Review Article

Impact of Clinical Decision Support Systems (CDSS) on Health Outcomes Improvement

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ABSTRACT

The inculcation of information technology into healthcare delivery has impacted all arenas from population health to financial and administrative management. It has proven to be a valuable tool in today's very complicated and diverse health environment. This paper explores various publications (Research, Opinions, and Articles) on the impact of decision systems on different aspects of healthcare, especially patient safety. Furthermore, it goes into details of how data inculcation in support systems can impact health processes in reducing the cost associated with care provision in the United States. The papers evaluated in this paper all provide different perspectives on how CDSS are changing healthcare and how to utilize them effectively and efficiently in achieving organizational goals. In a recent article published in Harvard Business Review on the impact of Big Data on healthcare, 63 percent of industry professionals have seen some effect on population health and 60 percent believe it has one way or another impacted preventive care. These valuable data assimilation with CDSS would have a positive impact on outcome research. As more technology are incorporated into healthcare activities and processes, the potential for changes in approach and benefit will continue to evolve.

Key words: Big Data, Clinical Decision Support Systems (CDSS), Data Analytics, Healthcare, Preventive medicine, Cost.

INTRODUCTION

Technological advancement in recent years has played a crucial role in aiding healthcare organizations in all aspects. Data analytics, utilization of "big data" and cloud computing have played a vital role in advancing and integration of Clinical Decision Support Systems (CDSS). The usage of these tools is aimed at aiding organizations to gain the upper hand in improving care quality as well as utilizing cost-saving approaches in care provision. Decision Support Systems as a tool has been very helpful in aiding organizations to gain a better understanding of specific trends and dynamics relating to medical conditions. This valuable tool has been utilized in practical applications for improving care as well as assimilating changes in the healthcare arena.

Patient information or data collection is a problem of the past, the main obstacle in recent years has the necessary tools to evaluate available data.

The utilization of health information exchanges and creation of governance standards has the potentials to aid health organizations in improving care quality. Quality care provision has been hindered in many communities across the United States for many reasons; these include mismanagement, financial constraints, poor research and lack of active patient participation or contribution to care in general. Recent publications indicate a growing trend in utilization of CDSS in the

quest of improving diverse areas of care delivery. In the expedition of understanding the impact of biomedical informatics and CDSS on health care systems, one needs to consider various fields such as demographics, finance, regulations, policies, and politics among many others.

Background

Clinical Decision Support Systems (CDSS) is a tool designed to assist physicians in healthcare decision making processes. It has been a valuable tool in clinical settings over the years. It continues to play a vital role in a clinical environment from disease prevention to drug interactions. Changes in healthcare law, as well as the need to improve quality of care, have been the encouragement of inculcation of CDSS within healthcare organizations.

This research aims to evaluate the impact of CDSS in diverse aspects of healthcare.

The avenues, approaches as well as specific tools that have proven effective/ ineffective in the healthcare arena will also be accessed.

MATERIALS AND METHODS

A review of recent publications (2000-2016) relating to CDSS from various databases was evaluated. Health Providers perspective and publication on the impact of CDSS will also be compared with the outcomes of published researchers.

The implementation processes reported in various publications for both successful and unsuccessful CDSS implementation will be analyzed.

RESULTS

The clinical decision supports systems are currently being utilized in almost every aspect of care delivery from medication contraindication checks to hospital inpatient cost-effective management. It is increasingly being used for administrative and management purposes and health outcome improvement. The section below provides details of how

CDSS is being utilized in the healthcare system today.

Hospitals and Healthcare Organizations

Rapid changes in healthcare delivery dynamics, as well as the astronomical cost associated with care, are at a point never seen before. Even though these dynamics are very complicated, there are tools available for exploring ways of addressing the problems facing healthcare delivery today. The ability to rapidly analyze structured and unstructured data set is improving patient care and is making substantial clinical significance to patients. [1] Such findings support the notion of efficient data management and positive outcomes in health care deliveries. Data analytics have made it possible for healthcare providers, epidemiologist, and infectious disease specialists gain reliable information in warding off potential problems before they cause serious problems. Exhibit 1 Below provides one with a general overview of the amount that could be saved with the implementation of CDSS.

Medication

In a recent publication in the Journal of patient safety, it was estimated that the number of individuals that suffer some preventable harm is between 210,000 to 400,000 each year. [2] Of these cases, the majority were about drugs and contraindications which have been shown as the significant reason for inpatient death. [3,4] CDSS plays a considerable role if inculcated adequately into the process of care as demonstrated by many researchers. [5] CDSS could serve as warning mechanisms when there are contraindications as well and any drug interactions as observed with many reports published by the FDA. Such arrangements will call on the administers of medications to be more cautious in executing their responsibilities.
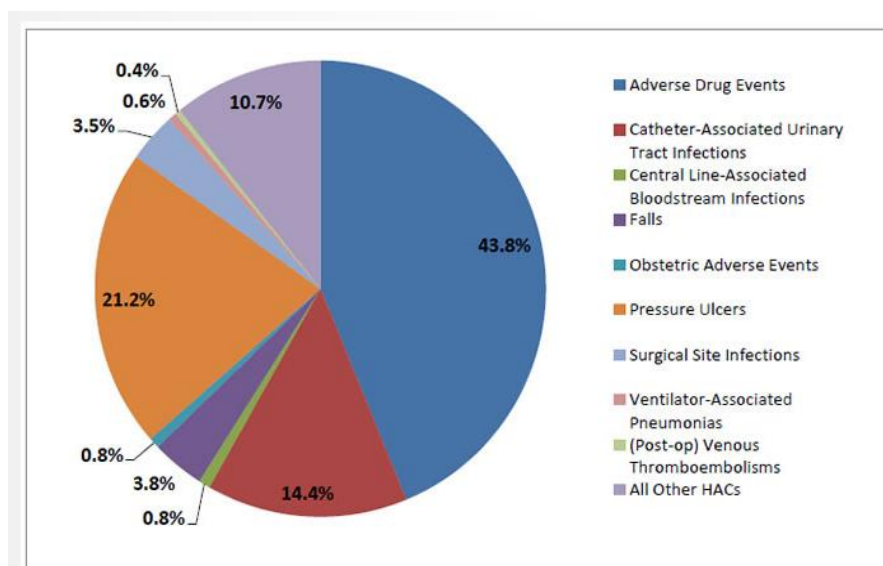
Exhibit 1. Source; AHRQ National Scorecard Estimates from Medicare Patient Safety Monitoring System, National Healthcare Safety Network, and Healthcare Cost and Utilization Project.

Clinical decision support systems help in prevention processes presentation such as thromboembolism over the study period; [6] the above statement further supports the fact that CDSS has a positive impact on diverse areas of care provision. Decision support systems aid in diagnosis and serves and reliable alert mechanisms to remind providers of standards on all levels of the care processes. The outcomes of such analytics have proven to be vital in diverse areas of care provision. For instance, health monitors provision of up to date information on patient physiological signs have revolutionized the approach to cardiac care; research by Castellano et al. indicates how practical such an approach is in cardiac care. [7] Such tools have aided in analyzing and gaining a better understanding of patient needs and hence tailoring of the medical plan. In the current environment, the utilization data through DSS from diverse sources and understanding trends on local, regional and national levels would evolve our approach to care. Below is a depiction of the prevalence of error in healthcare and demographics.
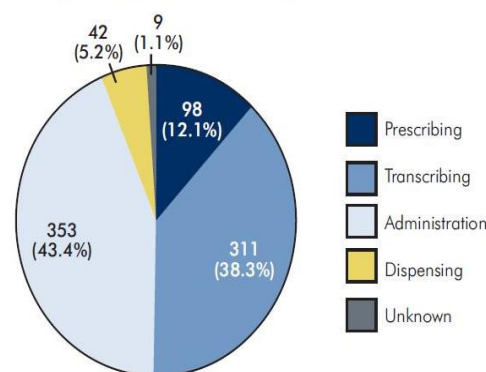

Exhibit 2. Source: Pennsylvania Patient Safety Advisory (2013)

Administrative

The McKinsey Global Institute estimated that excess spending on health administration and insurance accounted for as much as 21 percent of the estimated total excess spending ($477 billion in 2003). Brought forward, that 21 percent of excess spending on administration would amount to about $120 billion in 2006 and about $150 billion in 2008. [8] The above statement summarizes the impact of this arena in the process of care. The reason many healthcare facilities need much administrative staff could be answered when one takes a look at insurance policies and requirements. A study conducted by the Centers for Medicare and Medicaid found

an estimated 14 percent of healthcare expenditures goes toward administrative costs. [9,8] Analytic tools are available in aiding healthcare organization cut cost and create effective mechanisms for billing and insurance data collection. Moreover, these tools could assist in establishing a level platform for fair prices for consumers and better consumer intelligence for insurance companies. A clear understanding of data and its efficient utilization would play a substantial role in addressing many issues encountered in healthcare from an administrative point of view.

In the health sector, there is an extensive administrative component that is crucial for effective management of healthcare facilities.

Patients encounter administrative staff from the time of admission to discharge. Mistakes in the triage stage and initial presentation could profoundly affect the approach and manner of treatment. Furthermore, it directly impacts the financial aspect of cost and becomes a burden to patients and in many cases healthcare facilities as well. Decision systems implementation within these facilities could eliminate such issues. Such systems would ensure the proper patient record is maintained by a dual process where patients and administrative staff input information into an EHR system. The CDSS system would them aid in verification and picking up discrepancies or mismatch between these submissions. Such a tool would assist in eliminating medication errors and procedural administration as mentioned. The factors that affect the higher administrative costs are diverse, and decision support systems will aid in dressing some of the issue relating the increasingly high cost. [10]

Population Health

The United States has been spending increasingly more on healthcare than anticipated over the years. This among many other factors is directly encouraging more individuals and stakeholders to evaluate the impact big data could have on finding ways to address population health. "Big data" utilizes information provided by patients themselves; this empowers individuals in taking active roles in care approaches. For example, data used by big data could help individuals tailor diet, exercise, and other lifestyle modifications; healthcare has traditionally been delivered on a one-on-one approach to chronic disease management. [11] These aids all providers caring for a particular patient coordinate their strategy and hence better outcome of individualized care and the general population as a whole. Such statistics and information have been shown to be useful in evaluating the general population on tailoring health strategies.

Greenville Health System implemented a program to monitor and aid in controlling hospital-acquired infections; the study provided information that was better than other means of measurement utilized at their facilities before. Utilization of such tool in diverse areas of population health has proven to be vital in addressing hospital problems such as acquired infections or conditions. Tools such as Collaborative Assessments and Recommendation Engine (CARE) developed by a researcher at the University of Notre Dame that evaluate patients similarities and make risk suggestions for provider evaluations could be utilized as an early detection tool for specific diseases and medical presentations. This predictive diagnostic approach provides information promptly for stakeholders and individuals to allocate resources and make changes or seek consultations to address arising issues. Huang et al. published a community based infectious disease study in rural China; the study looked at individual factors affecting the prevalence of hepatitis. [12] The outcome of the study can provide one with a perspective on how big data can have a huge role in making such investigations more streamline.

Life expectancy has been increasing over the years; many factors contribute to this including advanced health approaches

and medical technologies. As the elderly population in the United States grows so will the need for strategic healthcare delivery to individuals above 65 years old. This age group undoubtedly spends more on healthcare than any other, and this is likely to continue; the lack of understanding for aged care is essential for long-term viability of the sector. [13] Data analytics provides us with vital information on tailoring and allocating resources to specific areas where these populations would need those most. This would eliminate substantial steps in the process of diagnosis and care provision; furthermore, it would aid in improving the quality of care provided to this population.

Preventive Medicine

Data has aided many organization predicts specific dynamics based on several factors; this has then assisted in planning and development of effective strategies for combating diseases or outbreaks. For example, the creation of module that aids in finding various dynamics associated with disease has proven to be useful in assisting in solution finding processes. A clear indication of such application is in the case and approach to tackling epidemics such as Ebola. [14] Just as this model aided in gaining a better understanding of the potential ways of the spread of disease, the practical strategies of halting and preparation could be created from such information. In the outbreak of Ebola in West-Africa, affected nations were not ready for the rapid spread; they also did not have adequate resources or better understanding of the disease. All these vital information could have changed the dynamics we still see today in West-Africa and other parts as in regards to Ebola and other medical conditions.

A recent study published by Ram et al. on predicting asthma-related emergency admissions further support the impact "big data" can have on studying disease trajectory. [15] One can see the direct effect of social media in understanding and prepare for medical presentations in the healthcare system. A recently published paper by Olsen et al. utilized pediatric health information database as a means of gaining information in tailoring surveillance for travel associated infectious diseases; the PHIS database offered several strength and surveillance tools that produced meaningful results for understanding pediatric health characteristics. [16] These examples further serve as proof of the effectiveness of data and CDSS or biomedical informatics in general in directing and devising protocols for specific medical issues.

DISCUSSION

There have been tremendous healthcare resources input into health information systems including CDSS. The outcome of this literature review will likely show a positive or negative trend based on certain approaches taken by researchers in implementing and utilization of CDSS. Gaining a thorough understanding of practical, viable implementation and outcome approaches would pave the way for decreasing healthcare cost and improving care quality. Furthermore, this research has the potential of highlighting various positives and negatives about adopting and implementing one CDSS compared to another.

As the cost of care increases in the United States so will difficulty to access affordable healthcare for a significant part of the population. The utilization of decision support systems (CDSS) as part of electronic health systems is imperative in achieving the goal of reaching patient and providing quality care. Furthermore, such systems would aid in improving outcome and ease of research for continuous improvement in the approaches to care as shown by many of the studies. Another critical aspect of healthcare in the United States is the rising administrative cost that directly and indirectly affects patient's affordability. Decision support systems could aid in eliminating some of these costs as well as prevent clerical errors within the healthcare system.

CONCLUSION

Healthcare delivery continues to change as needed based on several factors including legislation, technological advancements, and changes in medical protocol among many others. Biomedical informatics is at the forefront of these changes; it is imperative for all aspects of the healthcare industry to adequately understand the potential of this valuable asset. Biomedical informatics with inculcation of CDSS provides health professionals with a valuable resource in studying all aspects of healthcare; it also offers many answers relevant to addressing issues such as outbreaks and demographics. Furthermore, CDSS serves as a reliable means controlling management, medication and administrative activities. The main problem or concern of many stakeholders with regards to CDSS is physician or provider input; the proper utilization and inculcation of valuable data only aid providers make a better decision as shown in many studies mentioned above.

There is a need for continuous discussion and public education by healthcare organizations on how informatics and tools could revolutionize care approaches. Furthermore, a thorough explanation and assurance of the protection of patient information need to be made to gain more public trust on this issue. This paper provides a general overview of how informatics could be utilized in all aspects of healthcare to meet organizational goals as well as a general goal of improving care quality and cost. From the review of various studies and publications, it is evident that there is the active application of biomedical informatics and CDSS in healthcare. As mentioned above, the dynamics and approaches to care are evolving; the manner in which the healthcare organizations utilize information available to them will have a significant influence of what the future of healthcare will look like. It is therefore imperative for us to invest in continuing education in the field of biomedical informatics to improve all aspects of care delivery.

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