



An AHP Approach to Assess Hospital Websites

A.V.S. Prasad

Research Scholar, Department of OR&SQC,
Rayalaseema University, Kurnool,
Andhra Pradesh, India

Dr.Y. Raghunatha Reddy

Assistant Professor, Department of OR&SQC,
Rayalaseema University, Kurnool,
Andhra Pradesh, India

ABSTRACT

Hospital Website is a site that furnishes patients/users with online information and information related services, such as clinical services, various types of treatments, symptoms of a disease, doctors availability, and a channel of communication with the hospital and peer users. These days, many people are using the internet to choose a proper hospital/medical center website with their required medical needs. Hence the quality of websites of hospitals / medical centers is very important to provide the required information of the patients or users. In this paper, we use one of the most popular multi criteria decision methods (MCDM); analytical hierarchy process (AHP) to choose a hospital / medical center website in Hyderabad.

Keywords: *Multi-criteria decision method (MCDM), Analytical hierarchy process (AHP). Quality metrics*

1. INTRODUCTION:

These days, time is critical factor in human life. Consequently, the organizations including hospital/medical centers, are attempting to give electronic administrations to the patients/users. Hospitals are extremely populated centers; hence they cause so many problems like viral diseases like cold and flu and also, high price of doctor's appointments, long lines of reception in hospitals and necessity of physical presence in laboratories, radiology and sonography centers to receive the results have led to an increase in using of hospitals/medical websites. Using the internet and communication technology

provides the hospital and medical centers with the following benefits: to provide more qualified services, to provide valuable information for their patients, to decline the expenditures, to have direct interaction with patients, to save their time, to increase efficiency, and finally to enable the hospitals/medical centers to overcome the competitors. Recently, we have seen a proliferation of electronic websites with a tremendous amount of information either with high quality, or with low quality, as well as sites that are out right misleading. Furthermore, there has been a rapid increase in the use of the internet for health information and advice. Nowadays, it is believed that prevention is prior to treatment. The explosion of the web and increase in hospital/medical websites has determined the need of comprehensive frame work to evaluate the aspects related to the quality of hospital/medical websites. The objective is to make a hospital /medical website useful, profitable, efficient, reliable, safe, and accessible. Awareness of quality issues has recently affected all kinds of websites. An organization, hospital or a medical center, with a website which is difficult to use or to interact leads to a poor image on the internet and weakens an organization's position. Therefore, it is important for any hospital/medical center to have the ability to make an assessment of the quality of their services and information, in order to improve their offerings over time and benchmark against competitors.

There is limited number of research studies in which more than one or two assessment variables associated

with design, organization and implementation of a website are considered. Thus, while there should be a considerable number and variety of factors associated with website success, little researches exist about the combination of these factors and services. In another word, although there are various and remarkable number of success factors in websites, there is not any research comprehensively considers all of these factors and services. In fact, there is not any investigation relevant to hospital/medical websites. The users are considered as an important factor in realization of purposes in an organization. Accordingly, users and their needs should be the priority in designing and implementing websites. To know users means that to understand how they make preferences. Generally, user preferences for a website indirectly measured through an interview or a questionnaire. In our research, to interacted and consulted with users and studding the visitors and patients' feedback, a questionnaire was voluntarily distributed among a great number of users of four hospital/medical websites; including doctors, website designers and usual people. By visiting hospital/medical websites and their different sections and services, the users consciously or unconsciously gave different values to the factors evaluating websites' quality. Then, we used the obtained data as a base to make a conceptual frame work.

2. LITERATURE REVIEW

Because of the great expansion of websites in all dimensions of life and dependency on web services in different organizations, websites characteristics are really important. They have been a constant concern of research in different domains and they were widely studied in the e-commerce literature. Although, as it mentioned before, there are limited number of studies in which more than one or two variables associated with design, implementation and organization of web site are considered. Thus, while there should be a considerable number and variety of factors associated with website success, little research exists about the combination of these factors and services. Most of the current studies are either dealing with a limited number of quality factors or directed toward a specific web service. The literature review is organized in three sections as 1) literature review related to all types of websites in general, 2) literature review related to hospital/medical websites, 3) literature review related to mathematical models used to evaluate websites.

2.1. Literature review related to all types of websites in general

Chang liu et al. [1] had identified that the four factors, playfulness, system use, service quality, and system design are important in website success. Nicolae George Dragulanescu [2] had done an attempt to propose basic criteria to evaluate websites quality. Ming Hui Huang[3] had pointed that a successful website should be able to use its attributes to satisfy both entertainment and the information needs of users. Marquis, G.P.,[4] had studied the use of traditional system design techniques to website design. Soyoung Kim et.al.,[5] had introduce a dimensional hierarchy for quality of retailer websites, and they had also introduced websites quality dimensions presented by different persons and sources. Gonzalez, F.J.M et al.,[6]had evaluated commercial websites. They have pointed four categories: accessibility, speed, navigability, and content are the important factors for website success. Jos van Iwaarden et al.,[7] had conducted a survey on students of universities to identify the factors for university websites. Luis Casalo et al.,[8]had discussed the role of perceived usability, satisfaction, reputation and consumer familiarity on the website loyalty formation process. Layla Hassanet al.,[9] had proposed general criteria to evaluate the quality of website regardless of the type of service that it offers. They have identified that content quality, organization quality, design quality, and user -friendly quality is the dimensions for the criteria. To evaluate websites, Kuo et al.,[10] conducted a survey on organizational websites and identified four dimensions: information quality empathy, ease of use and accessibility. Zeithaml et al., [11] developed a measure scale including eleven dimensions of service quality of transaction websites by using focus group interviews of consumers. They are: personalization, security, responsiveness, assurance/trust, site aesthetics, access, ease of navigation, efficiency, flexibility, reliability, and price knowledge

2.2. Literature review related to hospital/medical websites

Pierre Michaud et al.[12] had studied implementation and evaluation of health website for adolescents in Switzerland which focused mainly on health issues. N.B.Teo et al.,[13] had used an interactive web-based questionnaire to evaluate a breast cancer website. Karsten Wend Land et al [14] had explained the optimal solutions for the website. Elizbeth Silence et

al.,[15] had discussed the health websites that people can trust hypertension. They have pointed the key difference between face-to-face communication and web-based systems. Recently, in health and medicine field, the internet has become an important mass medium for consumers seeking health information and health care services online [16]. Evaluation on websites related to medical health has naturally become a hot topic in the studies of health informatics and information management. Research of this kind involves Kim and colleagues' [17], Schmidt & Ernst's [18], Cui's[19], and Wang's[20], etc. In Schmidt & Ernst's research, it is found the most popular websites on complementary and alternative medicine for cancer offer information of extremely variable quality. Many endorse unproven therapies and some are outright dangerous. Similar views can also be found in Cui's research. In Wang's research, however, more attention is paid to the formation of index system with the statistical methods. Through taking the step of reviewing literature, it can be found that research concerning hospital website evaluation makes up for a minority although there is quite a number of researches related to evaluation on medicine-related information online [21–25]. Only Wang's study is related to evaluation on hospital websites in China. Increasingly, hospital websites are beginning to act as extension of hospital service, offering access to a range of information and applications. Therefore, in a bid to facilitate the public's access to reliable information and services from hospital websites, we deem that it is very imperative to evaluate hospital websites, especially those large-sized comprehensive ones.

2.3.Literature review related to mathematical models

Quahri Saremi et al.,[26], used graph theory definitions, quadratic problem approach, ant-colony technique and meta-heuristic method to design the website. Duan et al.,[27], had used algebraic reasoning for effective website maintenance. Moreno et al.,[28] used 2-tuple fuzzy linguistic approach for assessing websites. Zhou used [29] data crawler, recursive, parser and data transmission algorithms to measure the websites. However, the website selection involves multiple criteria, so instead of traditional methods the multicriteria decision methods (MCDM) can give the best solution. Multiple Criteria Decision Making(MCDM) is a largely used discipline to solve complex decision problems involving more than one criterion [30]. MCDM also is continuously growing in

fields of Mathematics, Decision Sciences, Business, Management and Accounting, Medicine, Social Sciences, Environmental Science, Economics, Econometrics and Finance, etc. MCDM methods are increasingly being used in the last decade. In order to evaluate web site quality, any process goes through a step of specifying certain criteria. The distribution of criteria importance and ranking web sites are generally solved by MCDM techniques[31]. There are many methods as AHP, ANP, TOPSIS, VIKOR, PROMETHEE, ELECTRE; choosing the best method is, it-self, a multi-criteria decision-making problem. In this paper, we considered Analytical hierarchy process (AHP) for website evaluation. AHP is developed by saaty [32]is a decision-making method for prioritizing alternatives when the multiple criteria must be considered. There are various applications of AHP, we review few studies. Dolan et al.,[33] provided a detailed review of the theoretical foundations and methodology of the AHP using the treatment of a dog bite wound as motivating example. Castro et al.,[34] applied AHP to the selection of diagnostic tests for upper abdominal pain. Richmen et al.,[35] applied the AHP for prostate cancer treatment. Turri.J.J., [36] applied AHP to select magnetic resonance imaging vendor. Tak, F.W., [37] used AHP to evaluate image quality of both conventional and computed radiology Hummel et al.,[38] proposed the application of AHP to the medical technology assessment that occurs during the development process and prior to clinical diffusion.. Kwak et al.,[39] used AHP to human resource planning in hospital. Chang et al[40] applied AHP as a part of study of service quality for nursing home. R. Rekik et al., [41] had used Fuzzy reduced method for evaluating the quality of institutional web sites.O. I. Markaki, et al., [42] had used Fuzzy Analytic Hierarchy Process to Evaluate the Quality of E-Government Web Sites. X. Yu, et al.[43], used AHP and fuzzy TOPSIS for ranking of e-commerce websites in e-alliance.

3. METHODOLOGY

In this study, we considered the seven-quality metrics/criteria: *content quality, design quality, organization quality, user friendly quality, performance quality, service quality and technical points*, proposed by Vahid Rafe et al., [44]and assumed that the patient/user's requirement is to know the disease symptoms ,to get second opinion from the concerned specialists, to know the information about various clinical services and process and to know the

preventive methods for normal health problems but not for serious , emergency cases.. This paper presents the ranking for the websites of top four hospitals in Hyderabad: APOH, CARH, YASH, KIMH, and the hospital names are not revealed because of their corporate security. The first three letters represent the hospital name. In this study, we use analytical hierarchy process (AHP) which can be used for qualitative and quantitative data The AHP measures the relative importance of alternatives. The importance of one priority over the another can be judged by numerical value using a scale of 1-9 where 1 denotes equal importance and 9 denotes the absolutely highest importance. The result of these comparisons using the AHP scale is a square $n \times n$ matrix. A pair wise comparison is based on evaluating two elements (alternatives or criteria) at a time. A pair

wise comparison is the process of comparing the relative importance, preference, or likelihood of two elements with respect an element in the level above. When all the pair wise comparisons are done, we calculate the priorities and a measure of consistency of our judgement. Generally, the consistency ratio should be less than 0.10(10%). The number of comparisons would be $\left(\frac{n(n-1)}{2}\right)$, where n is the number of criteria in the model. Detailed description of the theoretical aspects of AHP can be found in Saaty.[32] Table-I shows the quality metrics and corresponding indicators. Table-2 and 3 shows the AHP results

Table-1

Quality metrics	Elements and Indicators
Content quality	Comprehensive content, relevance usefulness, timely, Multilanguage.
Design quality	Appropriateness, attractiveness, colors, text,
Organization quality	Logical structure, sitemap, scope, links, navigation, organization.
User friendly quality	Ease of use, interactive features, privacy, customization, satisfaction.
Performance quality	Speed,accessibility,security, responsiveness, usability
Service quality	E-appointment, E-medical data base, E-laboratory, E-frequently asked questions, E-payment, Helping functions, Hospital events
Technical points	Programming language, page structure, size of website, extendibility, solving technical problems,

Table-2

Quality metrics	weightage	$\lambda_{max} = 10.9799$ $C.I = 0.663316$ $CR = 0.5025$
Content quality	0.174712	
Organization quality	0.167421	
Design quality	0.0980093	
Service quality	0.164308	
User friendly quality	0.129514	
Performance quality	0.155287	
Technical points	0.110749	

λ_{max} = largest eigen value, C.I = consistency index = $\left(\frac{\lambda_{max} - n}{n - 1}\right)$, C.R=consistency Ratio= C.I/saaty index, here $n=7$, saaty's index =1.32 (corresponding to $n=7$). The AHP solution shows that first rank for AHOP, second rank for KIMH, third rank for CARH, and fourth rank for YASH

Table-3

Website	AHP weighting	ranking
APOH	0.2804	1
YASH	0.2087	4
CARH	0.2477	3
KIMH	0.2595	2

4. CONCLUSION

In this study, we have applied Analytical hierarchy process (AHP) to give ranking for the four websites of hospitals corresponding to the seven-quality metrics. AHP is a good method which gives ranking for the alternative by using pair wise comparisons. We can use new criteria to evaluate websites and other methods of multi criteria methods (qualitative and quantitative). This technique can be used to evaluate other websites also.

REFERENCES:

- 1) Liu, ch, et al, Exploring the factors associated with website success in the context of electronic commerce. *Information. Manag.* 38:23-33, 2000
- 2) Dragulanescu, N.G., Website quality evaluations: criteria and tools. In: *Intl. Inform. & Libr. Rev.* 34, 247-254, 2002
- 3) Ming Hui Huang, Disigning website attributes to induce experiential encounters. *Comput. Hum. Behav.* 19:425-442, 2003
- 4) Marquis, G.P., Application of traditional system design techniques to web design. *Inform. Software Technol.* 44:507-512, 2002.
- 5) Soyoung Kim et al., Apparel retailers : website quality dimensions and satisfaction. *Journal of Retail Consumer Services*, 11: 109-117, 2004
- 6) Gonzalez, F.J.M et al., Qualitative evaluation of commercial websites: an empirical study of Spanish firms. *International journal of management*, 23:313-328, 2004
- 7) Jos van Iwaarden et al. Perceptions about the quality of websites: a survey amongst students at Northeastern University and Erasmus university, *Inf. Manage.* 41:947-959, 2004
- 8) Luis Casalo et al., The role of perceived usability, reputation, satisfaction and consumer familiarity on the website loyalty formation process. *Comput. Hum. Behav.* 24:325-345, 2008
- 9) Layla Hassanet al., Assessing the quality of websites. *Applied Computing and Informatics*, 9:11-29, 2011
- 10) Kuo et al., Measuring user's perceived portal service quality: an empirical study. *Total Quality Management and Business Excellence*, 16(3):309–320, 2005.
- 11) Zeithaml et al., A conceptual framework for understanding e-service quality: implications for future research and managerial practice. *MSI Working Paper Series*, No.00-115, Cambridge, MA, 1–49, 2001
- 12) Pierre Michaud et al. Implementation and evaluation of an internet health site for adolescents in Switzerland. *J Adolesc. Health* 33:287-290, 2005
- 13) N.B. Teo et al., Use of an interactive web based questionnaire to evaluate a breast cancer website. *Breast* 14:153-156, 2005
- 14) Karsten Wend Land et al., optimal solution for hospital websites. In : 14th IEEE International Requirements Engineering Conference, 2006.
- 15) Elizabeth Silence et al., Health websites that people can trust -the case of hypertension. *Interacting with computer*, 19:32-42, 2007
- 16) Eysenbach, G., Consumer health informatics. *BMJ.* 320:1713– 1716, 2000.
- 17) Kim, P., Eng, T. R., Deering, M. J., and Maxfield, A., Published criteria for evaluating health related websites: review. *BMJ.* 318:647–649, 1999.
- 18) Schmidt, K., and Ernst, E., Assessing websites on complementary and alternative medicine for cancer. *Ann. Oncol.* 15:733–742, 2004.
- 19) Cui, L., and Liu, H., Evaluation and analysis of Chinese medical consultation websites. *Journal of Medical Intelligence* 22(5):16– 18, 2001.
- 20) Wang, D., Zhu, L., and Li, M., The application of AHP in the evaluation of hospital website. *Journal of Mathematical Medicine* 17(5):464–465, 2004.
- 21) King, T., Wheeler, K. L., Robinson, B., and Cabana, M. D., Do the leading children's hospitals have quality web sites? a description of children's hospital web sites. *J. Med. Internet Res.* 6(2):e20, 2004.

- 22) Gruca, T. S., and Wakefield, D. S., Hospital web sites: promise and progress. *J. Bus. Res.* 57(9):1021–1025, 2004.
- 23) Norum, J., Evaluation of Norwegian cancer hospitals' web sites and explorative survey among cancer patients on their use of the Internet. *Med. Internet Res.* 3(4):30, 2001.
- 24) Minifie, J. R., Dietert, J., and Middlebrook, B., E-international hospital websites strategy comparisons, *Mountain Plains Journal of Business and Economics* [Internet], Available from: <http://www.mountainplains.org/articles/2005/general/MPMA%20jm13.doc> (accessed August 8 2009), 2005.
- 25) Llins, G., Rodriguez-lesta, D., Mira, J. J., Lorenzo, S., and Aibar, C., A comparison of websites from Spanish, American and British hospitals. *Methods Inf. Med.* 47(2):124–130, 2008
- 26) Qahri Saremi et al., Web site structure improvement: quadratic problem approach and ant-colony, meta-heuristic technique. *Appl,Math, Comput*,195:285-298,2007.
- 27) Duan et al. A formal approach to website maintenance .10th IEEE High Assurance Systems Engineering Symposium.419-420,2010
- 28) Moreno et al., A quality evaluation methodology for health-related websites based on a 2-tuple fuzzy linguistic approach. *Soft.Comput.*14:887-897,2010
- 29) Zhou, Z., Evaluating websites using a practical quality model.MPhil Thesis.Software technology Research Laboratory.Demontfort University,1-106,2009
- 30) B. Roy, “Decision-Aiding Today: What Should We Expect?” in *Multicriteria Decision Making*, vol. 21, T. Gal, T. J. Stewart, and T. Hanne, Eds. Boston, MA: Springer US, 1999, 1–35.
- 31) T. Gal, T. J. Stewart, and T. Hanne, Eds., *Multicriteria Decision Making*, 21. Boston, MA: Springer US, 1999.
- 32) T. L. Saaty, “The analytic hierarchy process: planning, priority setting, resources allocation,” New York: McGraw, 1980
- 33) Dolan et al., Using analytical hierarchy process to develop and disseminate guidelines. *Quality Review Bulletin*,18; 12,440-447,1992
- 34) Castor, F et al., Sequential test selection in the analysis of abdominal pain. *Medical Decision making*,16: 2,178-183,1996
- 35) Richmen et al., A novel computer based expert decision-making model for a prostate cancer disease management. *The journal of Urology*,174,2310-2318,2006
- 36) Turri.J.J. Program eases decision making. *Health progress* ,69:8,40-44,1988
- 37) Tak, F.W., Prelude to the benchmarking of general radiography. *Hong Kong Radiographers Journal*,6:1,3-9,2002
- 38) Hummel et al., Medical technology assessment: the use of the analytical hierarchy process as a tool for multi-disciplinary evaluation of medical devices. *International Journal of ArtificialOrgans*,23:11,782-787,2000
- 39) Kwak et al., A human resource planning model for hospital/medical technologists: an analytical hierarchy process approach. *Journal of Medical Systems*,21:3,173-187,1997
- 40) Chang ,C.L., Application of quality function deployment launches to enhancing nursing home service quality . *Total Quality Management*,17:3,287-302,2006
- 41) R. Rekik and I. Kallel, “Fuzzy reduced method for evaluating the quality of institutional web sites,” in 2011 7th International Conference on Next Generation Web Services Practices (NWeSP), 296–301,2011.
- 42) O. I. Markaki, D. E. Charilas, and D. Askounis, “Application of Fuzzy Analytic Hierarchy Process to Evaluate the Quality of EGovernment Web Sites,”, 21 –224,2010
- 43) X. Yu, S. Guo, J. Guo, and X. Huang, “Rank B2C e-commerce websites in e-alliance based on AHP and fuzzy TOPSIS,” *Expert Systems with Applications*, 38: 4. 3550–3557, 2011
- 44) Vahid Rafe et al., A qualitative frame work to assess hospital/medical websites, *Journal of Medical Systems*, 36: 5, 2927–2939,2012