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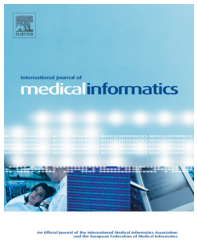

Rates, levels, and determinants of electronic health record system adoption: A study of hospitals in Riyadh, Saudi Arabia

*Bakheet Aldosari**

Department of Health Informatics, King Saud Bin AbdulAziz University, Mail Code: 2350, PO Box 22490, Riyadh 11426, Saudi Arabia

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ABSTRACT

Objective: Outside a small number of OECD countries, little information exists regarding the rates, levels, and determinants of hospital electronic health record (EHR) system adoption. This study examines EHR system adoption in Riyadh, Saudi Arabia.

Materials and methods: Respondents from 22 hospitals were surveyed regarding the implementation, maintenance, and improvement phases of EHR system adoption. Thirty-seven items were graded on a three-point scale of preparedness/completion. Measured determinants included hospital size, level of care, ownership, and EHR system development team composition.

Results: Eleven of the hospitals had implemented fully functioning EHR systems, eight had systems in progress, and three had not adopted a system. Sixteen different systems were being used across the 19 adopting hospitals. Differential adoption levels were positively related to hospital size and negatively to the level of care (secondary versus tertiary). Hospital ownership (nonprofit versus private) and development team composition showed mixed effects depending on the particular adoption phase being considered.

Discussion: Adoption rates compare favourably with those reported from other countries and other districts in Saudi Arabia, but wide variations exist among hospitals in the levels of adoption of individual items. General weaknesses in the implementation phase concern the legacy of paper data systems, including document scanning and data conversion; in the maintenance phase concern updating/maintaining software; and in the improvement phase concern the communication and exchange of health information.

Conclusion: This study is the first to investigate the level and determinants of EHR system adoption for public, other nonprofit, and private hospitals in Saudi Arabia. Wide interhospital variations in adoption bear implications for policy-making and funding intervention. Identified areas of weakness require action to increase the degree of adoption and usefulness of EHR systems.

1. Introduction and background

An electronic health record (EHR) is a centralized and longitudinal electronic record that holds patient health information such as patient demographics, progress notes, medications, vital signs, medical history, laboratory tests, and radiology reports [1]. EHRs report incidences of care across multiple healthcare personnel and organizations both within and between regions. EHRs support two main functions: the first

* Tel.: +966 1 801 1111x49800/49802.
E-mail addresses: dosarib@hotmail.com, dosarib@ngha.med.sa
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function includes patient care functions such as clinical reviews, decision support, and the provision of documentation, and the second is the administrative and financial functions such as statistical reports and quality measurement. The term "EHR system" describes the electronic organizational framework and infrastructure that allows EHRs to be stored, accessed, altered, and analyzed.

EHR systems provide important benefits for healthcare, including positive effects on outcomes such as the efficiency of care, the effectiveness of care, the reduction of error rates, and the reduction of healthcare costs [2–8]. Such systems will be particularly important in helping relieve overburdened health systems in the face of ageing populations and dramatic increases in the prevalence of chronic conditions. EHR systems should also enable new interfaces to be established between healthcare and research environments, leading to improvements in the scope and efficiency of research and the integration of new scientific evidence into practice [2,3]. Given the importance of EHR systems to the better management of healthcare, research interest has developed regarding the rates and levels of adoption of these systems and the determinants of differential adoption rates.

1.1. *Rates and levels of hospital EHR system adoption*

Studies of EHR system adoption show that adoption rates in hospital care settings are much lower than those in primary care (GP/family physician) settings (e.g., [9]). Jha et al. [9] studied EHR adoption rates in hospital care settings for the US, Canada, UK, Germany, Netherlands, Australia, and New Zealand. High quality data on EHR use in acute hospital care were lacking, highlighting a lack of reliable, systematic information. EHR adoption in hospitals was found to be low, with fewer than 10% of hospitals in any single country having the key components of an EHR system. The low rates were explained in terms of the lack of attention by policy-makers to adoption, and the expense and disruption initially caused by the systems and the need to integrate them with existing IT systems.

Jha et al. [10] used a survey of acute care hospitals in the US (as of March 2009) and found that the percentage of hospitals that had adopted either basic or comprehensive EHR systems had risen from 8.7% in 2008 to 11.9% in 2009. The percentages for basic EHR systems were 7.2% to 9.2%, and for comprehensive EHR systems were 1.5% to 2.7%.

As of early 2007, 18.9% of hospitals (249 from a sample of 1316 hospitals from a national total of 9026) in Japan had introduced EHR systems [11]. The adoption rate varied according to hospital size: 500 beds or more (37%), 400–499 (25%), 300–399 (17%), and <300 beds (7%). Adoption rates were higher for public hospitals than for private ones, 22.7% and 12.9%, respectively. Bah et al. [12] surveyed all 19 public hospitals in Eastern Province, Saudi Arabia, and found that only three (16%) used EHR systems (data late 2010).

1.2. *Determinants of hospital EHR system adoption*

Detailed information about determinants is available only from OECD countries, the US in particular. Various studies have tested empirical relationships between measures of the dependent variable (adoption level/status) and plausible independent variables (determinants) such as hospital size and ownership, and these same studies have proposed theoretical arguments explaining how these determinants are expected to influence EHR system adoption. The determinants identified are wide ranging and include: the degree of urbanicity and health system affiliation (positive effect [10,12,13]); hospital size (positive [10,12–16]); external incentives for improving quality (positive [16]); academic/teaching hospital status (positive [17,18]); maintenance costs (negative [17]); and public hospital (cf. private) status (positive [11,18]; negative [10]; no effect [13]). The influences of social proximity (hospitals in the same system) and spatial proximity to EHR-adopting hospitals on the likelihood of adoption in other hospitals have also been shown to have positive effects [18]. Hypothesized influences shown to have no effect include hospital financial position [16].

Elnahal et al. [19] used 2009 American Hospital Association survey data to compare levels of EHR adoption between high- and low-quality hospitals assessed using Hospital Quality Alliance quality of care measures. They found higher levels of adoption in high-quality hospitals in 11 of the 24 key EHR functions measured. High-quality hospitals tended to be: larger, nonprofit in ownership, teaching hospitals, members of a hospital system, and located in urban areas. Two-thirds of nonadopting and low-quality hospitals had no plans to implement EHR functions.

McGinn et al. [20] completed an extensive literature review of factors influencing EHR system implementation/adoption in North America, Europe, and Australasia. Factors included design and technical concerns, ease of use, interoperability between departments, privacy and security, costs, productivity, familiarity with EHRs, motivation to use EHRs, and user time/workload. Findings also indicated the importance of organization size, IT support, training, the relationship between administration and health professionals, and the choice of the particular EHR system.

1.3. *Research rationale and objectives*

Despite the prevailing view that EHR systems carry benefits for healthcare organizations, and despite governments in various countries developing policies and allocating funding for the implementation of hospital EHR systems, the uptake has been slow. Little is known about the rates and determinants of adoption outside a few OECD countries. Also, the findings of studies of adoption determinants are not consistent, reflecting variability in the drivers of adoption according to national, regional, and local health system contexts. Identification of the determinants of EHR system adoption is important so that variations in the rates of adoption in hospitals can be understood, and the rates themselves potentially accelerated.

This paper aims to establish the rates, levels, and determinants of EHR system adoption in a sample of Saudi hospitals. In the study, 'rate' refers to the percentage of hospitals that have adopted an EHR system, and 'level' refers to the degree to which an institution has completed the separate phases of implementation, maintenance, and improvement of its EHR system. The Saudi Ministry of Health (MoH) provides approximately 60% of healthcare services to citizens,