

Big Data, Big Problems

Incorporating Mission, Values, and Culture in Provider Affiliations

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KEYWORDS

- Big data • Comparative effectiveness • Orthopedics • Total joint arthroplasty
- Administrative database • Clinical database

KEY POINTS

- Big data refers to electronic health data sets so large and diverse that they cannot be easily managed with traditional software.
- Orthopedic data are often reported in five broad measures: structural, process, outcome, patient experience, and efficiency.
- On selection of electronic health record (EHR) systems, orthopedic surgeons must consider the capability of an EHR to ensure data quality, interoperability, and assistance at point of musculoskeletal care.

INTRODUCTION

Among the more compelling trends in health care is the rising use of big data. Driven by health care reform and efforts to improve delivery of care by cost-effective means, immense quantities of data (“big data”) are being collected over extensive periods of time.¹ These initiatives support wide ranges of health care function, such as population health management and clinical decision support (CDS).^{2,3} By definition, big data refers to electronic health data sets so large and diverse that they cannot be easily managed with traditional software.⁴ Inputs from clinical support systems, patient health records, sensor data, and patient-specific variables all contribute to big data in the health care industry.⁴ As such, big data enables regulatory

agencies to assess the performance of organizations, while allowing communities to understand specific population patterns and needs.

For health care providers amidst such complexity lies the opportunity to use big data to aid in assessment of practice patterns and predict future needs.⁴ At a macro level, governmental and organizational leadership have acquired the ability to assess performance maximization with use of big data analytics.^{5,6} Such evaluation will continue to grow, because it is reported that big data for US health care will soon reach to yottabytes (10²⁴ gigabytes) in size.⁷ Furthermore, efforts have been made to integrate computer technology, mobile applications, and electronic health record (EHR) software to store and track data.^{5,6} These inputs, collectively termed health information technology, have

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added to more than 120 patient registries either being developed or in operation.⁸ This exponential rise in big data initiatives draws the question of whether big data is truly an asset, at the grandeur often promoted for a new capability, for meeting needs within a host of more real-time and granular realities.

Despite the intentions of big data initiatives, some argue that for the past several decades improved health care delivery to patients has been limited, that health care reform has added little value to patient care.⁹ In part, the challenge results from the fact that the types of the data being collected are without proper context and compare outcomes over extended time periods. This purpose contrasts with the information needs of surgeons and patients in real-time. Within the orthopedic community use of big data analytics may allow surgeons to reach a deeper understanding of outcomes that can be applied at the point of musculoskeletal care. Specific population data may determine appropriate treatment options for particular patients, enhancing the decision-making process.

This article explores how integration of data from clinical registries and EHRs produces a quality impact within orthopedic practices. We differentiate data from information, and define several types of data that are collected and used in orthopedic outcome measurement. Furthermore, we assess the concept of comparative effectiveness and its impact on orthopedic clinical research. This article also places emphasis on how the concept of big data produces health care challenges balanced with benefits that may be faced by patients and orthopedic surgeons. Finally, we review essential characteristics of an EHR that interlinks musculoskeletal care and big data initiatives.

DIFFERENTIATING DATA AND INFORMATION

A large driver behind big data initiatives is the nationwide shift from a volume-based to value-based health care system.⁹ Adding value to musculoskeletal care cannot avoid collection and reporting of cost and quality information of orthopedic procedures.¹⁰ This perspective has lent toward objectifying value assessment by health outcomes per dollar spent.^{10,11} Thus, within the past decade an increasing tendency is noted toward public reporting of outcomes-based performance measures.¹² Consequently, it has become imperative for hospitals, providers, and patients to differentiate data from information. Data are simply the building blocks

by which information is built, whereas information gives data meaning and context.¹³ In some discussions data are raw, and have not been molded into information.¹³ Information gathered from such data may be used clinically, to aid in treatment of patients; administratively, to charge a patient or insurance party; and macroscopically, to analyze trends between hospitals or the competency of clinicians. Until data are rendered to generate information, they do not provide answers, or aid in clinical decision-making.¹³

TYPES OF DATA COLLECTED AND A BRIEF OVERVIEW OF LARGE DATASETS

Several types of data continue to be collected nationwide. Marjoua and colleagues¹⁰ demonstrate that orthopedic data are often reported in five broad measures: (1) structural, (2) process, (3) outcome, (4) patient experience, and (5) efficiency. **Table 1** provides definitions and examples of these types of measures.¹⁰ Such data are recorded in clinical databases that come in two forms: administrative databases and clinical registries. Administrative databases store insurance claims and reimbursement data, whereas clinical databases collect data specific to a disease process or procedure.^{14,15} The federal government afforded early efforts at reducing health care costs and driving outcomes research primarily focused on large administrative claims data.

These administrative datasets have been updated and maintained by the Centers for Medicare and Medicaid services and the Agency for Healthcare and Research Quality.^{14,15} The Agency for Healthcare and Research Quality is a federal agency charged with collecting and analyzing in-hospital outcomes and resource utilization trends nationally. Interestingly, federally curated datasets have been primarily used to report epidemiologic resource utilization analyses. Furthermore, claims data are limited in that they do not capture information on patient comorbidities, disease severity, conditions present during admission, patient satisfaction, and socioeconomic factors.^{14,15} Currently there are several databases available for the evaluation of administrative variables, with the ones most frequently used in orthopedics being the Medicare claims dataset, National Inpatient Sample, and Kid's Inpatient Database.^{14,15} The Medicare claims dataset is the most comprehensive database for inpatient and outpatient claims, with greater than 45 million identifiable patient samples.^{14,15} Although highly powered, the dataset

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