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COMPARATIVE ANALYSIS OF FREE HEALTH-RELATED ONLINE DATABASES BASED ON STUDENT KNOWLEDGE AND OPINION

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Abstract

In the growing field of pharmacy, drug information (DI) resources are frequently consulted by pharmacy students. Although students utilize the free online DI resources, there is limited information available about the usefulness of the sites. To compare six free common health-related online databases based on student assessment of the scope (presence or absence of answer) of the website and student opinion. A Drug Informatics course assigned a structured two-part survey for students to assess the online DI resources, where the first part examined the scope of the databases by locating 12 criteria points and the second part evaluated student opinions based on four themes. Data was analyzed using IBM SPSS Statistics 21. Drugs.com was rated the highest in information available (scope mean, 8.54 ± 1.816; user opinion mean, 16.25 ± 3.198) and DrugDigest.org was rated the lowest amongst students (scope mean, 5.34 ± 1.858; user opinion mean, 13.03 ± 3.516). Issues in locating data from the website were commonly found with information on diseases, drugs, drug-food interactions, and alternative/complementary medicines. From these findings, the resources were arranged based on ease of use and scope so that users may make better choices.

Keywords: Drug information, Free online database, Student opinion.

Introduction

In the growing field of pharmacy, it can be quite overwhelming with the amount of new data and information that is being added. Pharmacy students are pressured to meet the demands and expectations that are placed on them for health related information. The utilization of drug information (DI) resources is vital for students to meet these demands and become effective practitioners. Many types of DI resources exist, but there is an increasing need to be familiar with electronic databases. Online information literacy is an area where pharmacists require more training to dispense the right information to their patients[1]. Electronic resources are being used often due to their ease of access and constant updates with new information. To make students more comfortable with consulting online DI resources, students at Howard University's College of Pharmacy are exposed to many subscription based and free online databases. For this study, a focus was given to six randomly selected common free databases which included MayoClinic.com, MedicineNet.com, RxList.com, Medscape.com, DrugDigest.org, and Drugs.com.

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Each online database provides unique qualities and functions, but there is limited data available related to their usefulness and accessibility to pharmacy students. There has been a study that analyzed online databases using scope (absence or presence of an answer), completeness, and ease of use as criteria; however their study focused on subscription based websites[2]. Another study utilized students, faculty, and librarian opinions to determine the usefulness of electronic databases; however this study also focused on subscription databases[3]. Studies have tried to rank and evaluate the online DI resources, but there is limited data that primarily focuses on free online databases with student perspectives.

Objective

The purpose of this article is to compare the most common free online health related databases based on student opinions and responses to the scope of each website.

Methods

A study was conducted through surveys at Howard University's College of Pharmacy in an attempt to improve the Drug Informatics course. The Drug Informatics course is a 3 credit hour course offered to all first year professional pharmacy students. As part of the course, a 90 minute lecture was provided to students describing the different free DI internet databases. At the end of the lecture, students were given an assignment as part of the course to assess the usefulness of the database. A total of 76 first year pharmacy students participated in the survey. The survey was divided into two parts. The first part was about the scope of each website reviewed and the second part dealt with students' opinion regarding accessibility, reliability, and usefulness of the websites. There were a total of six different commonly used DI database websites selected for this study. Inclusion criteria for participants were pharmacy students currently enrolled in the Drug Informatics course.

The scope of the websites was examined based on twelve criteria points, which included the following: (1) disease information, (2) drug information, (3) drug identification tools, (4) medical dictionary tools, (5) expert help options, (6) procedure and test information, (7) medical journal access, (8) health e-mail options, (9) alternative and complementary medication information, (10) drug-drug interactions checker, (11) drug-food interactions checker, and (12) traveling medication information. These criteria points were evaluated by students through a point system. Students were instructed to give a single point for each criterion that they were able to locate on the website. The points were added together for each student and were coded individually for statistical analysis.

Student opinions were assessed based on four major themes using a Likert Scale with 1 being in strong disagreement and 5 being in strong agreement. The themes included (1) ease of navigating the site, (2) impression of the informational content available, (3) ease of accessing and downloading material, and (4) reliability of the site based on updates, history, and ownership of the material.

Statistical analysis was performed using IBM SPSS Statistics 21. Descriptive statistics were done to provide baseline information about the six individual sites. To determine the actual accessibility of information on the website, an expert fourth year professional pharmacy student under the direction of a supervising faculty assessed the individual databases in the same manner as the first year pharmacy students. This expert response was used as the absolute criteria for determining what existed on the website and it was used for comparisons with the T-test results that were obtained from the student's responses. Independent T-tests were performed to evaluate the scope of the database by assessing the mean differences for each point on whether it was found on the site or not. An analysis of variance (ANOVA) utilizing a Tukey post-hoc test compared the mean differences on the six databases based on informational rating, user opinion themes, and total user opinion rating. A Pearson correlation was conducted to provide a correlation between the total ratings of the database information to the total ratings for the user opinions of each website.

Results

There were a total of 76 students that participated in the study, but only 68 responded to the website scope assessment portion and 63 responded to the user opinions portion of the survey. A total of 4,896 responses for the scope assessment section and 1,508 responses for student opinions were

available for analysis. The mean scores for each website are shown in Table 1. Based on these results, Drugs.com received the highest mean score (mean, 8.54 ± 1.816) followed by MayoClinic.com and MedicineNet.com. DrugDigest.org received the lowest mean score (mean, 5.34 ± 1.858).

The mean scores for user opinions are shown in Table 2. Based on these results, the total score for user opinions was highest for Drugs.com (mean, 16.25 ± 3.198) and lowest for DrugsDigest.org (mean, 15.14 ± 3.232). On individual themes, Drugs.com had also received the highest ratings for the ease of navigating the database, quality of information available, and access to content and downloads. On the other hand, DrugsDigest.org received the lowest mean scores for the same themes (mean for navigating, 3.18 ± 0.967; quality, 3.29 ± 0.989; access, 3.31 ± 1.223). Regarding the theme for reliability of the database, MayoClinic.com was rated the highest (mean, 3.78 ± 1.142) and DrugsDigest.org rated the lowest (mean, 3.31 ± 1.223).

Independent T-tests were conducted to compare the mean total scores for information that was found on the website to those that were not found (Table 3). Scope criteria were classified as poorly accessible if T-test results were statistically significant ($p < 0.05$) and if it was found on the site by the expert response. Based on these conditions, RxList.com and MedicineNet.com tied with eight criteria points as the websites with the most areas of poor accessibility. Tied for the second worst for information accessibility with seven difficult areas to locate were Drugs.com and Medscape.com. Finally, the two sites that were tied for the least poorly accessible websites with four criteria points were MayoClinic.com and DrugDigest.org. The poor accessibility was mainly related to disease information, drug information, alternative/ complementary medicines information, and drug-food interaction information, which were all found in at least five of the six databases.

The mean total scores for both scope and opinion of each website were compared using an analysis of variance (ANOVA) test. Table 4 refers to the means scores related to the scope and Table 5 refers to the student opinion data. The ANOVA revealed significant differences in the scores ($p = 0.000$) for each website and a Tukey Post-Hoc analysis, which compares any two websites individually, also yielded results that showed significant differences.

According to the Tukey Post-Hoc analysis, DrugDigest.org was the lowest rated and Drugs.com was the highest rated website. Similarly, ANOVA tests were run for each theme of user opinions and each theme showed significant differences in mean scores, except for the website reliability theme ($p = 0.144$). Other themes showed greater differences in scores among the various databases when DrugDigest.org was compared with RxList.com, Medscape.com, MedicineNet.com, and Drugs.com ($p < 0.05$ for each comparison respectively). Drugs.com was statistically significant in scores when compared to Medscape.com for ease of navigating the site and accessing or downloading content ($p = 0.006$ and $p = 0.010$ respectively).

Correlation between database information and user opinions was determined for each individual site. RxList.com has a weak positive correlation ($p = 0.034$, $r = 0.270$) between the information available and the user's opinion. On the other hand, strong positive correlations were found for the following databases: DrugDigest.org ($r = 0.491$), Medscape.com ($r = 0.608$), MedicineNet.com ($r = 0.545$), and Drugs.com ($r = 0.446$) ($p = 0.000$ for each correlation respectively). There was no correlation between user opinion and database information for MayoClinic.com.

Error

A source of error in how the student's responded to the survey can be linked to how the questions were presented in the survey. Many of the criteria points had examples that students may have attempted to search and find. Students may not have been able to locate the specific example from the website; however in actuality the website did have the function or type of data available for use on the database.

Table No. 01: Descriptive Statistics for Internet Database Information Provided by the Site (N = 76)

Total Rating on Information by Database	N	Mean	Std Deviation	% Responders
Drugs.com	68	8.54	1.816	89.4
MayoClinic.com	68	7.21	1.570	89.4
MedicineNet.com	68	7.18	1.908	89.4
RxList.com	68	6.96	1.688	89.4
Medscape.com	68	6.60	2.481	89.4
DrugDigest.org	68	5.34	1.858	89.4

Scores were based on whether or not information for a particular area was provided. Categories that were covered by the database were added by the user to obtain a total score.

Table No. 02: Descriptive Statistics for User Opinion (N = 76)

Mean Total Scores ± Standard Deviation						
	Drugs	**MayoClinic**	**RxList**	**MedicineNet**	**Medscape**	**DrugDigest**
Ease of Navigating the Database.	4.2 ±0.971	3.84 ± 1.139	3.98 ± 0.959	3.87 ± 0.975	3.62 ± 1.128	3.18 ± 0.967
Quality of Information of the Database.	4.19±0.877	3.89 ± 1.064	3.95 ± 0.851	3.92 ± 0.989	3.84 ± 0.902	3.29 ± 1.136
Access to Content and Download.	4.08±1.036	3.76 ± 0.946	3.86 ± 0.998	3.71 ± 0.906	3.48 ± 1.014	3.26 ± 1.085
Reliability of the Database.	3.73±1.019	3.78 ± 1.142	3.44 ± 1.267	3.59 ± 1.240	3.76 ± 1.187	3.31 ± 1.223
Total Rating for User Opinion of the Database.	16.25±3.198	15.17 ± 3.319	15.14±3.232	15.08 ± 3.404	14.68± 3.11	13.03 ± 3.516
N (%).	63 (82.9)	63 (82.9)	63 (82.9)	63 (82.9)	63 (82.9)	62 (81.5)

Scores were based on a 1-5 Scale, where users were asked about whether or not the database met their expectations. (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)

Table No. 03: Independent T-Test Results Compared to Actual Presence of Internet Database Information Based on 12 Criteria Points

	P-value					
	MayoClinic	**DrugDigest**	**Medscape**	**Drugs.com**	**RxList**	**MedicineNet**
Disease Information	0.055	0.000*	0.000*	0.010*	0.000*	0.034*
Drug Information	0.017*	0.000*	0.000*	0.001*	0.010*	0.027*
Drug Identify Tool	0.041	0.000	0.010	0.034*	0.253	0.051
Medical Dictionary	0.000	0.851	0.028	0.070	-**	0.003*
Expert Help Option	0.015	0.011	0.000	0.002*	0.107	0.079
Procedure/Test Information	0.129	0.014	0.000*	0.002*	0.028	0.000*
Medical Journal Access	0.001*	0.005	0.211	0.104	0.003*	0.060
Health E-Mail Option	0.021*	0.203	0.006*	0.385	0.001*	0.198
Alternative Medicine	0.000*	0.000*	0.064	0.011*	0.040*	0.000*
Drug-Drug Interactions	0.125	0.325	0.000*	0.279	0.000*	0.000*
Drug-Food Interactions	0.065	0.003*	0.000*	0.000*	0.000*	0.000*
Traveling Med Information	0.000	0.618	0.000*	0.010	0.038*	0.000*

*Criterion was actually present on database site and showed a significant difference in total scores based on whether the user found it or not on the site.

** 100% of the surveyed responses showed the presence of a medical dictionary.

Table No. 04: ANOVA and Post-Hoc Comparisons of Mean Scope Scores

	Mean Difference	P-Value
ANOVA	-	0.000
DrugDigest.org – Drugs.com	3.20588	0.000
Drugs.com – Medscape.com	1.94118	0.000
DrugDigest.org – MedicineNet.com	1.83824	0.000
DrugDigest.org – MayoClinic.com	1.86765	0.000
DrugDigest.org – RxList.com	1.61675	0.000
Drugs.com – RxList.com	1.58824	0.000
Drugs.com – MedicineNet.com	1.36765	0.001
Drugs.com – MayoClinic.com	1.33824	0.001
DrugDigest.org – Medscape.com	1.26471	0.002

Analysis of variance (ANOVA) results compared the mean total rating for database information provided by the site. Post-Hoc analysis was conducted using a simple Tukey test and the mean difference was reported as an absolute value.

Table No. 05: ANOVA and Post-Hoc Comparisons of User Opinion Themes for each Database

	Mean Difference	P-Value
ANOVA for Ease of Navigating the Database	-	0.000
DrugDigest.org – Drugs.com	1.09242	0.000
DrugDigest.org – RxList.com	0.80671	0.000
DrugDigest.org – MedicineNet.com	0.69560	0.002
DrugDigest.org – MayoClinic.com	0.66385	0.005
Medscape.com – Drugs.com	0.66385	0.006
ANOVA for Quality of Information of the Database	-	0.000
DrugDigest.org – Drugs.com	0.90015	0.000
DrugDigest.org – RxList.com	0.66206	0.002
DrugDigest.org – MedicineNet.com	0.63031	0.005
DrugDigest.org – MayoClinic.com	0.59857	0.009
DrugDigest.org – Medscape.com	0.55095	0.021
ANOVA for Access to Content and Downloading	-	0.000
DrugDigest.org – Drugs.com	0.82130	0.000
Medscape.com – Drugs.com	0.60317	0.010
DrugDigest.org – RxList.com	0.57908	0.011
ANOVA for Reliability of Database	-	0.144
ANOVA for Total Rating for User Opinion of the Database	-	0.000
DrugDigest.org – Drugs.com	3.22171	0.000
DrugDigest.org – MayoClinic.com	2.14235	0.004
DrugDigest.org – RxList.com	2.11060	0.005
DrugDigest.org – MedicineNet.com	2.04711	0.008

Analysis of variance (ANOVA) results compared the user opinion theme scores and mean total rating for user opinions of the site. Post-Hoc analysis was conducted using a simple Tukey test and the mean difference was reported as an absolute value.

Discussion

DI resources are vital to today's practice and proper use of the resources has become a target for the academic setting. The study was performed to compare the usefulness of the free online drug databases according to students' opinions. Based on the scope of the online DI resources, the ranking of the websites from best to worst were Drugs.com, MayoClinic.com, MedicineNet.com, RxList.com, Medscape.com, and DrugDigest.org. Student opinions similarly rated the websites with only one minor switch in positions between RxList.com and MedcineNet.com. The switch is consistent with how close the scores were and how similar the websites were upon the fourth year professional pharmacy student evaluation of the databases. This study exposed many weaknesses in accessing the databases, as many students were not able to consistently find disease information, drug

information, alternative/complementary medicines, or drug-food interaction information in at least five of the six databases. However, these areas of information were present and were successfully located by the senior pharmacy student.

Drugs.com is an online non-subscription database[4]. A major strength of the database is related to the complete medication information provided by the site, which include drug monographs for users to analyze. Disease conditions are adequately presented for users and are geared towards finding treatment options. Drugs.com works as a complete database system by providing a medical dictionary, a resource center for healthcare providers, and an interaction checker. The site includes an emailing system to provide users with updates on health issues that is supported by the Food and Drug Administration.

Drugs.com was rated highest among the surveyed online non-subscription databases (scope mean, 8.54 ± 1.816; user opinion mean, 16.25 ± 3.198). The scores were strongly correlated for its scope and user opinion ($p = 0.000$, $r = 0.446$). The site was rated highest in all categories for user opinion themes, except in reliability of the database. The question of reliability was not an issue, as the website is linked to reputable sources like the FDA. Weaknesses with the website are linked to the seven criteria points determined to be issues with accessing information from the site. Surveyed responses show that disease information, drug information, drug identification tool, expert help option, alternative/complementary medicine information, and drug-food interaction information ($p < 0.05$ for each respectively) were areas where scores were significantly different for students who found it compared to those who did not.

Table No. 06: Correlation between Scope Ratings to User Opinions

Database	Pearson Correlation (r)	P-Value
Medscape.com	0.608	0.000
MedicineNet.com	0.545	0.000
DrugDigest.org	0.491	0.000
Drugs.com	0.446	0.000
RxList.com	0.270	0.034
MayoClinic.com	0.216	0.091

Correlation between total scores for both database information and user opinions. If $r \geq 0.70$ (very strong positive relationship), $r = 0.40$ to 0.69 (strong positive relationship), $r = 0.30$ to 0.39 (moderate positive relationship), $r = 0.20$ to 0.29 (weak positive relationship), $r = 0.01$ to -0.19 (no or negligible relationship), $r = -0.20$ to -0.29 (weak negative relationship), $r = -0.30$ to -0.39 (moderate negative relationship), $r = -0.40$ to -0.69 (strong negative relationship), and $r \leq -0.70$ (very strong negative relationship).

The MayoClinic.com is an online non-subscription database that describes treatment options and diseases[5]. The medication information is adequately presented as it is sourced from Micromedex, which is a subscription based internet database. Conditions are described and easily navigated to find pertinent information. It was rated the second best amongst the six databases (scope mean, 7.21 ± 1.570; user opinion mean, 15.17 ± 3.319); however the user opinion and information rating were not significantly correlated ($p = 0.091$). Problems in regards to accessing the information from the site were minimal, as it tied for the least amount of criteria points that required attention. These access issues were related to drug information, medical journal access, health e-mail options, and alternative/complementary medicine information ($p < 0.05$ for each respectively).

RxList.com is an online non-subscription database that focuses on providing information for disease states and drugs[6]. It is comprehensive in providing clinically relevant details and has interactive features that allow users to visualize various diseases through slideshows. Drug information provided by the site consists of a brief description of the drug, indications, dosages, precautions, clinical pharmacology, drug interactions, adverse drug effects, and consumer information. The consumer information includes answers to frequently asked questions by patients. Other functions that the site offers include a pill identifier, symptom checker, and medical dictionary to site visitors.

RxList.com has eight criteria points that were difficult to locate. Along with the more commonly

shared difficulty areas, students uniquely had trouble searching for medical journal access, health e-mail options, and traveling medication information. Users rated the site similarly to MedicineNet.com (scope mean, 6.96 ± 1.688; user opinion mean, 15.14 ± 3.232), which were both ranked near the middle out of the six databases. There was a weak positive correlation between information ratings and user opinions ($p = 0.034$, $r = 0.270$).

MedicineNet.com is another online non-subscription database[7]. It functions similarly to RxList.com, as it provides detailed information about medications and gives slideshows for various disease states. The strengths of the database lie in the information and interactive slideshows that it provides. Information on the medications consists of indications, clinical pharmacology, dosing, drug interactions, side effects, and precautions. Since there were similarity in website function and presentation between MedicineNet.com and RxList.com, the databases scored very closely to each other (scope mean, 7.18 ± 1.908; user opinion mean, 15.08 ± 3.404). The information rating and user opinions were strongly correlated with one another ($p = 0.000$, $r = 0.545$). Issues with accessing information on MedicineNet.com existed similarly to RxList.com, as it tied with RxList.com with the most critical points that students had difficulty locating. Some of the unique criteria points included medical dictionary, procedures/test information, drug-drug interaction information, and traveling medication information ($p < 0.05$ for each respectively).

Medscape.com is an online free-subscription database that provides published evidence for medications and diseases that is adapted for clinicians[8]. Diseases are separated by specialty sites and are always updated with current information. Drug information provided by the website includes indications, dosing, adverse drug effects, clinical pharmacology, pricing, patient information, warnings, and interactions. The site uniquely provides a directory of healthcare professionals for users to contact. Despite the evidence-based information, Medscape.com was ranked just above DrugDigest.org in scope and user opinion (scope mean, 6.60 ± 2.481; user opinion mean, 14.68 ± 3.110) due to its difficulty with access to content on the website. Scores for information and user opinion were closely related to one another, as the site received the highest correlation score ($p = 0.000$, $r = 0.608$). Issues regarding access to the database may be linked to the registration requirement; however the poorer rating from students is also attributed to difficulty in searching for seven criteria points. Some specific areas of issues in searching the website were related to procedure/tests information, health-email option, drug-drug interaction information, and traveling medication information ($p < 0.05$ for each respectively).

DrugDigest.org is a basic online non-subscription database that provides content on various disease states and medications[9]. The drugs in this database are described by indications, warnings, adverse drug effects and consumer information. There is also a unique feature that the site provides which is a drug cost saving tool. However, it received the lowest rating in all categories according to student usage (scope mean, 5.34 ± 1.858; user opinion mean, 13.03 ± 3.516). The site tied for the fewest criteria points for difficulty in locating information on the website. Users had difficulty finding disease information, drug information, alternative/ complementary medicine information, and drug-food interaction information ($p < 0.05$ for each respectively). The findings did not suggest that the database was easier to navigate or access content compared to other sites, as user opinions scored it the lowest for both themes. Instead, the findings showed that DrugDigest.org lacked a lot of key functions that other websites had to offer. The lack of functions on the website and the poor user opinions are highly correlated to one another ($p = 0.000$, $r = 0.491$).

Limitations

The study's limitation is that it was not able to assess whether the student's inability to locate the correct information was due to website accessibility issues, teaching issues, lack of computer skills, or student attitudes towards the assignment. Although the source of the limitation is not clearly defined, it provides areas of focus for the Drug Informatics course to consider. Another limitation to the study is that the databases are constantly being updated and changed according to the owners, so the findings of this study may not be true at a future time.

Conclusion

The study was a survey-based assessment of first year professional Howard pharmacy students and their proficiency in using six different free online health-related DI resources. Results in both the scope of the websites and user opinion showed that Drugs.com was the most useful, while DrugDigest.org was the least useful. Weaknesses in accessing information from the websites were primarily found with difficulty locating disease information, drug information, alternative/ complementary medicines information, and drug-food interaction information in at least 5 of the 6 databases. From these findings, the study was able to arrange the free databases so that students may make better choices in their DI resource.

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