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Leveraging value-based care principles in developing eHealth systems: A teaching case

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Abstract
Recently, many countries, including developing countries, have struggled to manage rising healthcare costs and challenges around decreasing quality of care. Previous studies suggest that electronic health systems could significantly improve the quality of care and facilitate better access to care. However, there is still a lack of studies providing sufficient evidence around how this can be achieved. This case study examines how a hospital uses its electronic health (eHealth) systems to offer better access, quality, and value by leveraging the principles of value-based care for its patients. This case study provides critical insights for healthcare stakeholders, public hospitals, especially in developing countries, healthcare providers and policymakers and proffers an approach to leverage the principles of value-based care when developing eHealth systems to offer better overall health and well-being services to their patients.

Introduction

eHealth systems have evolved from systems with a recording function that systematically collects and disseminates data (Borzekowski, 2009) to integrated systems that strive to achieve better health outcomes (Bernardi, 2017). eHealth today, thus, encompasses a wide range of technologies (Hameed et al., 2016), such as Management Information Systems (MIS) (Chen and Cheng, 2008), electronic health records (EHR) (Moerenhout et al., 2018), clinical IS (Mahmudul et al., 2013), computerized decision-support systems (Moja et al., 2014), and computerized order-entry systems (Murray–Weir et al., 2014).

To date, the processes that explain how IS (information systems) resources are orchestrated to achieve organizational performance remains unclear (Cragg 2008; Liang et al., 2010). This case study will examine how a hospital orchestrates its resources using its eHealth systems to leverage the principles of value-based care and thus, offers its patients high value and high-quality care that is readily accessible.

Background

Three critical aspects need to be presented to understand how they come together in the following case study: research orchestration, value-based care, and eHealth Systems.

Resource Orchestration (RO) offers a foundation for extending the resource-based view in a meaningful new direction (Barney et al. (2011). In particular, RO acknowledges the importance of managerial actions to orchestrate IS resources to achieve performance (Sirmon et al., 2011). Resources in this context refer to IS resources, consisting of tangible, human and intangible-IT resources (Bharadwaj 2000), while performance in this article relates to value-based care.

The concepts of value-based care were introduced by Porter and Tiesberg (Porter and Tiesberg, 2006). The guiding principle in value-based care is to stem the excessive wastage in healthcare delivery, especially in the US, and focus resources where they are needed to ensure high-quality outcomes, high patient satisfaction ensues (Porter and Lee, 2006).

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To do this critically requires tracking and monitoring many aspects of patients as they traverse their journey from pre-habilitation (before entering the hospital, through taking and registration, surgery, post-operative and recovery, and then discharge either to home or rehab (Porter & Lee, 2006). To do this and simultaneously assess at each point how clinical intervention can add value to patient care and the patient journey, data is required (Porter and Teisberg, 2006). Collecting and sharing these data effectively and efficiently necessitates sophisticated digital health solutions such as Electronic Medical Records (EMRs) (ibid).

The growth and diffusion of eHealth Systems or digital health solutions have increased rapidly over the last 5 years, with most OECD countries now investing in EMRs (Wickramasinghe, et al., 2019). These systems enable and support the seamless transfer of data (ibid). Further, all these systems support the collection of necessary multi-spectral data to ensure quality care is being administered to the patient throughout their journey. As such, we contend these eHealth Systems facilitate the embracing and enable the leveraging of value-based care principles to ensue (Wickramasinghe and Schaffer, 2019).

The following case study illustrated the interconnection and interplay of resource orchestration, value-based healthcare and eHealth systems. It further shows the benefits of healthcare delivery, patients, and clinicians by using eHealth systems to leverage the principles of value-based care and thereby maximize finite resources.

Setting the stage

Hospital background. S Hospital is the first hospital in Malaysia to offer paperless and filmless services with more than a decade of experience delivering value-based care programs (Rosnah, et al., 2004). It has more than 1400 hospital beds and 20 clinical disciplines (Jun, 2021). It offers advanced medical care and secondary and tertiary preventive care services equipped with state-of-the-art, integrated electronic health systems (eHealth). As the first of its kind, with the motto "We are ready to serve," it was recognized as a renowned healthcare provider in its region with 13 national awards from 2014 to 2019 (Anonymous, 2021).

In Malaysia, primary preventive care is generally provided at district public-health clinics (Liyanatul Najwa et al., 2016). In the S Hospital, preventive care services exist in every department. This enables the hospital to provide specialized care according to the patient's needs (see Figure 1). The preventive care is delivered explicitly to people with multiple chronic diseases whose health condition is at high risk of deteriorating and may require hospital readmission (Farooqui, et al., 2011; Leong, et al., 2007). Generally, this hospital does not accept walk-in outpatients, except for an emergency. Most of its patients are referrals from other district hospitals, health clinics, and private medical centers.

Introduction the eHealth case study

Returning from a medical seminar hosted by the Chief Technology Officer (CTO) of S Hospital stood in front of his office window with a cup of coffee, watching seminar participants walking towards the hospital car park. Each time after a seminar, he was able to crystalize further the success of the value-based services offered by S hospital. Looking back at the journey, he reflected that while it was not easy, they had achieved many goals, making it worth it.

With strong top management support and cooperation from all healthcare professionals in S Hospital, the hospital successfully implemented the eHealth system in 1999. This system enabled them to address and manage their rising healthcare costs and decreasing quality of care. Since then, the eHealth system contained the overall hospital operations and administration which are essential to improve healthcare service delivery and minimize healthcare costs of S Hospital. This eHealth system integrates with clinical, administrative, and financial systems. The clinical system consists of a hospital information system (HIS) and Picture Archiving Communication System (PACS). The HIS comprises of various applications, including Person Management, Scheduling, Order Management, Clinical Documentation, Pharmacy Information Systems, Laboratory Information Systems, and Radiology Information Systems. The Administration and Finance system is integrated to keep track of services delivered and patients' billing.

Empowered by eHealth, S Hospital has successfully provided value-based preventive care to its patients. They are mainly three components involved—administrative efficiency, quality of care, and health promotion.

Value-based care services

First, administrative efficiency is evidenced by the way S Hospital healthcare practitioners manage their services to patients. For example, the integrated eHealth system can display patient history with all relevant preventive care treatment recommendations for the healthcare expert to select and execute. More importantly, a patient report can be prepared in real-time while the subsequent treatment plans can be organized with a mouse click. Thus, it not only speeds up the patient diagnosis time but also eliminates medical errors. As Nurse K explained

> "When a patient is referred to this unit, the first thing is to organize the treatment procedures that the patient will need to go through. By doing this, the patient will understand the reason for getting the treatment. I will explain to the patient the importance of going through a carbon monoxide test to determine their smoking status and severity. If the patient is a light smoker, it is more likely that he may want to stop straight away."
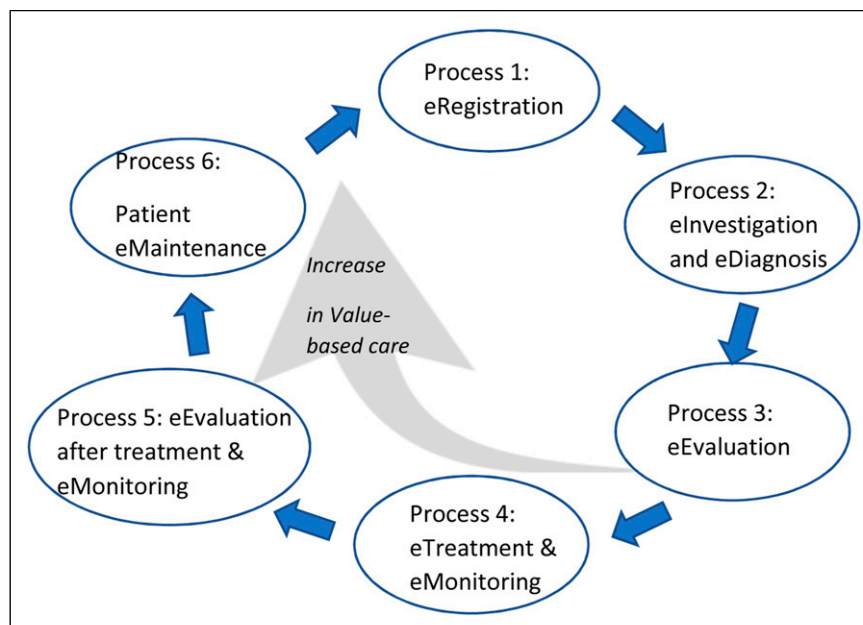
Figure 1. Value-based preventive care processes at S Hospital.

Second, quality of care refers to "whether individuals can access the health structures and processes of care, which they need and whether the care received is effective" (Campbell, et al., 2000, p. 1614). At S Hospital, a structured patient care process is provided. The patient will go through several appropriate care scenarios in each process to ensure they receive the best care from healthcare practitioners. More importantly, quality of care also includes how the news should be professionally communicated to patients. Dr St #39

> "A doctor is a role model to another practitioner. As a doctor, it is how you treat, communicate and educate a patient until you can clear the patient's doubt on their health issues. I always stress to my doctors how they should be cautious in delivering news on the patient's disease and advise the patient on the treatment alternatives and the treatment implications. If patients can understand the severity of their case, they will be open to accepting the doctor's suggestion on the treatment plans and finally follow all the treatment suggested."

Third, health promotion in S Hospital includes holding awareness campaigns for the inpatients, outpatients, and the public. The health-education unit manages this for conducting classes, patient education, counseling, and organizing events and activities to raise awareness, provide education on chronic disease risks, and provide care management. Gullotta and Bloom (2003) refer to health promotion as a range of activities to improve individuals, groups, and community's health through general activities like health education, health communication, and social activities. Classes are arranged according to the type of chronic disease, for example,

hypertension, diabetes, respiratory disease medication advice, and offering an opportunity to patients and the public to discuss any health-related issues. All these classes are provided at no charge, and usually, it includes a snack at the end of the session. The health-education class schedule is posted on the hospital website, can be obtained in the form of pamphlets from the health-education unit, is placed at the diabetes clinic, and is mounted as banners at the S Hospital main lobby entrance. During the class, a team of multidisciplinary healthcare practitioners deliver a talk, educate patients and the public regarding the risk factors of the disease under discussion, and provide knowledge about prevention. Education kits will also be provided to all participants.

Resource Orchestration for Value-based Care Delivery

To orchestrate resources within the hospital for quality care delivery requires top management support, cooperative hospital practitioners, and healthy hospital culture and mindset.

To avoid failure from underutilization and misused systems, the top management begins with enforcing hospital-wide paperless and filmless systems. However, to ensure all hospital practitioners are equipped with relevant skills and knowledge, a stringent selection process was carried out before sending several healthcare practitioners for eHealth training. Upon returning, these users have to provide training to their colleagues. Hence, through continual support and practice, users became more proficient in using the eHealth systems. According to a user

> "*Personally, I think S Hospital has the most user-friendly system. We train our staffs by batches and when it is needed.*"

As the industry leader, this hospital management introduced a six-step procedure to deliver value-based preventive care services to patients (see Figure 1):

Value-based care patient process 1: ePatient registration

The patient registration process mainly aims to gather the patient's medical history, including medication consumption, lifestyle information, nature of work, eating behavior, family health history, and other information that can be used to produce a comprehensive patient profile. The patient profile created from eHealth is crucial because patient details allow the healthcare providers to offer efficient administrative support, a better quality of care and promotion of better health (Bill, et al., 2013).

Upon arriving in the hospital, all new patients have to register and provide their medical history through the S Hospital eHealth system. In the first part of the clinic visit (approximately 30 min), a comprehensive assessment of the patient's medical and psycho-social is completed by an experienced nurse. To ensure appropriate services are delivered in this phase, training is essential in ensuring that nurses are well versed clinically with reasonable IT skills in using the eHealth systems. After this, a clear guideline is given to the registered nurse to allocate patients to the appropriate department accurately. A nurse trained in multi-specialty care will then examine the patient as she knows what questions to ask and can sense vital signs and issues during the discussion with the patient to identify possible support. According to Nurse R #16

> "*while gathering patient information, we will also ask about the patient's family history to see if it is an inherent disease. If so, we will record it into the patient registration record for further investigation. By doing so, it will help to produce a detailed patient profile to be shared and used by doctors.*"

S Hospital management treats mentoring programs very seriously, as the learning through such an induction program is efficient and cost-effective. The mentoring program ensures healthcare practitioners have a positive mentality in providing patients with quality care and support. All new recruits are attached to a mentor. This program offers them on-the-job training. It speeds up new recruits' familiarity with the working environment, hospital culture and values, expectations, and "how things are done around here." The hands-on training, including using eHealth systems and medical equipment, also comes in handy for day-to-day practical tasks.

With proper training and clear standard operating procedures, nurses will appropriately identify and provide relevant assistance to new patients. Patients with severe conditions are prepared for admission as an inpatient to receive preventive care treatment. While a less severe case, a patient is scheduled for an outpatient clinic consultation (usually within one to 2 weeks depending on severity) and is provided with appropriate medication, a treatment recovery plan that creates healthier lifestyle awareness.

Overall, the eRegistration has certainly created value by streamlining clinical workflows, freeing up nurses' time, and generally reducing clinical complexity. For that, it allows nurses to spend more quality time by providing attentive care to patients.

Value-based care patient process 2: eInvestigation and eDiagnosis

To provide value-based care, the main objective in this process is to deliver a better clinical diagnosis with accurate information disclosure for diagnosis (Jie, et al., 2016), reduce diagnosis delay (Harirchi, et al., 2015) and errors in this process to avoid misdiagnosis (Miller and Levy, 2015; Neale et al., 2011).

After the eRegistration, the patient is assisted to the relevant clinic for eInvestigation and eDiagnosis by relevant healthcare experts. eInvestigation refers to the type of investigation that locates digital information intending to use it for diagnosis. In a hospital, the digital record of patient's blood test results and X-rays will all be recorded in the patient's medical records (PMR) so that doctors can electronically perform a clinical diagnosis within 90 min. If more investigation is required, a doctor can refer the patient for further testing.

E-diagnosis refers to a diagnosis performed in the PMR. In this system, doctors can access complex patient reports, including patient's statements, vital signs, treatment history, and allergies history. Through this system, it helps to solve complex problems by reasoning through bodies of knowledge. It carries out rule matching on each PMR input to chase down the disease that best fits these diagnosis rules and provide a list of potential diagnosis plans for a doctor. Using this system makes the diagnosis more logical. It empowers doctors to evaluate the patient's stage of disease, plan and guide the patient for available treatment. For example,

> Dr L #7: Definitely, it [PMR] is convenient because I can locate results quicker, although I am at a ward and the result is still at the lab. I can compare the blood investigation or view a specific X-ray and reports. Thus, these help me evaluate the medical results quickly and discuss the suitable treatment with the patient and their family members.

The competency in designing preventive care treatment plans is developed from rich clinical experience and IT skills in using the PMR systems. To ensure all junior doctors are equipped with appropriate skills, they are trained by the senior doctors through the medical attachment program. This program is designed to prepare junior doctors with practical hands-on experience that equips them with knowledge, good communication skills, and the most desirable personality traits for chronic disease care (Dejesus et al., 2012). One of the senior doctors explained that in S Hospital, junior doctors are encouraged to do an attachment in certain units because this will help them learn unique skills and gain new knowledge in a specialized area, thus, developing the competency in designing a preventive care treatment plan.

> Dr S #37: We welcome junior doctors here for attachment to gain hepatobiliary surgery experience. I always remind them that you must always do to be 'a good doctor'. Because if you keep it in your mind, you will do the right thing. You will treat the patients under your care as if they are part of your own family. That's the skill that will give the best treatment for patients.

Equipped with the right mindset, doctors in this hospital are more compassionate and dedicated. That is the unique character that truly value-add to the quality of care to patients in this hospital.

When the patient suffers from a severe chronic disease, the doctor can request a nurse to prepare for patient admission. The system will then alert the receiving ward with the patient's information with a mouse click. According to a Nurse

> "*Anyone can use the system due to the simplicity of the system.*"

Such an incident is quite normal because most chronic diseases are known as "silent killers" with the signs or symptoms not appearing in the early stage of the disease. Thus, patients might not be aware that they have established a chronic disease until it shows complications. Therefore, einvestigation and ediagnosis for preventive care are essential. Without further delay, beds and relevant facilities that are needed are prepared to receive the patient. With all health practitioners are equipped with relevant IT skills to use the eHealth systems appropriately, patients have the chance to receive quality care, reduce the risk of complications, and have an opportunity to fight for survival in S Hospital.

Value-based care patient process 3: eEvaluation

The key objective of this process is to access data that hospital professionals need to provide continuous care to patients. This is primarily done by accurately mapping patient health conditions to the right preventive care plan for continuous evaluation. In this process, the S Hospital delivers and uses the eHealth system to record diagnosis results, share relevant information with patients on their treatment options and outcomes (Moxey, et al., 2003), and promote a healthier and sustainable lifestyle plan.

The challenge in this process is to provide an accurate patient evaluation. To do so, the management introduced a straightforward standard operating procedure to guide doctors and specialists responsible for planning comprehensive treatment procedures. Because of the service-orientated culture in this S Hospital, the specialist team are always willing to go the extra mile for their patients. This includes taking spare time explaining the importance of the preventive care treatment available and motivating patients to cooperate, obtain their confidence and trust in continuing to use hospital treatment.

They are also aware that respecting patients is also an essential unspoken role in this process. Patients have the right to refuse treatment (Zhou, et al., 2017). Hence, involving the patient in decisions about their treatment allows healthcare providers to become advocates that the patient can trust and from whom patients can obtain guidance for treatment options (Islam, et al., 2016). Based on the preventive care treatment provided by the eHealth systems, the specialist team will disclose all options for the patient to choose. With this mindset, they were very patient in assisting their patients. Dr. T #11 explained

> "One of my patients just recently knew that he had cancer. Depending on his emotional health, I suggested to him first to consider ostomy surgery. 2nd to consider creating a stoma with this pouch outside so intestinal contents will pass through the stoma. If the patient does not want any intervention, I will suggest he consider chemotherapy depending on his health condition. If he still cannot accept it, I will then have to refer him to the palliative unit to manage the final stage of his life."

Value-based care patient process 4: eTreatment and eMonitoring

This process aims to provide patients with access to care, improve their health, manage their existing health conditions, and reduce disease complications. To achieve value-based care, eHealth plays a critical role in allowing healthcare practitioners to access the integrated data for evaluation, plan and guide the patient to available treatment plans.

To maximize the value-based care in this process, the challenge is to form a team of multidisciplinary experts, doctors, nurses, pharmacists, dieticians, and physiotherapists to ensure a complete treatment and comprehensive evaluation are accurately delivered to chronic disease patients. Mutual trust and respect between nurses and doctors are essential as they value respective contributions towards patient care (Weller et al., 2011). Thus, team synergy has

eliminated unnecessary contradictory comments, thus, increasing patient confidence and overall treatment experience. A nurse described how she mediates between doctor and patient's needs:

> Nurse Sf #17: We work very closely with our patients. We are like the middle person between a doctor and the patients. Most of the time, patients are comfortable telling us about their physical condition and their feelings. On the other hand, doctors trust our ability to observe patients' conditions and provide feedback about patients' needs and problems to the doctors for further action.

However, healthcare practitioners may find it challenging to advise and convince patients to use conventional preventive care treatment that is scientifically proven rather than traditional medicine (Farooqui et al., 2011). This issue may be due to the lack of education, fear and beliefs held on the causes of the disease, and fear of side effects from modern treatment (Dickens et al., 2014; Farooqui et al., 2011). A diabetic educator described how she convinced patients to use hospital treatment:

> Nurse In #12: "Quite many of my patients didn't take modern medicine. They prefer herbal drinks and traditional pills. This situation is an ongoing challenging issue for me. We want to instil patient's trust in current treatment that is scientifically proven to treat chronic diseases like diabetes. Although I can't force my patient to follow my advice in getting hospital treatment, I always provide advice and show them some pictures of the effect of traditional medicine on the kidneys because such treatment may not be suitable for everyone."

Prioritizing patient's well-being has always been the focus of this hospital. S Hospital's healthcare practitioners will refer the patient to another relevant unit to strengthen the treatment delivered, such as dietetics, pharmacy, or physiotherapy. Depending on the patient's need, sometimes, they will have to motivate patients to undertake a beneficial treatment. As explained by the dietician

> "*I have one case where this patient has multiple chronic diseases. He is obese, and he is suffering from a stroke. This is a tricky case. As a team member, I plan for the patient's diet to reduce his weight. Next, we must ensure the patient can achieve a certain weight to perform relevant exercises to strengthen his muscles during physiotherapy sessions. Working as a team, together we continuously motivate our patients. Sometimes, it would be more convincing if the patient heard the advice repeatedly from different healthcare professionals. With continual reminder and proper treatment offered, I am happy to say that some of my patients could move their limbs and even walk.*"

For instance, a patient diagnosed with early diabetes will be referred by a doctor to the diabetes clinic to gain further understanding and awareness about diabetes. At this clinic, a diabetes educator will provide information about diabetes, show the correct way to use devices, and monitor the patient's progress. In addition, the educator may attend the outpatient ward to provide patients with advanced-stage diabetes and severe complications with education and counseling. For better preventive care outcomes, the educators encourage family members to participate in the follow-up visits and welcome inquiries from family members.

Value-based care patient process 5: eEvaluation after treatment and eMonitoring

In this process, the main objective is to evaluate and monitor patients' health development electronically. Based on the doctor's evaluation and nurse's observations, if further treatments are required (i.e., any forms of side-effects), the patient will be referred to another relevant unit. For example, the physiotherapist explains a different treatment plan that she provided her cancer patient:

> Physio F #5: The patient experienced swelling in their arm or leg caused by breast or cervical cancer. It is something to do with fluid retention and tissue swelling caused by a blocked lymphatic system. When tissue is removed from the breast, it will cause lymphatic drainage problems as the fluid has nowhere to go. After some time, the accumulated liquid can cause swelling to the arm or leg. We will do massage fatigue drainage to help the fluid flow to the functioning lymphatic system. Then we will bandage the arm or leg properly. In this case, it is essential to explain what is happening and treat the patient.

Given that the eHealth system is equipped with telemedicine, healthcare practitioners can provide 24*7 support to evaluate patients' progress after treatment and with additional assistance when required.

> Dietician: "a diabetic patient must be given a diabetic diet. Usually, patients will find that the food might be tasteless, but as a dietician, I always encourage the patient to take the planned diet to recover. After some time monitoring the patients' health records through the system, I will consult the patient and their family members on managing and controlling the patient's food intake and its impact on reducing diabetic complications".

The next challenge is the execution of the treatment plan. Often, healthcare professionals have to address mood disorders among cancer patients. A physiotherapist shares her experience:

Physio F #5: Usually, patients will experience psychological distress and have a low level of confidence. Therefore, we emphasize the psychological element that focuses on the patient's mind and emotions before physiotherapy. Emphasizing the patient's psychology is essential before we proceed with specific treatment. With support, our patient may understand her current health state and be prepared for what will happen next. Thus, I will encourage patients to be strong to go through the procedures. We will explain the treatment plan thoroughly with the patient.

Rich skills and experience are essential assets to enable healthcare practitioners to deliver value-based care. However, due to limited resources, S Hospital management had to be strategic. They introduced a professional development exchange program that encourages healthcare professionals to apply for an exchange attachment in another hospital. In response to the exchange program, a senior physiotherapist explained that it had given her an in-depth understanding of her field.

Physio F #5: I learned a lot from others in the three-month exchange program. The attachment provides me with the opportunity to advance my massage technique in lymphedema management. This knowledge allows me to better educate and address patient's emotional and physical well-being.

Value-based care patient process 6: eEvaluation after treatment and monitoring

In this process, mainly healthcare professionals continue to monitor patient's conditions. As part of the preventive care, patients will be discharged if they are deemed stable, do not require ongoing review, or have a follow-up from the nearest health clinic or district hospital. Before discharging patients, the dietician, pharmacist, and physiotherapist review the patient's plan with the patient and any caregiver, provide relevant information and plans about eating correctly at home, correct medication intake, and step-by-step exercises that can be applied at home.

Physio W #2: If a patient stops doing exercises, it will slow their recovery. That is why physical exercises are essential to help patients improve their condition. We understand that at home, the patient may not have the same hospital exercise equipment. Therefore, we teach the family members or the carers to modify suitable things at home into functional exercise equipment. This will encourage the patient to continue doing exercises when they are at home, thus helping to reduce muscle stiffness.

Further, all the patient's data gathered from the clinical procedures are recorded and stored systematically in eHealth Systems for further evaluation and future reference by the healthcare team in S Hospital and other hospitals.

S Hospital also provides other preventive care services for long-term health through three units—the diabetes clinic, quit-smoking clinic, and health-education class. Diabetes and quit-smoking clinics were established to promote health through education and counseling. The clinics are run by experienced senior nurses and are supervised by senior doctors and consultants. These services are provided on a referral basis, whereby doctors can refer patients from any inpatient department for further advice and continuous health improvement during their treatment and before discharge.

At the quit-smoking clinic, patients are provided with education and counseling to help them practice positive steps in quitting smoking. Patients are also scheduled for follow-up and are supplied with medication to reduce their smoking. Patients who visit this clinic include addicted smokers with chronic diseases such as cancer, cardiovascular disease, and respiratory disease.

Conclusion: Current status of preventive care

To optimize scarce healthcare and social services resources, early investment in effective prevention has been noted to significantly reduce the prevalence rates of ill health and attain sustainable productivity growth (Wang and Wang, 2021). Incorporating a value-based healthcare lens and leveraging the principles of value-based healthcare, it is thus possible to deploy resources more effectively and efficiently while ensuring high-quality patient experience. Hence, this teaching case contributes to creating awareness in this area. First, it provides a clearer understanding of preventive care in developing countries. Second, it offers a clear illustration of how a hospital can use its eHealth systems to provide value-based care to its patients, apart from drawing insights on the resources being orchestrated in delivering value-based care.

Teaching note

Based on the case study above, try to answer the following questions:

1. What are the three factors of value-based care identified in S Hospital?
2. What are the orchestrated resources that have contributed to the success of using eHealth Systems?
3. Explain how S Hospital manages its resources in providing quality preventive care services to its patients?

4. What are the benefits of value-based healthcare from clinicians, patients, hospital senior management and payers?
5. Is the success of and ability to realize value-based delivery healthcare a result of the eHealth systems, People or Processes? Why?

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