A Review of Search Interfaces in Consumer Health Websites

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ABSTRACT
There is a surging interest among consumers to search for health and wellness-related information on the web. Many health websites have been developed to satisfy this interest. However, consumers are still frustrated by their search experience. To identify opportunities to improve the design of such websites, we reviewed the search interface of 18 representative consumer health websites. Design implications are discussed based on the results.

Categories and Subject Descriptors
H.1.2 [**Information Systems**]: User/Machine Systems – *human factors, human information processing.*

General Terms
Design, Human Factors.

Keywords
Search interface, consumer health websites, consumer health informatics, information architecture

1. INTRODUCTION
In modern healthcare, instead of being a passive recipient of service, patients are encouraged to take a more active role in interacting with health providers, making healthcare decisions, and managing their diseases [1]. An effective role change, to a large extent, hinges on patients' ability to search for relevant health information, make sense of the information, and make decisions based on the information. In the past decade, more people turned to the web for health-related information. Pew research revealed that more than 80% of the web users in the U.S. have searched health information online and this activity is the third most popular online activity across all age groups [5, 14].

In response to this wide consumer interest in health information and the enormous potential economic benefits associated with this interest, numerous consumer health websites were created or redesigned in the past several years. However, making the health information available does not ensure that the information was readily accessible and usable. Consumers still reported having tremendous difficulties in finding relevant health information. One major difficulty lies in formulating queries. Studies consistently reported that consumers have difficulties finding proper medical terms to describe their intention, and furthermore, correctly spelling the medical terms [3, 9, 12]. The other common difficulty reported by consumers was finding information tailored to their particular situations [e.g., 2, 10]. Identifying personally relevant information was particularly difficult when the request involved multiple conditions or body parts [13]. Consumers also expressed a need for assistance with content evaluation and credibility judgment [10].

It is obvious that to better support health information searching, a better search interface that could provide users cognitive assistance at every step in the search process is needed. To examine the current status of the search interface of consumer health websites and identify opportunities for improvement, this review was performed.

2. METHOD
Eighteen consumer health websites were selected for the review (Table 1). These sites were identified by reviewing published research articles [e.g., 4], checking website recommendations provided by medical libraries, and conducting searches in Google to select websites with adequate interface designs. These selection strategies ensure that the reviewed sites are widely recognized and representative of the state-of-the-art design in this category of websites.

Table 1. Selected websites for the review

No.	Site name	URL
1	Center for disease control and prevention	www.cdc.gov
2	Discovery fit & health	health.discovery.com
3	Everyday Health	www.everydayhealth.com
4	FamilyDoctor	familydoctor.org
5	Healia	healia.com
6	Health.com	health.com
7	Healthfinder	www.healthfinder.gov
8	Healthline	www.healthline.com
9	Mayo Clinic	mayoclinic.com/health-information
10	Medhelp	www.medhelp.org
11	MedicineNet.com	medicinenet.com
12	MedlinePlus	www.nlm.nih.gov/medlineplus
13	MyOptumHealth	www.myoptumhealth.com
14	NIH health portal	health.nih.gov
15	Revolution Health	www.revolutionhealth.com
16	WebMD	www.webmd.com
17	WrongDiagnosis	www.wrongdiagnosis.com
18	Yahoo! Health	health.yahoo.net

This review examines the search interface of these sites from three aspects: types of search, support for query formulation, and support for accessing search results. During the review, we conducted the same searches across the websites to ensure comparable results. The review was performed between March-July, 2011. Two researchers reviewed these sites independently and several discussion sessions were held between the two coders to discuss disagreements, which helped to improve the accuracy of the labeling and categorization of certain functions on some of these sites.

3. RESULTS

3.1 Types of search

3.1.1 Simple search

All 18 sites provided a simple search function, which mostly consisted of a search box and a button named "Search", "Go", or "Health Search" or marked by an arrow icon. All of the simple search functions searched site-wide. Only two sites, Healia and Healthline, allowed users to specify the scope of their searches. Healia (Figure 1) allowed users to limit their search to different types of information in the site, including health information, communities, blogs, and guides. In Health Search, users could limit their searches to everything on the site, the web, medical journals, or clinical trials.

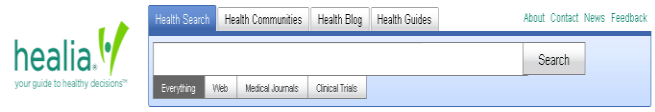

Figure 1. Healia search bar

Healthline provided a site-wide simple search. But at the same time, it allowed users to limit their search to symptom, treatment, doctor, or drug, as shown in Figure 2.

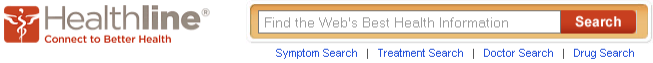

Figure 2. Healthline search bar

3.1.2 Advanced search

Only two sites, FamilyDoctor and the NIH health portal provided an advanced search. The advanced search on both sites allowed users to perform Boolean search (AND, OR, NOT) and phrase search, specify results in a particular language, specify where on the result page the search terms occur (title or URL), specify a specific website or a specific domain from which the results should be from, and define how the results should be ranked (by relevance or date). FamilyDoctor also allowed users to perform page-specific searches to find pages that link to a designated page.

3.1.3 Faceted search

Faceted searches allow users to progressively refine search results by selecting a value of a facet [11]. Only Healia provided a faceted search. After an initial query, four facets were provided, as shown in Figure 3.

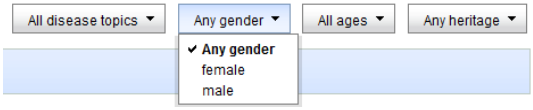

Figure 3. Faceted search in Healia

The values of each facet were:

- Disease topic: all, prevention, diagnosis/tests, symptom, risks, and treatments
- Gender: male and female
- Ages: all, children, teens, seniors
- Heritage: any, Asian, African, Hispanic, and Native people

3.2 Support of Query Formulation

Three main functions were identified on these sites to support query formulation and/or reformulation: auto-completion, spelling check, and query recommendations.

3.2.1 Query auto-completion

Query auto-expansion refers to the automatic completion of query terms when users start typing. Only one site, RevolutionHealth, provided this function (in the form of a drop-down menu).

3.2.2 Spelling check

The spelling check function was examined by searching for intentionally misspelled queries including brest cancer (correct spelling is breast cancer) and asprine (correct spelling is: aspirin). Twelve sites (66.7%) provided spelling corrections by asking "Did you mean …?" The remaining 6 sites (33.3%), including Discovery fit & health, EverydayHealth, Healia, MayoClinic, MedHelp, and myOptumHealth, did not provide recommendations for correct spellings.

3.2.3 Query recommendations

Query recommendations refer to the function of recommending search queries based on users' initial query. Nine sites (50%) provided this function and the function was named "related searches", "related topics", "suggested topics", "related terms", "related search results", or "you may also try". MyOptumHealth also explicitly provided recommendations to narrow or broaden the existing search.

Query recommendations were mostly provided as a list. Only Healthline provided related searches in the form of a tag cloud, as shown in Figure 3 (query: breast cancer).

Figure 4. Related searches in Healthline

3.3 Accessing results

Accessing search results is an important, but less researched, step in the process of information searching [8]. In this review, accessing results was examined from four aspects: the ways in which search results were presented, whether users have options to sort the results, whether users can filter results based on certain criteria, and whether users can save their search history.

3.3.1 Presentation of search results

Table 2 illustrates how search results were organized on the 18 sites. The majority of the sites (11 out of 18; 61.1%) presented search results as a list. The basic elements of an entry in the list included a clickable title of the resulting document, a snippet of the summary, and the URL or the source of the document. Several sites also provided the types of information (e.g., Health Tools and Health & Wellness Directory) or a link for more matching results.

Two sites, Health.com and MedlinePlus, provided a brief summary of the condition that users searched for (e.g. bronchitis, cold), before the result list. The summary links users to a precompiled collection of resources concerning the condition.

Five sites organized search results into categories. When searching for a particular condition, *Yahoo! Health* provided a health topic summary, followed by treatments and results

organized by different information types (e.g., articles, photos, and videos).

Table 2. Presentation of search results

Presentations	Elements	Sites
List	List (title + snippet + URL/Source)	1, 3, 4, 7, 11, 14, 17[a]
	List (title + snippet)	MayoClinic
	List (title + Snippet + Information types/Source)	WebMD MyOptumHealth
	List (title + Source + Snippet + See more matching results)	RevolutionHealth
Health topic + list	A health topic summary (health condition center) + List (title + snippet)	Health.com
	A health topic summary + List (title + snippet + URL + Information types)	MedlinePlus
Categories	A health topic summary + Treatments + Different information types (e.g., articles, photos, and videos)	Yahoo! Health
	Site results + Shopping results + Video results + Results from other networks	Discovery fit & health
	Medical journals + Clinical trials	Healia
	Recommended health topic link + Different information types (e.g., posts, articles, forums & groups, medical glossary, and user journals, blogs)	MedHelp
	The topic in learning center + Explore a related organ + Top Healthline results + media (videos, images) + Latest news + Top web results list	HealthLine

a. The number is corresponding to the number of each site in Table 1.

Discovery fit & health listed results into categories including site results, video results, shopping results, and results from other networks, with a list of results being provided under each category. *Healia* listed results into two categories: medical journals and clinical trials, with the first 5 results being displayed under each category. *MedHelp* listed more types of information, including health-related documents, such as articles, medical glossary, health pages, and drugs, as well as user-generated content, such as user journals, posts, forums & groups, and blogs, with several results being listed under each information type. *Healthline* listed several different categories of information, starting with a snippet of a health topic in its learning center, an option to explore related organs, followed by a list of top search results, a media collection listing videos, images, and 3D body maps in different tabs, a list of recent news, and a list of top web results.

Highlighting keywords can effectively assist users in evaluating and accessing results. Fifteen sites (83.3%) highlighted keywords in the title of a result (4), in the snippet (2), or in both (9). Three sites, Discovery fit & health, MedHelp, and myOptumHealth, did not highlight keywords in results.

3.3.2 Sort results

Only three sites allowed users to sort search results: FamilyDoctor, NIH health portal, and Healthfinder. Two sorting options were provided: by date and by relevance, with the latter being the default setting.

3.3.3 Filter results: Group by/Refine by

Half of the 18 sites (50%) allowed users to filter search results, that is, to access a subset of the results. Table 3 listed options provided by these sites.

Table 3. Options to filter search results

Refine by	Websites (options)
Information type	**MedlinePlus** (e.g., Health topics, external links, drugs and supplements, encyclopedia, videos and tutorials, news …) **MedicineNet** (Slideshows, news & views, features, tips & recipes, MedTerms dictionary) **MedHelp** (Posts from users, articles, forums & Groups, medical glossary, user journals, blogs, health pages, and drugs) **Yahoo! Health** (articles written by experts, news, articles, photos, videos, and tips) **Everyday Health** (articles & news, blogs & forums) **myOptumHealth** (articles, news, tools, and videos) **RevolutionHealth** (articles, news, recipes, drugs & treatments, doctors, hospitals, clinical trials, questions, blogs, personal stories, profiles, groups) **WebMD** (Overview & facts, treatment & care, causes & risks)
Topic/ Keywords	MedlinePlus, WebMD, MedicineNet
Facets	Healia (disease topic, gender, age, and heritage)
No group /filtering	CDCP, Discovery fit & Health FamilyDoctor, MayoClinic, NIH health portal, Health.com, Healthfinder, Healthline, WrongDiagnosis.

Eight sites (44.4%) allowed users to refine search results by type of information. Different sites provided different options, as listed in the table. It is worth noting that in addition to traditional information types such as encyclopedia, videos, images, slideshows, clinical trials, and news, several sites provided types of information generated by users, such as forums and groups, user journals, blogs, personal stories, and user profiles. As an example, Figure 4 illustrates the result refinement panel from RevolutionHealth.

Figure 4. RevolutionHealth results refinement panel

Three sites, MedlinePlus, WebMD, and MedicineNet, allowed users to refine results by a predefined topic, such as medications, symptoms, and procedures or by system-generated keywords. Healia allowed users to refine results by four facets: disease topic, gender, age, and heritage.

3.3.4 Save searches

Among all these sites, only RevolutionHealth provided an option for users to save previous searches after logging into the site.

4. DISSCUSSION AND CONCLUSIONS

Information searching is a problem-solving or decision-making process, often involving intensive cognitive activities such as sense-making and learning. This is particularly true for health information searching. Medicine is a highly specialized area and users consistently reported having significant difficulties finding personally relevant information. To better support consumer

health information searching, effective cognitive assistance should be provided at every step of the information searching process, including defining problems, selecting sources, formulating queries, accessing results, extracting information, and reflecting on the results [7].

From the review, it is apparent that the existing consumer health websites attempted to provide various functions that will assist users. Nevertheless, there is room for improvement. In terms of types of search provided, all the sites provided simple searches while only two provided advanced and one provided faceted search. To better support search, options could be provided to allow users to specify the scope or source of their searches. At the same time, advanced search functions could be made more explicit to help users construct more complex queries.

Coming up with search terms is the major difficulty reported by users in health information searching. Nevertheless, only one site provided query auto-completion to level down the cognitive load of having to remember the spelling of a particular term. None provided a function to help users find proper medical terms to describe their needs. Half of the sites did provide query recommendations after an initial query. Nonetheless, few made the rationale for the recommendations transparent or the semantic relations between the recommended queries and the original query explicit. Only MyOptumHealth explicitly labeled certain suggested queries as narrowing or broadening the search. Spelling search terms is another major difficulty for consumers [e.g., 9]. Still, about 33% of the reviewed sites did not provide the spelling check function.

Similar to general search engines, the majority of these sites provided search results as a list, with keywords being highlighted in the entry. Five sites organized results into different sections, often by source of information or type of information. Only one site, MedHelp, listed search results from user-generated content, such as blogs and forum, as separate sections. In supporting accessing results, about half of the 18 sites also provided options for users to refine search results by information types, keywords/topics, or facets. Among these sites, three allowed users to limit results to user-generated content. Recent research suggested that consumers value the practical information from their peers and like to evaluate and leverage peers' knowledge before making health-related decisions [6]. This phenomenon urges designers to explore how to properly present user-generated content in the consumer health domain and how to weave such content with existing health information resources.

It is worth noting that only three sites provided options to sort results by relevance or date and only one site allowed users to save search results. Search history could be very useful when users perform more complex and exploratory search tasks as such tasks often require them to connect, compare, or integrate results from several query trials [13].

In summary, the existing consumer health websites provided various functions to support query formulation and results access, but improvements could be made. Furthermore, more efforts are needed to design functions that could support other steps in the search process, such as defining problems and reflecting on results, as few such functions were observed on these reviewed websites.

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