increase (Li & Carayon, 2021: 3).

Healthcare 4.0, which is a new paradigm in the management of healthcare operations, is characterized by a revolution followed by the development of industry 4.0, where the healthcare delivery process becomes a cyber-physical system complete with IoT or internet of things and radio-frequency identification or RFID, wearables, all types of medical equipment, intelligent sensors medical robots, and others that are all integrated with cloud computing, extensive data analysis, and decision support techniques to achieve intelligent and interconnected health care delivery (Li & Carayon, 2021: 3). This technology-connected system in health care 4.0 integrates or connects healthcare organizations and facilities such as hospitals, clinics or long-term facilities, nursing homes and communities engaged in the health sector. Patient treatment history, diagnostic records, lab results, treatment plans, pharmacy refills, billing and insurance claims can be managed through adequate protocols. The role of AI in health care 4.0 is significant in integrating healthcare operating systems.

RESEARCH METHODOLOGY

This research uses data from books, journals, magazines, and others. In this study, researchers analyzed previous studies related to the topics discussed by analyzing secondary data related to research so that researchers could shorten the time in collecting data. According to Dale (1988, in Bell, 2019: 295-297), there are several advantages to analyzing secondary data, namely: first, related to cost and time, where by analyzing secondary data, researchers will be presented with good quality data. The second advantage is high-quality data. As mentioned earlier, by analyzing secondary data, the chance of obtaining high-quality data is higher. This secondary data is taken using a strict sampling procedure, often a national sample or at least covering various regions and the data is examined by experienced researchers.

DISCUSSION

When the COVID-19 cases began to decline, and people could return to visit the hospital for treatment, the condition of the hospital was again crowded with patients

with various needs for their care. This condition requires proper hospital operational management so that there is no accumulation of patients and patients can be adequately served. Cinaroglu (2015: 12) states that healthcare organizations are one of the most complex systems. Healthcare organizations are experiencing rapid technological changes, so they must adapt to messy situations and be successful at every step of the clinical and organizational process (Weisbrod, 1992, pp. 524–526). Many stakeholder groups with different expectations cause complexity in healthcare organizations. Then this complex condition is also coupled with the fast development of science and technology in the clinical world.

This rapid change in the medical world requires medical professionals to increase their ability to use new technology and knowledge (Salem-Schatz et al., 1990). Innovations are also needed to adapt to new technologies in the medical world and to be able to improve business processes in every work unit or department. Innovations can be carried out in the form of leadership methods in the world of media, teamwork, time management, and others. When human resources (HR) in healthcare organizations have superior competence, professionals who are experts in diverse expertise will be created. This superior HR will be able to lead collaboration between employees, collaborate and communicate with each other, and manage different functions within the healthcare organization. The crucial role of managers in this situation is to increase collaboration among staff to create effective management of healthcare organizations (Succi, 1999).

The rapid development of science and technology in the medical field, coupled with demands from society to improve services, has made healthcare organizations strive to improve their system design and to be able to work effectively and efficiently. One way that can be done to develop effective client-centred health care is to separate the front-office and back-office configurations. Wikner et al. (2017: 7) illustrate back-office and front-office activities and the use of lean and agility in 3 (three) maintenance designs or flows. First is rupture flow, which treats conscious patients who do not require hospitalization. In this flow, the patient's treatment period is short, and there are various diseases that the patient suffers. Although the rupture flow is less intense when compared to the injury flow, it requires prompt treatment and high intensity. The second flow is fracture flow. This pathway treats conscious patients who may require hospitalization in a short time. The treatment period in this pathway is short, and there are also a variety of ailments that patients suffer. The number of patients in this pathway is high, but the injuries are less intense than those with severe injuries and require appropriate treatment. When a suspected fracture is found in a patient's limb, they will be sent to radiology for a more apparent diagnosis. The third flow is the serious injuries flow, consisting of a low work volume but wide variety and variability. The patient's condition may require resuscitation, so the response time is critical. When the patient is stable, the patient will go through a different treatment process based on the patient's situation and condition.

Furthermore, Wikner et al. (2017: 7-9) formulate 5 (five) steps to understand the application of decoupling thinking in the context of services, especially in solving thought content and flow discontinuities. The first step is evaluation. The company requires evaluation to test and assess the content and flow. Things to consider are in the context of the internal environment, such

as skill mix, availability of resources and finance, and target and performance measures, and external environments, such as population health, cultural mix, availability of funds, and technology development. In this first step, there are also other things to improve linkages and communication between service providers, in this case, hospitals, and consumers, namely patients. The primary key in this step is expanding the system being studied. The endpoint in this step is usually the customer, but upstream service coverage is a matter of decision. For example, in a case where only planning for order fulfillment is carried out, only the flow starting from the patient's arrival needs to be included. Against this, when new patient preparation is entered into the system, it must include several parts, such as the upstream point where the customer enters the system. This evaluation requires concrete evidence and an exact information/performance management system premise.

According to Wikner et al. (2017), the second step is an estimation. Estimation is intended to consider the design of the services to be designed and needs estimates of crucial information related to lead time, bid costs, and patient value. To create effective and efficient services, hospital operations managers need to understand the patient value, capacity and demand, and estimation of resources and conditions. Especially in health care, estimates are difficult to predict because the level of demand needs to be clarified. Nevertheless, the effectiveness of operational activities can be achieved amid this difficult-to-estimate demand. The effectiveness of operational activities can be done by minimizing supply costs, ensuring patients are controlled promptly to increase value propositions, properly qualifying staff, and carrying out correct diagnoses. In addition, this step also groups patients consisting of 3 (three) people with conditions that are related to each other. It will provide information regarding how often the patient needs to be controlled.

The third step is designing, focusing on workflow or business process design and positioning in decoupling points. Wikner et al. (2017) illustrate several policies related to the design of hospital operational processes. The first relates to consumers, which in the context of a hospital means patients. Of the three business processes or workflows mentioned earlier, the most appropriate way of providing services to patients is by providing care as needed, not delaying patient care, and providing the proper treatment and disease diagnosis. When this is achieved, the patient's naja will follow a precise workflow and assurance that they are receiving superior and safe care.

The second illustration in the design is the boundary or boundary. Before the patient arrives at the emergency department (Wikner, 2017, p. 8), an uncontrollable situation generally occurs in the hospital and its staff. To prevent an uncontrollable situation, good communication is needed with all parties involved with the patient before he arrives at the emergency room (ER). The availability of all information before the patient arrives at the emergency room ensures that back-office activities can be carried out, adequate equipment has been prepared, and medical personnel is ready to provide care to patients according to their illness. In addition, essential preparations are usually made before the patient is known, such as forecasts related to spending on equipment and general emergency room preparations.

The third illustration is the drivers. The arrival of the patient in the emergency room is the trigger that drives the start of patient

care (Wikner, 2017, p. 8). Medical personnel can obtain information regarding the patient's condition from the patient, family, or ambulance staff. The challenge medical personnel faces balancing the demand for care with the capacity to care for patients. Medical personnel will quickly identify patient care needs with the historical data of patient care. Then there is differentiation. At this stage, the diagnosis of accidents in patients is identified according to the proper procedure, either rupture, fracture, or severe injury. At this stage, the decision made by the medical team is to identify the pathways that need to be passed by the patient and information about providing urgent care for the patient (Wikner et al., 2017, p. 8). The final illustration is the patient contract. In the emergency department, it is challenging to map patients based on the schedule provided, considering that patients can come anytime in this department. However, medical personnel in this department must act quickly, precisely, safely, and flexibly and be able to adjust to patient care needs, considering that this department is the front guard.

The fourth step is to manage/control. Wikner (2017: 9) mentions that the control flow and management of products and services depend on decoupled flow. The availability of information and resources in this step is crucial, considering that the planning and control of the three business processes depend on it. In contrast, the last stage is realigning. Once decoupling points are identified, it is necessary to regularly review and adjust in response to the dynamic organizational operating environment (Wikner, 2017: 9). Regular review and adjustment are critical to healthcare operations as they face challenges both financial and resource constraints, policy issues, technological developments, an aging population, cultural diversity, and many other challenges.

In improving healthcare quality management and process improvement, Jacobs and Chase (2018: 662-663) state that service quality is essential in hospital operational management. The quality of hospital services will increase with a hospital information system. That is integrated not only into one hospital but also with other healthcare that can provide treatment information from upstream to downstream—moreover, integrated with other healthcare to make it easier for patients to complete the treatment. When healthcare organizations have already applied this system, it can be stated as healthcare 4.0.

Healthcare 4.0 cannot be separated from the development of industry 4.0. This industry is not only related to technological developments but more than that. Qin et al. (2016: 5) stated that the industry 4.0 concept was developed by integrating six main principles, namely interoperability, decentralization, virtualization, modularity, service orientation, and real-time capabilities. Interoperability is a fundamental principle or initiator of industry 4.0. For example, interoperability can make it easier for humans and machines to get real-time data. Then, the modular system allows the organization to respond quickly to requests and guarantees the safety of the initial investment during fluctuations. Virtualization can make it easier for organizations to minimize errors, improve processes, and deal with complex situations (Chanchaichujit et al., 2019a, pp. 5-6).

Discussing industry 4.0 and healthcare 4.0 is closely related to IoT. The role of IoT in health care is to provide infrastructure or equipment that makes it easier for medical personnel to control patients. With IoT, medical personnel can save time and effort

in monitoring patients because they can be accessed through a continuous flow of information. In addition, IoT can also improve the quality of healthcare services and reduce costs related to services. IoT transmits data via Wi-Fi or Bluetooth and is synchronized in the Google Device Health application, which can be accessed multiple times via mobile platforms, both Android and iOS (Chanchaichujit et al., 2019b, p. 22). Then, Wireless IoT is a solution for accessing patient data anytime and anywhere. The network regulating healthcare devices and facilities will assist medical personnel in collecting patient data information and determining the proper treatment.

Furthermore, healthcare 4.0 cannot be separated from big data. The use of big data in healthcare will make it easier for medical personnel to explore new insights and find optimal solutions to operational constraints to provide better health services (Chanchaichujit et al., 2019b, p. 28). Furthermore, Chanchaichujit et al. (2019b: 28) also found 5 (five) potential advantages of data analytic capabilities in healthcare organizations, namely in the aspects of information technology infrastructure, operational, organizational, managerial, and strategic. Big data analytics must be considered in healthcare 4.0 because it can reform policy-making by providing a clearer view and transparency of functional operational performance and performance achievements.

One example of a country implementing IoT and big data in health operations management is Singapore. The Ministry of Health launched the National Electronic Health Record (NEHR) system in 2011 (Chanchaichujit, 2019c, p. 31). The NEHR is managed by Integrated Health Information Systems and aims to unify the health data of all patients, both from other hospitals and health service providers. This innovation carried out by Singapore has made the country listed as one of the countries that record the conditions of its patients digitally. Having a digital record of the patient's health will help medical staff further analyze what actions to take to ensure appropriate patient care and preventive measures.

CONCLUSION

From the explanation above, healthcare 4.0 is a solution for hospitals to improve the quality of their services to consumers. The facilities offered by health services 4.0 make it easier for medical personnel to manage health service operational activities with integrated data from upstream to downstream. The data also contains the patient's medical history and treatment to make it easier for medical personnel to take appropriate treatment measures. Not only that, but it will also be easier for patients to access what treatment they will undergo and what health facilities they can enjoy so that they recover soon. Medical personnel and patients can easily access this data anywhere, anytime, and on any device.

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