

A Mathematical Model to Plan the Adoption of EHR Systems

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INTRODUCTION

A systemic diffusion and deployment of eHealth systems and services is occurring worldwide, as it is meant to positively impact and strengthen healthcare professionals daily work, making easier the path of integration and coordination among the different tasks, as well as the deployment of new organizational dynamics. The present chapter is intended to introduce a prescriptive mathematical model to plan the adoption process of an EHR framework, that integrates clinical and administrative information provided by different healthcare operators during the entire citizen's life. In particular, the model establishes how different subjects (GPs and patients) are involved in the testing process and how the resources provided can be invested to find out the most suitable intervention strategies. In this perspective, the objective is twofold: on the one hand, to figure out, besides the intrinsic technical reliability, the EHR proper nature of innovation; on the other hand, to design a realistic, scalable and exportable model, capable of addressing a wide range of clinical, administrative, and financial decisions in healthcare, for a particular kind of patients.

The chapter introduces the mathematical formulation of this model, making clear how and why it can be considered an efficient way to measure "ex-ante" both adequacy and significance of the adoption process.

BACKGROUND

National healthcare systems are called to face considerable challenges, mainly due to fundamental demographic changes, decreasing financial budgets for healthcare and innovative technological developments (Schlessinger & Eddy, 2002; Arning & Ziefle, 2009). Particularly, a systemic diffusion and deployment of eHealth systems and services are then occurring, since those are expected to cover the interaction between patients and health-service providers, institution-to-institution transmission of data as well as peer-to-peer communication between patients or health professionals. Furthermore, the development of high-quality information systems is having a major impact in the delivery of patient services improving the procedures implemented for storing, organizing and sharing clinical data, knowledge and information among healthcare operators. Moreover, information systems foster a stronger connection between hospital and territory, through the development of new skills as well as the diffusion of new technologies (Djellal & Gallouj, 2005).

The successful application and the consequent systematic adoption of Health Information Technologies is broadly considered a promising strategy to improve the economic sustainability of healthcare, while ensuring and enhancing the quality of services (Serbanati, Ricci, Mercurio & Vasileanu, 2011).

MAIN FOCUS

Issues, Controversies, Problems

EHRs stand worldwide at the heart of many complex platforms for healthcare delivery system, as they can provide each individual with aggregate, secure and private lifetime record of their key health history and care within the health system, and share encounter information available electronically with authorized health care providers and the individual anywhere, anytime in support of high quality care (e.g. Canada Health Infoway, 2006; Ludwick & Doucette, 2009). EHRs and EHR networks are called to be: (i) *longitudinal* (containing records over an extended period of time); (ii) *comprehensive* (containing virtually all clinical encounters with a wide range of healthcare providers); (iii) *interoperable* (accessible in standard electronic format via various EHR systems from any location) (Rothstein, 2010): this makes them heavily involved in managing and monitoring national roadmaps to innovate the eHealth sector (Tang, 2003; eHealth ERA Project, 2007). Their uprising degree of adoption both in public and private sectors of healthcare can lead to lower cost service delivery while increasing the quality of healthcare. It is therefore up to the regional and national competencies to lead and sustain the necessary EHR adoption strategies, along with the costs/investments policies.

In the field of Operational Research, this translates into a series of optimization problems to be worked out, in order to achieve an optimal (or at least the best fitting) allocation of resources, subject to a budget constraint (Stinnett & Paltiel, 1996). Models for the economic evaluation of health technologies can provide – mostly on a national level – valuable information to decision makers, provided that viable and appropriate assumptions are made available from the analysis of the evaluation context (Eldabi, Irani & Paul, 2002; Brennan, Chick & Davies, 2006). Specifically, the use of mathematical modeling is often required for the CEA (Cost–Effectiveness Analysis) issues and decision rules, since CEA

deals with the maximization of aggregate health effectiveness (Johannesson & Weinstein, 1993). On a regional level, the Governments are always called to “match” somehow the national directives with the local issues, and the mentioned budget constraints often make decision makers unable to fund and implement all the healthcare technologies adoption programs with positive net benefits. The relevance of the benefits evaluation becomes so clear, especially given that it strictly depends on the kind of results pursued. This being the case, the challenge turns then in an optimization problem in which benefits have to be maximized subject to a budget constraint, and can be better worked out by using the CBA (Cost–Benefit Analysis) method (Stinnett & Paltiel, 1996). Based on CBA, the model introduced is therefore meant to determine and demonstrate the suitability of the resources provided in order to: (i) address all the issues concerning the feasibility of the adoption process, along with its technical, political and organizational features; (ii) redesign if necessary an adoption and running plan better aligned with the nurtured expectations.

CBA can give a valid support to pursue the “innovation of value” recognizing the benefits coming with the adoption and diffusion of EHR systems in terms of clinical appropriateness, or as support to the treatment of chronic illnesses: a fundamental change of attitude, i.e. centered on healthcare strategies and care processes, with the design of the suitable technological solutions as a consequence (Rossi Mori, 2007).

LUMIR System: A Case Study

The LUMIR system was developed under the direction of the Institute of Biomedical Technologies of the Italian National Research Council (ITB – CNR) (Contenti, Mercurio, Ricci & Serbanati, 2010). It is composed by a “registry” of data and a “repository” of documents supplied by different healthcare providers via an universal wrapper that guarantees the delivery of documents from different Health Care Organizations (HCOs) to LUMIR, and provides the link between LUMIR

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