

## Evaluation of the Quality and Accessibility of Available Websites on Kidney Transplantation

Saeideh Valizadeh-Haghi<sup>1</sup>, Shahabedin Rahmatizadeh<sup>2\*</sup>

**Purpose:** (i) to assess the quality of health websites on kidney transplant and (ii) to evaluate the accessibility of these websites and their concordance with the existing guidelines.

**Materials and Methods:** The terms “kidney transplantation” and “renal transplantation” were searched in the three most popular search engines Google, Yahoo, and Bing. 58 unique websites were eligible for the analysis. The Websites accessibility was evaluated using the AChecker tool. Kruskal–Wallis test was performed to examine any significant difference between accessibility issues across different domains. The eligible websites were screened for quality based on the HONcode of conducts. Moreover, the daily traffic data of each website was determined by Alexa. The correlation of known accessibility problems with website popularity was examined too.

**Result:** The main reported known problems belonged to “scripts must have functional text,” “text equivalents,” “accessible forms,” and “text links for server-side image map”. Although the mean accessibility errors in governmental ( $10.25 \pm 7.274$ ) and organizational ( $12.31 \pm 9.469$ ) websites were less than those in the other domains, the differences were not significant ( $P = 0.60$ ). Findings showed no significant correlation ( $P > 0.05$ ) between the extent of known problems ( $16.50 \pm 12.18$ ) and Alexa ranking ( $253675.07 \pm 534690.947$ ). Furthermore, most websites on kidney transplant were not certified by the HONcode.

**Conclusion:** The health websites designers should be aware of accessibility problems, because there is a growing population of potential users with disabilities. This study indicated the need to ensure the compliance of kidney transplant websites with accessibility guidelines such as Section 508. Furthermore, most surveyed websites were of poor quality and unreliable. Therefore, physicians should warn their patients about unqualified online health information and guide them to websites which are more reliable.

**Keywords:** kidney transplantation; consumer health information; web accessibility; HONcode; health education; health informatics; website popularity; Alexa ranking

### INTRODUCTION

End-stage renal disease (ESRD), which causes an irreversible impairment in renal function, may be fatal if transplantation or dialysis is discarded<sup>(1)</sup>. Despite major advances in diagnostic and surgical methods for kidney transplant, the associated complications remain a major clinical problem, which can improve the risk of hospitalization and morbidity and increase medical costs<sup>(5)</sup>. Therefore, the patients who need a kidney transplant should decide informatively. To do so, in addition to medical consultations, they need extra information about the conditions, side effects and postsurgical care. Health information can be obtained from various sources and a person’s choice of the source of information would affect their future health-related decisions<sup>(4)</sup>. Following the increasing demand for health awareness, the Internet has become a vital source of information. This highlights the need for reliable health websites that help users understand their health status and make appropriate decisions<sup>(5)</sup>.

Despite its advantages, e.g., availability, online health information may not always be reliable<sup>(6)</sup>. Previous

studies have reported the poor quality of many websites due to the dissemination of misleading, inaccurate, incomplete, and inappropriate information. Grewal and Alagaratnam assessed the quality of colorectal disease websites for colorectal cancer. Their study showed that colorectal cancer websites were potentially unreliable<sup>(7)</sup>. In another study, Haymes assessed the quality of health information regarding rhinoplasty on the internet. The findings showed that, the quality of information available on the Internet with regard to rhinoplasty was generally of low quality and unreliable<sup>(8)</sup>. In another study, the information on total ankle replacement (TAR) available to the general public through the Internet were evaluated. The study has demonstrated a low quality of TAR information available across all website types<sup>(9)</sup>.

Considering the significant effects of the use of online health information on an individual’s overall health, the provision of unreliable or inappropriate information would increase the risk of negative consequences, such as ineffective treatments or delays in seeking medical care<sup>(10)</sup>. Therefore, evaluation and identification of the quality of health websites are necessary.

<sup>1</sup>Assistant professor, Department of Medical Library and Information Sciences, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

<sup>2</sup>Assistant professor, Department of Health Information Technology and Management, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

\*Correspondence: 4th floor, No 21, Darband st., Tajrish sq., Tehran. Iran; Email: sh.rahmatizadeh@sbm.ac.ir.

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**Table 1.** Most frequent accessibility error types

Check ID	Description	Error category	Webpages (%)
90	Script must have a noscript section	Script must have functional text	*91.4
1	Img element missing alt attribute	Text equivalents	56.9
57	Input element, type of "text", missing an associated label	Accessible forms	46.6
7	Image used as anchor is missing valid Alt text	Text equivalents	36.2
91	Select element missing an associated label	Accessible forms	8.6
58	Image used for input element is missing Alt text	Accessible forms	6.9
121	Input element, type of "radio", missing an associated label	Accessible forms	3.4
91	Select element missing an associated label	Accessible forms	3.4
118	Input element, type of "password", missing an associated label	Accessible forms	1.7
13	Client-side image map missing duplicate text links	Text links for server-side image map	1.7
119	Input element, type of "checkbox", missing an associated label	Accessible forms	1.7

\*Most of the websites showed error in check90.

However, considering the growing number of potential users with disabilities<sup>(11)</sup>, the accessibility of many health websites to physically challenged users is very limited<sup>(12)</sup>. Through web accessibility, people can comprehend, navigate, and interact with the Internet, regardless of their limitations<sup>(13)</sup>. Therefore, web designers should take accessibility into account to satisfy needs of such users. To understand the accessibility barriers of health websites, web accessibility evaluation is needed, which refers to the evaluation of Internet use by physically challenged individuals.

Currently, there are no studies assessing the quality and accessibility of health websites on kidney transplant. In this study, by considering the Internet as an information source for patients, we (i) assessed the quality of health websites on kidney transplant and (ii) evaluated the accessibility of these websites and their concordance with the existing guidelines.

**MATERIALS AND METHODS**

The terms “kidney transplantation” and “renal transplantation ” were searched in the three most popular search engines, i.e., Google, Yahoo, and Bing. the first three pages of search results provided by each of the above-mentioned search engines (180 URLs) were evaluated in this study.

All URLs were analyzed, and redundant websites (containing links to portable document files, repeated unreachable addresses, non-English websites, and advertising websites) were excluded. After exclusion, 58 unique websites were eligible for the analysis . Each retrieved website was classified as governmental (.gov), educational (.edu), commercial (.com), and organizational (.org).

In this study, website accessibility was evaluated using the AChecker automatic tool<sup>(16)</sup>, because it has been accredited by the World Wide Web Consortium and has been introduced in the consortium portal (“Web Accessibility Evaluation Tools List,” n.d.). Furthermore, AChecker is a reliable, cost-effective tool and has been

used in several studies to examine website accessibility<sup>(17,18)</sup>. AChecker defines three levels of problems, including “known,” “likely,” and “potential”. Known problems are identified as certain accessibility barriers and should be resolved by website owners. Likely problems are identified as probable barriers, which should be identified by an individual. Finally, potential problems cannot be identified by AChecker and require a human decision<sup>(19)</sup>. In this study, known problems were reported as per the Section 508 guidelines. Non-parametric Kruskal–Wallis test was performed to examine any significant difference between accessibility issues across different domains.

The eligible websites were sequentially screened for quality based on the HONcode of conducts, which has set regulations to make website developers adhere to ethical standards in presenting information and to assist readers in identifying the purpose and source of data. For this purpose, HON principles were applied using the HONcode toolbar (http://www.hon.ch)<sup>(20)</sup>. This toolbar function, which has been used and examined in different studies, is considered valid<sup>(21)</sup>.

Kruskal–Wallis test was performed to examine possible differences in the mean ranking of known problems between HONcode-verified and unverified websites. Moreover, the daily traffic data of each website, determined by Alexa as an index of popularity of websites, was used by the researchers. Alexa’s Traffic Ranks are based on the traffic data provided by users in Alexa’s global data panel over a 3 month rolling period<sup>(22)</sup>. To examine the correlation of known accessibility problems with website popularity, non-parametric Spearman’s test was conducted. For statistical analyses, SPSS version 24 was used. The level of statistical significance was set at  $P < 0.05$  .

**RESULTS**

All URLs were analyzed, and redundant websites were excluded. After exclusion, 58 unique websites were eligible for the analysis . Four out of 58 websites were not responsive to online evaluation. The most frequent accessibility error types reported by AChecker, along with the percentage of websites with these errors, are presented in **Table 1**.

The main reported known problems belonged to: “scripts must have functional text,” “text equivalents,” “accessible forms,” and “text links for server-side image map” (**Table 2**).

To investigate the relationship between the extent of ac-

**Table 2.** Accessibility error rate by category

Error category	Websites n (%)
Script must have functional text	53 (91.4%)
Text equivalents	41 (70.7%)
Accessible forms	30 (51.7%)
Text links for server-side image map	1 (1.7%)

**Table 3.** Mean and standard deviation of known problems of website accessibility across domains

Domain	Number of Websites (n)	Known Problems	
		Mean	Standard Deviation
Commercial (com)	19	22.16	12.807
Educational (edu)	9	19.44	15.018
Organizational (org)	26	12.31	9.469
Governmental (gov)	4	10.25	7.274
Total	58	16.50	12.180

cessibility errors and domain of studied websites, first, quantitative normalization of the extent of errors was investigated by Smirnov–Kolmogorov test. Considering the absence of normal distribution, comparisons were made by Kruskal–Wallis test in different domains. According to **Table 3**, although the mean accessibility errors in governmental ( $10.25 \pm 7.274$ ) and organizational ( $12.31 \pm 9.469$ ) websites were less than those in the other domains, the differences were not significant ( $P = 0.60$ ).

Spearman’s correlation coefficient test showed no significant correlation ( $P > 0.05$ ) between the extent of known problems and Alexa ranking.

Most websites on kidney transplant (70.7%) were not certified by the HONcode toolbar. The mean of known problems was lower in the HON-verified websites ( $11.41 \pm 7.78$ ) than in the verified websites ( $18.61 \pm 13.10$ ). Differences were statistically significant ( $X^2 = 4.428$ ;  $P = 0.035$  on Kruskal–Wallis test; **Table 4**).

Table 4. Kruskal–Wallis test results comparing verified and unverified websites

## DISCUSSION

To the best of our knowledge, this is the first study to investigate the status of accessibility as well as quality of websites containing information regarding kidney transplant. Generally, websites with complex interaction modalities and user interfaces expose physically challenged people to new opportunities as well as challenges<sup>(23)</sup>. Currently, attention to the issue of website accessibility is very important. Adherence to the guidelines of web accessibility is essential to reduce the gap between digitally underserved (e.g., physically challenged people) and information-affluent people<sup>(24)</sup>.

Unfortunately, several websites are inaccessible to most people. Overall, web accessibility status is largely unknown, particularly in health information websites, because limited studies have assessed the level of compliance of health websites. Accordingly, the present study aimed to examine the current status of accessibility to health websites on kidney transplant for people with disabilities.

The accessibility status of health websites is variable, depending on different health topics. The results of accessibility evaluation in prostate cancer websites

showed that the majority of websites (92%) were accessible<sup>(25)</sup>. The results of accessibility evaluation of aortic aneurysm treatment websites also showed moderate quality in terms of accessibility<sup>(26)</sup>.

Some other studies on health website accessibility in different subjects have shown that most health websites are not accessible enough to people with disabilities<sup>(27)</sup>. Similarly, the present research showed that the majority of kidney transplant websites (96.6%) had accessibility barriers to physically challenged people. Findings are discouraging because most kidney transplant websites do not fulfill the criteria.

The majority of accessibility problems, particularly those related to scripts, are addressed by web developers<sup>(28)</sup>. Similarly, the present study revealed that most of health websites on kidney transplant (91.4%) have problems in “script must have functional text” category. Therefore, health website designers should use scripting languages (for displaying content or creating interface elements), which can be read using assistive technologies<sup>(29)</sup>.

A developer can increase website accessibility by including alternate texts for video files, images, and audio files; the idea is to present a textual description<sup>(30)</sup>. The present study revealed that 70.7% of surveyed websites had accessibility issues in the “text equivalent” category, mainly “img element missing alt attribute” error type (**Table 2**). Therefore, in health websites on kidney transplant, textual equivalents should be presented for all non-text elements that convey information to make the websites more accessible to physically challenged people. Moreover, providing alternate texts for image maps is necessary<sup>(30)</sup>.

Client-side image maps, instead of server-side maps, should be used to improve accessibility in the present study, most websites had taken this point into account. In fact, without a text alternative for each section, server-side image maps are not accessible<sup>(29)</sup>.

Special considerations should be taken regarding the design of health website accessible forms since much of the information retrieved from the Internet is gathered in online forms<sup>(29)</sup>. However, our study showed that 51.7% of surveyed websites had problems in “accessible forms” category (**Table 2**). Therefore, physically challenged users may encounter problems while using these websites.

Since government-sponsored websites and educational institutions present reliable health information and are trustable<sup>(31)</sup>, it is expected that people, including physically challenged patients, use these types of websites more than the commercial and private ones. Therefore, it is expected that designers of these health websites consider equal access to the information for all users. Zeng and Bambang (2003) revealed that governmental and educational health websites exhibit better performance on web accessibility than other domains<sup>(32)</sup>. In the present study, governmental and educational websites were speculated to show better performance re-

**Table 4.** Kruskal–Wallis test results comparing verified and unverified websites

Known Problem	HON not verified		HON verified		P-value
	Mean (SD)	Median	Mean (SD)	Median	
	18.61 (13.10)	19.00	11.41 (7.78)	8.00	0.035

garding accessibility. Nevertheless, the results showed no significant differences among various domains with regard to accessibility barriers (**Table 3**).

In this study, accessibility barriers exist in all categories of websites (e.g., educational and governmental), especially commercial websites. Because physically challenged people prefer to use websites with less accessibility barriers, they may visit accessible websites, which contain unreliable health information and can negatively affect their health.

In general, accessibility may have positive effects on a website's popularity<sup>(2,4)</sup>. Nevertheless, in the present study, the results revealed that the correlation between accessibility barriers and website popularity is not significant ( $r = 0.172$ ,  $P = 0.205$ ). This implies that people with disabilities may encounter accessibility barriers, even if they visit popular websites. Because physically challenged people are among the Internet users, popular websites should pay special attention to the accessibility guidelines to make their websites more accessible; this can in turn increase the website visits and popularity. Based on the results, various factors may be responsible for the limited compliance of websites with accessibility guidelines. In some studies, one of the main problems was that many developers did not prioritize accessibility<sup>(33)</sup>. Another reason is that websites may not be evaluated or modified after the design, based on accessibility guidelines.

While web design strategies should be in line with accessibility needs assessment of users with different disabilities (e.g., cognitive, visual, auditory, and motor disabilities)<sup>(34)</sup>. In addition to accessibility, quality of health websites is important, because it may affect the patients' decision-making. Therefore, we assessed the quality of health websites on kidney transplant, as well. Our study showed that kidney transplant websites are of poor quality, as only 17 out of 58 (29.3%) websites were HON-verified, which is in line with the studies in various health topics<sup>(8,9)</sup>; therefore, patients should use these websites with more caution.

Moreover, accessibility errors in HON-verified websites were fewer than the unverified ones, and differences were statistically significant ( $P = 0.035$ ). Authoritative websites on kidney transplant had made more efforts to make their websites more accessible. Therefore, physically challenged people who use authoritative websites to fulfill their information needs on kidney transplant, are able to use assistive technologies more effectively and encounter fewer barriers while obtaining health information.

## CONCLUSIONS

The health websites designers, as well as owners, should be aware of accessibility problems, because there is a growing population of potential users with disabilities. This study indicated the need to ensure the compliance of kidney transplant websites with accessibility guidelines such as Section 508. Furthermore, because most surveyed websites were of poor quality and unreliable, there is a need to pay special attention to this problem. Physicians should warn their patients about unqualified online health information and guide them to websites which are more reliable.

Because limited studies have examined the accessibility of health websites, besides the present study, it is recommended to pay more attention to the assessment

of website accessibility on different topics. This effort is expected to increase awareness on web accessibility issues in health information websites.

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## CONFLICT OF INTEREST

The authors report no conflict of interest.

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