The technological imperative for value-based health care

ABSTRACT

The overarching principle of a value-based health-care strategy is to provide higher quality care at a lower cost. To achieve the goals of a value-based health-care system is highly dependent on the availability and the effective use of technologies. This article explores the potential for the use of technology to enable value and the key design factors associated with their implementation in a value-based health-care system.

The ultimate goal of a value-based health-care system is to achieve 'better outcomes at lower cost' (Adler-Milstein et al, 2017). Value-based health care is dependent on the ability to capture and evaluate outcomes and measure costs from the level of an individual patient to an entire population (Porter and Teisberg, 2006). This is challenging, as health care is a complex adaptive system (Wachter, 2016) where every patient is unique, but where standardization across patient populations has been shown to be crucial to increase value (Porter and Teisberg, 2006). To meet this challenge many health-care organizations are leveraging digitization and technological innovation. New technology systems and approaches can support the collection, processing and dissemination of personalized information at scale because of their capability to collect patient data from different sources (e.g. primary and secondary care) and allow data to be accumulated with time (Porter and Teisberg, 2006).

It should be noted that digitizing the system alone is not enough. Planning, evaluation and change management are as important as the technology itself. In addition, the increased use of technologies requires an attentiveness to technological trends and opportunities that can facilitate a value-based health-care system. It should be taken into account that use of new technology may also carry risk. Security and privacy-related challenges remain one of the biggest concerns for creating a technology-led value-based health-care system. This article focuses on technologies that are being used to enable a value-based health-care system and discusses how these technologies are helping achieve value in health care. The article will also outline the trends in technology that are enabling a value-based health-care system.

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How is technology enabling a value-based system in health care?

Transformation towards a value-based system is both enabled by and informs the technological evolution of the health-care setting. It is enabled through the ability to analyse processes at individual patient and population levels and informs digitization through the use of this evidence to identify the next generation of solutions required for increasing value.

The widespread use of electronic health records has been one of the most significant technological advances in health care (*Table 1*). Electronic health records are described as the 'backbone' of health informatics (Porter and Teisberg, 2006), benefiting health care on three levels (Menachemi and Collum, 2011):

1. Patient, e.g. iatrogenic handwriting transcription errors are immediately reduced when information, such as prescriptions, is entered electronically
2. Organization, e.g. service usage, when entered into an electronic health record, can facilitate business planning
3. Societal (population), e.g. when implemented across organizations, electronic health records can also facilitate data sharing, reducing the chance of unnecessary ordering of medical tests and improving efficiency.

The concept of an electronic health record, owned and siloed by an individual health-care organization, is currently being challenged by connected health records or personal health records, although there is currently a lack of consensus on what these concepts comprise. They are evolutions of the electronic health record that reflect:

1. The increasing delivery of care by accountable care organizations (or similar integrated care organizations in the UK)

Table 1. Some benefits of digital technology enablement	
Improving patient safety and outcomes by	Using insights from the integration of different types of data (e.g. health, environment) collected by different sources (e.g. mobile devices, electronic health record)
	Using data for improved prediction (e.g. artificial intelligence)
Facilitate people's lives and reduce costs by	Providing tools such as voice-assisted note taking and reminders
	Automating processes that do not need humans
Improving health-care delivery by	More actively involving people in their health-care decisions
	Providing the right information at the right time
	Giving access to health care like other industries such as banking and retail industry do (e.g. Amazon) by providing teleconsultation, ePrescribing and delivery of medication

2. An increasingly mobile, engaged and informed patient population, who see their health records as information owned by them rather than the health-care providers they chose to deliver episodes of their care.

Potential technological drivers of change

Three contemporary technologies stand out as having the potential to be key drivers of value-based change:

Voice interfaces

For many years voice transcription has been used in health care, but this has evolved to include advanced autonomous speech recognition technologies (Al-Aynati and Chorneyko, 2003), such as that used by the Amazon Echo or Apple's Siri. At a basic level, speech recognition technology can already improve reporting time of patient diagnosis and thus impact quality of health-care delivery through the 'timely delivery' of care (Johnson et al, 2014).

Internet of things and artificial intelligence

Individually, and in combination, these tools have the potential to deliver advanced collection and processing of data alongside optimization of care process models. The internet of things refers to the concept of connectivity between different technologies, smart devices, people and places (Riazul Islam et al, 2015) and artificial intelligence refers to using computer powered, intelligent technologies to perform activities that would normally require human intelligence using 'minimal human intervention' (Hamet and Tremblay, 2017).

Together technologies such as artificial intelligence and the internet of things can be leveraged for behaviour change. For example, Omada, a digital therapeutics company, helps organizations to improve their employees' health by using technology. Omada uses a set of digital tools such as 'scales, wearables, and a food-tracking app' to improve the health of their clients (Davis, 2017). Data from the technologies are shared with the company creating an internet of things network, and the company then uses machine learning (a form of artificial intelligence) to 'coach' individuals on weight loss and behaviour change (Davis, 2017). The healthier the employees, the lower the price the employer pays for their insurance cover. This creates value by reducing the costs while supporting individuals to have better health outcomes.

Technologies used in health care are enabling a value-based system. This happening through digitizing the system, developing current technologies such as artificial intelligence and the internet of things for use in health care, and collecting and analysing population-level data in a continuous way to improve services. The health technology examples mentioned above show to what extent technologies can enhance and improve health-care services to achieve value in health care.

Trends supporting technology-led value-based care

A value-based health-care system is user centred, so it has to take into account factors that can enable user-centred care. Technologies are being leveraged to enhance user-centred designs and trends such as creating a value-enabling information technology platform, interoperability, user experience, patient empowerment, disintermediation of care and real-time analytics.

To enable the use of technology for a value-based health-care system, taking into account health technology standards is essential for the adoption of the technology. This is reflected in Porter's classic model (Porter and Lee, 2013) which is underpinned by an enabling information technology platform that:

Is centred on patients

Patient-centred care can contribute to the value-based health-care system by enabling 'shared decision making', health promotion, and prevention and consideration of health-care costs paid by patients (Tseng and Hicks, 2016).

Uses common data definitions

Using common data definitions can allow 'seamless' data sharing within an organization and between other organizations, allow universal access to data by different stakeholders (e.g. patient, primary care provider, secondary care providers) and help achieve data interoperability (Healthcare Information and Management Systems Society,

> An effective information technology platform should enable easy extraction of information about health outcomes during and after care to be able to monitor outcomes and help in decision making.

2015). This can also allow patients to play a more active role in their care by easily accessing and understanding their health records (Healthcare Information and Management Systems Society, 2015).

Encompasses all types of patient data

There are different forms of patient data, and everything from physician notes taken during a physical examination, the patient's health record, to test results should be kept in the same information technology platform to provide the most comprehensive patient data (Porter and Lee, 2013).

Comprises medical records that are accessible to all parties involved in care

Data sharing between the different parties allows a more comprehensive view of patient data and can improve health-care quality and reduce medical errors (Healthcare Information and Management Systems Society, 2015).

Includes templates and expert systems for each medical condition

To provide holistic care for patients requires more efficient ways for data entry and data viewing. Templates can help make sure that all factors which need to be taken into consideration regarding a health condition are included (Porter and Lee, 2013).

Has an architecture that makes it easy to extract information

An effective information technology platform should enable easy extraction of information about health outcomes during and after care to be able to monitor outcomes and help in decision making. This can be enabled by making health information from the information technology portal 'readily extracted using natural language processing' (Porter and Lee, 2013).

Design and technical considerations in system implementation

Interoperability is defined as the ability of different systems to exchange and interpret data from each other and it is possible when the systems are able to exchange the data and interpret it (Healthcare Information and Management Systems Society, 2016b). Interoperability can be achieved when different health-care organizations and systems use the same standards for data collection and sharing which allows easy information exchange between the systems (Walker et al, 2005). Interoperability-enabled information exchange can significantly contribute to the value-based system by eliminating repetition of services, eliminating use of paper, resulting in better care and consequently allowing significant financial savings (Walker et al, 2005).

According to the International Organization for Standardization, user experience is a 'person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service' (International Organization for Standardization, 2010). User experience is about the ease and comfort a user experiences when using a technology. The increase in health technology use such as medical health records introduced the concept of 'user-centred design principles' to health care (Healthcare Information and Management Systems Society, 2016a). The idea is that a technology should not make a person's life harder, rather it should enhance and improve the experience of the clinician and/or patient rather than act as an obstacle. Athena Health, a USA-based health insurance provider, emphasizes that there is no one-step solution to user experience, as what looks like an ideal solution to one provider might be the opposite for another (Foley, 2011). This emphasizes the importance of tailoring the services to the users and holding user experience as a priority for the maintenance and effective use of the technologies contributing to the value-based system.

Patient empowerment

Patient empowerment was defined as 'a multidimensional concept where communication, decision, and health care system combined together and converge in the enhancement of the patient' (Marzorati and Pravettoni, 2017). A value-based health-care system allows patients to be more involved in decisions regarding their health which leads them to feel in control and empowered (Marzorati and Pravettoni, 2017). This can be achieved by increasing patient involvement in decisions regarding their care, involvement in health-care research and freedom to provide consent for patient data to be used for research (Adler-Milstein et al, 2017). Examples of methods that may increase patient empowerment through the use of technology include allowing patients access to their patient records through an electronic patient portal and easily allowing patients to participate in research through a 'digital infrastructure' where patient consent can be obtained electronically and providers can easily communicate research opportunities to patients (Adler-Milstein et al, 2017).

Evaluating cost and value

Disintermediation of care can help lower costs, save time and improve health care. The key to disintermediation is to 'automate' some of the features of a health insurance by taking advantage of existing systems (Goldsmith, 2000). In other words, removing the third party between the patient and health care to reduce waiting times and costs, and to increase value. One example of disintermediation of care is

Continued on p. 331

Continued from p. 330

retailer-based health care made possible by the availability of digital platforms. Patients get access to health care through easy to access retailers such as CVS and Walmart in the USA. Both CVS and Walmart offer pharmacy services in their stores and are now offering in-store clinics. In addition, the retailers are looking to provide a 'holistic care approach' where patients can be advised on health behaviour such as nutrition and given a shopping list of healthy choices which they can easily obtain in the stores. This model ensures shorter waiting times, lower costs and more integrated care (Das, 2016).

The widespread adoption of such integrated digital health technologies is enabling real-time analytics of health outcomes that move from reactive to proactive care. Longitudinal data analysis allows real world data capture; use of real world evidence methods and application of advanced analytic techniques enable new means of aggregate population-wide data analysis. Value-based health-care outcomes and costs can be supported by the increasing use of 'big data', which is characterized by large amounts of data, in various formats (e.g. data from electronic health records, data from health insurance, data from wearable sensors), and data that are unable to be processed and analysed by traditional methods (Roski et al, 2014). Additionally, accumulation of such large amounts of data is allowing for new capabilities in real-time analytics. One of the real-time analytics methods, 'automated analysis' of various test results such as computed tomography scans and X-rays, has made it possible to create individualized treatment for patients according to their risk factors (Roski et al, 2014). Organizations are able to create a 'detailed risk profile' for patients, create predictive models based on patient characteristics and come up with the most cost-effective treatment with the best care outcomes using real-time analytics methods (Raghupathi and Raghupathi, 2014; Roski et al, 2014).

New payment and reimbursement schemes are incentivizing pharmaceutical companies to create alternate mechanisms for product price development. This value-based pricing enables paying for products based on the benefit they bring to the patient instead of the cost of development. In the UK, value from a pharmaceutical drug is determined using measures such as the quality-adjusted life year (Claxton et al, 2008). If a drug is able to add one quality-adjusted life year per £20 000–30 000 spent it is paid for by the NHS, anything that costs more than that is not acceptable (Claxton et al, 2008). These measures are driving pharmaceutical companies to increase value while lowering costs and are also contributing to new drug discoveries with better value.

Risks associated with increased technology integration

A health system that achieves increased capability via technology enablement must also manage issues incumbent with complex technology delivery. Increasing digitization requires significant change and project management to ensure that initiative outcomes are aligned with expectations. Considerations including long-term adoption, sustainability, scalability and privacy are also significant areas requiring oversight, as increased digital footprints create resource demands and the possibility of data breaches. The oversight of these issues is complicated in the delivery of the simplest of technology projects; in the implementation of more complex systems where there is an objective to leverage broad elements of a patient's data, skills and capabilities necessary to manage these issues are vital. With careful oversight, these risks are predictable and manageable but require continuous review to ensure mitigation.

KEY POINTS

- The complex nature of health-care systems creates a challenge for adoption of a value-based approach.
- Technology is an enabler which can provide detailed monitoring of outcomes and costs, while facilitating change in processes and delivery of care.
- Opportunities for technology to facilitate a value-based health-care system need to take into account the following trends: creating a value-enabling information technology platform, interoperability, user experience, patient empowerment, disintermediation of care and real-time analytics.

Conclusions

This article has given an overview to help understand the tools and factors associated with the use of technology for the delivery of a value-based health-care system. Adopting health-care technologies is one way of creating a value-based system. There is also a need to deploy user-centred solutions (for patients and professionals) that encourage and support new models of care. In addition, risks and challenges linked to use of technology in health care need to be taken into account to not be misled that the use of technology alone can enable a value-based health-care system. Future research should focus on identifying the most effective technologies in creating value in health care to be able to scale up and leverage the technologies in current systems. **BJHM**

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