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# Investigating evaluation frameworks for health information systems

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## ABSTRACT

**Background and purpose:** Evaluation of health information systems (HIS) enables the assessment of the extent to which HIS are fulfilling their objectives in supporting the services of healthcare delivery. This paper presents an overview of evaluation in health informatics and information systems.

**Methods:** Literature review on discourses, dimensions and methods of HIS and IS evaluation. A critical appraisal of selected HIS and IS evaluation frameworks is undertaken in order to identify HIS evaluation dimensions and measures. The frameworks are compared based on their inclusion of human, organizational and technological factors.

**Results:** We found that an increasing number of evaluation studies deal with two distinct trends of HIS: one considers human and organizational issues and the other is concerned with the employment of a subjectivist approach. Our review indicates that current evaluation methods complement each other in that they evaluate different aspects of HIS and they can be improved upon.

**Conclusions:** Evaluation is complex; it is easy to measure many things but not necessarily the right ones. Nevertheless, it is possible to consider, a HIS evaluation framework with more comprehensive and specific measures that would incorporate technological, human and organizational issues to facilitate HIS evaluation.

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## 1. Introduction

Researchers and practitioners in the health informatics field recognize the importance of the evaluation of HIS. The focus of such evaluations is moving from technical issues to human and organizational issues (trend 1); and from an objectivist to a subjectivist approach (trend 2) [1].

The extent to which HIS fulfil their role and support the services of healthcare delivery is obviously important. Ammenwerth et al. [2] defined HIS evaluation as “the act of measuring or exploring attributes of a HIS (in planning, devel-

opment, implementation, or operation), the result of which informs a decision to be made concerning that system in a specific context”. This definition outlines three key issues: measuring, attributes of HIS and the support of decision making. Undertaking the evaluation is challenging as the decision making in design, development, purchase or management in HIS all requires evaluation [3].

It is claimed that HIS evaluation is not straightforward and a number of problems pose challenges to its evaluators, which are partly due to HIS complexity [4–6]. HIS evaluation seeks to answer the *why, who, when, what* and *how* questions relating to

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technological, human and organizational issues surrounding it [7]. In addition, HIS evaluation is unclear and confusing [8] and it is argued that an existing strong foundation for good evaluation theory and practice is yet to be disseminated in an understandable form [2]. This may explain why despite an increasing number of HIS being developed, the number of published evaluations is very limited [2,9]. Evaluation of HIS is also difficult to perform, particularly in selecting a framework to be applied and methods to be used [2]. However, there are a number of proposed approaches that can be adopted/adapted to overcome these problems [2,4] as well as deriving some more improved methods and extensions [3].

This paper reviews the discourses, dimensions and methods of HIS evaluation described in the wider health informatics and information systems literature. The review covered HIS evaluation studies as well as some related IS studies, studies of human and organizational factors in HIS and existing HIS evaluation frameworks. In order to present this review, the paper is organized as follows. The following section provides an overview of HIS and their classification. Section 3 presents a classification of early evaluation studies that highlights the main evaluation themes and concerns. This discussion is followed by a critical analysis section (Section 4) examining the existing frameworks for HIS evaluation. These frameworks have been selected for their intent to evaluate HIS from different perspectives. Some preliminary discussion, together with conclusions, closes this paper, and sets the scene for another paper (part II—current issue), which introduces a framework, that arose naturally from follow up research to the present work.

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## 2. An overview of health information systems

In order to explain what an information systems (IS) is, the paper adopts the following understanding of what constitutes a system and information. According to Lederer and Salmela [10], input, processing and output are elements that form a system. A system also comprises a combination of variables or components that are interrelated, organized and depends on each other [11]. According to Martin and Powell [12], information is the outcome of data processing and is used to aid in decision making. Lucas [11] defines IS as a number of procedures organized to facilitate decision making, communication and control in organizations. Hence, IS assists organizations to gather, process and disseminate information within the organization and their environment [13]. Wetherbe [14] regards IS as a physical process, which supports system objects in achieving organizational goal. Based on the above definitions, in this paper, an information system is defined as a group of interrelated processes implemented to aid in enhancing the efficiency and effectiveness of an organization in performing its functions and attaining its objectives.

For the purpose of this review, the term health information systems is used to refer to computer based information systems used in healthcare settings. HIS are used extensively in healthcare organizations to support various conventional data processing tasks including patient billing, accounting, inventory control, statistics calculation and patient history

maintenance (see Table 1). They are also used for scheduling, automating nurse stations, monitoring intensive care patients and providing preliminary diagnoses [15].

HIS range from simple systems, such as transaction processing systems, to complex systems, such as clinical decision support systems (CDSS). The health informatics literature defines in various terms different types of HIS and these terms are applied inconsistently. Hence, the classification of different types of HIS is offered in Table 1.

Patient centered information systems are the core system in healthcare organizations; they are usually linked to other HIS to provide patients' information and their medical history. Clinical information systems are designed uniquely according to each clinical department. A number of systems are identified as clinical support information systems including radiology information systems, laboratory information systems and pharmacy information systems [16]. Hospital information systems is a general term that spans a variety of hospital information processing system types. For example, clinical physician order entry (CPOE) systems are gaining popularity and are commonly integrated with CDSS to support basic decision making (drug-allergy checking, basic dosing guidance, formulary decision support, duplicate therapy checking and drug–drug interaction checking), as well as advanced decision making (such as guidance for medication-related laboratory testing, drug-pregnancy checking and drug-disease contraindication checking) [17,18]. Whatever type of HIS, an effective evaluation technique to assess their appropriateness to their organization could be useful. In the next section, we present a number of evaluation frameworks that have been used for this purpose.

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## 3. Health information systems evaluation

Evaluation serves a number of purposes. Given the unpredictable characteristics of IS in general and the aim of improving clinical performance and patient outcomes in particular, evaluation is undertaken to understand system performance [16]. Potentially, the evaluation of health informatics application can help improve the quality of care and its costs and to determine the safety and effectiveness of HIS [16,19]. Evaluation can be used to improve HIS through using past experience to identify more effective techniques or methods, investigate failure and learn from previous mistakes [4].

### 3.1. Early approaches to health information system evaluation

As mentioned above, evaluation seeks to answer the *why* (objective of evaluation), *who* (which stakeholders' perspective is going to be evaluated), *when* (which phase in the system development life cycle), *what* (aspects or focus of evaluation) and *how* (methods of evaluation) questions. A discussion of early studies on HIS evaluation is presented based on these evaluation questions and a summary presented in Table 2. Due to its relative popularity, there are a large number of evaluation studies on clinical decision support systems (CDSS).

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