Chapter 7
Challenges in Implementing Clinical Decision Support Systems for the Management of Infectious Diseases

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ABSTRACT

The increased availability of routine healthcare data collected through electronic medical record (EMR) systems provide opportunities for a much greater data-driven approach to healthcare. In infectious diseases, a number of Clinical Decision Support Systems (CDSSs) have shown promising results to improve quality and safety of healthcare management. However, most CDSSs have not been evaluated in real-world clinical settings and are not implemented into clinical practice. The aim of this chapter is to highlight the major challenges in translating CDSS research in infectious diseases into effective tools suitable for use in the clinical setting. Exemplars of real-world implementations and experience of introducing CDSS in infectious diseases are provided, and discussion on measurable outcomes, integration, and framework for clinical implementation proposed.

DOI: 10.4018/978-1-6684-5092-5.ch007

INTRODUCTION

The increased availability of routine healthcare data collected through electronic medical record (EMR) systems provide opportunities for a much greater data-driven approach to healthcare. There exists considerable variation in the clinical approaches taken in decision-making, in turn a reflection of the immense diversity in this field. The heterogeneity inherent in patients' groups, medical conditions, treatment pathways, infrastructure and health policies result in significant challenges for translating basic research in clinical decision support to impact in the real-world setting. The implementation approaches of such CDSS are therefore contingent on understanding and addressing these contextual challenges which exist in the clinic.

Within healthcare itself, priorities differ greatly between conditions and specialties. For this chapter we have chosen the field of infectious diseases to provide an exemplar for CDSS research. Infectious diseases caused by bacteria, viruses, protozoa and fungi exert significant global burdens and provide a broad representation of the key priorities in healthcare. Specific illnesses such as malaria, tuberculosis, HIV and sepsis likewise disproportionately impact fragile health systems found in low and middle-income country (LMIC) settings. The consequences of infections and the risk of antimicrobial resistance are inherently cross-cutting across all aspects of health, for example infections in surgical post operative settings, opportunistic infections post chemotherapy or as a consequence of chronic conditions such as diabetes. Finally, the COVID-19 pandemic has highlighted the role of diverse factors including the environment and human behaviour and their pleotropic effect on individual health.

The following chapter highlight the major challenges in translating CDSS research into effective tools suitable for use in the clinical setting. Exemplars of real-world implementations and experience of introducing CDSS in infectious diseases are provided, and discussion on measurable outcomes, integration and framework for clinical implementation proposed.

BACKGROUND

Rapid and easy access to updated information is a *sine qua non condition* for physicians to make optimal clinical and therapeutic decision. Computer-based clinical decision support systems (CDSS) have been developed for their potential to answer this need (Garg et al., 2005). They are software which present individualized assessments or suggestions to prescribers towards clinical and/or therapeutic decisions, either providing unsolicited information (e.g., pop-up alerts for drug-drug interactions) or providing solicited information (e.g., diagnostic support systems). Early CDSS were based on expert systems, developed from recommendations elaborated by medical experts. For instance, electronical algorithms from patient care guidelines are among commonly used CDSS (Rawson et al., 2017; Durieux et al., 2000). The physician enters the patient's clinical information and access the diagnostic or therapeutic guidelines adapted to the specific patient's situation. Expert systems main limitation is their lack of flexibility in dealing with unexpected situations i.e. when experts did not explicitly code all possible situations beforehand. Machine learning (ML) was developed to meet the need for adaptability in decision making. Machine learning CDSS (ML-CDSS) find their own decision rules from massive volume of data. They are increasingly being developed and may replace knowledge-based CDSS (Peiffer-Smadja et al., 2020a).

Daily management of infectious diseases (ID) requires considering and adapting to constantly changing variables. The physician must take into account patient factors (such as demographics and medical his-