Chapter 18
The Benefits of Big Data Analytics in the Healthcare Sector:
What Are They and Who Benefits?

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ABSTRACT

The benefits of big data analytics in the healthcare sector are assumed to be substantial, and early proponents have been very enthusiastic (Chen, Chiang, & Storey, 2012), but little research has been carried out to confirm just what those benefits are, and to whom they accrue (Bollier, 2010). This chapter presents an overview of existing literature that demonstrates quantifiable, measurable benefits of big data analytics, confirmed by researchers across a variety of healthcare disciplines. The chapter examines aspects of clinical operations in healthcare including Cost Effectiveness Research (CER), Clinical Decision Support Systems (CDS), Remote Patient Monitoring (RPM), Personalized Medicine (PM), as well as several public health initiatives. This examination is in the context of searching for the benefits described resulting from the deployment of big data analytics. Results indicate the principle benefits are delivered in terms of improved outcomes for patients and lower costs for healthcare providers.

INTRODUCTION

Biomedical informatics is the science of information applied to medicine and is "distinct from related fields like computer science, statistics and biomedicine, which have different objects of study"(Bernstam, Smith, & Johnson, 2010). Biomedical informatics incorporates a "core set of methodologies for managing data, information and knowledge" (Sarkar, 2010) with the goal of "improving the quality and safety of healthcare while reducing the costs" (Hersh, 2009).

Advances in biomedical informatics have been proceeding at an astonishing pace, with some no-

DOI: 10.4018/978-1-4666-6611-5.ch018

table successes and some equally notable setbacks. The following chapter offers a comprehensive review of what benefits, and what drawbacks, current research into the application of big data analytics to healthcare and biomedical engineering have revealed, in an effort to guide further research and to understand more clearly what benefits arise where big data intersects with healthcare, and to whom those benefits accrue.

According to a McKinsey report (2011) on the potential financial savings to be harvested from big data analytics, healthcare is particularly rich in opportunity. Clinical operations, payment and pricing, R&D, public health and new business models all have the potential to benefit from the analysis of large sets of data. Preliminary investigation reveals that there have been many documented, quantified gains that accumulate to improve physician performance, provide better guidance for treatment, dramatically improve patient outcomes and significantly lower costs for hospitals, insurers and co-payees.

The looming demographic shift in the United States and other developed nations portends health care costs that will consume a significant portion of national budgets in the years to come, and delivering better health care to more people for less cost will be a critical policy issue (Ahern, Smith, Topol, Mack, & Fitzgerald, 2013; Bloom, Börsch-Supan, McGee, & Seike, 2012; Morton & Weng, 2013; Vogeli et al., 2007).

BACKGROUND

What is Big Data?

In general, we can define big data as pools of information so large that conventional analytical techniques cannot make sense of them (Bertot, Jaeger, & Grimes, 2010). In a very real sense, the definition is a moving target. As our capacity to store information increases and techniques to analyze that data continue to develop and improve, the amounts of data that constitute big are similarly changing (see Figure 1). Since launching the National Archives and Records Administration in 2005 (Sproull & Eisenberg, 2005), the amount of information in the form of archival records the US government is managing has grown from 17 terabytes (TB) to 142 TB as of 2012, representing over 7 billion electronic artifacts, a number that is projected to continue to grow (Reed, Murray, & Jacobson, 2013).

Two important characteristics distinguish big data from ordinary data:

1. The efficacy of standard analytical techniques
2. The dynamic nature of the analysis.

Figure 1. Virtual storage terms and definitions

1 bit = binary digit

8 bits = 1 byte

1024 bytes = 1 kilobyte

1024 kilobytes = 1 megabyte

1024 megabytes = 1 gigabyte

1024 gigabytes = terabyte

1024 terabytes = 1 petabyte

1024 petabytes = 1 exabyte

1024 exabytes = 1 zettabyte

1024 zettabytes = 1 yottabyte

1024 yottabytes = 1 brontobyte

1024 brontobytes = 1 geopbyte

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