Towards a Weighted Average Framework For Evaluating the Quality of Web-Located Health Information

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A weighted average framework for evaluating the quality of Web-located health information

Abstract.

This paper proposes a framework for evaluating the quality of Web-located health information. A set of affirmative-response evaluation features are identified across four quality categories— currency/authority, accuracy, objectivity and privacy— and are used as the basis for determining the fundamental quality of Web-located health information. Furthermore, the researchers add a value dimension to the framework by using a weighted average technique allowing information features to be scored proportionally— a feature that other assessment frameworks tend to overlook. The framework was used to test 56 health information documents published on the Web, concluding that only four pages addressed all the core criteria proposed in the framework. The study also found that a relatively high number of commercial health sites intermixed health information with product promotion and advertising. The study was exploratory and because sampling was not probalistic, it is difficult to claim generalisability at this stage. However, some notable results identified in this study may serve as the foundations for future research.

Keywords: Web-located, heath information, quality, accuracy, authoritative, disclosure, privacy, weighted average.

1. Introduction

The World Wide Web has become the preferred medium for delivering business and organisational documents— a medium that allows information to be effectively collated and presented in a useful form. Indeed, the powerful publishing features of the Web are embodied in the various informational models proposed by the general systems and information science literature [1-3]. The Web has also become a valuable resource for people seeking health information, with the quality of this information being critical in potentially affecting health outcomes for many users [4, 5] . According to Khechine et al. [6], people have become more informed as a result of online health information, and for patients with a chronic illness the Web allows them to source information to better manage their condition. Indeed, the wide spread accessibility of the Web allows patients and their families to search for timely and authoritative health information— searches being extensive with individuals exploring many sites and drilling down through numerous pages in search of what they believe to be appropriate and relevant information. As early as 1999, a group of 'Internet-Positive' patients— defined as adults who access on-line health information— were identified and their number said to be on a par with the number of people who searched for information relating to sporting and entertainment subjects [7].

Traditionally, medical information publications have been required to meet a stringent review process before being printed. Such a process involves a peer group examination of submitted papers before they are published. This has assisted the health care profession by providing a form of publishing self-regulation and an important quality control mechanism. However, in the electronic age, and with the proliferation of the World Wide Web, this review process can be circumvented with individuals able to easily publish on-line. It has been suggested

that some fifty percent of medical Web-located information does not provide a list of citations or sources [8]. Brotherton et al. [9] reported that the use of the online information by oncology patients identified concerns about the discovery of inappropriate, inaccurate or distressing information. Arguably, as the number of Web-located health sites increase there is a likelihood that the amount of medical misinformation will also increase. Yet, the quality of health information on the Internet appears to be variable and as such may be difficult to assess for quality and veracity [5, 10]. This paper examines some of the important quality characteristics associated with online health information, proposes a weighted-average assessment framework for the evaluation of on-line health information and reports on a study that employs the framework to evaluate health information on Australian-based health information Web sites.

2. The Quality of Web-located Information

Various research has examined the quality of information, both prior to and since the Internet became popular as a medium for information dissemination. In 1996, Miller [11] proposed that information had multiple dimensions associated with quality— dimensions that tend to be business customer defined and dynamic in nature. Miller's quality dimensions related to the relevance and accuracy of the information; its currency (timeliness), the degree of completeness and format, how well the information 'hangs together' (coherence), how accessible it is, how it can be combined with other information (compatibility), how secure it is and if it can be verified as being true (validity). The library community has historically evaluated information quality in the traditional print media using criteria such as content, purpose, scope, currency and cost [12]. In the Internet age the library community has also proposed various evaluating methods for determining the quality of on-line information. Grassian [13] has proposed a critical thinking approach to Web information evaluation that focuses on the source of the website information and whether the pages have a peculiar discipline presentation style. Another methodology for evaluating on-line information is based on applying a series of questions to an informational Web page [14]. Each affirmative response to a question posed about the information would suggest the information is of a high quality (high scores equate with high quality information). Using this evaluation method Alexander and Tate indicate that features associated with authority, currency, accuracy and objectivity can be readily determined. Barnes and Vidgen [15] through the use of their WebQual™ instrument have been able to assesses the overall business quality of websites. WebQual™ evaluates a number of areas related to website functionality— usability including site appearance; ease of use and navigation; design; service interaction that reflects user experience as they delve into the site (features that are embodied by empathy and trust); and dimensions of information quality published. The information quality features examined by WebQual™ include accuracy, believability, timeliness, relevance, ease of understanding, level of detail, and format. Berkman [16] provides another business perspective to on-line information evaluation proposing that Web-located information should be assessed for quality using important business features such as timeliness, update frequency and ease of searching. Arguably, the assumption is that such assessment is applied to sources after they have been found to be credible. Davenport [3], on the other hand, identifies business-based information as being integral to an organisation and suggests some six categories for assessing information— accuracy, timeliness, accessibility, engagement, applicability and rarity. Indeed, there appears to be general and business-based information features associated with currency, source, structure, authority and objectivity.

3. Web-located health information

Web-located health and medical related information has become an important resource for people [4]. Indeed, many individuals including patients, parents of sick children or individuals endeavouring to self-diagnosis, have been shown to access online health information to subsequently seek more timely medical advice[7, 9], and even improved the understanding and management of their health states [6, 10, 17]. Arguably, in an environment were the Internet has become a primary information source, the integrity of information that can potential impact on personal health outcomes highlights the importance of having relevant criteria to assess the quality of Web-located health pages.

Early research by Silberg *et al* [18] on the quality of online health information indicated that a critical thinking framework allowed quality standards to be formulated and used to assess electronic medical documents. Silberg *et al* indicated that a core set of criteria for assessing online information included authorship and attribution; publication currency and disclosure— disclosure relating to website ownership and sponsorship. Wyatt [19] adds to the evaluation of Web-located medical literature by discussing evaluation from a functionality perspective, suggesting important criteria such as:

- Determining the value of links to other quality pages.
- The effectiveness of multi-media that may be used to communicate information.
- How accessible the medical information may be via the commonly used Web search engines.

Biermann et al [20] evaluated cancer information found on 400 websites and reported that 6% of the pages contained erroneous content and may have undermined effective treatment. Biermann and colleagues suggested that as well as authorship, currency and referencing, a good starting point for evaluation of medical information is to categorise the source of the information based on genres that included anecdotal or testimonial; alternative; medical case study; general medical information and primary treatment information. Pembleton and Goldblatt [21] employ a simple checklist for medical information similar to Tate and Alexander's [14] criteria. However, they include important issues such as:

- Whether the institution that supports the author is reputable (branding)?
- Can references be easily verified and confirmed?
- Is the information associated with the sale of a specific product?
- What is the website's source of revenue?

Since 1997, the Internet Healthcare Coalition (IHC) has been openly working to provide some clear guide to the evaluation of on-line health. IHC has widespread community support and, in an ambitious project, has formulated a set of eight guidelines that seek to evaluate Web-based products, services and information. Some of the evaluation criteria suggested include [8]:

- Candour: where conflicts of interests must be disclosed and may include links to commercial or educational organisations.
- Honesty: in that there must be differentiation between product promotion and editorial content and recommendations.

- Quality: a feature that encompasses numerous criteria including those that have been generally proposed by library community. The IHC introduces less tangible criteria when measuring information suggesting that it should be 'understandable' and 'easy-to -read'.

Williams *et al* [22] investigated the user experience as the basis for evaluating Web-located health information published on the UK based *Surgery Door* website (http://www.surgerydoor.co.uk/). The authors identified numerous Web design issues that negatively impacted on user information retrieval tasks— page clutter, site design and confusing navigation. With respect to information quality, positive user experiences were found to be associated with content that was informative, well written, authoritative and devoid of commercial features. The study reports that users although acknowledging information authority, did not mention important quality features such as currency and attribution— which may indicate that a user-experience approach to quality evaluation may overlook certain important information traits.

Health portals assist in addressing certain aspects of health sites that enhance the quality of medical information on-line. Numerous sites carry the American-based *Health on the Net Foundation* Code of Conduct symbol. Health on the Net Foundation is a non-profit organisation that has identified certain ethical criteria that health information sites should address in order to be seen as providing 'quality' medical information. These ethical issues include confidentiality of data, site funding, advertising policy and author credentials [23]. Australia's government endorsed portal, HealthInsite, aims at directing users quickly to useful health resources. Criteria for evaluating HealthInsite information quality is based on the Commonwealth government's online publishing guidelines and addresses website— features associated with the qualification(s) of content creator(s), accuracy, information appropriateness and documentation of sources [24].

3.1. Towards a framework for evaluating the quality of Web-located health information

Notwithstanding the broad array of features that have been identified from the previously discussed literature, this section argues and proposes a set of core criteria aimed at evaluating the *fundamental* quality features associated with Web-located health information. The authors make the assumption that in the age of information overload, it would be disadvantageous to develop an evaluation tool that is more complex to use and interpret than the health information that people may wish to assess. Indeed, a long and complex evaluation process could be considered to be counter-productive— hence, a fundamental set of evaluation features associated with health information not only appears appropriate, but desirable.

The literature identified several areas for measuring the quality of Web-located health information that overlap with dimensions that examine online information quality from a general [12, 14] and business [3, 11, 15, 16] perspective. Hence, in developing an information quality instrument there is an expectation that basic quality features would be represented— features such as *authorship* and *currency*. The quality attributes associated with authority and currency include the author's name, creation date and contact details. Arguably, an important component of the authoritative process is to determine the reputability of the organisation that hosts the information. Another attribute evident from the literature [8, 18, 20, 21, 24] that addresses online health information quality is the importance given to attribution— which allows further investigation and substantiation of health-related claims— a feature that addresses the accuracy of a Web-located information through well

defined citation. Hence, *accuracy* as a core evaluative feature is included in the framework. Numerous health information articles [8, 18, 19, 21, 23, 24] have advocated that an important aspect of evaluating Web-located health information is one of objectivity. *Objectivity*, as adopted for use in this instrument has two features— one associated with the diagnostic limitations of the information (disclosure); and the declaration of any commercial interest or product promotion. According to several authors [23, 24], privacy issues associated with data confidentiality or case study portrayal is an important feature associated with the dimension of Web-located information quality. The presentation of health information should not specifically name or use characteristics to identify individuals. Arguably, a privacy statement should be a constant when an organisation implements a website however, the sensitive nature of health information necessitates the inclusion of a privacy or confidentiality statement especially when patient data is being presented. Indeed, not only could this feature be considered indicative of quality, but one of ethics. Moreover, there also appears to be a legal aspect to including privacy declarations and statements on websites— hence, *privacy* has been included as a fundamental evaluation category in the proposed quality instrument. Some authors proposed features such as classification of health information into specific genres [20]; evaluation of hypertext links to other pages [19]; content that was easy-to-read and understandable [8]; appropriate website page design and navigation [22]— all features that were deem by the authors to not only have strong affiliation to technical Web design values but outside the objective of developing an evaluative and *fundamental* information quality instrument.

The proposed categories are detailed in Table 1 and use the affirmative response assessment [5, 14, 20] as an evaluative process— a process that appears to have been easily implemented and utilised amongst previously discussed evaluation systems.

Table 1. Evaluation categories for Web-located health information

Evaluation Category	Features and Affirmative Response Questions
Authority and Currency includes the core features such as the Web page's author name, creation and contact details. Part of the authoritative process is to determine the reputability of the organisation that hosts the information.	Authorship— Is the author's name present?
	Creation— Is there a date of creation and/or date of last modification?
	Contact Details— Is there an address or telephone number located on the Web page (email only is insufficient)?
	Reputable— Is the organisation associated with the health information reputable?
Accuracy addresses features associated with the attribution of sources, allowing substantiation of health claims and the ability to engage in follow up reading.	Are obvious references and/or sources to information content provided?
Objectivity entails two core features that address information disclosure as a warning to the reader of the diagnostic limitations of the value of the Web-located health information; and commercial advertising—that enables a reader to assess potential conflicts of interests in the presentation of the information.	Disclosure—Is there a disclaimer/disclosure of cause and effect?
	No Advertising— The information content of the Web page is not associated with advertising or promotional material?
Privacy addresses the data and information confidentiality dimension associated with online health information.	Is there a data confidentiality statement?

4. Notions of user information quality

Information quality can have different evaluative dimensions depending on the research approach undertaken or the sphere of investigation. For example, the notion of information quality has been related to user perceptions, where a measure of quality is embodied in user requirements and values [11]. Indeed, the functionality of the previously referred to WebQual™ instrument, is based on the arbitrary opinion of website users to determine the importance of website information quality— a feature that allows WebQual™ to subsequently compare websites [15]. Moreover, the WebQual™ approach tends to highlight how customer perceptions direct information quality that is premised on economic values associated with business consumerism. With Web-located health

information— an individual's evaluation of quality is not linked to a business type outcome, but to intangible values that are of a more personal nature and invariably associated with health well being [5]. Miller [11] also suggests that information quality is based on user perceptions that tend to alter over time— a premise also articulated in the context of the business environment, where customers tend to be viewed as a principle focus and the drivers of business marketing. Clearly, in the commercial environment, consumer perceptions appear to be the primary measure of the quality of online business information— enhanced customer satisfaction and sales being an indicator of high quality pages. Arguably, there are significant quality expectations associated with Web-located health information when contrasted to commercially based information, where tangible economic information values relevant to the business world— tend to be supplanted by user values associated with person-related wellness issues.

There are several groups of online health information users. Healthcare professionals such as doctors, nurses, scientists, administrators and medical librarians— being the traditionally originators and publishers of medical information— will have information quality expectations commensurate with their professional employment and research environment. These perceptions of information quality will presumably be based on traditionally health publication protocols and the associated stringent review process. Another type of online health information user is the healthcare consumer who may seek information for self diagnosis; to perhaps reinforce a medical opinion received after consultation; to seek further information about a diagnosis or some other health related purpose [6, 9, 10, 17]. However, considering that healthcare consumer is unlikely to be medically trained or informed to effectively assess the quality features associated with Web-located health information— or in some instances have the emotional detachment that might cloud evaluative judgement— the concept of user-centric or user-defined quality [11, 25], is not only difficult, but potentially dangerous if erroneous information were encountered [5, 9, 20]. Moreover, recent work by Cotten and Gupta [26] indicates that the online health information seeker tends to place high reliance on the health care professional for direction to health information— indeed, the online health information reader becomes effectively reliant on the *expert* health professionals to impart information quality on a publication. Thus, it becomes not only appropriate, but a desirable requirement that an instrument that evaluates health information should include suitable weighting for each feature based on the perception the health experts and professionals.

5. Extending the framework: A weighted average approach

Many previously suggested information evaluation instruments or techniques measure individual criteria on an equal basis— in effect an all or nothing acceptance measure. For example, the *authority* feature associated with an online information document is given the same equivalence value or weighting as its *accuracy* attribute. Information *currency* may be scored with the same weighting as features associated with online *privacy* of health information. Arguably, this type of evaluation does not consider that some features may be more important than others and recognize that there are relative differences between information features. Drawing from business-world accounting practices where the allocation of different weightings can be used to reflect the different values of business assets (tangible and intangible) — the proposed evaluation framework introduces a *weighted average* component that is based on a relative value for each feature. Statistically, the assignment of a *weight* in an evaluation framework allows a factor to be *assigned to a number in a computation, as in determining an average,*

to make the number's effect on the computation reflect its importance [27]. Furthermore, a *weighted average* tends to reflect an average that takes into account the proportional relevance of each component, rather than treating each component equally [28]. The weighted-average approach is typically used for determining valuations associated with the cost of business capital and to compare variations in different techniques that may have been used to evaluate projects. The typical representation for a weighted average (*WA*) calculation, involves assigning a weight for each observation (w_i) against the value of the criteria (c_i) being measured where:

WA is the weighted average or score

w_i is the weight for each observation. In this research refers to the weight applied to the evaluation of each feature identified as desirable in Web-located health information. For example, authorship may be deemed to have a weight of 5 units, whilst presence of the article publication/creation details may have a weight of 15 units assigned.

c_i is the value assigned to the particular feature— for the purposes of this exercise this value will either be 1 [met criteria] or 0 [did not meet criteria].

The assignment of a weight (w_i) to each feature is important in that it will impact on resultant evaluation outcomes after analysis. Indeed, within many industry sectors the allocation of weightings as part of a business evaluation process may be based on historical trends or be controlled by industry-wide agreed standards. In this paper, individual weights have been assigned to each feature to demonstrate the application of the *weighted average* (*WA*) technique as part of the evaluation framework. The arbitrary assignment of these weightings reflects the experience of one of the authors within the medical and health fields that spans a 15 year period— a period that covers the rise of the Internet as a significant information delivery channel. Table 2 shows the weights (w_i) that have been assigned to the evaluation features. The weightings as well as being based author experience in the health field have been confirmed through exchanges with associates spanning the areas of medical, nursing and health administration. Indeed, the arbitrary allocation of weightings is acknowledged as being a limitation of the instrument, however the exploratory nature of the study is one of providing a starting point for progressing and maturing the framework. Moreover, the determination of an expanded set of weightings will be the examined in the next stage of the research focusing on Australian health professionals.

Table 2. Evaluation categories with associated feature weightings

Evaluation Category	Features	Weight (w_i) units
Authority and Currency	Authorship	5
	Creation	15
	Contact Details	5
	Reputable	25
Accuracy	Sources to information	10

	content	
Objectivity	Disclosure	10
	No Advertising	20
Privacy	Data confidentiality statement	10
		100

5.1. An example of how the weighting technique works

The assigned weightings (w_i) when evaluating Web-located health information would rate the perceived *reputation* of the organisation providing the information **five times** more important than the *contact* or *authorship* features associated with the health information. The weighting associated with Web-located health information peculiar to *disclosure*, *privacy* and *accuracy* features are equivalent, but their importance represents half the value of weightings assigned to health information pages that are devoid of *advertising*. When the information was *created* is weighted relatively high— reflecting the *oldness* or *newness* of the information— when compared to other health information features.

Furthermore, when assigning weights it is possible to determine scores for each information feature— each individual weighted score contributing to the overall quality of the health information. For example, when health information is a gauged as being published by a reputable organization, this feature contributes 25 units to the composite quality score of the information; the inclusion of authorship on the same health information page is a feature that contributes 5 units towards quality. Absent features on information pages do not contribute to the overall health information quality. The collation of the quality weighted scores for individual features that are associated with Web-located health information give an overall indication of the quality of the information with a *perfect* score being 100 units.

6. Methodology

The authors decided to test the framework on Australian health information pages. Web-located health information pages were selected from three areas— Australian public hospitals, commercial health product suppliers and HealthInsite. The authors felt that these sources provided a diverse spread of the different types of health information pages available to a typical on-line user, and a means by which to see if the framework highlighted obvious differences.

The online Yellow Pages directory (http://www.yellowpages.com.au/search/search Entry.do) was used to select public hospitals (N=27) from each state of Australia. From each hospital's home page three medical-related words (cancer, treatment and medication) were searched for. The returned list from this search was examined for links that led to health related information. Each health information page was evaluated for quality by one of the

authors — as an absolute value and as a weighted average— addressing the areas of authority and currency, accuracy, objectivity and privacy.

The use of the Yellow Pages directory allowed commercial suppliers (N=15) of health products to be identified. Again, from the home page of each commercial health product supplier three medical-related words (cancer, treatment and medication) were searched for and pages that contained health related information.

Also included in the study as a form of benchmarking was a set of HealthInsite pages. HealthInsite is a Commonwealth Government Web initiative in providing up-to-date and quality assured information on important health topics. The HeathInsite site enabled the same three medical-related words (cancer, treatment and medication) to be searched for allowing government endorsed health information Web pages (N=16) to be identified and evaluated.

6.1. Notes on evaluation process

Media releases were not evaluated, nor were links that led to pdf (Adobe Portable Document Format) and word processed documents— only evaluation of health related information published in HTML was undertaken.

Where the search facility was absent, the home page was examined for possible links to potential health information. Hypertext links such as FAQ, clinical information, pharmacy and patient information were typical of links that were examined. Again only health related information published on Web pages was undertaken— media releases, pdf and word documents were not tested.

As indicated earlier, the researcher evaluating the health information had a health and medical science background and was deemed health information literate and to have the appropriate knowledge level that allowed the 'quality' of information on health pages to be determined.

7. Results and discussion

The Web-located health information pages evaluated composed a variety of medical-related issues, ranging from treatments for specific medical conditions to the use of health products to achieve medically significant outcomes. A total of 58 Web-located health information pages were evaluated. Results associated with the evaluation of the health information pages from these sources against the four quality categories are summarised in Table 3. Each website was evaluated according to whether it contained ($c_i = 1$) or did not contain ($c_i = 0$) the evaluation feature, or in the instance of being unable to not decide ($c_i = 0.5$).

Table 3. Evaluation results for Pubic hospital, HealthInsite and Commercial suppliers (N=58)

	Authority and Currency				Accuracy	Objectivity		Privacy	
	Author	**Creation**	**Contact Details**	**Reputable**		**Disclosure**	**No Advertising**		
[1] Percentage of overall page features (N)	25.9% (15)	58.6% (34)	77.6% (45)	79.3% (46)	32.8% (19)	58.6% (34)	81.0% (47)	56.9% (33)	
[2] Assigned weighting (w_i) (Maximum value)	5	15	5	25	10	10	20	10	**Total Score (/100)**
Weighted Score (*WA*) ([1] x [2])	1.3	8.8	3.9	19.8	3.3	5.9	16.2	5.7	**64.9**

The evaluation of Web-located health information indicates variability across the features examined. Authorship (1.3) was the quality feature that scored the least value across evaluated health information pages whilst there was an overall high adherence of health pages in excluding promotional advertising (weighted score = 16.2). The reputability of health web pages scored relatively high (19.8) and, arguably, this property directly reflects the organisation's standing and general promotion within the community— a form of branding that is associated with general media exposure and promotion. Indeed, authorship may have been dispensed with in recognition of the brand value associated with the website on which the information appeared. A notable finding is that the referencing of online health information was not widely implemented (32.8%) ands scored poorly (3.3)— this feature may have allowed the reader to further investigate and determine the accuracy of information on health pages. For all of the websites, the overall weight score for each feature was calculated by multiplying the percent of sites that had passed the criteria by the allocated weighting. The total score value of all sites was 64.9— indicating the overall information quality across the Web-located health pages was not particularly high. The relative low weighted scores associated with the accuracy and authorship features were the main contributors to the low total score.

The results from Table 3 are further expanded in Table 4, 5 and 6 on the basis of the three organisational types evaluated.

7.1. Australian public hospital published health pages

Table 4 summarises the evaluation of health information located on Australian public hospital pages.

Table 4. Evaluation of Australian public hospital information (N=27)

	Authority and Currency				Accuracy	Objectivity		Privacy
	Author	**Creation**	**Contact Details**	**Reputable**		**Disclosure**	**No Advertising**	
[1] Percentage of overall page features (N)	40.7% (11)	66.7% (18)	59.3% (15)	100% (27)	18.5% (5)	55.6% (15)	100% (27)	40.7% (11)

[2] Assigned weighting (w_i) (Maximum value)	5	15	5	25	10	10	20	10	**Total Score (/100)**
Weighted Score (*WA*) ([1] x [2])	2.0	10.0	3.0	25.0	1.8	5.6	20	4.1	**71.5**

A notable observation of hospital health pages is a failure to address some basic website implementation features such as a creation date (10.0) and the listing of contact details (3.0). Indeed, the creation of a Web page will reflect information currency and has a relatively high weight value associated with it— a feature that should be easy to include at the time of publishing and/or updating. Health information authorship associated with hospital websites was evident on only 40.7% of pages contributing only 2.0 units to the overall total score associated with this feature. Article citation (1.8) was poorly addressed by the majority of pages examined— a feature that would prevent information accuracy to be confirmed by readers. The poor scoring of the highly weighted accuracy feature is a significant contributor to the poor total score for Public Hospital Web-located information. In the areas of disclosure (5.6) and privacy (4.1)— features that not only address the quality of information, but have a legal dimension associated with them— not all Web-located health information found on hospital sites contained these important quality features. Web-located health information pages associated with Australian Public Hospitals were found to have no advertising (25.0) and were all perceived as being reputable (25.0) by the researcher. The total score value of all Australian public hospital health pages sites was 71.5.

7.2. HealthInsite published health pages

Table 5 summarises the evaluation of health information located on HealthInsite— an Australian Government's sponsored health site.

Table 5. Evaluation of Australian Government HealthInsite information (N=16)

	Authority and Currency				**Accuracy**	**Objectivity**		**Privacy**	
	Author	**Creation**	**Contact Details**	**Reputable**		**Disclosure**	**No Advertising**		
[1] Percentage of overall page features (N)	25.0% (4)	81.3% (13)	93.8% (15)	87.5% (14)	43.8% (7)	81.3% (13)	100% (16)	81.3% (13)	
[2] Assigned weighting (w_i) (Maximum value)	5	15	5	25	10	10	20	10	**Total Score (/100)**
Weighted Score (*WA*) ([1] x [2])	1.2	12.2	4.7	21.9	4.4	8.1	20.0	8.1	**80.6**

The aim of HealthInsite is to provide the Australian information-seeking consumer with access to up-to-date and quality information— health sites are submitted to HealthInsite's editorial board of independent health professionals for approval. Arguably, the health information located on HealthInsite should exhibit a value that meets all the requirements of the proposed quality categories— however, only the no-advertising property (20.0) was fully addressed by all sites evaluated. Some 25.0% of Web-located information associated with HealthInsite had an author listed, with 75.0% of sites being judged as reputable by the researcher— again tending to suggest

that organisational branding is may be a substitute for authorship as a quality indicator. A notable finding is the relatively higher proportion of health pages that address the accuracy (43.8%) feature— allowing information to be checked in the absence of an officially documented author (25.0%). The total score for HealthInsite sponsored health pages sites was 80.6 ranking higher than the Hospital pages, short of the expectation that such pages would have implemented features that exhibited an exemplary quality dimension associated with health information.

7.3. Commercial health product suppliers published health pages

A set (N=15) of commercial health product websites that published health information was evaluated using the proposed quality categories. Results are detailed in Table 6.

Table 6 Evaluation of commercial health product supplier information (N=15)

	Authority and Currency				**Accuracy**	**Objectivity**		**Privacy**	
	Author	**Creation**	**Contact Details**	**Reputable**		**Disclosure**	**No Advertising**		
[1] Percentage of overall page features (N)	0% (0)	20.0% (3)	93.3% (14)	53.3% (8)	46.7% (7)	40.0% (6)	26.7% (4)	60.0% (9)	
[2] Assigned weighting (w_i) (Maximum value)	5	15	5	25	10	10	20	10	**Total Score (/100)**
Weighted Score (*WA*) ([1] x [2])	0.0	3.0	4.7	13.3	4.7	4.0	5.3	6.0	**41.0**

No commercial health product organisation listed or identified the specific contributing author of health information articles. Previously noted was the emerging trend amongst the Public Hospital and HealthInsite informational Web pages to overlook individual authorship, with the publishing organisation being viewed as an appropriate substitute— the organisation‘s reputability enforcing authorship quality. The non-use of attributable authorship on health information pages published by commercial health product organisations may due to the perceived brand value of the company name as a substitute for information attribution— hence, informational authority takes on a marketing perspective built around brand recognition. Even though no pages listed a contributing author, 46.7% of these pages had some form of attribution by citing various references that allowed substantiation of aspects of the health information. It was noted that in some instances this citation was selective and supportive of some of the products a commercial organisation produced. The total score for commercial health product websites was 41.0 with features that had high weightings addressing advertising and reputability contributing to this poor quality score associated with this type of health information. Indeed, only 8 of the 15 commercial health page evaluated were deemed by the researcher to have been associated with reputable organisations.

A comparison across quality categories across the three different types of health entities is summarised in Table 7.

Table 7 Weighted score Comparison of information quality on Australian Public Hospital, HealthInsite and Commercial Organisation sites

Category	Features	Australian Public Hospital (N =27)		Australia's HealthInsite (N=16)		Commercial Organisation (N=15)	
		%	Weighted Score	%	Weighted Score	%	Weighted Score
Authority and Currency	Author	40.7% (11)	**2.0**	25.0% (4)	**1.2**	0.0% (0)	**0.0**
	Creation	66.7% (18)	**10.0**	81.3% (13)	**12.2**	20.0% (3)	**3.0**
	Contact Details	59.3% (16)	**3.0**	93.8% (15)	**4.7**	93.3% (14)	**4.7**
	Reputable	100.0% (27)	**25.0**	75.0% (12)	**21.9**	46.7% (7)	**13.3**
Accuracy	Obvious references/sources	18.5% (5)	**1.8**	43.8% (7)	**4.4**	46.7% (7)	**4.7**
Objectivity	Disclosure	55.6% (15)	**5.6**	81.3% (13)	**8.1**	40.0% (6)	**4.0**
	No Advertising	100.0% (27)	**20.0**	100.0% (16)	**20.0**	26.7% (4)	**5.3**
Privacy	Confidentiality	40.7% (11)	**4.1**	81.3% (13)	**8.1**	60.0% (9)	**6.0**
Total			**71.5**		**80.6**		**41.0**

One of significant comparative finding relates to the propensity of commercial-health product manufacturers to include advertising on their Web-located health information pages. This advertising took on various forms, for example—

- One company manufactured the products mentioned in the health article as a possible treatment for the health problem described
- One company advertised their product on the same page as health-related information that dealt with conditions that may have utilised the product as a possible treatment.
- One company promoted their product as part of a health information page.

The other already mentioned finding is the absence of authorship and date of creation— from commercial health information publications when compared to Public Hospital and HealthInsite Web pages – the latter feature having a major effect on the weighted score. Commercially based health pages also scored highly when it came to addressing the accuracy feature— however, it was noted that some commercial organisations tended to justify claims through the selective citation of source material that promoted their product. Indeed, the weighted score of many commercial health information pages may have been elevated by this selective attribution practice.

7.4. Other notable findings

Only four pages that were evaluated were found to have addressed all criteria in the four categories— two Public Hospital pages and two pages associated with the HealthInsite domain. Given that the evaluation criteria was drawn from the existing literature, with many features examined being fundamental to the notion of information quality, these findings suggest that the publishing of online health information is one that requires improvement.

It was noted that many public hospital websites— some deemed as high profile by Australian and even world standards— were devoid of any health information pages, whilst some hospitals maintained numerous pages with descriptive heath-related information. The reasons for this disparity are not obvious and may provide a future area for research.

8. Conclusion

Various methods for evaluating Web-located health information have been proposed ranging from widely based quality criteria to those instruments that instigate a thorough and specific checklist. Several health information evaluation methods appear to be emerging, some robust but technically based, others being more general and simplistic. This paper proposed a fundamental set of criteria that allowed the assessment of information found on health-related Web pages on the basis of authority and currency, accuracy, objectivity and privacy. Unlike many previously proposed information evaluation techniques, the proposed framework borrowed from the business field to assign weightings (w_i) to information features allowing proportional contribution by each feature to an overall information quality score. Moreover, contrary to business-based scenarios where the evaluation of online information quality tends to have a user-perception focus, it was argued that health information requires an *expert* third party in the form of health professionals to establish weightings (w_i) for quality features— the health information consumer requiring the guiding hand of the traditional creators and publishers of this information. The guidelines can be considered to be a minimum set of evaluation measures that can be easily applied, assessed and scored by the health information consumer or professional.

The proposed framework was used to evaluate Australian-based health information websites for information quality. The study was exploratory and because sampling was not probalistic, generalisations cannot be made at this stage however, some notable results identified in this study may serve as the foundations for future research. One pertinent finding in the study relates to a relatively high number of commercial health sites that intermixed health information with product promotion and advertising. Another finding found that only 4 of 58 health information pages studied complied fully with the set of core evaluation criteria suggesting that many organisations that publish health related information are not addressing some simple and fundamental quality features. Indeed, the evaluation framework should be viewed as a starting point for further development and refinement however, even in its current state the authors contend that it is a valuable differentiation instrument detecting Web pages that may provide wide fluctuations in the quality of health information published. Indeed, the instrument could motivate health content providers into improving the quality dimension of their online health information— a quality dimension that was identified as being poorly addressed by Australian based groups in this study.

9. Further studies

The authors argued that the main contributions of this paper were:

- The identification of criteria that can be used to assess the quality of Web-located health information
- That a weight (w_i) should be consistently applied to each evaluation criteria and that such weightings need to be based on quality values determined by health care professionals rather than the health information consumer.

However, the authors realise that the current framework has limitations and that further work needs to be carried out in relation to the following:

- Confirmation of the appropriate weightings allocated to the information features. Future research is anticipated in refining the allocated weight values assigned to the different Web-located health information features allowing the evaluation framework to appropriately reflect the quality views of health care professionals including doctors, nurses, administrators and medical librarians.
- Sourcing and evaluation of online health information from different countries— which would allow a cross-country comparison of the quality dimension. Indeed, it was noted that a number of online quality evaluation instruments [23, 24, 29] are being used different in countries — each instrument having its own particular application. Arguably, health information quality should not be geographically dependent.
- A broader study using the framework will allow generalisations and comparisons to be made about features of Web-located health information that is published on different types of organisational websites.

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