Chapter 18

Big Data to Improve Public Health in Low- and Middle-Income Countries:

Big Public Health Data in LMICs

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ABSTRACT

The field of public health provides a multidisciplinary area of research, and new challenges in analytics and operations management are reshaping the strategic decision-making dynamics. Big data is an emerging and promising area of research that has great potential to transform public health. Developed countries are designing big data tools and analytic techniques and using them to provide leadership. In this respect, low- and middle-income countries (LMICs) need to become more engaged in the big data ecosystem and to become more aware of how to use new analytical techniques. This chapter provides an overview of big data analytic techniques in public health and their potential to transform strategic public health management in LMICs. To achieve this goal, this chapter explains big data analytics and big data tools in public health and discusses development strategies for LMIC's big public data potential to ensure a better knowledge base for LMIC health policymakers.

INTRODUCTION

The term "big data" refers to the emerging use of rapidly collected, complex data in large quantities (Ward and Barker, 2013). Health care delivery is a complex endeavor at both an individual and population level. However, public health can be improved with big data as it can provide insights into the causes and outcomes of diseases, identify better drug targets for precision medicine, and enhance disease prediction and prevention (Khoury and Ioannidis, 2014). At a clinical level, the tailored provision of care to individuals is guided, in part, by medical history, physical examinations, vital signs, and evidence. At the population level, traditional health data include information from vital statistics registries and

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hospital admission statistics (Wyber et al., 2015). Advancements in information technologies represent a milestone in facilitating the development of learning systems for care that enables us to improve public health (Kache and Seuring, 2017). Thus, the era of major data transformation has spurred the use of advanced analytics and big data technologies in public health care (Veyane et al., 2018). Electronic medical records, mobile phone applications, geographical positioning systems, and social media are some of the popular big data sources in public health (Lou et al., 2016).

In addition to the transformation potential of big data in health care, there are potential risks involving this approach (Nambiar et al., 2013). Thus, the high quality collection and analysis of data in health care is critical to improving the effectiveness and efficiency of health care delivery, with the added benefit of a concomitant reduction in health costs (Murdoch and Detsky, 2013). A substantial fraction of the waste in public health care policies and expenditure ensues from not knowing what works for particular patients in particular clinical contexts. Consequently, big data has huge potential to improve public health and achieve better health outcomes (Ellaway et al., 2014).

Big data analytics in public health have already led to better outcomes in many countries, by analyzing patient characteristics and the cost and outcomes of care, permitting caregivers better capacity to identify the most clinically and cost-effective treatments, along with offering analysis and tools, thereby influencing provider behavior by applying advanced analytics to patient profiles (Raghupathi and Raghupathi, 2014). The public health system can be transformed by incorporation of family history, genetic data, lab results, and symptoms into a digital patient data storage system and by providing a data-based computational aid system for physicians to use in assessing their patients' disease risk. Moreover, understanding hospital readmissions and costly illnesses will help health professionals provide a better balance between capacity and costs (Chawla and Davis 2013). In other words, big data analytical systems provide a significant benefit by allowing health professionals to identify patterns of care and control costs using a broader view of evidence-based clinical care (Wang et al. 2018).

Identification of high-cost patients, readmissions, triage, decompensation (i.e., when a patient's condition worsens), adverse events, and treatment optimization for diseases affecting multiple organ systems are the areas of opportunity for using big data in public health (Bates et al., 2014). These development areas have great potential for improving value added in health care (Roski et al., 2014). For a more specific example, electronic health records provide phenotypic profiles of large cohorts, which are very useful for cancer treatment (Bibault et al. 2016). Additionally, big data analytics can potentially predict which patients may suffer from adverse drug events by assessing genomic and laboratory information and vital signs (Bates et al. 2014). Furthermore, information collected directly from individuals is fraught with ethical, regulatory, and technological issues, and also involves high costs (Wyber et al., 2015). For instance, mobile health technologies are easily accessible for everyone and have low entry barriers. However, big data technologies need more technical skills, interoperability standards, coherent data collection and analytic systems (Tomlinson et al. 2013; Wyber et al. 2015).

In clinical medicine, big data is expected to provide extensive opportunities to identify causality of patient symptoms in predicting disease risks and improving primary care quality (Wang and Krishnan 2014). Clinical big data is different from large datasets in other disciplines; it is structured based on protocols. The Framingham Heart Study (FHS), which has followed a cohort in the town of Framingham, Massachusetts since 1948, is a remarkable example of clinical big data. FHS collected detailed information about individuals' medical histories, physical examinations, and laboratory tests (Hubert et al. 1983; Cupples et al. 2003). As an extensive application of clinical big data, FHS was able to enlighten

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