Big Data Analytic, Big Step for Patient Management and Care in Puerto Rico

During the last decades, the United States of America (US) health care system have been criticized for not doing enough to contain costs, showing an unsustainable projected trajectory that has led to increase the value of health care nearly twice that in most other developed countries (1). And Puerto Rico has follow its pattern, where health cost has constantly increased and has been available to a few number of the population.

One of the key facets of the US health reform has been the adoption of electronic health records with the purpose of increasing health care providers' access to patients' record and offers the potential for cost savings. Moreover, the rapid growth of electronic health records in US have made possible the access to unprecedented amounts of clinical data that are available electronically to be used to answer clinical questions (2). This collection of high volume, variety, and potential for rapid accumulation of data and analytics is what many experts have been called big data. Big data sets can be then subjected to different software tools that allow for stratification of risk to predict an outcome or the natural history of a disease. These predictive analytics tools link data from multiple sources, including clinical, genetic and genomic, outcomes, claims, and social and economic data with the purpose of achieving clinical predictive outcome (Figure 1).

In a recent visit of the author to Stanford University Hospitals, he joined to the clinical informatics fellows to get a sense of how informatics has been integrated to the care and management of their patients. A currently Stanford pilot project address the

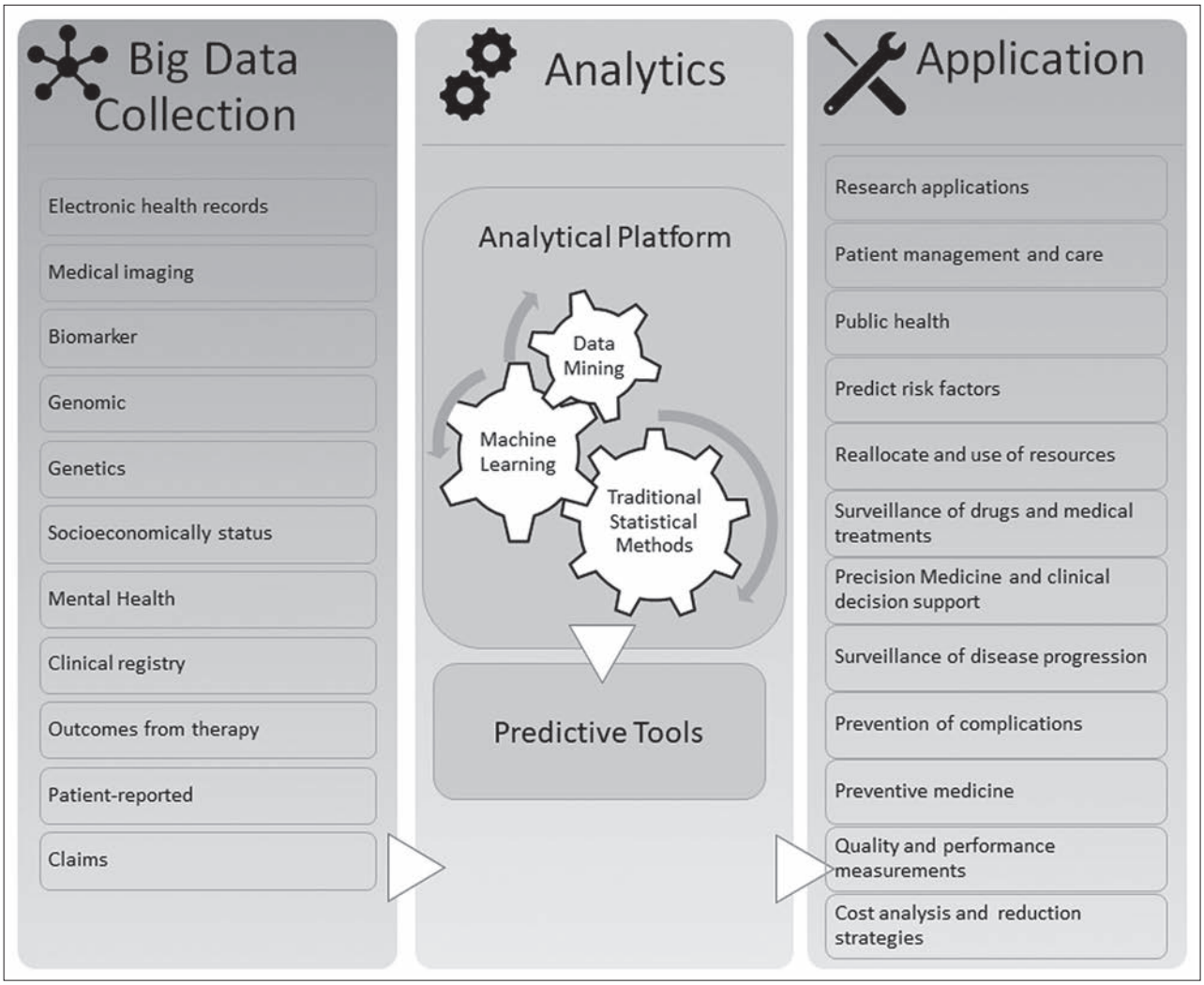

Figure 1. Big data analytic collects multiple inputs (data source) and processed it with predictive analytic tools to make most effective informing health care decisions that can potentially improve quality and outcomes of care.

problem of efficiently identified decompensated inpatients. The standard protocol may be to monitor patient's vital signs and alarm is turned on when any parameter value gets outside of a predetermined range. The problem with this approach is that the specificity is low, giving many false positives, which constantly turn on an alert. As a result, with the time these alarms are tending to be ignored by the healthcare personal or in the better of the cases elicit a slow response by health care worker. Therefore, current efforts in Stanford's Hospital consist on scrutinizes big data sets from their inpatients to find new monitor parameters that can be used to predict whether the patient is a risk for decompensating. Moreover, they are also considering to integrated devices that sits under the mattress and that collect data about: respiratory rate, pulse and movement. The data is then transmitted to a server, where it is analyzed with predictive tools to determine if the patient is likely to be decompensated. When the system detects a likely decompensation, an email or message is send to the corresponding on-duty health care worker's smartphone.

Integrating predictive algorithms into clinical work flow can also be useful for estimating the risk of complications of patients to be admitted, such that managing staffing and bed resources can be efficiently relocated. In a second pilot project, clinicians at Stanford are scrutinizing hundredths of patient records to come with a severity-illness score for adults at risk of sepsis. This score to be calculated in real time, is combined with trends in vital sings, and other information, such as how long the patient has been in the hospital. If the information collectively indicates that a patient has a risk of deteriorating greater than a predetermined value in the next few hours, an alert is sent to the responsible providers. In other intent to reduce the number of complications of their patient after a major surgery, such as pneumonia, wound infections or pressure ulcers; clinicians at Stanford are using predictive tools obtained from big data analytics to anticipate the need for a transfer to an appropriate unit, and informing overall strategy for managing the patient.

Big data analytics have the potential to predict with substantial accuracy which patient may suffer an adverse event (including renal failure, infection and adverse drug events) by assessing genetic and genomic information, laboratory data, information from vital signs, and other data. Prevention of adverse events represent a significant way to improve care while reducing costs, since these adverse events occur frequently and are cause of substantial morbidity and mortality.

Nowadays, the ability of caregiver to manage chronic conditions that span more than one organ system, such as autoimmune disorders, hematological, immunological, or neurologic manifestations, is limited by the complexities resulting from the heterogeneity in clinical phenotypes, the diversity of available measurements, and lack of high-precision markers. Predictive tool derived from big data analytics can combine the multitude of measurements taken as part of routine care to infer the progression of a patient's disease and tailor treatments to that patient.

Big data analytic represents an approach by which organizations can obtain new algorithms, assessment scores, and registries to implement changes that will improve care and outcome. Although, the potential for big data analytics is tremendous, its application in health care is at a nascent stage (3). Nevertheless, if literature continue showing how big data analytics can improve quality of care and patient outcomes, it will fulfil its potential as an important component of a learning health-care system. However, how in Puerto Rico we can move from potential use of big data analytic to realization? Clearly, electronic health records have made possible in US healthcare organizations to collect high volume of data to be used to create models of diagnostic and care that combine thousands of disparate measurements to generate evidence in real time. Hence, the first big step required in Puerto Rico is to adopt an efficient implementation of electronic health records that not only allow to a given organization to collect data from their patients but that also allow cross transmission of information among organizations. It is imperative to generate engines that allow our clinicians and healthcare organizations to deploy predictive tactics in their clinical work flow, as well as payment reforms strategies that incentivize value to invest in cost reduction. These measures will likely accelerate the adoption of electronic health records and analytics.

Acknowledgment

The author acknowledges Dr. Clemente Diaz (Faculty, Clinical and Translational Research Training Program at University of Puerto Rico School of Medicine) for support in making possible the visit to Stanford University, and Ms. Bird-Collado for the help in editing the document. The author has no conflict of interest to disclose.

Ernesto E. Borrero, MD, PhD, Resident, Neurology Training Program, School of Medicine, University of Puerto Rico Medical Sciences Campus, PO Box 365067, San Juan, PR 00936-5067.
Email: ernesto.borrero@upr.edu

References

1. Roski J, Bo-Linn GW & Andrews TA. Creating value in health care through big data: opportunities and policy implications. Health Aff (Millwood) 2014;33:1115-1122.
2. Murff HJ et al. Automated identification of postoperative complications within an electronic medical record using natural language processing. JAMA 2011;306:848-855.
3. Bates DW, Saria S, Ohno-Machado L, Shah A & Escobar G. Big data in health care: using analytics to identify and manage high-risk and high-cost patients. Health Aff (Millwood) 2014;33:1123-1131.