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Evaluation of Hospital Portals Using Knowledge Management Mechanisms

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Abstract. Hospital portals are becoming increasingly popular since they play an important role to provide, acquire and exchange information. Knowledge management (KM) mechanisms will be useful to hospitals that need to manage health related information, and to exchange and share information with their patients and visitors. This paper presents a comprehensive analysis of knowledge management mechanisms used by 20 hospital portals from North America and Asia to access, create and transfer knowledge. We developed a systematic and structured approach to evaluate how well the portals captured and delivered information to patients and visitors about the hospitals' business processes, products, services, and customers from the perspective of three KM mechanisms (i.e. knowledge access, knowledge creation and knowledge transfer). Our results show that our selected hospital portals provided varying degrees of support for these KM mechanisms.

Keywords: Portals, hospitals, checklist, knowledge management framework, knowledge access, knowledge creation, knowledge transfer.

1. Introduction

The number of people looking for health information online is increasing rapidly and so is the demand for hospital portals [5]. Clearly, providing up-to-date and relevant information is an important mission for hospitals since misplaced truths may influence serious health decisions. As such, effective information storage and management to ensure that the contents on the hospital portals are timely, credible and accurate is a responsibility of these hospitals. Past studies have shown that knowledge management (KM) is an effective strategy to store and manage information in an organization [11]. Specifically, KM helps in identifying strengths and weaknesses, problem solving, dynamic learning, creating opportunities, and strategic planning. In addition, KM provides the process to help both organizations and users to capture, store, organize and share the knowledge

within and across communities effectively [14]. Hence, it seems intuitive to relate KM mechanisms to studies on hospital portals since portals are considered to be tools that revolutionize the access to information and knowledge [1].

Undoubtedly, the Internet enables individuals to access a huge amount of information and knowledge. Thus the ability to seek, share and evaluate information through various mechanisms has become a key requirement for the success of any website [15]. However, despite the proliferation of Internet portals, to the best of our knowledge, there are no standardized evaluation guidelines found in the literature to guide hospitals in developing their portals, especially those designed with a KM agenda.

The objective of this study is to evaluate various interactive features used by hospital portals to facilitate KM and collaboration between hospitals and users. We examined hospital portals from two geographical regions (i.e. North America and Asia). We developed a systematic and structured approach to evaluate how well the portals capture and deliver information to the users about the hospitals' business processes, products, services, and customers from a KM perspective. The focus is on three KM mechanisms, namely, knowledge access, knowledge creation and knowledge transfer.

2. Literature Review

Various definitions of Internet portals exist. Some studies defined Internet portals as single-point-access software systems to provide easy and timely access to information and to support communities of knowledge workers [11]. Other studies defined Internet portals as a one-stop solution to the information problem created by the World Wide Web that increases the access to information in a specific domain [9]. Finally, there are other studies that viewed Internet portals as tools to revolutionize access to information and knowledge [1]. Here, we view portals as KM tools and propose that KM mechanisms will be useful to hospitals in accessing, creating and transferring knowledge via their portals.

Various methods of assessing and evaluating websites and portals have been conducted in past studies. Fritch [6] also proposed a set of heuristics, tools and systems to help evaluate health information on the Internet. For portal quality evaluations, Dragulanescu [3] proposed the use of total quality management specific tools and techniques. Factors such as accuracy, authority, coverage, currency, density, interactivity, objectivity, and promptness were considered. Another study done by [8] on healthcare portal evaluation focused on credibility evaluation. Nah et al. [13] evaluated how e-commerce and financial service websites disseminate, acquire and share knowledge using KM mechanisms. The review of past portal evaluation studies showed that there is little work done in establishing guidelines for hospitals in implementing KM mechanisms in portals, and our present work is therefore timely.

3. Research Model

We extended [13] model to examine the KM mechanisms that will be in effective in hospital portals. From our review of the literature, we modified the KM mechanisms in [13] to reflect the mechanisms that are appropriate and significant for hospital portals. Hence, our modified model as shown in Figure 1 consists of three main elements: Knowledge Access, Knowledge Creation, and Knowledge Transfer. The *Knowledge Access mechanism* refers to the mechanisms through which the users get access to the portal and information on the portal [2]. The *Knowledge Creation mechanism* refers to the process of capturing users' information such as demographics, preferences and behavioral behaviors [13] and creates new knowledge that will benefit the portal providers and the users [14]. The *Knowledge Transfer mechanism* refers to the mechanisms that allow the portal providers to foster user-to-user and provider-to-user sharing of knowledge [13].

Fig 1. Research model.

4. Methodology

4.1 Data Collection

We sampled 20 hospital portals from North America and Asia (see Table 1). We focused on these two regions because of the availability of a large number of hospital portals for selection. Portals that are not available in English were excluded. We selected hospitals portals based on a combination of the following: 1) they appeared in the Best Hospitals 2005 survey conducted by US News & World Report, Best Health [21], 2) they were recipients of prestigious awards such as the eHealthcare Leadership Awards [12], 3) they received high ratings from third-party agencies such as alexa.com, 4) they provided self-regulating policies and third party seals such as HON Code and TRUSTe, 5) they were easily accessible via popular search engines such as Google, Yahoo and MSN.

4.2 Evaluation Checklist Formulation

Our evaluation checklist consists of 52 items that were derived by reviewing the features available on the selected portals and with reference to past studies. These checklist items were grouped under sub-dimensions based on similar functionalities. These collections of sub-dimensions were further grouped into dimensions. Finally, the dimensions were grouped under the three KM mechanisms. Based on the three modified KM mechanisms in our research model, 13 dimensions were formed.¹

4.3 Portal Evaluation Approach

Each portal was evaluated by two members of the research team. For each portal, the evaluation results obtained were compared and any discrepancies were eliminated by combined re-assessment. Cohen's Kappa test was also conducted to measure the agreement of each question or checklist item by two evaluators. The results of test ranged from 0.77 to 1.0 and suggest a high degree of agreement among evaluators. Our portal evaluation approach consisted of the following three steps.

Step 1: Rating Scheme. For each checklist item, a rating of 1='Yes' or 0='No' based on whether those features are supported by the portals was assigned.

Step 2: Weighting Scheme. This study adopts the technique of assigning the weighting criteria as applied by [4]. They suggested the usage of the "Delphi" technique in assigning weights. The Delphi technique is a qualitative technique that requires the convergence of expert opinions which is anonymously and possibly subjective to the underlying criterion in an attempt to produce more precise results. In this work, we modified the technique to adopt the approach of [10] and [7]. Here, each evaluator in the group assigned weights between a scale of 1 to 5 to each sub-dimension independently, with five being the most important and one being the least important. When wide discrepancies occurred, the group discussed until a general agreement was reached. Finally, an average was taken to obtain single numerical weighting value for each sub-dimension. Following this, the final weighting is divided with the number of questions or checklist items.

Step 3: Scoring Finally, after ensuring that the evaluation results obtained are unbiased and accurate as possible, the scores for each sub-dimension were computed by multiplying the ratings of 1 or 0 with the weightings and summing them up.

5. Analysis and findings

In this section, we present our findings on how well our selected hospital portals scored for each of the KM mechanisms.

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¹ Due to space constraints, we do not provide the evaluation questionnaire containing the 13 dimensions. The authors can be contacted for this if necessary.

Table 1. Evaluation results of the knowledge access mechanism.

	Hospitals	AP	Q	R	B	ICU	ICO	A	IP
N. America	Alegent Hospital, US	5.0	1.2	0.0	3.0	3.3	4.3	0.0	3.0
	Cleveland Clinic, US	5.0	2.4	3.0	3.0	2.2	4.3	0.8	4.0
	Comer Children's Hospital, US	5.0	2.4	1.5	1.0	0.0	0.0	0.8	1.0
	Henry Ford Hospital, US	5.0	1.2	0.0	3.0	3.3	4.3	0.0	3.0
	John Hopkins Hospital, US	5.0	2.4	3.0	2.0	0.0	4.3	0.0	4.0
	Mayo Clinic, US	5.0	1.2	0.0	3.0	2.2	4.3	0.0	3.0
	Mt.Sinai Hospital, CA	5.0	1.2	1.5	1.0	0.0	4.3	0.0	1.0
	St Michael Hospital, CA	5.0	1.2	0.0	1.0	0.0	0.0	0.0	1.0
	Stanford Hospital, US	5.0	2.4	1.5	2.0	0.0	4.3	0.0	2.0
	The Ottawa Hospital, CA	5.0	1.2	0.0	1.0	0.0	0.0	0.8	1.0
Asia	Alfred Hospital, AU	5.0	1.2	1.5	0.0	0.0	0.0	0.0	0.0
	King Faisal Specialist Hospital, SA	5.0	1.2	0.0	1.0	0.0	0.0	0.8	1.0
	MohanRao Memorial Hospital, IN	5.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0
	National University Hospital, SG	5.0	1.2	0.0	2.0	0.0	4.3	0.0	1.0
	Pantai Group of Hospitals, MY	5.0	1.2	0.0	0.0	0.0	0.0	0.0	1.0
	Royal Adelaide Hospital, AU	5.0	1.2	0.0	1.0	0.0	0.0	0.8	1.0
	Starship Children's Hospital, NZ	5.0	1.2	0.0	1.0	0.0	0.0	0.0	1.0
	Tan Tok Seng Hospital, SG	5.0	1.2	0.0	1.0	0.0	4.3	0.0	0.0
	United Family Hospitals, CN	5.0	1.2	0.0	0.0	0.0	0.0	0.8	0.0
	Wockhardt Hospitals, IN	5.0	1.2	0.0	1.0	0.0	0.0	0.0	4.0

Note: AU: Australia, CA: Canada, CN: China, IN: India, MY: Malaysia, NZ: New Zealand, SA: Saudi Arabia, SG: Singapore, US: United States of America

5.1 Knowledge Access (KA)

KA refers to the mechanism through which users access the portal and its information. The results for each of the sub-dimensions of KA mechanism are shown in Table 1.

Access to Portal (AP) All hospital portals are accessible from the top search engines which rank these portals as most popular or the best-known pages when search terms such as “best hospitals” or “best hospital websites” followed by the country name or city name were used. Alternately, some of the portals were selected from the list of hospital websites maintained by Massachusetts General Hospital and Harvard. This was retrieved from search engines by querying for “listing of hospitals websites worldwide”.

Searching We further examined 2 sub-dimensions: Query (Q) and Results (R). With the exception of MohanRao Memorial Hospital, India, the query feature is existent on all

other portals. However, advanced query features such as to expand or modify search results are usually not available.

Browsing (B) We found that three hospital portals, Pantai Group of Hospitals Malaysia, Alfred Hospital Australia, and United Family Hospitals China did not provide any browsing features. In general, most of the US portals provided more variety of browsing features than hospitals portals in Asia.

Personalization and Customization We further examined 2 sub-dimensions: Information Customized by User (ICU) and Information Customized by Organization (ICO). Only 9 of the hospital portals provided such features. Henry Ford Hospital US, and Alegant Hospital US are examples of hospitals that provide personalization and customization features.

Accessibility (A) Only six hospital portals from both geographical regions provide accessibility feature, through either multilingual support or multiple interfaces (i.e. intensive and low graphics, text interface).

Information Presentation (IP) Majority of the hospital portals and all portals from North American region provided at least one medium to aid in information presentation. Wockhardt Hospital India, John Hopkins Hospital US, and Cleveland Clinic US fulfill all the requirements in this dimension.

5.2 Knowledge Creation (KC)

KC refers to the mechanism through which an organization acquires information from users and creates new knowledge in the enterprise repository for the benefit of the organization and users. The results obtained from each of the sub-dimensions of the KC mechanism are shown in Table 2.

Acquisition of User Information (ACU) More than half of the hospital portals provided features to capture information from users.

Feedback (FB) This is an important feature and is listed as one of the mandatory features that a portal must have. All the hospital portals surveyed managed to obtain a full score in providing feedback.

Domain Data Acquisition (DDA) Only Chicago Comer Children's Hospital US, John Hopkins Hospital US, Mt. Sinai Hospital Canada, United Family Hospital China, and Pantai Group of Hospital Malaysia portals offered one of the domain data acquisition features.

Table 2. Evaluation results of the knowledge creation mechanism.

	Hospitals	ACUI	FB	DDA
N. America	Alegent Hospital, US	4.0	4.7	0.0
	Cleveland Clinic, US	4.0	4.7	0.0

	Comer Children's Hospital, US	0.0	4.7	1.0
	Henry Ford Hospital, US	4.0	4.7	0.0
	John Hopkins Hospital, US	2.7	4.7	1.0
	Mayo Clinic, US	4.0	4.7	0.0
	Mt.Sinai Hospital, CA	2.7	4.7	1.0
	St Michael Hospital, CA	1.3	4.7	0.0
	Stanford Hospital, US	0.0	4.7	0.0
	The Ottawa Hospital, CA	0.0	4.7	0.0
Asia	Alfred Hospital, AU	0.0	4.7	0.0
	King Faisal Specialist Hospital, SA	2.7	4.7	0.0
	MohanRao Memorial Hospital, IN	1.3	4.7	0.0
	National University Hospital, SG	0.0	4.7	0.0
	Pantai Group of Hospitals, MY	0.0	4.7	1.0
	Royal Adelaide Hospital, AU	1.3	4.7	0.0
	Starship Children's Hospital, NZ	0.0	4.7	0.0
	Tan Tok Seng Hospital, SG	1.3	4.7	0.0
	United Family Hospitals, CN	2.7	4.7	1.0
	Wockhardt Hospitals, IN	2.7	4.7	0.0

5.3 Knowledge Transfer (KT)

KT refers to the mechanism through which the knowledge is transferred or shared between the organization and users and among the users. The results obtained from each of the sub-dimensions of the KT mechanism are shown in Table 3.

Online Collaboration We further examined 3 sub-dimensions: Collaboration from Organization to User (COU), Collaboration Between Users (CBU), and Synchronous Support (SS). Overall, few of the hospital portals offered online collaboration features. Those that did are Alegent Hospital US, Henry Ford Hospital US, and MohanRao Memorial Hospital India that employed 'Ask an Expert' feature which allowed users to ask questions about specific topics. Only Johns Hopkins Hospital US provided features such as discussion forums and online groups to promote collaboration between users.

Information Alerts (IA) Our findings show that with the exception of Royal Adelaide Hospital, Australia, all hospital portals managed to have at least one feature to alert users to any new information.

Users Support (US) Three hospital portals, King Faisal Specialist Saudi Arabia, Alfred Hospital Australia, and Chicago Comer Children's Hospital US failed to provide any user support features. Mayo Clinic, Cleveland Clinic, and John Hopkins from the US, scored

the highest among all portals in this category by providing four of five features. None of the portals provided usage demos or tutorials to guide users on their services provided.

Resource Sharing (RS) Except for Alfred Hospital Australia, all sampled hospital portals managed to have at least one feature for resource sharing. Wockhardt Hospital India was the only portal that fulfilled all the requirements in this dimension.

Table 3. Evaluation results of the knowledge transfer mechanism.

	Hospitals	COU	CBU	SS	RS	US	IA
N. America	Alegent Hospital, US	2.3	0.0	0.0	2.1	0.7	2.4
	Cleveland Clinic, US	0.0	0.0	1.7	2.1	2.7	2.4
	Comer Children's Hospital, US	0.0	0.0	0.0	0.5	0.0	1.2
	Henry Ford Hospital, US	0.0	0.0	1.7	1.6	0.7	2.4
	John Hopkins Hospital, US	0.0	0.9	1.7	2.1	2.7	2.4
	Mayo Clinic, US	2.3	0.0	1.7	1.0	2.7	2.4
	Mt.Sinai Hospital, CA	0.0	0.0	0.0	1.0	0.7	2.4
	St Michael Hospital, CA	0.0	0.0	0.0	1.6	1.3	2.4
	Stanford Hospital, US	0.0	0.0	0.0	0.5	1.3	2.4
	The Ottawa Hospital, CA	0.0	0.0	0.0	1.6	0.7	1.2
Asia	Alfred Hospital, AU	0.0	0.0	0.0	1.0	0.0	0.0
	King Faisal Specialist Hospital, SA	0.0	0.0	0.0	2.1	0.0	1.2
	MohanRao Memorial Hospital, IN	2.3	0.0	1.7	1.0	0.7	2.4
	National University Hospital, SG	0.0	0.0	0.0	1.0	0.7	1.2
	Pantai Group of Hospitals, MY	0.0	0.0	0.0	1.6	0.7	1.2
	Royal Adelaide Hospital, AU	0.0	0.0	0.0	0.0	0.7	1.2
	Starship Children's Hospital, NZ	0.0	0.0	0.0	0.5	0.7	1.2
	Tan Tok Seng Hospital, SG	0.0	0.0	0.0	1.6	0.7	1.2
	United Family Hospitals, CN	0.0	0.0	0.0	1.6	0.7	1.2
	Wockhardt Hospitals, IN	0.0	0.0	0.0	0.5	0.7	3.7

6. Discussion and Conclusion

Results indicate that all selected 20 hospital portals utilized a combination of KA, KC and KT mechanisms. Overall, our results also suggest that North America hospital portals appeared to perform better than Asia hospital portals in terms of meeting the KM evaluation criteria. Specifically, the top seven hospital portals that were able to utilize KM mechanisms to access, create and transfer knowledge effectively and efficiently were all from North America.

Unsurprisingly, our results show that the KA mechanism was more prevalent than KC and KT mechanisms in most hospital portals. The most commonly available feature to support the KA mechanism is providing portal access to users via search engines. The most commonly available feature to support the KC mechanism was getting feedback from users. This finding is also consistent with the findings of Nah et al.[13] in their study on financial websites. The most uncommonly available feature for creating knowledge is acquiring domain/subject specific data from users. The most commonly available features to support KT mechanism is via resource sharing in terms of providing catalog information, external links to other websites and viewing information contributed by other users. Surprisingly, we find that supporting the KT mechanism via online collaboration among and between users is still lacking in many portals.

Our research has provided several important contributions. One major contribution is a comprehensive and systematic evaluation checklist that includes 13 dimensions and 52 items for hospital portals using KM mechanisms. We have thus taken an important first step to expand our knowledge on the relevance of KM mechanisms for hospital portals. This checklist may even be useful to portals outside the hospital domain that have been designed with a KM agenda. Second, we believe that the checklist and results obtained can be utilized by hospitals to develop highly interactive portals to meet users' expectations. Stakeholders should however decide whether these gaps should be addressed given the objectives and scope of their respective portals. In addition, the evaluation checklist does not include design and usability issues as these are sufficiently addressed in the literature. Developers should therefore use our checklist in conjunction with established usability instruments and guidelines during portal implementation.

There are two main limitations in our study. First, the selection of portals was limited to hospitals from North America and Asia that are available in English; this may prevent generalization. Future work can look into evaluating portals in other languages, and from other regions. Second, there are currently many portals that also provide healthcare information but are not operated by hospitals. Some of these are operated by the government (e.g. US Food and Drug Administration) and some by other business organizations (e.g. Healthcentral.com). Future work can look into evaluating these non-hospital portals and examine the differences between them and hospital portals in terms of accessing, creating and transferring health related information and knowledge.

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