Trigger Criteria: Big Data

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KEYWORDS

• Rapid response system • Monitoring • Risk prediction • Deterioration

KEY POINTS

- The US health care system is rapidly adopting electronic medical records (EMRs). The capability to analyze a huge amount of clinical data during a care episode will dramatically increase.
- Existing analytical techniques can be applied to enable better prediction of outcomes, which can be applied to the point-of-care decision-making process.
- This change will occur in the near future.
- Aggregate warning systems for imminent death using vital sign abnormalities are now being combined with so-called big data derived from the EMR, offering a great opportunity to detect and respond to the clinical changes that precede clinical deterioration and rapid response team activation.

INTRODUCTION

The US health care system is rapidly adopting electronic medical records (EMRs) and this will dramatically increase the quantity of clinical data available for sophisticated analysis during inpatient and outpatient care. Outpatient information that is becoming routinely available includes notifications of when patients fill their prescriptions and when they use their devices, such as an inhaler for asthma or chronic obstructive pulmonary disease, and noninvasive positive pressure ventilators for obstructive sleep apnea, as well as compliance with follow-up in outpatient clinics. Inpatient data include recent laboratory tests, imaging, vital sign monitoring with continuous electrocardiogram, carbon dioxide monitoring, pulse oximeters, and motion sensors that will monitor respiratory patterns and change in pulse. An integrated approach to analyzing this information creates the opportunity to improve health care quality, distribute resources adequately, and decrease cost. The types and quantity of information

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available and the ability to analyze it in ways that can affect patient management in real time are referred to as big data.

In 2012, big data was described as "large volumes of high velocity, complex and variable data that requires advanced techniques and technologies to enable the capture, storage, distribution, management and analysis of the information."[1] Existing analytical techniques can be applied to the vast amount of existing patient-related health and medical data to reach a deeper understanding of outcomes, which can be applied to point-of-care management and assist physicians and their patients during the decision-making process and help determine the most appropriate treatment option. Numerous questions can be addressed with big data analytics and the potential benefits include detecting diseases at earlier stages, managing specific individual and population health, and detecting health care fraud more quickly and efficiently.[2] Additionally, the McKinsey Global Institute estimates that big data analytics can generate more than $300 billion in savings in US health care through reduction of waste and inefficiency in clinical operations, research, and development.[3]

There are several opportunities to use big data to improve the quality of health care and decrease health care costs.[4] Some of these uses include

- Identification of high-cost patients
- Identification of patients at risk for readmission
- Triage of resources and estimation of the risk of complications for patients admitted to the hospital
- Early detection of clinical deterioration
- Identification of patients at risk for adverse effects from medications or treatment
- Identification and treatment optimization for diseases affecting multiple organs.

The applications of analysis of big data in health care are not limited to these examples. This is just the beginning of the growing list of benefits of data analysis in health care.

This article describes the potential impact of big data analysis on risk stratification and early detection of serious deterioration, including death. Although the application of big data analysis can affect care for a wide variety of syndromes and treatment modalities, this article focuses on the relationship between the ability to analyze huge data sets to identify and predict deterioration with the occurrence of clinical deterioration requiring a rapid response team (RRT) activation.

BIG DATA IN THE HOSPITAL WARDS

Sudden decompensation leading to cardiac arrest and death occurs uncommonly in hospital wards, affecting only about 1% of patients outside the intensive care unit (ICU). As much as 80% of cardiopulmonary arrests are preceded by prolonged periods of physiologic and clinical instability.[5] These signs may be present up to 24 hours before a serious clinical event requiring intensive interventions.[6] There are 2 approaches to determining when a crisis occurs that can be used as triggers for calling the RRT. The first is the single-parameter system. In this system, any single abnormal vital sign value that is out of bounds is sufficient for the rapid response system (RRS) to be activated. Although single-parameter systems have lower sensitivity and specificity than multiple-parameter and weighted systems, they are very easy to teach and implement. The other approach is to use an aggregate weighted scoring system (AWSS), the most common form of which is the early warning score (EWS) system and its many variants. EWS systems have been developed with the aim of identifying clinical deterioration early, have been recommended by the National Institution of Health and