BIG DATA AND HEALTHCARE ANALYTICS

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ABSTRACT

This paper delves into the use of mobile-based or computer-based apps for reducing patient readmission rates in the American healthcare industry. Such interventions are required for improving population health, increasing patient satisfaction, and reducing costs per capita. The aim of the quadruple aim is to simultaneously achieve its three major goals that are mentioned above. It will also investigate the concept of big data from a generalized perspective before inspecting its application in health analytics and information management systems. One potentially effective approach of introducing and marrying these two distinct concepts would involve exemplifying the adoption of digital electronic terminals in healthcare facilities. Additionally, the Quadruple Aim would be analyzed from the perspective of creating efficiency and strategic operational capacity; which is the essence of big data and health analytics.

INTRODUCTION

Continuously changing dynamics in the global healthcare industry has increased the pressure on healthcare providers and health practitioners to deliver safe and patient-centered care. Consistent or increasing readmission rates are an indication of poor and inefficient healthcare services (Berenson, Paulus, &Kalman, 2012). However, recent development in digital technology and online data management systems provide some degree of hope to the sector. Interestingly, many organizations and even some healthcare research groups are interested in the relationship between big data and healthcare analytics in the quest to improve the healthcare industry's efficiency score.

One aspect of the international community and healthcare stakeholders' intention of creating efficiency in the healthcare systems involves marrying big data into health analytics. Big data involves the creation, manipulation, management, and storage of information in either a structured or unstructured manner. The information itself may also be structured or unstructured. Consequently, researchers are studying how such data may assist organizations that acquire and create vast amounts of data to mutate it into efficiency and strategic capacity.

Health analytics involves the process of collecting data and information from the four main areas of healthcare practice and investigating it for trends, strategic potential, efficiency creation, and research purposes. Therefore, big data and healthcare analytics cannot be divorced if the healthcare sector is to benefit from such developments in the internet of things and other information technology infrastructure. However, in order to achieve any headway in such research, the healthcare's entire set of patient and organizational information must be converted to data that online devices can recognize and use.

DIGITALIZING THE HEALTHCARE INDUSTRY'S INFORMATION

The first step of converting a hospital's paper-based patient record system into an electronic one is data verification. The existing patient information has to be verified in order to make sure the conversion is not a waste of resources. Cross checking should be done in a meticulous manner to ensure all information is accurate.

The second step is data capturing and entry into the system. This process can be accomplished using photography or manual data entry (Schatz & Berlin, 2011). The system receiving the patient or medical information must have the capability of accepting data in various forms and storing it securely. It should also have the ability to capture future medical records through biometric processes or through other digital devices such as tablets and hospital computing terminals.

Once the system has received all relevant information, security capabilities must be built into its core framework to ensure only verified and acceptable personnel from the health institution or insurance service providers can access it (Shortliffe, 2013). It should also be able to keep a tamper-proof record of all personnel who accessed it and the specific tasks done or records affected in a timely log.

Considering system interoperability and integration, the future health services provider's electronic health system would also include alarm and emergency detection and reporting capacity. Fall monitors would be integrated into the call system to alert medical personnel of such emergencies. Biometric detection of health personnel accessing the system, hospital equipment and the patients' rooms would also contribute to better management and reduction of liability (Silverstein & Foster, 2013). Additionally, the incorporation of video-based monitoring processes in the surgical room to capture such detailed procedures would also enable insurance and medical personnel to identify all treatment regimens applied on a certain patient.

EXAMPLES OF THE MARRIAGE BETWEEN BIG DATA AND HEALTHCARE ANALYTICS

One aspect that demonstrates this tactical move is hospitals acquiring systems to create efficiency in their provision of healthcare services. One indicator of an efficient practice is reduced readmission rates. Accordingly, healthcare providers in the United States are experimenting different strategies to reduce readmission rates (Berenson, Paulus, &Kalman, 2012). One of the primary causes of readmission rates is the lack of patient awareness and poor

communication between patients and healthcare providers, which provoke patients to consider the option of readmission. On the other hand, technological interventions and modifications have positively affected the quality of healthcare services as well as induced innovations through medical science. Other technology healthcare services like Electronic Healthcare records have also facilitated the implementation of evidence-based and patient-centered care. For this reason, this particular business plan highlights the efficiency of phone-based and computer-based applications (apps) to reduce readmission rates of patients. Such applications are cheap to develop, and can be used to communicate with patients in real-time allowing them to take precautionary measures as well as medicine to enhance self-sufficient care.

OVERVIEW OF THE QUADRUPLE AIM

The quadruple aim has positive outcomes to overcome numerous problems in the global healthcare industry, such as nurse burnout and implement patient-centered care. The quadruple aim is based on improving patient satisfaction and population health while reducing the costs to deliver same healthcare services (Jackson et al., 2015). Accordingly, the quadruple aim helps in accomplishing the overall purpose of the healthcare industry, which is to provide patient-centered care in an efficient manner, and without hampering the interests of any stakeholders. The aim of the quadruple aim is to simultaneously achieve its three major goals that are mentioned above. In order to increase the satisfaction of the patients, it is crucial to reduce their readmission rate, and in such a way that is convenient for them and does not impose additional financial burden on them. Likewise, eliminating the reasons for patient readmission will automatically improve population health (Jackson et al., 2015). This is based on the reason that through mobile-based or computer-based apps patients will be able to induce self-sufficient care and take precautionary measures to avoid infections and side effects of medical treatment. In addition, the decreased readmission rate has also a positive impact on costs per capita in the healthcare industry. Patients' readmissions under Medicare have a financial burden of at least $17 billion on the American healthcare industry, according to a research conducted in 2009 (Berenson, Paulus, &Kalman, 2012). This means that reducing patient readmissions have also positive outcomes for reducing healthcare costs for healthcare providers as well as patients.

Also, reduced number of patient readmissions reduces work burden on nurses and health practitioners, which indirectly reduces financial burden of health providers associated with high employee turnover. Accordingly, usage of mobile-based or computer-based apps to reduce patient readmission rates is line with the context of quadruple aim.

THE QUADRUPLE AIM'S CONTRIBUTIONS TO BETTER EHR MANAGEMENT

The Quadruple Aim in healthcare reduces nurse burnout through increased ability to meet the patients' treatment needs and create job satisfaction. The approach enables the nurses and other medical personnel to gauge each patient's specific treatment needs and design the best treatment strategy. One consideration in the effective treatment of patients within the modern context of efficiency, effective patient care, and cost effectiveness is proper management of Electronic Health Records. Industrial observations and research findings collaborate on the fact that proper patient health documentation management and processing increases the health care process's efficacy while improving both the physician's and patients' experiences. Additionally, such strategic management of the important patient information and subsequent processing methods lead to cost efficiency in the long term.

Job satisfaction is an important aspect of the Quadruple Aim's process of optimizing the healthcare environment. Nurses and physicians who operate in medical environments that utilize efficient systems that optimize patient treatment, reduce fatigue, and reduce costs have demonstrated increased job satisfaction. Comparatively, medical personnel who operate in efficient operating environments characterized by inefficient electronic health record management, substandard patient experiences, and mismanaged financial management system end up both frustrated and fatigued.

RATIONALE

Globalization and internationalization of the world has induced rapid changes in the global business environment. Majority of these changes are dynamic in nature, and are unable to sustain the continuously changing global business environment. This is based on the reason that rapid technological advancements and increased flow of information has facilitated innovation-based models in all types of industries. Accordingly, improvements should be in line with technology-based solutions in order to be effective in the longer run (Jackson et al., 2015). Similarly, strategies required for reducing patient readmission rate have to consider the positive impact on reducing operational costs as well as facilitating communication. For this reason, the business plan of collaborating technology in the form of mobile-based or computer-based apps will not only reduce healthcare costs but will also improve population health due to increased flow of communication. In addition, newer generations are more tech-savvy as compared to previous generations, which further increases the effectiveness of mobile-based or computer-based apps in the longer run. Changes and innovations that reflect positive outcomes in the longer run have more chances of getting implemented throughout the industry (Jackson et al., 2015). This is because changes like Electronic Health Records take time for implementation throughout the industry, and new, improved technological interventions within the implementation phase may reduce the effectiveness of the initially recommended change.

THE QUADRUPLE AIM'S RELATIONSHIP WITH REDUCTION OF HOSPITAL READMISSIONS IN THE US HEALTHCARE SECTOR

One positive aspect of the US healthcare sector's initiative to reduce the expensive hospital readmissions is the penalty program established under the Affordable Care Act (ACA). This initiative penalizes all healthcare providers that engage in processes that cause preventable readmissions (Jackson et al., 2015). Some of the causes of such misfortune include inconsiderate or premature discharge from index hospitalizations, mismanagement of important patient information, and misappropriated in-patient stay resources caused by erroneous decision making in the Emergency department.

The Quadruple Aim relates very well to these common causes of readmission. First, proper management of the EHR and other patient records during admission, treatment, and discharge is one of the pillars of the Aim in reducing the rates of readmission in US hospitals. By adopting digitalized technology such as tablets which as mobile and fast, medical personnel could avoid errors such as premature discharge from the index hospitalization.

Additionally, improper management of patient EHR and other relevant information is easier using such tablets as part of a digitalized system as opposed to older computer terminal-based and paper-based systems. Therefore, mismanagement of such information, which is one main cause of readmission, could be reduced improving patient experience, physical job satisfaction, and costs of operation. Finally, digitalized technology such as handheld computers and tablets as part of the Quadruple Aim could reduce chances of the Emergency Department misappropriating in-patient resources and causing future readmissions.

EVIDENCE-BASED RESEARCH

Evidence-based research has become mandatory form of practice in the 21st century. This is based on the reason that evidence-based practice has positive outcomes for improved population health, and also helps in the elimination of medication errors and adverse drug events. In addition, evidence-based practice is a simultaneous application of clinical expertise, patient values and preferences, and best research evidence. Keeping in view the best research evidence for the positive impact of mobile-based or computer based apps for patient readmissions; it is revealed that the New York City-based Health Recovery Solutions found that patient readmissions were reduced by least 53%, as a result of using a tablet-based program for congestive heart failure patients (Pai, 2015). It has been concluded that scientific interventions at the patient end may reduce their readmission rates by 25% to 50% (Berenson, Paulus, &Kalman, 2012). This means that scientific changes in the healthcare industry have the capability to reduce patient readmission rates by a visible difference, which will maximize patient satisfaction, improve population health, and reduce cost per capita. Moreover, the current strategies of the United States government to reduce patient readmission rates among individuals covered under Medicare are too weak (Berenson, Paulus, &Kalman, 2012). In

addition, it has been researched that majority of the patients suffering from a chronic or cardiovascular disease are most likely to positively effect the 30-day patient readmission rates (Hines, Yu, & Randall, 2010). For this reason, some researchers are of the view that heart failure readmission rates should be the top priority area for reducing patient readmission rates (Hines, Yu, & Randall, 2010). On the other hand, there are few case studies that yielded positive outcomes for reduction in patient readmission rates. For example, tele-monitoring allows health practitioners to communicate and treat patients remotely, without their admission in a healthcare facility (Chaudhry et al., 2010). Health practitioners are of the view that it is more beneficial in the context of patient satisfaction, improved population health, and reduced cost per capita to treat patients remotely (Chaudhry et al., 2010). Accordingly, the business plan of mobile-based or computer-based apps to treat patients is in line with research evidence.

FINANCIAL ANALYSIS BASED ON EXEMPLIFIED US FIGURES

The financial analysis of devising mobile-based or computer-based apps for reducing patient readmission rates reflects extremely positive results. This is because the readmission rates accounted for more than $17 billion in additional expenses for patients covered under Medicare only. On a national level, the high patient readmission rate costs billions of dollars, this increase the costs of everyday healthcare services. For this reason, mobile-based or computer-based apps that may reduce patient readmission rates have financial returns of millions of dollars on monthly basis. Development of customized apps for each hospital or healthcare facility will require setting up an in-house IT team, with no more than 5 individuals. A startup cost of around $100,000 is expected due to the IT equipment required and for paying IT professionals. In addition, advance payment can be easily asked from clients willing to use mobile-based or computer-based apps for reducing patient readmission rate at their facilities. One-time costs, in addition to annual maintenance costs, will be charged from the clients.

FINANCIAL IMPLICATIONS OF THE QUADRUPLE AIM IN ITS OBJECTIVES OF REDUCING PATIENT READMISSIONS

Based on the need to implement a digitalized technological system according to the Quadruple Aim, the process of implementation would need some distinct parameters. These could be the betterment of EGR and patient data, improvement of physician job satisfaction though access to all necessary teams and patient data, and intended reduction in costs of operations. All these parameters would be governed by the overall need to reduce patient readmissions which cost the US economy US $17 billion annually.

Implementation of the digital system relies on existing infrastructure meaning a lot of the innovation would be software-based. While some healthcare providers may require purchasing tablets and other relevant hand-held computing and internet-capable devices, most of the innovation would rely in applications and software upgrades. One consideration that makes the implementation of such a system in the course of achieving the reduced readmission rate objective sensible is the low relative cost of software. Compared to the billions lost through preventable hospital readmissions, software and tablets that cost hundreds of thousands of dollars, or system upgrades and implementations that cost millions of dollars makes long-term financial sense (Jackson et al., 2015). Additionally, the reduction in preventable readmissions, improved physician job satisfaction, and modernization of the EHR infrastructure provide much needed improvements in the US health sector.

HOW BIG DATA HAS BECOME A NECESSITY IN THE MEDICAL INDUSTRY

While big data accounts for a large percentage of the developments health analytics is currently making, many may argue its overall importance in the medical sector. Many individuals as well as organizations involved in the research endeavor to establish the importance of big data in health analytics and the healthcare industry concur on its importance (Cottler, 2011). Significant organization such as the American College of Cardiology and the Healthcare Information and Management Systems Society agree that big data will play a major role in the coming decades in terms of augmenting the providence and management of healthcare in the world.

Perhaps the best approach to understanding how big data is becoming a medical necessity is looking at the role it plays in the four segments of the healthcare analytics practice. First, big data seems to be growing as a necessity for an efficient and effective claim and cost data practice. Healthcare without an effective cost management practice could never achieve the level of efficiency needed to make things work the growing global population relative to reduced resources (Greener, Harrington& Hunter, 2014). One way that big data is making things more efficient in this regard is the healthcare information management system. Modern developments in big data have led to better data collection, capturing, management, and storage systems. Such strategies not only reduce readmission as earlier discussed, they assist patients manage their health care costs more effectively. Insurance and reimbursements are also important parts of the process of streamlining the providence of healthcare services. Big data developments make collection and management of healthcare related information more accurately possible (Li & Hoang, 2016). Such practices make for better healthcare management tactics that reduce the occurrence of fraud in the insurance sector as well as inefficiency in the health insurance industry.

Another part of the medical industry where big data is making its mark as demonstrated by healthcare analytics is pharmaceutical, research and development data. The pharmaceutical sector of the medical industry relies heavily on feedback from the users of medical drugs and their prescription personnel. Through social media avenues, on-site feedback systems, doctor hand-held devices, and manufacturing company organizational data storage, big data is able to identify which drugs are in short supply, which ones have adverse side effects, and which ones need to be adjusted due to mutations and changes in the pathogens (Li & Hoang, 2016). Similarly, research and development in the medical field relies a lot on feedback making big data a priceless asset. In every aspect of a communications feedback loop, medical research and development relies on to-and-fro exchanges between patients, medical research organization, research personnel, and educational institutions. Big data enables not only the collection of such information in terms of research findings, but their analysis by simulation computing systems, artificial intelligence analysis systems, and storage infrastructure. The development of most modern vaccines, emergency medical tissue, and drugs could not be as efficient without big data and health analytics.

Clinical data relates to all information given voluntarily or involuntarily by the patient to a certified and qualified medical professional for the sake of treatment and healthcare management. The manner in which such information and data is collected, managed, and stored has been a major influence to the effectiveness of modern medicine. Consequently, modern integrated systems referred to as Electronic Health and Medical Information Management and Recording Systems have been created to enable this process (Li & Hoang, 2016). However, without big data, such systems could not serve their purpose. They rely on supporting infrastructure such as hand-held digital devices such as tablets, palm-top computers, and smart phones as well as digital medical systems connected to the internet of all things. These devices may be imaging equipment, life support systems, laparoscopic surgical equipment, dental surgery and imaging equipment and such. Therefore, one cannot fail to see the link between these online devices, the supporting electronic healthcare information management system, and big data.

Patient behavior and healthcare sentiment data is the fourth part of the healthcare analytics practice. Patient behavior refers to the trends in patients when choosing medical services providers and their products. Big data plays an important role in this part of healthcare analytics in a manner similar to that of marketing information to the marketing department of a business organization (Greener, Harrington& Hunter, 2014). Healthcare sentiment on the other hand refers to the feedback that healthcare service providers and product manufacturers generate in the patient's mind or that of other stakeholders. Big data is an important part of the process of taping into this sentiment and understanding the needs and desires of all stakeholders within the healthcare industry.

CONCLUSION

While big data obviously continues to play a big role in the development of healthcare reform such as efficient healthcare analytics, the supporting technology is still under development. Until sufficient developments are made in fields such as machine learning, artificial intelligence, and neural networks, this relationship cannot serve its full potential.

However, current trends in the healthcare sector in areas such as claims management, reduced readmission rates, increased customer satisfaction, better research methodology, and the all-important Electronic Healthcare Record System/Infrastructure owe their existence to the growing relationship between big data and healthcare analytics. Indeed, big data is the new age medical necessity.

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