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An Analysis of Knowledge Management Mechanisms in Healthcare Portals

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Abstract

Healthcare portals are becoming increasingly popular with Internet users since they play an important role in supporting interaction between individuals and healthcare organizations with a web presence. Additionally, many of these organizations make use of knowledge management mechanisms on their healthcare portals to manage the abundance of health related information, exchange and share information with their users. Hence, the objective of this study is to evaluate the extent to which knowledge management mechanisms can be supported by healthcare portals.

This paper presents a comprehensive analysis of knowledge management mechanisms used by 60 healthcare portals to access, create and transfer knowledge. We selected healthcare portals from two geographical regions (i.e. North America and Asia) and three healthcare portal provider categories (i.e. hospital, government, non-government). We found that healthcare portals from different geographical regions and portal provider categories differ significantly on how they used their portals to access, create and transfer knowledge. The results of this study can be used by healthcare portal providers to enhance their knowledge management practices and improve their customer service relationships.

Keywords: Portals; healthcare; checklist; knowledge management; knowledge access; knowledge creation; knowledge transfer

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Introduction

The Internet has emerged as a valuable tool to distribute knowledge and to communicate with worldwide audiences. It has been found that that 80% of American Internet users have searched for health related topics (Fox and Fallows 2003) and approximately 117 million adults look for healthcare information online (Krane 2005). Clearly, as the number of people looking for health information online increases rapidly, the demand for healthcare portals, which typically provide such information, surges (Bernard and Wisnicki 2000).

Ensuring credible and timely content is crucial for any website and/or portal. In particular, healthcare portals must provide up-to-date and relevant information since misplaced truths may sway a serious health decision (URAC 2006). As such, effective information management and knowledge management (KM) to ensure that the contents are timely, credible and accurate is a responsibility of healthcare portals. Here, we would like to distinguish between information management and knowledge management. Even though the terms information and knowledge are often used interchangeably, they have significantly discrete meanings. While information is defined as data endowed with relevance and purpose (Drucker 1988), knowledge is richer, deeper and more valuable than information (Davenport 1997). Specifically, knowledge refers to the information that facilitates action or information with direction (Jensen and Meckling 1996; Jurisica 2000; Alavi and Leidner 2001). KM is often viewed as a collection of processes that govern the creation, dissemination, and utilization of knowledge in an organization (Nonaka 1994; Davenport and Prusak 1998; Alavi and Leidner 2001).

Past studies have shown that KM is an effective technique to store, manage and use information in an organization (Mack, Ravin and Byrd 2001). Specifically, KM helps in

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identifying strengths and weakness, problem solving, dynamic learning, creating opportunities, and strategic planning (Gupta, Lyer and Aronson 2000). In addition, KM provides the process to help both the organization and user to capture, store, organize and share the knowledge within and across communities effectively (Mack, Ravin and Byrd 2001). Hence, it seems intuitive to relate KM mechanism to studies on portals since portals are considered to be tools to revolutionize the access to information and knowledge (Cloete and Snyman 2003).

Undoubtedly, the Internet enables individuals to access a huge amount of information. As such the ability to seek information through various retrieval mechanisms and the ability to evaluate the information have become key requirements for the success of any website Tabatabai and Shore (2005). Hence, it is not surprising that many past studies have advocated the importance of evaluating the various websites features (Luo and Najdawi, 2004; Nah, Siau, Tian and Ling 2002; Nah, Siau and Tian 2005). Past studies on healthcare portal evaluation were focused on evaluating quality, contents, and credibility of the portals e.g. (Luo and Najdawi 2004; Fritch 2003; Kim, Eng, Deering, and Maxfield 1999). However, despite the plethora of related works, there are currently no standardized guidelines on the effective features to be included in healthcare portals. As discussed earlier, KM focuses on the information that facilitates action. Since the focus of this study is on the influence of a portal's features on both portal users' and portal providers' subsequent actions and decisions to access, create and transfer knowledge, it is therefore appropriate to approach this study from a KM lens. Further, a KM perspective of evaluating Internet healthcare portals remains a relatively uncharted research frontier.

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The objective of this study is to evaluate various interactive features used by healthcare portals to facilitate knowledge management and collaboration between healthcare portal providers and users. We examined different categories of healthcare portals providers (i.e. hospital, government and non-government) and healthcare portals from different geographical regions (i.e. North America and Asia-Pacific). We developed a systematic and structured approach to evaluate how well the portals capture and deliver information to the users about the organization's processes, products, services, and customers from the perspective of three KM mechanisms (i.e. knowledge access, knowledge creation and knowledge transfer). We also identified essential features for these knowledge management mechanisms that are critical for healthcare portals. Specifically, we aim to explore the following research questions:

What are the commonly available features for accessing, creating and transferring knowledge in healthcare portals?

Are there any significant differences for healthcare portals in different geographical regions in terms of accessing, creating, and transferring knowledge?

Are there any significant differences for different categories of healthcare portals in terms of accessing, creating and transferring knowledge?

Literature Review

Internet Portals and Their Evaluation

Various definitions of Internet portals can be found in past studies. Some studies defined Internet portals as single-point-access software systems to provide easy and timely access to

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information and to support communities of knowledge workers who share common goals (URAC 2006). 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 (Kotorov and Hsu 2001). Finally, there are other studies that viewed Internet portals as tools to revolutionize access to information and knowledge (Cloete and Snyman 2003). In this study, we adopt this viewpoint and regard Internet portals as KM tools. Furthermore, we argue that KM mechanisms form an important underpinning in helping healthcare portal providers and Internet users' access, create and transfer knowledge.

An important aspect of healthcare is information sharing and communication for the purposes of patient care and treatment (Masseroli, Visconti, Bano, and Pinciroli 2006). Hence, healthcare portals typically contain features that allow online health information seekers to be better informed and connected with other like-minded people (Gupta, Lyer, and Aronson, 2000). Additionally, past studies have shown that online health information seekers not only have high demand for healthcare information but they also frequently look for information related to products and services offered by the portal provider (Bernard and Wisnicki 2000). In sum, the primary purpose of healthcare portals is to facilitate improvements in healthcare quality and efficiency by providing online educational information to the users in the form of discussion forums, useful articles, newsletters, interactive tools, and other useful health related resources.

Hence, healthcare portals are increasingly becoming an essential gateway to support interaction between individuals and healthcare organizations. Given that health information on the Internet is heavily accessed by the public, healthcare and medical professionals are concerned about the ramifications of inadvertently publishing erroneous health information.

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This concern has created interest among the healthcare professionals to develop tools for assessing the accuracy of health information (Fritch 2003).

Various methods of assessing and evaluating websites and portals have been done in past studies. Nielsen's (1994; 2000) heuristic evaluation is one of the most popular usability inspection methods to evaluate portals. Fritch (2003) also proposes a set of heuristics, tools and systems to help evaluate health information on the Internet. For portal quality evaluations, Dragulanescu (2002) proposes the use of total quality management specific tools and techniques. The study focuses on factors such as accuracy, authority, coverage, currency, density, interactivity, objectivity, and promptness. Work done by Kim, Eng, Deering and Maxfield (1999) seeks to evaluate the credibility of healthcare portals. This study identifies rating tools which has explicit criteria for evaluating healthcare websites. Examples of the factors that are identified include content, design, aesthetics, disclosure of authors and sponsors. Another important criterion for healthcare portals evaluation relates to trust building issues (Luo and Najdawi 2004). On this aspect, healthcare portals typically adopt measures such as online privacy policies and participating in third party seal programs. Hence the five measures identified to evaluate trust building issues are self-regulating policies, source disclosure, owner disclosure, third party seals, and established branding. Finally, Nah, Siau, Tian and Ling (2002) and Nah, Siau, and Tian (2005) evaluate how e-commerce and financial service websites disseminate, acquired and share knowledge using KM mechanisms. However, to our knowledge, no study has attempted to conduct a comprehensive healthcare portal evaluation using KM mechanisms.

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Knowledge Management Framework

A number of models to represent KM elements have been proposed in past KM studies. One of the most important models is the AOD Model developed by Schwartz and Brasethvik. (2000) which deals with three distinct elements: acquisition, organization and distribution. According to them, acquisition is concerned with how to collect knowledge from members of the organization or other resources, and store that knowledge in an organizational memory; organization is concerned with structuring, indexing, and formatting the acquired knowledge; and distribution deals with how to get the relevant knowledge to the person who needs it at the right time. The main focus of their study is to explore various methods that can be employed to deliver the organizational knowledge to the users to execute actions. It should be noted that this model did not include the flow of knowledge between the different users. Another important KM model is that proposed by Tiwana (2000) which detailed a three-phase customer knowledge cycle which considers customer knowledge as the main criteria. This model consists of three broad phases which runs in parallel: acquisition, sharing and utilization.

Drawing on these two models, Nah, Siau, Tian and Ling (2002) developed a KM model to stress the importance of effective management of customer knowledge in e-commerce applications. Their research model is similar to the AOD model except that it includes knowledge sharing which is an important mechanism for e-commerce sites. The other mechanisms included in the model consist of knowledge dissemination, knowledge acquisition and knowledge sharing mechanisms which are important mechanisms to study the exchange and share of information among user communities and between users and organizations. The difference between these two models is that knowledge dissemination

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element is used in place of knowledge utilization. According to Nah, Siau, Tian and Ling (2002), knowledge dissemination was used because they found that this was more appropriate for e-commerce sites. Moreover, knowledge dissemination can be directly observed from e-commerce sites whereas knowledge utilization is internal to the organization and cannot be observed from e-commerce sites. Nah, Siau and Tian (2005) further tested this model on financial service websites and found that KM mechanisms are effective for evaluating such websites.

Research Model

While the research model by Nah, Siau and Tian (2005) has its strengths when compared to the other models, it is more applicable to e-commerce Web sites, and does not include relevant KM mechanisms that could be potentially useful to healthcare and elsewhere. In our work, we extended their model to address this issue. Our modified model as shown in Figure 1 consists of three main elements: Knowledge Access, Knowledge Creation, and Knowledge Transfer. Additionally, we explicitly specified the flow of knowledge between the different participants (i.e. users, healthcare portal providers) for each of the KM mechanisms in the model. From the KM perspective, the direction flow of knowledge between users and healthcare portal providers is important but is not captured in past models. Specifically, it will alert portal providers of the roles and responsibilities of the initiator/recipient in each of the KM mechanisms and hence enable portal providers to be more effective in service deployment. The descriptions of the three mechanisms follow next.

Insert Figure 1

Lee, C.S., Goh, D.H., and Chua, A. (2010). An analysis of knowledge management mechanisms in healthcare portals. *Journal of Librarianship and Information Science*, 42(1), 20-44.

The *Knowledge Access (KA) mechanism* refers to the mechanisms through which users access the portal and its information. Specifically, users can access knowledge through searching, browsing, personalization, accessibility options, multimedia, and multi-lingual support. The mechanism highlights the importance of tools that are able to integrate capabilities for searching information with greater precision and tools that are able to personalize the content and presentation of the interface (Davies et al. 2005).

The *Knowledge Creation (KC) mechanism* refers to the process of capturing users' information such as demographics, preferences and behaviours (Nah, Siau and Tian 2005) and creating new knowledge that will benefit portal providers and the users (Smith 2000). The knowledge creation process is a continuous and cumulative process that should consequently improve the future business value of the portal providers (Bhatt 2000). The mechanism emphasizes techniques and processes that are able to capture users' information and create value from it.

The *Knowledge Transfer (KT) mechanism* refers to the mechanisms that allow the portal providers to foster user-to-user and provider-to-user sharing of knowledge (Nah, Siau and Tian 2005). Specifically, this mechanism highlights tools that enable user to share their knowledge with fellow users as well as tools to interact directly or indirectly with experts, advisors, and customer representatives. This mechanism is included in the model because knowledge transfer can facilitate design and delivery of services in a more effective, efficient, and responsive fashion.

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Methodology

This section describes the data collection and portal evaluation process. First, we discuss the sample selection criteria and procedure. Next, we elaborate on the evaluation criteria formation. Lastly we discuss how the sampled healthcare portals were evaluated.

Data Collection

There are varieties of healthcare portals and they may come from different countries, belong to different categories of organizations or available in different languages. Healthcare portal providers include government, support groups, clinics/hospitals, media, medical databases, charity sites, pharmaceutical sites, sales sites, non-governmental and personal sites (Sillence, Briggs, Harris and Fishwick 2006). For this study, we focused on healthcare portals from the following categories of providers: hospitals, governments, and non-government organizations (NGO) from the following geographical regions: North America and Asia-Pacific. Healthcare portals that are not available in English were excluded.

As mentioned in the earlier section, there is a lack of standard evaluation criteria to determine the features of a good healthcare portal. As such different criteria have been used in different geographical regions to determine and recognize top healthcare portals. First, some countries confer formal awards to their top healthcare portals (Strategic Health Care Communications 2005). For example, in the USA, eHealthcare Leadership Awards are given annually to healthcare organizations to recognize their efforts in creating outstanding healthcare portals (Medseek 2005). Second, other healthcare portals utilized ratings from third-party agencies (e.g. alexa.com) to distinguish themselves from others healthcare portals.

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Third, many healthcare portals also employ self-regulating policies and third-party seals like HON Code and TRUSTe to assure the users the authenticity of their portals.

Our selection of top healthcare portals for evaluation was done on the basis of a combination of the criteria discussed above and is consistent with our earlier preliminary work done in this area (Lee, Goh, and Chua 2007). It should be noted that Yahoo!, Google and MSN search engines were initially used to search for the portals. The portals selected belonged to countries such as USA, Canada, Jamaica, Australia, China, India, Indonesia, Korea, Malaysia, New Zealand, Pakistan, Philippines, Singapore, and Saudi Arabia. The hospital sites selected from USA are rated among the top 16 in the recent survey of Best Hospitals 2005 conducted by US News & World Report (U.S. News & World Report 2006). Five North American hospital portals listed are also the recipients of eHealthcare Leadership Awards. Similarly healthcare portals in government category like HealthyOntario and non-government organization category such as HealthGrades, HealthForums, News Rx are also recipient of eHealthcare Leadership Awards (Medseek 2005). Our final sample size consisted of 60 healthcare portals is shown in Table 1.

Insert Table 1

Evaluation Checklist Formulation

Checklists are widely used in quality assurance to check process compliance, standardization and error prevention. A checklist lists the criteria and specifies the presence or absence of the results (Shank 2006). Specifically, a sound evaluation checklist clarifies the criteria; aids the evaluator not to forget important criteria; and enhances the assessment's objectivity, credibility, and reproducibility (Stufflebeam 2006). As such, a checklist is useful in

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monitoring an enterprise, checking its compliancy, and assessing its outcomes. Furthermore, a checklist lists the criteria and specifies the presence and absence of the results, it makes it easy to assess because it does not require the evaluator to make in between judgments. For these reasons, we deem the use of an evaluation checklist to be appropriate for evaluating portals.

Checklists are valuable evaluation devices when they are carefully developed, validated and applied. Hence, the formulation of an evaluation checklist is important and these steps need to be noted. First, to ensure unbiased evaluation, items included in the checklist are not domain specific so as to cater for all portals in the healthcare domain and all audience (men, women, seniors, disabled). Second, items in the evaluation checklist are based on both practical and theoretical perspectives. Specifically, we identified items/criteria that are most relevant and important for healthcare portals from the literature and cross referenced these items/criteria with the features available on our sampled portals. Third, since the focus of this study is on KM mechanisms, we focus on interactive features that are relevant to the management of knowledge for healthcare portals. As such, some important interactive features related to other domains (e.g. content management, security) may be excluded.

Our evaluation checklist consists of 52 items or questions that were derived by reviewing the features available on the selected portals and with reference from past research. These checklist items are grouped under sub-dimensions based on similar functionalities. These collections of sub-dimensions are further grouped into dimensions. Finally, the collections of dimensions are grouped under the three KM mechanisms. We conducted an iterative process to develop the checklist used for evaluation in this study. Specifically, three members of the research team were involved in the classification of the items to the appropriate KM

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dimension and inclusion of the items in the checklist. Any disagreements were discussed until there were no further disagreements. The final checklist classification was further pre-tested by another three members of the research team who were not involved with the identification and classification of the checklist items. For the pre-test, we achieved an inter-coder reliability of 0.9 which is within the acceptable range.

Based on the three modified KM mechanisms in our research model, 13 dimensions are formed across the three KM mechanisms. The descriptions of the dimensions in KA, KC and KT mechanisms are shown in tables 2, 3 and 4 respectively. The detailed checklist questions used by the research team to evaluate the portals are shown in Appendix A.

Insert tables 2 to 4

Portal Evaluation Approach

As discussed earlier, the 60 portals chosen for evaluation belonged to three healthcare portal categories, namely, hospital owned portals, government portals, and non-government organization owned portals. The number of portals was evenly split into the three portal categories, i.e., 20 portals from each category. Each portal was evaluated by two authors independently in all the three categories, making a total of 40 portals evaluation by each author. 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 the Cohen's Kappa test ranged from 0.77 to 1.0 and suggest a high degree of agreement between evaluators. Our portal evaluation approach consisted of the following three steps.

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Step 1: Rating Scheme

For each checklist item, the rating could be 'Yes' or 'No' based on whether those features were supported by the portals. 'Yes' and 'No' was assigned a rating of 1 and 0 respectively which denoted the existent or non-existent feature in the portal.

Step 2: Weighting Scheme

This study adopted the technique of assigning the weighting criteria as applied by previous studies conducted by (Edmonds and Urban 1984). This technique was modified to fit the application of current evaluation checklist. They suggested the usage of the Delphi technique in assigning the weight. 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. The technique is suitable to fit the gap of traditional quantitative techniques (Kaynak, Bloom and Leibold 1994). Each evaluator in the group assigned a weighting of between 1 to 5 scales to each sub-dimension independently, with five being the most important feature and one being the least important. When wide discrepancy weightings were given by different evaluators, 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 was divided with the number of questions or checklist items. This approach is similar to the work done by Loo (2002) and Goh et al. (2006).

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Step 3: Scoring

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

Lastly, ANOVA tests and t-tests were conducted to compare the overall performance of the three portal categories and two geographical regions in terms of accessing, creating and transferring knowledge.

Analysis and Findings

In this section, we present our findings on how well our selected healthcare portals from the different portal categories scored for each of the KM mechanisms.

Knowledge Access (KA)

The KA mechanism refers to the means through which users get access to the portal and information in the portal. The results for each of the sub-dimensions of KA mechanisms are shown in table 5 for hospital portals, table 6 for government portals and table 7 for non-government portals.

Insert tables 5 to 7

Access to Portal

This dimension evaluates the probability of portals appearing on the first page of at least one search engines. All hospital portals were accessible from the top search engines which rank these portals as most popular or the best-known pages when search terms such as “best

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hospitals” or “best hospital websites” followed by the country name or city name were used. Alternatively, some of the healthcare portals were selected from the list of hospital websites maintained by Massachusetts General Hospital US and Harvard University US. This was retrieved from the search engines by querying for “listing of hospitals websites worldwide”.

All government portals were also easily accessible from the top search engines. Basic keywords were used during the search such as “Ministry of Health”, “Department of Health”, “Government Health”, “National Health”, “Health”, or “Medical” and followed by country name, state, or province. The US Food and Drug Administration (FDA) portal was linked from FirstGov.gov which is the US Government’s Official Web Portals. However, we found that NGO portals were rather difficult to be accessed from search engines. Specifically, we found that NGO portals typically appeared on the first result page of search engines only if the user entered near exact names of the portal.

Searching

This dimension evaluates the different methods of finding information by using words or concepts. Searching consists of two sub-dimensions: queries and results. Both sub-dimensions carry different weights. Query features include free-text search, advanced search, and recommended search. Result features include capabilities to sort and narrow the search results. With the exception of MohanRao Memorial Hospital India, the query feature existed in all other portals. However, advanced search features such as to expand or modify search results were usually not available. All government portals provided at least one query feature and more features to customize results as compared to hospital and NGO portals. With the exception of Natural Healthcare Canada, all NGOs portals had at least one query feature but did not provide extended features to sort and narrow results. In sum, we found that features to

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sort and narrow results were not common or popular in all the three categories of healthcare portals in our study.

Browsing

This dimension evaluates the exploration of information based on the organization on the collections or scanning lists, rather than by direct searching. Features evaluated were glossary, sitemaps and indexes. 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 while most of the US portals provided more variety of browsing features than hospitals portals in Asia-Pacific. Almost all government portals except for Department of Health Indonesia had at least one browsing feature. Queensland Health Australia and US Food and Drug Administration US were the top scorers by providing a complete set of browsing features. Surprisingly, only few NGO portals provide browsing features and none of the NGO portals fulfil all the requirements.

Personalization and Customization

This dimension evaluates the nature and level of personalization and customization offered by the portal for individual users. It consists of two sub-dimensions: information customized by users and information customized by organization. Both sub-dimensions carry different weights. Information customized by users includes features to create user profiles, to create collection of favorites, and to specify preferences. Information customized by organization includes information organization to suit specific users.

Very few hospital portals provided features to enable users to customize information based on their needs. Only 9 out of 20 hospital portals provided personalization and

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customization features. Henry Ford Hospital US, and Alegant Hospital US are examples of hospitals that provided personalization and customization features. Under government portals, HealthInsite Australia was the only portal which has a complete set of personalization and customization features. It should be noted that Ministry of Health South Korea did not provide information customized by user features but provided information customized by organization. NGO portals had the fewest personalization and customization features compared to other portal categories. HealthAtoZ US, Sympatico/MSN Canada, Dental Health Singapore, and Dental Association Malaysia had a full score for information customized by organization.

In sum, we found that features that customized information by users are rarely offered by healthcare portals. These features may not be suitable for government portals that cater to large audiences, but they could be more applicable to NGOs and hospital portals as part of the organizations' strategy to promote their services.

Accessibility

This dimension evaluates the various means through which people with disabilities can access the portal. The accessibility dimension included features such as multiple interfaces (e.g. intensive and low graphics, text interface) accessibility for visual and hearing impaired. Only six hospital portals from both geographical regions provided accessibility features, which was either multilingual support or multiple interfaces. Most government portals provided accessibility features including multilingual support, multiple interfaces and aids for the visually impaired, but failed to provide features for hearing impaired. An interesting finding of this study is that all NGO portals failed to provide any accessibility features for disabilities. Support for visually impaired and hearing impaired was rather difficult to find in

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most of the portals. Some US portals provided accessibility information but not features to aid users in accessing information. Some portals provided different font sizes to support users with failing eyesight.

Information Presentation

This dimension evaluates how information is delivered or presented on the portal. Features to be evaluated under this dimension include different type of information delivery or visualization methods, which were images, video files, audio files, and animations used as information needs. The results showed that majority of the hospital portals and all portals from North American region provide at least one medium to aid in information presentation. Wockhardt Hospital India, Johns Hopkins Hospital US, and Cleveland Clinic US fulfilled all the requirements in this dimension. Under the government category, North American portals provided more ways to aid in information presentation as compared to Asia-Pacific portals. National Cancer Institute US and US Food and Drug Administration US fulfil all requirements. NGO portals from North American region offered more medium to aid in information presentation than NGO portals in Asia-Pacific. In sum, few healthcare portals employed different types of information presentation techniques to prevent information overload and to improve on the content presentation.

Knowledge Creation (KC)

The KC mechanism refers to the means through which organizations acquire information from users and create new knowledge in the enterprise repository for the benefit of the organization and users. The results for each of the sub-dimensions of KC mechanisms are

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shown in table 8 for hospital portals, table 9 for government portals and table 10 for non-government portals.

Insert tables 8 to 10

Acquisition of User Information (AUI)

This dimension evaluates the mechanisms employed by the portal to acquire information about its users. The checklist items evaluated were membership sign-up, acquisition of contact information and personal information. More than half of the hospital and government portals provided features to capture information from users. In comparison, very few NGO portals provided tools to capture user information. Under the hospital category, we found that portals (i.e. Cleveland Clinic US, Mayo Clinic US, Henry Ford Hospital US, and Alegent Hospital US) that fulfilled all the requirements were from North America. Under the government category, Ministry of Health South Korea and US Food and Drug Administration fulfilled all the requirements. Under the NGO category, only four portals, eMedical Australia, Dental Association Malaysia, Dental Health Foundation Singapore, and HealthAtoZ US fulfilled all the requirements.

Feedback

This dimension evaluates the mechanisms employed by the portal to acquire feedback from its users. The feature evaluated in this dimension relates to whether users can provide feedback via the portal. All the hospital portals surveyed obtained a full score in providing the feedback feature. This feature was provided by all government portals with the exception of Department of Health Indonesia, Department of Health, Philippines, and Department of Health and Human Services US. Compared to the hospital and government portals, fewer

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NGOs employed the feedback feature on their portals. Specifically, portals from the hospital and government categories usually employed feedback feature for users to post any suggestions or comments regarding portal features or information. However, many of the NGO portals failed to provide this function in their design.

Domain Data Acquisition

This dimension evaluated mechanisms employed by the portal to acquire subject and domain specific data from users. The three items evaluated under this dimension relate to whether the portals use surveys and polls to acquire specific domain data or information from users. Domain data acquisition features were not widely supported across the three different healthcare providers' categories (i.e. hospitals, government and NGO portals). For the hospital category, only Chicago Comer Children's Hospital US, Johns Hopkins Hospital US, Mt. Sinai Hospital Canada, United Family Hospitals China, and Pantai Group of Hospitals Malaysia portals offered one of the domain data acquisition features. One would expect that data acquisition was an important means of data collection for government portals but surprisingly very few portals in this category provided surveys and polls. Moreover, the ones that attempted to acquire data only manage to offer two of the three features. As for NGO portals, very few employed any domain data acquisition features on their portals. Examples of NGO portals that provided at least one of the domain data acquisition features are MDAdvice US, Sympatico/MSN Canada, and Doctor.org Pakistan.

Knowledge Transfer (KT)

The KT mechanism refers to the means through which knowledge is transferred or shared between the organization and users and among the users. The results for each of the sub-

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dimensions of KT mechanisms are shown in table 11 (hospital portals), table 12 (government portals) and table 13 (non-government portals).

Insert tables 11 to 13

Online Collaboration

This dimension evaluates support provided by the portal for collaboration between the portal and its users, and among users. This dimension consists of three sub-dimensions, which are collaboration from organization to user (COU), collaboration between users (CBU), and synchronous support (SS). Collaboration from organization to user evaluates support provided by the portal (e.g. Ask an Expert feature). Overall, only few hospital portals offered online collaboration features. Those that did are Alegent Hospital US, Henry Ford Hospital US, and MohanRao Memorial Hospital India which employed an 'Ask an Expert' feature that allowed users to ask questions about specific topics. Only Johns Hopkins Hospital provides features such as discussion forums and online groups to promote collaboration between users. Under the government category, Health Ontario Canada, National Cancer Institute US, and HealthInsite Australia provided the "Ask an Expert" feature. Three portals from Asia-Pacific, Ministry of Health New Zealand, Department of Health Philippines, and Ministry of Health South Korea provided features to allow collaboration. None of the government portals from North America employed any such features. In comparison with hospital and government portals, NGO portals offered more online collaboration features. It should be noted that Johns Hopkins Hospital US, Mayo Clinic US, Henry Ford US, Ministry of Health South Korea, Department of Health Philippines, eMedical Australia, and MDAdvice US, were the only

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portals that offered more variety of online collaboration features even though these portals did not offer complete online collaboration features.

Resource Sharing (RS)

This dimension evaluates the supply of information available on the portal for users to browse and search. Features evaluated are catalog of information, external links to other websites, and viewing information contributed by other users. Except for Alfred Hospital Australia, all hospital portals had at least one feature for resource sharing. Wockhardt Hospitals India was the only portal under this category that fulfils all the requirements. All government portals offered at least one resource sharing feature. Queensland Health Australia and the Department of Health and Human Services US provide all mentioned resource sharing features on their portals. Two of the NGO portals, Dental Association Malaysia and NewsRx US, did not provide any resource sharing capabilities. Interestingly, providing external links to other websites was a popular feature in both hospital and government portals but not so in NGO portals.

Users Support (US)

This dimension evaluated the extent and depth of user support provided by the portal to find required information easily and quickly. It consisted of five checklist items, which were FAQ, helpdesk or hotline, help, search tips, and how-to-use demos or tutorials. Three hospital portals, King Faisal Specialist Saudi Arabia, Alfred Hospital Australia, and Comer Children's Hospital US failed to provide any user support features. Mayo Clinic, Cleveland Clinic, and Johns Hopkins from US, score the highest among other portals in this category by providing

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four of five features. None of the portals in this category provided how-to-use demos or tutorials to guide users on the services provided by the portals.

All government portals have at least one user support feature. Specifically, FAQ was a popular feature in government portals. Most government portals provided four out of five features compared to hospital portals. Features in this dimension were not commonly found in NGO portals. Only three portals, HealthAtoZ US, Natural Healthcare Canada, and Doctor.ork.pk Pakistan provide at least one of the features in this dimension.

Information Alerts (IA)

This dimension evaluates the delivery of news and alerts to users. It consists of seven checklist items, which are newsletters, what's new, events calendar, email alerts, mobile alerts, update frequency, and RSS feeds. The finding showed that with the exception of Royal Adelaide Hospital Australia, all hospital portals have at least one feature to alert users for any new information. Similarly, all the government portals provided at least one feature to alert users for new information. In fact, the US Food and Drug Administration portal provided six of the seven mentioned features. NGO portals scored the lowest for this sub-dimension compared to other portal categories. All in all, government portals seem to offer more information alert features than the other two portal categories.

The effect of Geographical Region and Category in evaluation

To compare the overall performance of the three portal categories and two geographical regions, a two-factor ANOVA was performed. The analysis revealed that there was a significant main effect for the geographical region factor ($F(1) = 11.24, p < .05$), a significant main effect for the category factor ($F(2) = 20.04, p < .05$), and significant interacting effect

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between region and category ($F(2) = 3.61, p < .05$). The results indicate that both geographical region and healthcare organization category contribute significant differences to the overall portal evaluation in terms of meeting the checklist criteria.

Portal performance by geographical regions

To compare whether there are any significant differences between portals in the geographical regions in terms of accessing, creating and transferring knowledge, a t-test was conducted. Our results show that there was a significant effect ($t(50) = -2.58, p < .05$) with portals from North America receiving higher scores than portals from Asia-Pacific. Hence, our results indicate that portals from North America perform better than Asia-Pacific portals in terms of accessing, creating and transferring knowledge.

Portal performance by healthcare portal provider categories

Figures 2 to 4 show the portal performance by the three healthcare portal provider categories. The percentages were calculated by dividing the number of features of a given portal by the total number of features listed in the evaluation checklist. On average, NGO portals scored less than 50%. HealthAtoZ US scores the highest among all NGO portals with 42%. US Food and Drug Administration scores the highest among all government portals with 74%. Cleveland Clinic US, which is nominated as one of best hospital portals scores.

Insert Figures 2 to 4

Discussion

This research aims to explore the following research questions:

What are the commonly available features for accessing, creating and transferring knowledge in healthcare portals?

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Are there any significant differences between healthcare portals in different geographical regions in terms of accessing, creating, and transferring knowledge?

Are there any significant differences for healthcare portals from different categories of healthcare portals providers in terms of accessing, creating and transferring knowledge?

Our results indicate that all selected 60 portals utilized a combination of KA, KC and KT mechanisms in varying degrees. Overall, our study supports the finding of past work indicating that different healthcare portals provide varied features and information depending on the provider and health issues (Strategic Health Care Communications 2005). Additionally, our results show that the KA mechanism was more prevalent than the KC and KT mechanisms in most healthcare portals. This is not surprising since past studies have indicated that it is a natural progression for healthcare providers to turn available healthcare information into knowledge for visitors or potential visitors through the use of portal technology (Murray 1999).

The most commonly available feature to support the KA mechanism is their ability to be accessed via popular search engines easily. However, supporting the KA mechanism via the use of different accessibility features (e.g. textual/audio information to support visually/hearing impaired) seems to be lacking in most healthcare portals. This is definitely an area that healthcare portals should pay attention to since giving user the options to choose different types of access according to their preference is important. In fact, one of the most important objectives of an Internet portal is the ability to provide information that is personalized for each user (Murray 1999). Further, with the proliferation of wireless communication devices such as Personal Digital Assistants, it is likely that there will be an increasing need to provide information access to such mobile or wireless devices which is

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likely to be displayed and formatted differently due to the size of these devices. Hence, it is vital for healthcare portals to provide user the option to choose any types of information access depending on their needs and preferences.

The most commonly available feature to support the KC mechanism is getting feedback from users. In fact, the feedback feature is the most popular feature and is employed by most of the hospitals and government portals. This finding is also consistent with the findings of (Nah, Siau and Tian 2005) in their study on financial websites. The most uncommonly available feature for creating knowledge is acquiring domain/subject specific data from users. This is not surprising since acquiring domain and specific data from users maybe difficult and time consuming due to issues related to data privacy and confidential health information. Furthermore, unnecessary acquisition of specific data may turn users away. A way around the problem is for portals to put in place security and authentication measures to ensure users that information acquired will not be misused (Gummerus, Liljander, Pura, and Riel 2004).

The most commonly available feature to support the KT mechanism is via resource sharing in terms of providing catalogs of information, external links to other websites and viewing information contributed by other users. Surprisingly, we found that supporting the KT mechanism via online collaboration among users and between users and healthcare portal was still lacking in many portals. This is definitely an important area that healthcare portals should pay attention to because one of the most important aspects of healthcare portal is its ability to provide information exchange that may not be easily be found elsewhere (Gummerus, Liljander, Pura, and Riel 2004). For example, online discussion forums allow people to receive emotional support from others who are experiencing or have experienced similar health problems.

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Our results show that there are significant differences between portals from North America and Asia-Pacific in terms of supporting the three KM mechanisms. Specifically, we found that portals from North America performed better in meeting the evaluation criteria than portals in Asia-Pacific. This could be attributed to the demand for electronic health services being more prevalent in North America than in Asia-Pacific. In fact, in the USA, up to 80% of Internet users had sought healthcare related information on the Web by the beginning of 2002 (Taylor 2002). In addition, our results also suggest that healthcare portals and Internet users in Asia-Pacific differ from their counterparts in North America in accessing, creating and transferring healthcare information and knowledge. This is not surprising since there are potential disparities in health problems and beliefs across the two regions due to differences such as cultures, races, social economic backgrounds, and etc. Hence, this finding highlights that it is important for healthcare portal providers to understand the specific needs and cultures of their users during the development and implementation of their portals.

We also found that there are significant differences among the three categories of healthcare portals – hospitals, government, and NGO portals. Specifically, NGO portals which include commercial portals, scored the lowest among all portal categories in terms of meeting the evaluation criteria. Among all portal categories, government portals show slightly better scores than hospital portals in terms of meeting the evaluation criteria. This means that healthcare organizations such as hospitals and governments were more willing to invest time and money to develop more comprehensive portals sites than NGO portals. A possible explanation is these organizations have found that the Internet not only provides a

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way to reach out to consumers of general health related information but also for them to draw consumers to the services they provide (Murray 1999).

Contributions

Our research has provided several important contributions. One of the important contributions is to point out the relevance of knowledge management in developing and maintaining portals in organizations. Specifically, multiple past studies (e.g. Duffy, 2000, Broadbent 1998, Yeh 2000) have highlighted the importance of KM initiatives to the work done by information professionals in organizations. Our study further shows that knowledge management frameworks, and in particular, the present framework for knowledge access, creation and transfer, are definitely relevant to information professionals working on web portals management. Second, to our knowledge, this is one of few studies that attempt to provide a comprehensive and systematic evaluation checklist for healthcare portals using KM mechanisms. Thus, from this work, we have taken an important first step to expand our knowledge on the relevance of KM mechanisms in the healthcare domain. Third, we believe that the results obtained from this study can be utilized by a variety of organizations in developing highly interactive portals that meet users' expectations. Even though we focused on healthcare portals in our study, our findings are definitely applicable to portals in other domains as well. Specifically, web portals facilitate the collection, organization and dissemination of information and knowledge resources. Hence, our analysis provides a better understanding of the types of KM mechanisms and their associated features which will lead to better utilization of information and knowledge.

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Limitations and future work

There are several limitations in our study. First, the selection of portals was limited to three healthcare portal categories, two geographical regions and portals that are available in the English language; this may prevent generalization. Future work can look into evaluating portals in other languages, from other categories and geographical regions. Second, our checklist was derived based on the common set of interactive features employed by selected portals and with cross reference from past studies. However, more specific or important features for healthcare portals may be excluded from the checklist if they are not found in our selected portals. A possible area of future work is to include additional domain specific features (e.g. Body Mass Index calculation tool) that may not be relevant for all healthcare portals. To do this, a different set of criteria should be established to further expand the checklist. In addition, the scope of the evaluation model does not include design and usability issues as these are sufficiently addressed in the literature (e.g. Barnes and Vidgen 2003). Portal developers should therefore use our model in conjunction with established usability instruments and guidelines during implementation. Third, the various weights given to the sub-dimensions were assigned through discussion among the members of the research team. Even though we have adopted measures (i.e. iterative discussion, Kappa-test) to ensure the reliability of our results, the assigned weights may still be subjective due to the common background of members of the research team. We suggest that organizations that plan to implement or modify healthcare portals conduct a survey using a larger sample size from their organization members and customers to obtain a more generalized and unbiased weight assignment.

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Tables and Figures

Table 1 Data Sample

	Hospitals Healthcare Portals	Government Healthcare Portals	Non Government Healthcare Portals
N. America	Alegent Hospital, US www.alegent.com	Canada Health Portal, CA Chp-pcs.gc.ca/CHP/	CBC News Healthcare, CA www.cbc.ca
	Cleveland Clinic, US www.clevelandclinic.org	Dept. of HHS, US www.hhs.gov	Health Grades, US www.healthgrades.com
	Chicago Comer Children's Hospital, US www.uchicagokidshospital.org	FDA, US www.fda.gov/oc/buyonline	Health Scout, US www.healthscout.com
	Henry Ford Hospital, US www.henryford.com	Health Canada, CA www.hc-sc.gc.ca/index_e.html	HealthAtoZ, US www.healthatoz.com
	Johns Hopkins Hospital, US www.hopkinhospital.org	Health Ontario, CA www.HealthyOntario.com	HealthCentral.com, US www.healthcentral.com
	Mayo Clinic, US www.mayoclinic.com	Medicare and Medicaid, US www.cms.hhs.gov	HealthForums.com, US www.healthforums.com
	Mt.Sinai Hospital, CA www.mtsinai.on.ca	Medicare, US www.medicare.gov/default.asp	MDAdvice.com, US www.mdadvice.com
	St Michael Hospital, CA www.stmichaelshospital.com	Ministry of Health, JM www.moh.gov.jm	Natural Healthcare, CA www.naturalhealthcare.ca
	Stanford Hospital, US www.stanfordhospital.com	National Cancer Institute, US www.cancer.gov	NewsRx, US www.newrx.com
	The Ottawa Hospital, CA www.ottawahospital.on.ca	Ontario MOH, CA www.health.gov.on.ca	Sympatico/MSN, CA Medirource.sumpatico.ca
Asia-Pacific	Alfred Hospital, AU www.alfred.org.au	Department of Health, ID www.depkes.go.id/en/index_en.htm	All Ayurveda, IN www.allayurveda.com
	King Faisal Specialist Hospital, SA www.kfshrc.edu.sa	Department of Health, PH www.doh.gov.ph	ASHM, AU www.ashm.org.au
	MohanRao Memorial Hospital, IN www.mohanraohospital.com	Health Promotion Board, SG www.hpb.gov.sg	Dental Association, MY www.mda.org.my
	National University Hospital, SG www.nuh.com.sg	HealthInsite, AU www.healthinsite.gov.au	Dental Health Foundation, SG www.deantalhealth.org.sg
	Pantai Group of Hospitals, MY www.pantai.com.my	Medsafe, NZ www.medsafe.govt.nz/index.asp	Doctor.org.pk, PK www.doctor.org.pk
	Royal Adelaide Hospital, AU www.rah.sa.gov.au/homepage.php	Ministry of Health & Family Welfare, IN mohfw.nic.in	eMedical, AU www.emedical.com.au
	Starship Children's Hospital, NZ www.starship.org.nz	Ministry of Health, KR english/mohw.go.kr	Everybody, NZ www.everybody.co.nz
	Tan Tok Seng Hospital, SG www.ttsh.com.sg/asp/index.asp	Ministry of Health, NZ www.moh.govt.nz	Family Doctor, NZ www.familydoctor.co.nz
	United Family Hospitals, CN www.unitedfamilyhospitals.com	Ministry of Health, SG www.moh.gov.sg	Med India.com, IN www.medindia.net
	Wockhardt Hospitals, IN www.wockhardthospitals.net	Queensland Health, AU www.healthqld.gov.au	SingHealth, SG www.singhealth.com.sg

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Table 2 Description of the dimensions in KA Mechanism

Dimensions	Description
Access to Portal	This dimension evaluates the probability of portals appearing on the first page of at least one top search engines such as Yahoo, Google and MSN.
Searching	This dimension evaluates the different methods of finding information by using words or concepts. Searching consists of two sub-dimensions: queries and results. Both sub-dimensions carry different weights. Query features include free-text search, advanced search, and recommended search. Result features include capabilities to sort and narrow the search results.
Browsing	This dimension evaluates the exploration of information based on the organization on the collections or scanning lists, rather than by direct searching. Browsing refers to informal way of seeking information and includes features such as glossary, sitemaps and indexes which aids browsing
Personalization and Customization	This dimension evaluates the nature and level of personalization and customization offered by the portal for individual users. Personalization enables the creation of user profiles so that each user can arrange and organize the features and information relevant to them. Customization allows the portal to individually target the users and know their likes and dislikes This dimension is further differentiated as information customized by user and information customized by organization.
Accessibility	This dimension evaluates the various means through each people with disabilities can access the portal. It evaluates features such as multiple interfaces (intensive and low graphics, text interface), multilingual support, accessibility for visual and hearing impaired.
Information Presentation	This dimension evaluates how information is delivered or presented on the portal. It evaluates the different type of information delivery or visualization methods available on the portal. Information can be presented to the users in various forms such as text, graphics, images, audio, and video output.

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Table 3 Description of the dimensions in KC mechanism

Dimensions	Description
Acquisition of User Information	<p>This dimension evaluates the mechanisms employed by the portal to acquire information about its users.</p> <p>This dimension consists of three checklist items which are membership sign-up, acquisition of contact information, personal information, psychographic information and preferences.</p>
Feedback	<p>This dimension evaluates the mechanisms employed by the portal to acquire feedback from its users.</p> <p>Feedback feature facilitates the users to write back to the organization about any queries This may be done either by filling up a form and submitting online or by just sending email. The feedback helps the organization to collect information from the users regarding the evaluation and comments about the products and services.</p>
Domain Data Acquisition	<p>This dimension evaluates mechanisms employed by the portal to acquire subject and domain specific data from users.</p> <p>This dimension consists of three items relating to the use of surveys and polls. Surveys are used to gather specific information about the users needs on the portal contents and also on users' prior knowledge. Polls may be used to elicit feedback regarding the users' views and experiences about a particular topic. Polls can also be used for consensus building by enabling users to interact with each other to reach a mutual agreement</p>

Lee, C.S., Goh, D.H., and Chua, A. (2010). An analysis of knowledge management mechanisms in healthcare portals. *Journal of Librarianship and Information Science*, 42(1), 20-44.

Table 4 Description of the dimensions in KT mechanism

Dimensions	Description
Online Collaboration	<p>This dimension evaluates support provided the portal for collaboration between portal and user and among users.</p> <p>This dimension consists of three sub-dimensions, which are collaboration from organization to user, collaboration between users, and synchronous support. Collaboration from organization to user evaluates support provided by the portal like Ask an Expert feature.</p>
Information Alerts	<p>This dimension evaluates the delivery of news and alerts to the users.</p> <p>This dimension consists of seven checklist items, which are newsletter, what's new, events calendar, email alert, mobile alert, update frequency, and RSS feed aggregator.</p>
User Support	<p>This dimension evaluates the extent and depth of user support provided the portal to find required information easily and quickly.</p> <p>This dimension consists of five checklist items, which are FAQ, helpdesk or hotline, help, search tips, and how-to-use demo or tutorial.</p>
Resource Sharing	<p>This dimension evaluates the supply of information available on the portal for users to browse and search. Resource sharing makes it possible for users to browse or search in hyperlinks provided by the organization. This dimension consists of features such as catalog of information, external link to other website, and viewing information contributed by other users.</p>

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Table 5 KA Mechanism Evaluation Results of Hospital Portals

	Access to Portal	Searching		Browsing	Personalization and Customization		Accessibility	Info. Presentation
		Query	Results		Info. By Users	Info. By Orgn.		
North 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-Pacific								
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

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Table 6 KA Mechanism Evaluation Results of Government Portals

	Access to Portal	Searching		Browsing	Personalization and Customization		Accessibility	Info. Presentation
		Query	Results		Info. By Users	Info. By Orgn		
North America								
Canada Health Portal, CA	5.0	2.4	3.0	1.0	0.0	0.0	2.3	1.0
Dept. of HSS, US	5.0	2.4	1.5	1.0	0.0	4.3	0.8	3.0
FDA, US	5.0	2.4	3.0	3.0	0.0	4.3	2.3	4.0
Health Canada, CA	5.0	2.4	0.0	2.0	0.0	0.0	1.5	3.0
Health Ontario, CA	5.0	2.4	1.5	1.0	0.0	4.3	1.5	3.0
Medicare and Medicaid, US	5.0	2.4	1.5	1.0	0.0	4.3	0.0	1.0
Medicare, US	5.0	2.4	1.5	1.0	0.0	4.3	1.5	0.0
MOH, JM	5.0	1.2	1.5	1.0	0.0	0.0	0.0	0.0
National Cancer Institute, US	5.0	1.2	1.5	2.0	0.0	0.0	1.5	4.0
Ontario MOH, CA	5.0	1.2	0.0	2.0	0.0	0.0	1.5	3.0
Asia-Pacific								
Department of Health, ID	5.0	1.2	0.0	0.0	0.0	0.0	0.8	0.0
Department of Health, PH	5.0	1.2	0.0	1.0	0.0	0.0	0.0	2.0
Health Promotion Board, SG	5.0	1.2	0.0	2.0	0.0	0.0	0.0	3.0
HealthInsite, AU	5.0	3.7	1.5	1.0	3.3	4.3	0.8	1.0
Medsafe, NZ	5.0	1.2	0.0	1.0	0.0	4.3	0.0	0.0
MOH & Family Welfare, IN	5.0	1.2	0.0	1.0	0.0	0.0	0.0	0.0
MOH, KR	5.0	2.4	3.0	1.0	1.1	4.3	0.8	3.0
MOH, NZ	5.0	1.2	3.0	1.0	0.0	0.0	0.0	0.0
MOH, SG	5.0	2.4	0.0	1.0	0.0	4.3	0.0	2.0
Queensland Health, AU	5.0	1.2	0.0	3.0	0.0	0.0	0.8	2.0

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Table 7 KA Mechanism Evaluation Results of Non-Government Portals

	Access to Portal	Searching		Browsing	Personalization and Customization		Accessibility	Info. Presentation
		Query	Results		Info. By Users	Info. By Orgn		
North America								
CBC News Healthcare, CA	0.0	1.2	0.0	0.0	0.0	0.0	0.0	2.0
Health Grades, US	5.0	1.2	0.0	1.0	0.0	0.0	0.0	1.0
Health Scout, US	5.0	1.2	0.0	1.0	0.0	0.0	0.0	2.0
HealthAtoZ, US	5.0	1.2	0.0	1.0	0.0	4.3	0.0	1.0
HealthCentral.com, US	5.0	1.2	0.0	1.0	0.0	0.0	0.0	3.0
HealthForums.com, US	5.0	1.2	0.0	0.0	0.0	0.0	0.0	2.0
MDAdvice.com, US	0.0	3.7	0.0	1.0	0.0	0.0	0.0	2.0
Natural Healthcare, CA	0.0	0.0	0.0	2.0	0.0	0.0	0.0	1.0
NewsRx, US	0.0	2.4	0.0	0.0	0.0	0.0	0.0	1.0
Sympatico/MSN, CA	0.0	1.2	0.0	0.0	0.0	4.3	0.0	3.0
Asia-Pacific								
All Ayurveda, IN	0.0	1.2	0.0	0.0	0.0	0.0	0.0	1.0
ASHM, AU	0.0	1.2	0.0	1.0	0.0	0.0	0.0	1.0
Dental Association, MY	0.0	1.2	0.0	1.0	1.1	4.3	0.0	1.0
Dental Health Foundation, SG	0.0	2.4	0.0	1.0	1.1	4.3	0.0	1.0
Doctor.org.pk, PK	0.0	1.2	0.0	0.0	0.0	0.0	0.0	1.0
eMedical, AU	0.0	1.2	0.0	0.0	1.1	0.0	0.0	1.0
Everybody, NZ	0.0	2.4	0.0	2.0	0.0	0.0	0.0	1.0
Family Doctor, NZ	0.0	1.2	0.0	1.0	0.0	0.0	0.0	0.0
Med India.com, IN	0.0	1.2	0.0	1.0	0.0	0.0	0.0	1.0
SingHealth, SG	5.0	3.7	0.0	1.0	0.0	0.0	0.0	1.0

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Table 8 KC Mechanism Evaluation Results of Hospital Portals

	Acquisition of User Info.	Feedback	Domain Data Acquisition
North 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-Pacific			
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

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Table 9 KC Mechanism Evaluation Results of Government Portals

	Acquisition of User Info.	Feedback	Domain Data Acquisition
North America			
CBC News Healthcare, CA	0.0	4.7	2.0
Health Grades, US	2.7	0.0	0.0
Health Scout, US	4.0	4.7	2.0
HealthAtoZ, US	0.0	4.7	0.0
HealthCentral.com, US	2.7	4.7	2.0
HealthForums.com, US	1.3	4.7	0.0
MDAdvice.com, US	1.3	4.7	0.0
Natural Healthcare, CA	1.3	4.7	0.0
NewsRx, US	2.7	4.7	1.0
Sympatico/MSN, CA	0.0	4.7	1.0
Asia-Pacific			
All Ayurveda, IN	0.0	0.0	0.0
ASHM, AU	0.0	0.0	0.0
Dental Association, MY	0.0	4.7	1.0
Dental Health Foundation, SG	2.7	4.7	1.0
Doctor.org.pk, PK	1.3	4.7	0.0
eMedical, AU	1.3	4.7	0.0
Everybody, NZ	4.0	4.7	0.0
Family Doctor, NZ	0.0	4.7	0.0
Med India.com, IN	1.3	4.7	2.0
SingHealth, SG	1.3	4.7	0.0

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Table 10 KC Mechanism Evaluation Results of Non-Government Portals

	Acquisition of User Info.	Feedback	Domain Data Acquisition
North America			
CBC News Healthcare, CA	0.0	4.7	0.0
Health Grades, US	1.3	0.0	0.0
Health Scout, US	0.0	0.0	0.0
HealthAtoZ, US	4.0	4.7	0.0
HealthCentral.com, US	0.0	0.0	0.0
HealthForums.com, US	0.0	0.0	0.0
MDAdvice.com, US	1.3	4.7	1.0
Natural Healthcare, CA	0.0	4.7	0.0
NewsRx, US	2.7	4.7	0.0
Sympatico/MSN, CA	1.3	0.0	1.0
Asia-Pacific			
All Ayurveda, IN	0.0	4.7	0.0
ASHM, AU	0.0	4.7	0.0
Dental Association, MY	4.0	0.0	0.0
Dental Health Foundation, SG	4.0	0.0	0.0
Doctor.org.pk, PK	0.0	4.7	1.0
eMedical, AU	4.0	4.7	0.0
Everybody, NZ	0.0	4.7	2.0
Family Doctor, NZ	0.0	4.7	0.0
Med India.com, IN	2.7	4.7	0.0
SingHealth, SG	0.0	0.0	0.0

Lee, C.S., Goh, D.H., and Chua, A. (2010). An analysis of knowledge management mechanisms in healthcare portals. *Journal of Librarianship and Information Science*, 42(1), 20-44.

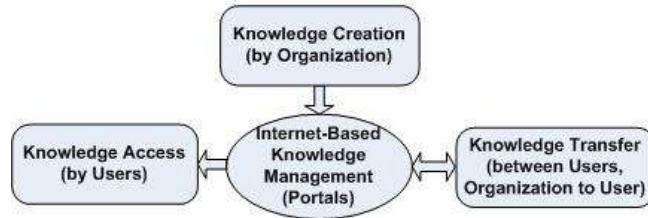


Figure 1 Research Model

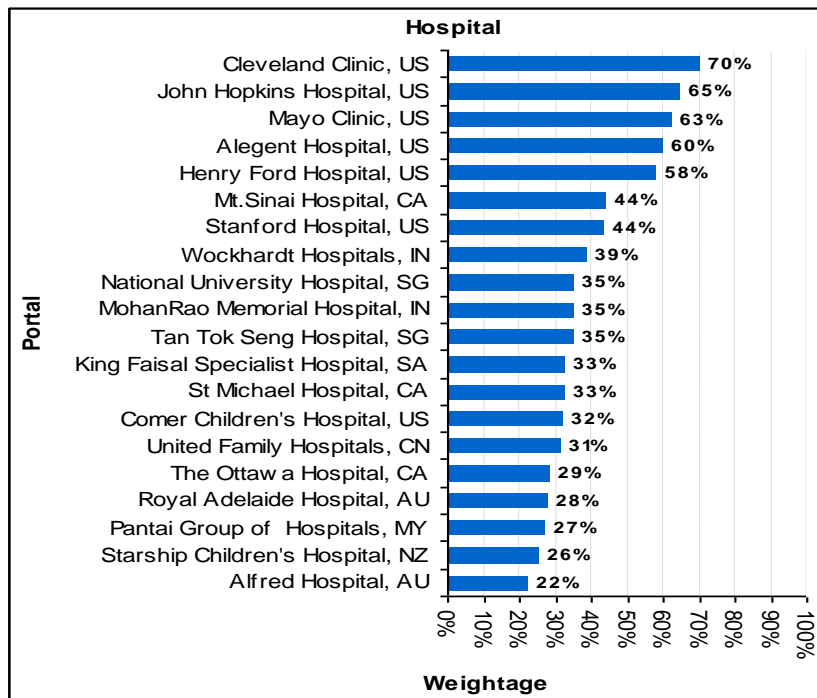


Figure 2 Portal Performances by Hospital Portals

Lee, C.S., Goh, D.H., and Chua, A. (2010). An analysis of knowledge management mechanisms in healthcare portals. *Journal of Librarianship and Information Science*, 42(1), 20-44.

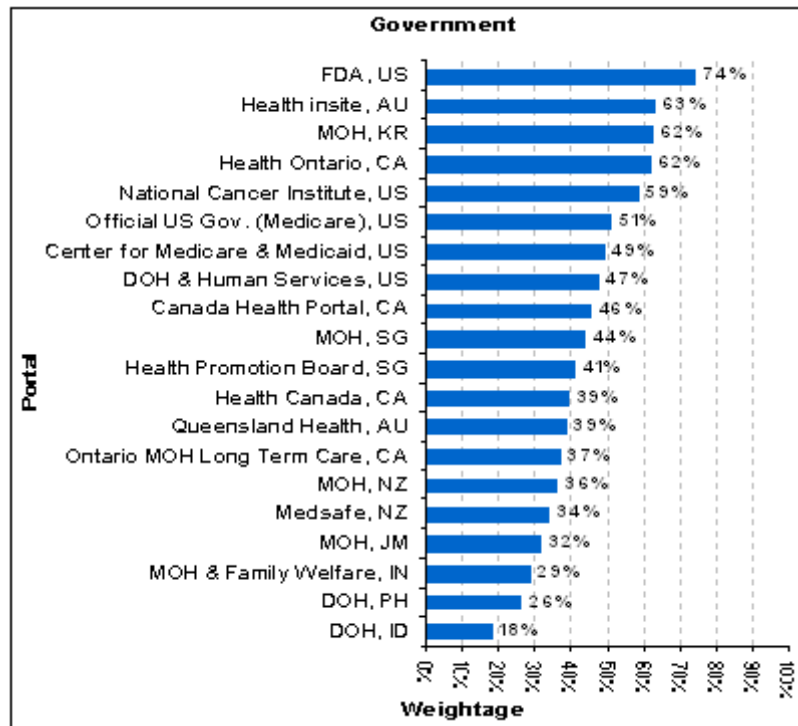


Figure 3 Portal Performances by Non-Government Portals

Lee, C.S., Goh, D.H., and Chua, A. (2010). An analysis of knowledge management mechanisms in healthcare portals. *Journal of Librarianship and Information Science*, 42(1), 20-44.

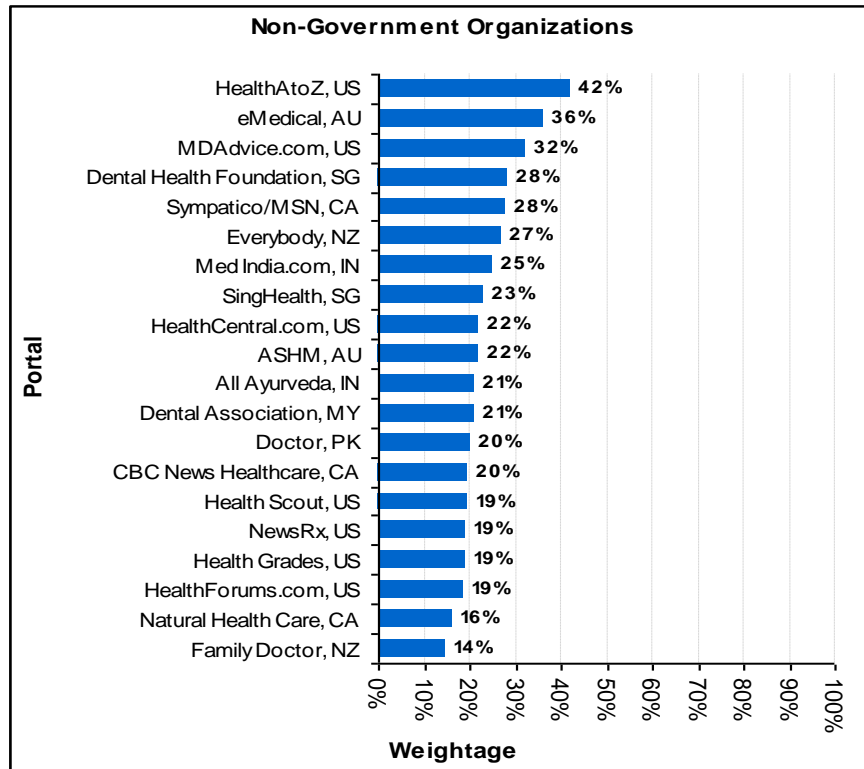


Figure 4 Portal Performances by Non-Government Portals

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Appendix A: Evaluation Checklist Questions

Knowledge Access Mechanism: The mechanism through which the user get access to the portal and information in the portals.

Dimensions	Sub-dimensions	Questions
Access to Portal Evaluates the probability of portals appearing in the search engines.		Is the portal listed on the 1 st page of searched results of search engine (Yahoo, Google, MSN)?
Searching Evaluates different methods of finding information, by using words or concepts.	Querying	Is a free text search provided?
		Is an advanced search provided?
		Are recommended searches provided?
	Result Display	Can results be sorted?
		Can users search within the results?
Browsing Evaluates the exploration of information to the organization of the collections or scanning lists, rather than by direct searching.		Is a Glossary provided?
		Is a Sitemap provided
		Is an Index provided?
Personalization and Customization Evaluates the nature and level of personalization and customization offered by the portal for individual users.	Information Customized by user	Can registered users create their own user profiles?
		Can registered users create a collection of favorites?
		Can registered users specify the types of information to be displayed/viewed (e.g. business, health, news, finance)?
	Information customized by organization	Is the information tailored for specific users? (e.g. seniors, children, men, women, adults, professionals, media, general public)
Accessibility Evaluates the various means through which people with disabilities can access Web. Encompasses all disabilities that affect access to the Web, including visual, auditory, physical, speech, cognitive, and neurological disabilities.		Does the portal support multiple interfaces like intensive graphics, text only and low graphics?
		Is multilingual support provided?
		Does the portal provide support for the visually impaired?
		Does the portal provide support for the hearing impaired?
Information Presentation Evaluates how information is delivered or presented on the portal.		Are images (graphics, illustrations and maps) used as information aid?
		Are video files used as an information aid?
		Are audio files used as an information aid?
		Is animation used as an information aid?

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Knowledge Creation Mechanism: The mechanism implemented by the organization to capture knowledge about/from the user

Dimensions	Sub-Dimensions	Questions
Acquisition of User Information Evaluates the mechanisms employed by the portal to acquire information about its users.		Is membership sign up provided?
		Does the portal acquire contact information?
		Does the portal acquire personal information? (e.g. age, gender)
Feedback Evaluates the mechanisms employed by the portal to acquire feedback from its users.		Can users provide feedback on the general portal features (e.g. via email or form)?
Domain Data Acquisition Evaluates mechanisms employed by the portal to acquire subject/domain specific data from users.		Are surveys conducted on portal features?
		Are general surveys conducted to know about public awareness or opinions on domain specific topics? (e.g. diseases, finances)
		Are there polls provided to rate the website or a particular document (e.g. articles, images, etc)?

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Knowledge Transfer: The mechanism implemented to foster user-to-user as well as organization-to-user sharing

Dimensions	Sub-Dimensions	Questions
<p>Online Collaboration</p> <p>Evaluates support provided by the portal for user-user/user-portal interaction and sharing.</p>	<p>Collaboration from organization to user</p>	Is Ask an Expert feature available?
		<p>Collaboration between users</p>
	Are Discussion Forums available?	
	Are Blogs available?	
	Are Wikis supported?	
	Is Instant Messaging available?	
	Is an Online Groups service provided?	
	<p>Synchronous support</p>	Can users email the web links/pages to a friend?
Is Online chat available?		
<p>Information Alerts</p> <p>Evaluates the delivery of news and alerts to the users.</p>		Are newsletters provided?
		Is a What's New Information provided?
		Is there an event's calendar provided?
		Does the portal provide e-email alerts?
		Does the portal provide Mobile Alerts?
		Is update frequency of documents indicated?
		Is RSS Feed available?
<p>User Support</p> <p>Evaluates the extent and depth of user support provided by the portal to find required information easily and quickly.</p>		Are FAQ available?
		Is Helpdesk/Hotline information available?
		Is "Help" provided online?
		Are search tips provided?
		Are Tutorials or "How-To-Use" demo provided?
<p>Resource Sharing</p> <p>Evaluates portals for the nature and extent of their own collection of information that can be both browsed and searched.</p>		Does the portal contain its own catalog of information?
		Are links provided to other websites for information?
		Does the portal display the information contributed by the users for sharing among other users?