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ABSTRACT

There is an important need to understand how health information technology impacts healthcare quality. In this systematic review we analyze recent literature to understand the relationship between health information technology and healthcare quality. We report preliminary findings and offer recommendations for future study.

Keywords

Health information technology, healthcare, quality.

INTRODUCTION

Healthcare organizations continue to make large investments in health information technology to improve quality of care and lower costs [1, 2]. Examples of such health information technologies include large systems such as electronic medical records as well as specific components such as ePrescribing. Given the large investments and the critical nature of healthcare, there is a need for a more thorough understanding of the expected impact of health information technology on healthcare. Specifically, it is important to evaluate the impact of the information technologies designed to support patient care on the quality of care services and health outcomes.

While there have been several recent studies on the impact of IT on quality [3, 4], the nature of the relationship between HIT and quality is not evident due to conflicting findings on the impact of HIT on quality [5], narrow technology focus of many studies [6], narrow outcome focus [7], and wide range of outcomes studied that include health outcomes related to specific disease conditions [8] to those measuring service quality and quality of care process [9]. There is limited literature that provides a comprehensive understanding of the relationship between health information technology and various dimensions of quality, and more specifically the factors that influence the realization of potential quality benefits from health information technology.

In order to develop a thorough understanding of how HIT effects healthcare quality and the mechanisms through which such effects take place we undertake a systematic review of relevant literature. In this paper we present some preliminary findings on the current state of the research in this area and identify opportunities for future research.

METHODOLOGY

The literature search strategy involved executing a search on the PUBMED database seeking English language articles published between January 1, 2000 and March 15, 2011. The search terms used were "Health Information Technology" AND Quality. These terms were sought in all fields. The search returned 251 results. Additional recently published articles were added to the pool from prior searches of other databases. Each of the articles' was reviewed, and from this pool only relevant articles were considered for inclusion in our analysis. Articles meeting the following criteria were considered relevant:

- The article reported on formal research conducted in empirical studies.
- The primary focus of the study is the implementation or use of HIT.
- The study identifies the effects of the implementation or use of HIT on the quality of service or patient outcomes.

Applying these criteria resulted in 32 articles. While the list of articles identified through our search process is not exhaustive, we feel our sample is a fair representation of recent domain literature, and provides a cross-section of not only technologies frequently studied but also of common implementation environments.

OBSERVATIONS

We reviewed each article and where available details about study attributes were recorded. This included the specific HIT system, disease conditions under study, research methodology, extent of user base, context of technology use and adoption, outcome measures and facilitators and barriers to this adoption. A summary of our observations is presented in Table 1.

In terms of technology, Electronic Medical Records (EMR) were the most commonly investigated technologies [7, 8, 10-24], followed by Computerized Physician Order Entry (CPOE) [5, 14, 16, 25, 26], Clinical Decision Support (CDS) [12, 14, 17, 25], Adverse-Drug-Event Systems [3, 25] and . Both qualitative and quantitative research methodologies were employed to investigate the impact of HIT on quality. While a majority of the studies employed quantitative research methods, qualitative methods were also used regularly, and multiple authors incorporated some techniques from both methodologies [13, 17, 27]. Most studies focused on a wide variety of health outcome measures commonly measured in primary care settings. However, there is also much research on the affects of HIT on individual diseases and within specific healthcare specialties such as asthma [20], HIV [8] and breast cancer [28]. The most attention was devoted to how HIT affects diabetic patients [18, 19, 23, 24].

Table 1. Summary of HIT - Quality Studies

Study Attribute	Number of Articles	Number of Strong Positive	Number of Mixed	Number of Strong Negative
Technology				
EMR/EHR	17	8	8	1
CPOE	5	1	2	2
CDSS	4	1	2	1
ADE	2	1	0	1
Other	12	7	5	0
Outcome Measures				
Facility-based	13	7	4	2
Patient-based	11	6	4	1

Most studies use one of two primary methods to measure outcomes when determining if benefits had been realized after implementation. About half of the studies used facility-based measures which is comparing a facility's performance measure (e.g. mortality rate) [3]pre and post implementation to judge results. The remaining half used patient-based measurements (e.g. glucose levels, blood pressure) [18] to make the determination of realized benefits.

As is evident in Table 1, there is no clear trend towards either a positive or a negative impact of information technology on healthcare quality. While many studies offered strong support for the implementation of HIT [6, 10], almost as many found either marginal benefits [5, 12], improvements to quality from some IT systems and not others [17], or benefits for only some patients [28].

According to the Yu et al., study, it also appears that the quality performance of an health care system is a strong predictor of IT adoption, but information technology adoption is not a strong predictor of improved quality indicating that technology adoption alone is not sufficient to realize quality benefits and that the way in which technology is used does have a significant influence on the direction and extent of quality impacts [29]. This is also reinforced by the Tavakoli et al study where workflow changes combined with existing technology is shown to yield better quality outcomes [9].

In deeper analysis of the papers that evaluate the impact of technology on healthcare quality, we also see patterns that are in line with the DeLone and McLean model for Information System success [30]. Specifically, system quality, information quality, and use are identified in many papers as being key factors that influence the realization of quality benefits of information systems [31, 32]. Some studies also indicate that quality focused information systems such as quality reporting and benchmarking [18]or drug interaction and adverse drug event systems offered more benefits than general health information technologies such as EMR when evaluated with respect to impact on quality [17].

FUTURE RESEARCH

When looking at results from multiple studies, it appears that HIT's impact on the quality of healthcare is ambiguous at best. However, what is clearer is that there are mitigating aspects affecting the impact of these technologies, and in some cases these dynamics are impeding their potential benefits. A more thorough understanding needs to be developed of these factors through an in-depth examination of dependent, independent and control variables. Another aspect to be explored includes how the adoption of quality focused IT systems such as dashboards, quality and benchmarking systems impact the quality benefits as compared to clinical information systems. In future research, we intend to further analyze the literature to identify the contextual factors including system use, system quality, system purpose and the nature of outcome measures to understand the relationship between health information technologies and health care quality.

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