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ORIGINAL PAPER

Benefits and Challenges of Electronic Health Record System on Stakeholders: A Qualitative Study of Outpatient Physicians

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Abstract Electronic health record system (EHRS) is an important healthcare innovation associated with many controversies about the benefits and challenges to different stakeholders. The aim of this study was to investigate the utility of EHRS by outpatient physicians in Macao and to identify, in their opinions, the significance of EHRS on health institutes, patients, and physicians. Semi-structured interviews were conducted with 32 physicians who worked in the outpatient department. The interview data showed that 78 % physicians interviewed used EHRS frequently during their daily practice despite individual preferences of documentation methods. They agreed that systemic health record offered by EHRS allowing smooth communication was beneficial to the health institutes, patients and physicians. However, privacy and confidentiality concerned both the health institutes and patients. Inefficiency of the EHRS that only allowed retrieval of limited medical information of the patients hindered physicians' acceptability of EHRS. It was also suggested that the health institutes should take into consideration interests of different stakeholders when designing and implementing EHRS.

Keywords Electronic health record system · Stakeholder · Physician · Hospital · Patient

Introduction

Electronic health record system (EHRS) is widely adopted in the world and has become an important tool for daily medical practices and health care management [1]. It is considered as one of the healthcare innovation items in current and future trends [2]. Implementation of EHRS has been reported to offer improvements in the quality, efficiency and safety of health care services [3]. In the late 1960s, computer-based hospital information systems started to emerge in the United States and were used in main hospitals, and gradually small hospitals. However, the system did not process any laboratory reports to help with diagnosis. In 1972, Morris Collen, who was a pioneer in the use of hospital-based systems, further developed the system to store and present laboratory test results as part of preventive care. Since then, the electronic health records continued to emerge and improved with multifunctions that helped in diagnosis and decision making [4]. In recent years, increasing benefits of EHRS have been demonstrated in terms of reducing health care costs and improving the quality of health care in the primary care practices as shown in numerous studies [5].

While medical innovation is considered as one of the most important strategies in improving health care delivery at all times, EHRS showing promising potentials as an advanced innovative technology is going to play a crucial role in provision of quality patient care, ensuring patient safety, data collection, quality management, disease surveillance and many more in the future perspective [6]. There are visions in the United States to fully actuate the meaningful use of EHRS by 2015. Full implementation of EHRS by means of certified electronic health record technology is anticipated across all breadth (the spread among medical staff) and extent (the level or frequency of electronic health record use in organization-wide clinical decision making and nursing workflow), and throughout the course of quality improvement [7]. In the future, there should be wide-ranging capabilities and potentials for improving quality of EHRS [8]. As many benefits as EHRS has to offer evidently, studies have found that the adoption rate remains low. Only 24 % of physicians were using EHRS in outpatient settings in 2005

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[9]. It was even lower in some developed countries, such as South Korea, with only 9 % of hospitals adopted EHRS [10].

Multiple barriers about implementing EHRS originated from multiple perspectives have been reported. Lack of standards for recording clinical information, high implementation and maintenance costs, clinical and financial benefits not relevant to physicians in ambulatory care, concerns about violation of privacy and confidentiality by the patients, concerns about legal liability by the physicians are among the various obstacles to universal adoption. Another study showed that 46 % of patients would trust the physicians more if they were to receive hard copies of their medical record [11]. Moreover, potential benefits of EHRS were often offset by the need of continuous financial input to maintain and improve the system.

In addition to the many unsolved issues, there are already additional functions in need such as interoperability between different EHRS allowing medical information exchange across hospitals. A study in Taiwan showed that 97 % of the emergency physicians agreed that interexchange of health information was critical to provision of appropriate clinical care. However, 86 % of the physicians believed that it would be difficult to obtain patient medical information from external sources [12]. Many national projects in the healthcare departments in different countries had been carried out in an attempt to integrate different EHRS. There were only a few successes despite full compliance to standards recommended by Health Level 7 [13]. Software challenges, communication standardization in addition to many other technical issues had left interoperability of EHRSs practically very difficult [14].

Experiences from different countries show that there are yet many barriers remained unsolved and needs unmet, which inspires this study to investigate the benefits and barriers of implementing EHRS in Macao Special Administrative Region of the People's Republic of China (Macao). Macao carries a population of around 600,000 with most residents rely on free medical services at the government institutes, with over 1,310,000 numbers of visits to the public hospital, known as Hospital Conde S. Januário, and 2,580,000 visits to primary care centers in 2011 [15]. The government hospital and the primary care centers share a common EHRS. For residents who opt to avoid long waiting time at the public institutes and pay for private health care, most of them go to Kiang Wu Hospital for primary or secondary health care where a different EHRS is used. The EHRS in these health institutes have emerged since 1990s. Both systems enabled physicians to document medical records and laboratory reports, prescription. However, EHRS was not used to the full extent as many physicians still rely on papers at least partially such as writing referral letters. As it is a common phenomenon that residents go to the public and private health institutes for health care simultaneously, the need for interoperability has been emphasis. As Macao economy takes off, there appears an increasing demand for better medical service, which in turn pushes the administrators in the health institutes to improve the functionality of EHRS. In order to meet expectations for EHRS, comprehensive understanding of stakeholders' interests and needs is essential. This inspires this study to investigate the utility of EHRS by outpatient physicians in Macao and to identify, in their opinions, the significance of EHRS on health institutes, patients, and physicians.

Methodology

Data collection

To collect data, face-to face semi-structured interviews to outpatient physicians were conducted during October 2012 and February 2013. One hundred requests were made with 32 responded giving a response rate of 32 %. The subjects were randomly chosen in the public hospital, the private hospital and four primary care health centers mentioned above. Interviews were made specific to the EHRS used in these health institutes which would provide an insight of the utility of EHRS in Macao as most residents relied on these health institutes. The background information of physicians interviewed was summarized in Table 1. The interviewed physicians included 15 primary care physicians and 17 specialists of the health institutes. All physicians had used electronic health records for 5 years or more. Twenty six physicians had received training offered by the healthcare institutes either by written guidelines or lectures organized by the IT departments. Nine of the 32 physicians had experiences of using EHRS in places other than Macao.

Each semi-structure interview lasted about 15–30 min. With face to face interviews, more detailed information could be obtained rather than using questionnaires. The interview questions mainly focused on: (1) physicians' extent of use of EHRS (2) benefits and challenges for physicians when using EHRS; (3) benefits and challenges for healthcare institutes when adopting EHRS; (4) benefits and challenges for patients with the application of EHRS; (5) suggestions for future improvement of EHRS. For the list of interview questions, please refer to Appendix 1.

Data analysis

Data analysis was carried out in an orderly manner. Firstly, the data collected was summarized by main themes, including utility of EHRS, benefits and challenges for health institutes, patients and physicians respectively. Secondly, concept analysis for qualitative data was chosen to generate the main findings in each theme [16]. Thirdly, suggestions for future improvement of EHRS were summarized separately.

Table 1 Profile of physicians interviewed

	Frequency (N=32)
Age	
30–40	12
41–50	13
>50	7
Sex	
Male	18
Female	14
Physicians type	
Primary care	15
Specialty	17
Hospital Type	
Public	21
Private	11
Usage of EHRS	
Using Fully	25
Using partially	7
Experience of using EHRS	
5–10 years	13
>10 years	19
Used EHRS in other country	9
EHRS Training offered	
Yes	26
No	6

Results

Usage of physicians

It was shown that most physicians (78 %) used EHRS fully, while the others only used the system partially during their medical practices. The physicians who used the system fully recorded all medical information in their computer. They used the system to carry out many kinds of activities, including checking patient medical history, laboratory results, drug allergy alert and warnings, medication history, prescribing and making referrals.

For physicians who used EHRS partially, they input the summary of the consultation into the computer and relied largely on paper to record detailed medical information of the patients. The worries according to the physicians were legal liability and lack of skills to use the system. They also preferred hand writing referral note. Discrepancies in the utility of EHRS by physicians were also due to lack of authoritative order by the administrators. Nothing more than encouragement to promote the use of EHRS resulted in coexistence of computer-based and paper-based medical records.

Benefits for stakeholders

Most physicians believed that the administrators of the health institutes brought in EHRS because of the importance of medical innovation. The major significance of EHRS as suggested by 80 % of physicians interviewed was systemic storage of medical information. This allowed easy data collection for research and disease management purposes. At the same time, paper resources were saved and the space for documentation minimized. Moreover, one-third of physicians believed that EHRS could improve communication, encourage information sharing and promote work efficiencies among departments in the health institutes. Nearly all physicians interviewed indicated that they benefited from EHRS due to convenience in checking patient medical records which was time saving. Having patient medical information readily available and easily accessible would make up for the shortcomings of human memories. Another advantage that EHRS could offer was the timely access to laboratory results and radiology images as soon as they were available, which could help to speed up diagnosis process and treatment decision-making. The faster diagnosis process could benefit the patients with better health care services. Individual medical information could be retrieved by medical staff efficiently and systematically. Medication repetition and drug allergy could be avoided by having convenient access to patient medication history. Availability of patient medical history in the system would also help with making diagnosis for the patients.

Challenges for health institutes

One-third of physicians interviewed suggested that there might be risks of data loss for health institutes should software errors occur. However, most physicians believed that the IT departments of the health institutes had applied sufficient data security and backup measures. One-third of physicians were worried about patient privacy in cases of illegal information leakage especially when not only physicians but also administrative staff might get access to patient information in the EHRS. Only 10 % of physicians mentioned high cost as a negative impact for health institutes by adopting and maintaining the system. They believed that Macao health institutes were allocating considerable resources to improve the EHRS currently in use in order to meet the international standards and the users' needs.

Challenges for patients

There were only a few or no challenges on patients when adopting EHRS according to the physicians interviewed. Over 90 % of physicians saw no reason for patients to refuse using the system. Only 4 of 32 physicians concerned about

the patient privacy as there were already measures to protect privacy in the EHRS. There was a general trust by the patients on the physicians to use the EHRS. However, 2 of 32 physicians suggested that less eye contact and face-to-face communication might occur at time when physicians were preoccupied when inputting information into the computer during consultation.

Challenges for physicians

As the main users of EHRS, the physicians were concerned very much about the efficiency of the system to facilitate their daily work. The main challenges for the physicians to use the EHRS were the slow typing process without any templates for guidance or standardization. There were complaints about numerous interfaces or settings to check the past records, which affected the work efficiency. Two senior physicians complained that EHRS was more time consuming than paper records. They explained that this might be due to their slow typing and lack of template. Furthermore, 4 of 32 physicians suggested the standardization of languages used for documentation was a concern. In the government health institutes, the languages of documentation were in English or Portuguese, while the private institutes mainly used Chinese or English. Moreover, some physicians mentioned that only limited individual medical information could be retrieved from the EHRS due to incomplete data input by other physicians and laboratory technicians. As a result, some medical procedure needed to be repeated for confirmation of disease progression, which was inefficient for work.

In general, the benefits and challenges for hospital, patient and physician were summarized in Table 2 as below.

Table 2 Summary of benefits and challenges for three types of stakeholders

	Benefits	Challenges
For hospital	• Record systematically	• High cost
	• Efficient for work	• Risk of data loss
	• Space saving	• Risk of privacy loss
	• Data for further research	
For patient	• Convenient for checking record	• Privacy
	• Drug safety	
	• Reduce duplicated medical test	
For physicians	• Convenient for accessing record	• Slow system
	• Time saving	• Unfamiliar with system
		• Limited information

Discussion

Some literature suggested that most physicians agreed that EHRS was beneficial to their daily practice especially when it enabled convenient retrieval of patient medical information to help with prompt and accurate diagnosis. Nevertheless, the system inefficiency, complicated interfaces and lack of template for data input might result in a less user-friendly system [17]. According to the physicians interviewed, system inefficiency was noted as an important factor reducing acceptance and adoption rate of EHRS. Other studies also showed that physicians were dissatisfied with the EHRS because of long processing time and difficulty in getting access to laboratory reports, which coincided with our findings [18]. It is, therefore, suggested that a fast system should be provided to improve the utility of EHRS.

There were similar benefits of EHRS among the three groups of stakeholders. Electronic health record enabled more efficient medical practice by providing access to systematic medical data. Health institutes need to organize data for administrative management and disease management. Patients need to get hold of and show their own health information in details to their new physicians. Physicians can make quicker diagnosis and treatment decisions by using EHRS. For the stakeholders, studies have shown that using EHRS would enable better communications of accurate patient medical information among departments in a health institutes, and between patients and physicians, which might otherwise compromised by cognitive loss [19, 20]. Our results showed similar benefits to the stakeholders specifically in hospital management, patient medical information documentation and retrieval, quality of health care, and facilitation of communication.

In our study, the physicians suggested that the issue of privacy and data loss might pose concerns to administrators of the health institutes and patients. It was a key challenge for physicians to use EHRS fully in Macao with insufficient trust. Risk of bleaching privacy would be prominent should there be no legislation to protect illegal movement of patient medical in EHRS. This finding was consistent with many studies stating that privacy was the core concern to patients [21]. On the other hand, there were concerns about data loss due to technologic problems for administrators suggestively. The presence of information technology support would be essential to prevent and fix any flaws in the system and prevent any data loss. However, for the physicians, the biggest challenges they encountered were the lack of knowledge or skills to use EHRS efficiently, and the limitation of information they were able to retrieve from the system. Adoption of EHRS would be low if the system ran too slowly, was complicated to operate or only enabled incomplete information for retrieval. For some physicians, the habit of using paper records could also hinder the transition to EHRS [22, 23]. To

combat the impact of insufficient knowledge about the features of the EHRS and how to operate the system, appropriate assistance, training and guidelines should be made available especially to physicians who might not be computer literate [24, 25]. The system should also remain highly user-friendly and authoritative requirements of using EHRS should be endorsed strategically to provide physicians with motivations for changes.

Recommendation

Macao, like many regions and countries, has been dedicated to improving healthcare services. EHRS is considered as one of the essential tools for healthcare innovation which requires maintenance and improvement to consummate current service and meet future needs. In order to ensure the development of EHRS matches the needs of users, input from various stakeholders is essential for appropriate and timely improvement. Among all stakeholders, physician's involvement is believed to be the most influential. In this study, physicians shared their opinions about the utility of EHRS and their concerns, as well as what they see as the concerns of the administrators in the health institutes and their patients. It is anticipated that, based on the findings of this study, more emphasis would be made on improving the efficiency of the system, increasing IT human resources, providing better training to physicians and updating the system to meet the international standard to meet physicians' expectations. At the same time, communications between the patients and the physicians should be encouraged further to build the patients' trust in EHRS. Having the administrators aware and agreed on the suggestions was believed to be the key to success of the EHRS. In the future, with an efficient EHRS, it was believed that better disease management could be achieved. Moreover, EHRS could also allow patient-centered interactions such as incorporation of health-related quality of life modules which could help to improve the quality of care.

Conclusion

EHRS as an important healthcare innovation can contribute to better quality of healthcare services. There are various benefits and challenges for stakeholders to adopt the system. An efficient EHRS allows seamless communications of disease diagnosis and treatment process, and hence brings forward better disease management. As users, physicians' opinions on the design of the system are critical and should be considered seriously by the administrators of the health institutes. It had been shown that continuous interventions and incentive programs from health institutes should be incorporated for improvements of physicians' satisfaction about EHRS, and hence the adoption rate [26]. Nevertheless, opinions from other stakeholders are also important to the design and success of EHRS.

There are inevitably barriers to promote the adoption of EHRS and optimize beneficial outcome of the system, such as lack of standardization, regulation, and trust among stakeholders. It had been proved that implementation of EHRS was difficult to achieve full benefits for the health institutes and the patients unless policies were executed and trust built correspondingly [27]. Therefore, it would be necessary for potential users to participate in the design and implementation of the system.

There were some research limitations to our study worth further exploration in the future. Firstly, this study collected opinions from physicians solely. Future research could collect data directly from patients and the administrators of the health institutes to obtain more comprehensive views about benefits and challenges of EHRS. Secondly, the data was collected only from the outpatient settings. Future research could collect data from other medical settings such as ambulatory and inpatient settings. Thirdly, future study can also collect information from government that acts as important stakeholder in many countries. With these further studies, opinions from diversified stakeholders should contribute to facilitate the adoption of EHRS for better health care services.

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Conflict of Interest Statement There are no potential conflicts of interest in this paper.

Appendix 1 interview to physicians

Personal information

Sex:	M/F
Age:	<30 / 30-40 / 40-50/ 50-60/>60
Place of work:	Government/private
Position:	
Working years:	____years
Experience on EHR:	Y/N,___years
Training offered:	Y/N
Use in other country:	Y/N

Electronic health record system adoption

1. Do you use the electronic health record system? What functions you use in the electronic health record system?
2. Do you think the hospital agree to use electronic health record system? What are the benefits of using electronic health record system for to the hospitals? What are the

steps for the health institutes to implement the electronic health record system ?

3. What are the challenges for the health institutes to adopt and maintain the electronic health record system?
4. Do you think the physicians agree to use electronic health record system? What are the benefits of using electronic health record system for the physicians?
5. What are the difficulties or challenges for the physicians to use the electronic health record system?
6. Do you think the patients agree to use the electronic health record system? What are the benefits for them when their physicians use the electronic health record system?
7. Have the patients disagree to use the electronic health record system? What are the concerns that the patients would meet?
8. What are the potential improvements you suggest to the current electronic health record system?
9. Do you agree to link the government and private electronic health record system?
10. Is there any changes of physicians' practice after implementing the electronic health record system?

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