Point-of-Care Knowledge-Based Resource Needs of Clinicians

A Survey from a Large Academic Medical Center

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Keywords

Electronic health records, evidence-based medicine, information storage and retrieval, point of care technology, user-computer interface

Summary

Objective: To better understand the literature searching preferences of clinical providers we conducted an institution-wide survey assessing the most preferred knowledge searching techniques.

Materials and Methods: A survey regarding literature searching preferences was sent to 1862 unique clinical providers throughout Mayo Clinic. The survey consisted of 25 items asking respondents to select which clinical scenarios most often prompt literature searches as well as identify their most preferred knowledge resources.

Results: A total of 450 completed surveys were returned and analyzed (24% response rate). 48% of respondents perform literature searches for more than half of their patient interactions with 91% of all searches occurring either before or within 3 hours of the patient interaction. When a search is performed 57% of respondents prefer synthesized information sources as compared to only 13% who prefer original research. 82% of knowledge searches are performed on a workstation or office computer while just 10% occur on a mobile device or at home.

Conclusion: Providers in our survey demonstrate a need to answer clinical questions on a regular basis, especially in the diagnosis and therapy domains. Responses suggest that most of these searches occur using synthesized knowledge sources in the patient care setting within a very short time from the patient interaction.

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1. Background

Clinicians frequently have significant information needs while performing their patient care duties. Studies suggest that up to 5 clinical questions may arise during a single patient interaction [1]. Despite the number of clinical questions encountered, a large proportion of these questions remain unanswered, either due to lack of a formal search [2] or the inability to find an adequate answer despite an attempted search [3]. The correct use of online informational retrieval systems increases the accuracy of answers to clinical questions, even among experienced clinicians [4]. However, despite the growing popularity of online resources, many barriers remain that prevent clinicians from frequently and successfully answering clinical questions using online knowledge searches. These barriers include, but are not limited to, time limitations, uncertain knowledge accuracy, technology malfunction, and knowledge seeker forgetfulness of the questions needing answered [5–10].

Improving the ability to correctly and efficiently answer clinical questions has become a priority, with evidence-based medicine curricula playing a large part in many clinical training programs [11–14]. The advancement of differing levels of evidence gives the knowledge seeker the opportunity to search a range from original journal articles and synthesized reports to evidence-based textbooks and computerized decision support tools [15]. In addition, the development of online resources compatible with mobile devices has also increased, and these have become popular knowledge searching tools, especially in resource poor settings [12, 16, 17].

More recently, point-of-care context-sensitive information retrieval tools, termed infobuttons, have been developed to help bridge knowledge seeking gaps. Infobuttons link local clinical information systems to well-known electronic knowledge sources using interfaces that provide the user with a list of sources tailored to the specific patient-user context [18, 19]. The use of topic-specific infobuttons has repeatedly been shown to improve both the efficacy and quality of information seeking efforts [3, 20] with high approval [18, 19, 21] and increased usage [18, 19] ratings. In addition, many institutions develop their own methods to link clinical information to their local digital library in efforts to increase knowledge at the point-of-care [22, 23].

Despite these advancements, there still remains the challenge of customizing these point-of-care tools to the knowledge-seeking preferences of users. Often, these institutional electronic health records (EHRs) with infobutton capabilities are accessed by a variety of providers spread over many specialties, clinical roles, and hospital settings. The "one-size-fits-all solution" does not apply, and consideration should be given to individualize source management in a way to improve usability and overcome barriers to successful knowledge searches [24]. Knowing the habits and preferences of potential users may help guide the customization of such tools and increase the probability of their successful use.

2. Objectives

Using an institution-wide survey among clinical providers in various settings, we attempted to understand the knowledge searching habits of clinical users in relation to their use of online sources for answering clinical questions. In doing so we intend to guide point-of-care resource designers on how best to customize these tools to the needs and preferences of the unique users.

3. Methods

3.1 Study Design

A web-based survey was conducted at Mayo Clinic, Rochester, MN, an academic tertiary health care center, equipped with a comprehensive EHR and electronic library. The survey was conducted amongst staff of varying roles and medical specialties. The study was deemed exempt from consent requirements by the Institutional Review Board.

3.2 Study Subjects

Institutional group e-mail distribution lists were used to recruit study participants. Individuals on each distribution list were current employees of the institution or trainees/students enrolled in training programs at the time of the survey.

3.3 Institution's Electronic Library

Our academic medical center's intranet homepage contains a hyperlink to the electronic library that gives users ready access to various knowledge sources. This resource is easily accessible from campus and home and is available to all institution employees. The resource homepage largely consists of a search component that allows users the option to search for terms within all available or selected (PubMed, UpToDate, Google Scholar) sources. Individual links (either on the homepage or in the catalog) to all sources our library has access to are provided. Of note, UpToDate is the only synthesized source with a direct link provided on the library homepage. Other synthesized sources must be accessed via a search of the library catalog. No funding or promotion from any knowledge source was sought, procured, or used as part of this study.

3.4 Survey

3.4.1 Survey Design

An expert panel consisting of a medical informaticist, clinical fellow, and librarian developed a survey consisting of 25 questions aimed to determine the literature searching preferences of clinical providers. Questions were organized into either a radio-button single answer or check-box multiple answer format. For questions with an "other" option, a text box was provided for further explanation (Supplemetary Appendix).

3.4.2 Survey Content

In addition to demographic information, the 25-question survey contained specific questions relating to the following topics:

1. timing and location of most searches;
2. preferred level of evidence;
3. clinical domain (diagnosis, therapy, etiology/prognosis, prevention) most likely to prompt a search and the preferred sources for each domain;
4. barriers that prevent successful searches and point-of-care preferences.

Of note, respondents were asked to determine their preferred level of evidence by selecting 1 of the 3 options: original research/reviews (PubMed), synthesized (UpToDate), and no preference/whatever is available.

3.4.3 Survey Distribution

The survey utilized the Research Electronic Data Capture (REDCap) web-based application [25] and was distributed to the study participants via an embedded e-mail link. The identity of participants and survey results were kept confidential from all subjects and investigators. Potential participants were given 2 weeks to complete the survey with no further e-mail reminders or survey invitations sent.

3.5 Data Analysis

Survey responses were collected and tabulated by the REDCap tool. Groupings by clinical role for data presentation in ▶Table 2 and ▶Table 3 are as follows:

1. attending;
2. trainee – resident, fellow, medical student;

3. non-physician practitioner (NPP) – nurse practitioner (NP), physician assistant (PA), certified registered nurse anesthetist (CRNA);
4. other – registered nurse (RN), other.

Clinical setting groupings are as identified in the tables.

4. Results

4.1 Respondents

A total of 1862 surveys were distributed, with 450 completed surveys returned and analyzed, giving a response rate of 24%. The number of respondents varied according to clinical role and patient care area as demonstrated in ▶Table 1. Of the respondents, 40% were trainees (resident, fellow, medical student) and 28% had a non-physician background. Approximately 40% of respondents primarily care for patients in the outpatient setting compared to more than half that practice in the hospital [i.e. hospital floor, operating room (OR), intensive care unit (ICU), emergency department (ED)] setting.

4.2 Frequency, Timing, and Location

Forty-eight percent of respondents perform literature searches for more than half of their patient interactions, with 91% of all searches occurring either before or within 3 hours of a patient interaction (▶Table 2). The majority (82%) of literature searches are performed on a workstation or office computer, with very few occurring on a mobile device (6%) or at home (4%).

4.3 Level of Evidence

When a search is performed, 57% of respondents prefer synthesized information sources as compared to only 13% who prefer original research. Twenty-nine percent had no preference. When stratified by clinical role, each group had a preference for synthesized data over original research (▶Figure 1). Of the 59 respondents that preferred original research, 55 (93%) were physicians (attending, fellow, resident). Medical students, future physicians, preferred synthesized information 97% of the time with no student preferring original research. Only 1 NPP preferred original research.

4.4 Domain and Source

Respondents were asked to select which clinical domains often prompt knowledge searches to answer a clinical question. The most commonly selected domain was *therapy* (80%), followed by *diagnosis* (46%), *etiology/prognosis* (37%), and *prevention* (13%). ▶Figure 2 shows the preferred online knowledge source(s) of respondents when faced with a clinical question stratified by clinical domain. Respondents were allowed to select more than one source for each domain. UpToDate was the most selected preferred reference in all 4 domains, with more than two-thirds of respondents selecting this reference in the *therapy*, *diagnosis,* and *etiology* domains. The 2 next most popular sources for *therapy* questions were MEDLINE and Micromedex. For *diagnosis*, the next 2 were Google and MEDLINE. Additionally, more than 30% would ask a colleague and/or reference Ask Mayo Expert, a local web-based knowledge resource, when faced with a *therapy* or *diagnosis* question.

4.5 Barriers and Point-of-Care

The most commonly identified barrier to performing successful online searches (single answer format) was that they "take too much time" (▶Table 3). Similar numbers of respondents identified "non user-friendly search processes," "too many resources," and "limited bedside access to online resources" as the next most common barriers. When survey participants were asked to select the fre-

quency of links they would prefer if provided point-of-care prompts embedded into the EHR, a majority preferred a single link to one specific source as opposed to multiple links that require the user to select their preferred source (▶Table 3). Twenty-five percent of respondents prefer to search for their own answer rather than being provided point-of-care prompts.

5. Discussion

We conducted a survey at a large academic medical center to assess the knowledge searching preferences and habits of clinicians in an effort to better understand how to create point-of-care knowledge resource tools to fit the needs of the user. To our knowledge, this is the first study attempting to assess these specific needs in a systematic way. Our survey had a large number of respondents that were distributed among various clinical role designations and practice settings.

Our survey demonstrated that providers have a need to answer clinical questions on a regular basis, especially in the *therapy* and *diagnosis* domains, a finding that would be expected clinically. Most of these knowledge searches (91%) occur in the patient care setting within a very short time from the patient interaction. Interestingly, only a fraction of these searches actually occur at home or on a mobile device, a finding that is in contrast to previous studies [16, 17].

In general, respondents prefer to access synthesized sources as opposed to original research. For example, UpToDate was the preferred source in each domain, often by a large margin. Other studies have corroborated this finding with UpToDate frequently being the source most often used to generate the correct answer to various clinical questions [6, 14, 26]. What is difficult to glean from these results, however, is whether respondents actually prefer synthesized information generally or whether or not they are most familiar with and have ready access to UpToDate and responded accordingly. Our study demonstrates variety in source preference when stratified by clinical role, an example being that physicians responded that original research still plays a role in their knowledge-searching activities.

The importance of our survey's content is supported by a recent systematic review by Del Fiol et al [8] regarding questions that clinicians raise in the context of patient care decision making. Twenty studies were identified that provided information on the frequency of clinical questions with a range of 0.16 to 1.85 questions per patient visit being reported. However, in the 2 direct observational studies only a mean of 47% (22%-71%) of questions were actually pursued [27, 28]. Nonetheless, when a knowledge search was ultimately performed, a success rate of nearly 80% was consistently reported, regardless of study type. The most common barriers to performing a search, in both our study and the systematic review (cited in 11 studies), were time related. In addition, the review demonstrated that the type of question types clinicians frequently encounter follow a Pareto distribution. Of the 13 types of questions (categorized by the taxonomy of Ely et al [29]) that were identified to account for 80% of all questions asked, 11 would be considered *diagnosis* or *therapy* related, the most commonly identified question domains in our survey.

A possible solution to the barriers and complications limiting successful knowledge searches would be the increased design and adoption of point-of-care tools directly embedded into clinical information systems that provide answers quickly and efficiently. As mentioned earlier, the creation of context-specific infobuttons are being used more frequently and successfully by clinicians in various settings [18, 19]. The availability of open access resources such as OpenInfobutton and Librarian Infobutton Tailoring Environment (LITE) have allowed institutions to more easily adopt infobuttons that meet HL7 "meaningful use" standards [30, 31]. These tools allow institutions to link most knowledge sources to virtually any EHR. A handful of academic centers have expertise in implementing infobuttons and have published their results and insights that others have followed to adopt these tools in their unique settings [24, 32]. However, despite the overall increase in usage rates, the overall rate still remains low [21, 33, 34], with many users not using these tools to help improve knowledge searching success.

The results of our survey demonstrate variability in the knowledge-searching preferences among potential users. It may be possible that the low usage rates of point-of-care tools demonstrated by others may be related to this variation. These findings suggest that creation of "one-size-fits all" knowledge searching tools may not maximize their potential and possibly limit their usability and

adoption. For example, respondents from our survey demonstrated that ready access to a single source was preferred just slightly over a tool that provides multiple links to various sources. These findings suggest that an infobutton with options for varying degrees of resource density may be a way to personalize these tools to the different information-seeking strategies of the user [35]. For example, users who prefer only a single source may select an option where point-of-care links would take a user directly to the UpToDate article (or similar source based on user preference) on the topic rather than have to select from a myriad of sources provided them. This function would hopefully resolve the barrier of "too many resources" that was identified by nearly 20% of our survey participants while at the same time still provide options for increased source availability to those preferring multiple options.

Another important finding of our survey was the frequency with which users refer to colleagues for help in answering their clinical questions. We found that more than 30% percent of respondents would either ask a colleague and/or reference Ask Mayo Expert when faced with a therapy or diagnosis question. Ask Mayo Expert is an institution-specific, point-of-care, web-based knowledge resource for clinicians, written by expert clinicians within the institution, specifically aimed to answer clinical questions unfamiliar to the user [36]. Building upon these resources and improving access to information specific to the user's institution or practice setting is another way to improve knowledge searching success and efficiency.

The major limitation of our survey is the fact that it was performed at a single institution, therefore complicating the ability to extrapolate these results to the general population. However, Mayo Clinic is a large academic institution with clinicians and trainees coming from all around the world. This diversity enhances the heterogenicity of the study population and robustness of the study. The response rate of 24% might be considered low for an ideal survey-based study; however, we feel that the overall absolute response number and distribution among various roles and settings gives validity to our results and allows for appropriate clinical interpretations.

Our study design does potentially introduce bias. We asked clinicians to state their preferences rather than using audit logs to determine their actual searching habits. We attempted to minimize this risk by offering respondents as many possible source choices (the majority of source options at our institution) when asked about searching preferences. However, not all aspects of this limitation could be accounted for.

6. Conclusion

Providers in our survey demonstrate a consistent need to answer clinical questions on a regular basis, especially in the *therapy* and *diagnosis* domains. Responses suggest that most of these searches occur using synthesized knowledge sources in the patient care setting within a very short time from the patient interaction. Creation of point-of-care knowledge searching tools should be based on principles obtained from this survey and could possibly allow for personal customization, as a "one-size-fits-all" approach would not seem to meet the unique preferences of potential users.

Clinical Relevance Statement

The creation of point-of-care information retrieval tools have improved the ability of clinicians to search for answers to clinical questions. However, clinicians have various knowledge-searching preferences and habits. The identification of these preferences is vital in order to develop tools better equipped to meet the needs of clinicians and improve evidence based medicine practices.

Conflict of Interest

None of the authors have any financial or conflict of interest disclosures to report.

Protection of Human and Animal Subjects

The study was performed in compliance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects, and was reviewed by the Mayo Clinic Institutional Review Board.

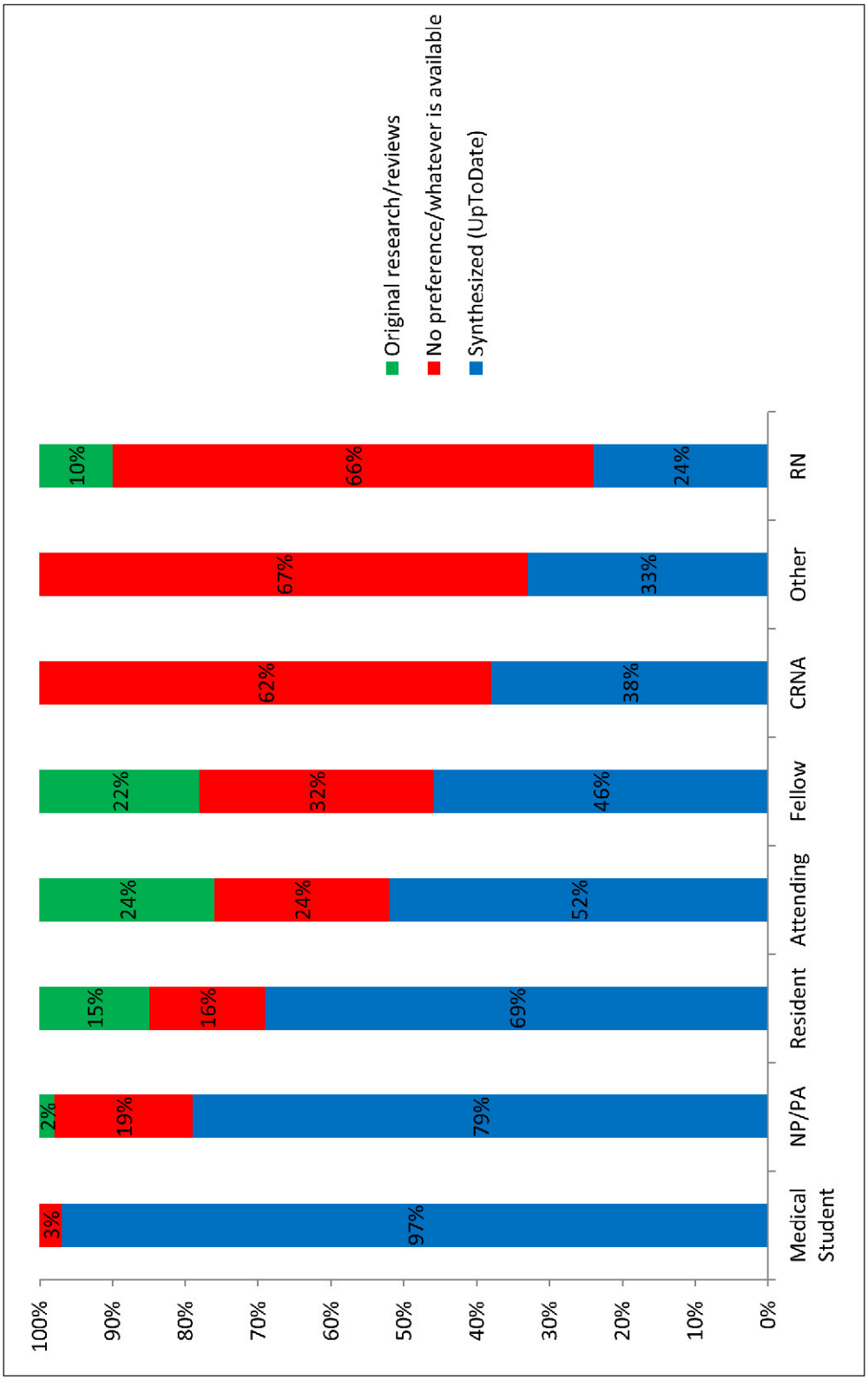

Fig. 1 Preferred level of evidence stratified by clinical role.

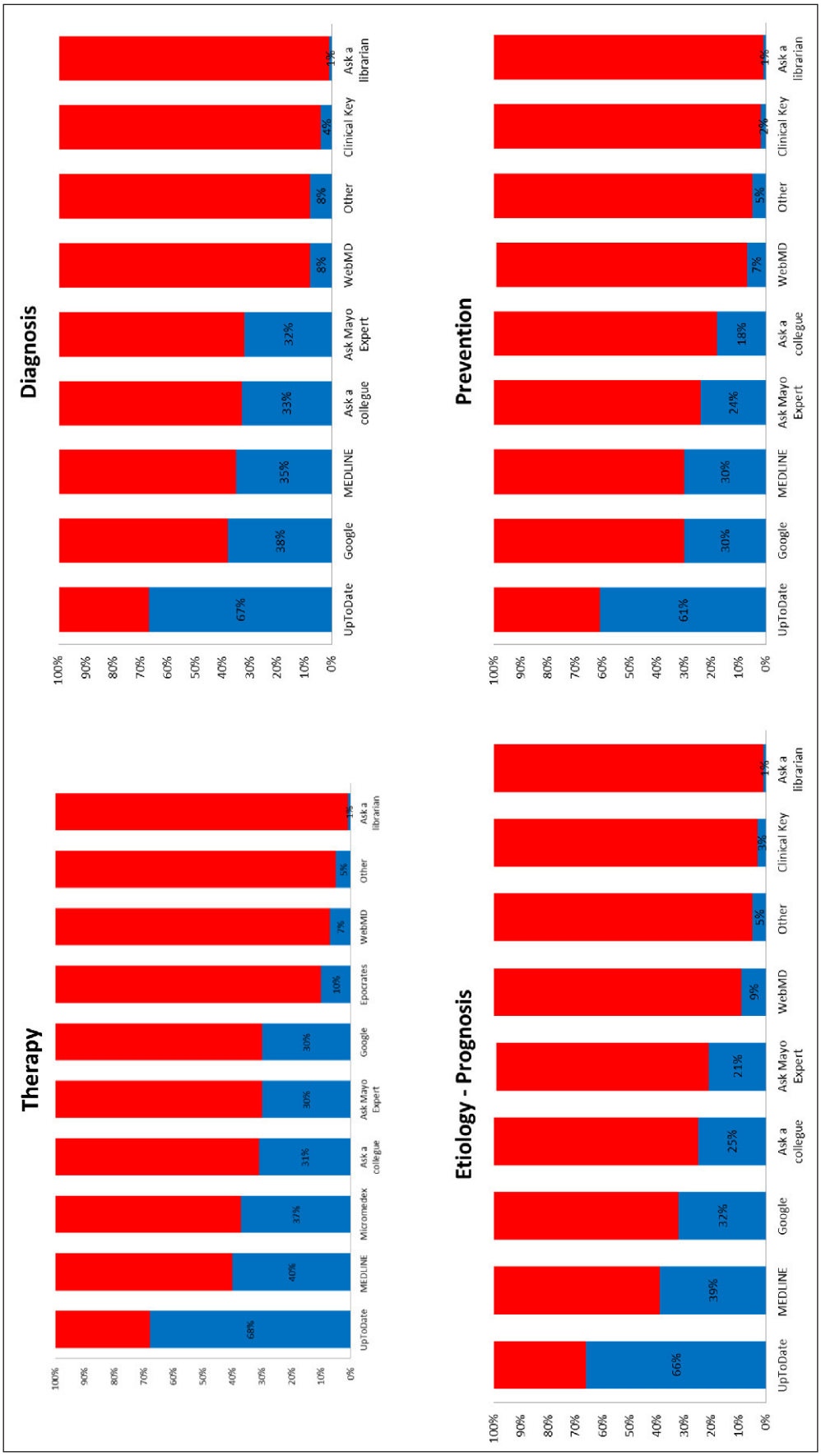

Fig. 2 Preferred online knowledge source(s) when faced with a clinical question stratified by clinical domain. Respondents were allowed to select more than one source for each domain.

Table 1 Demographics

Clinical role	Total	Clinical Setting				
	n (%)	Outpatient	OR	Hospital Floor	ICU	ED/Other
Attending	123 (27.3)	66 (36.7)	25 (22.9)	6 (6.5)	18 (50.0)	8 (25.0)
Resident	95 (21.1)	20 (11.1)	22 (20.2)	45 (48.4)	0 (0.0)	8 (25.0)
NP/PA	53 (11.8)	18 (10.0)	13 (11.9)	12 (12.8)	8 (22.2)	2 (6.3)
Fellow	51 (11.3)	30 (16.6)	2 (1.8)	9 (9.7)	9 (25.0)	1 (3.1)
CRNA	43 (9.6)	1 (0.6)	41 (37.6)	0 (0.0)	0 (0.0)	1 (3.1)
Medical Student	34 (7.6)	1 (0.6)	1 (0.9)	21 (22.6)	0 (0.0)	11 (34.4)
RN	29 (6.4)	29 (16.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Other	22 (4.9)	15 (8.3)	5 (4.7)	0 (0.0)	1 (2.8)	1 (3.1)

Note: Percentages do not include missing values
Abbreviations: CRNA – certified registered nurse anesthetist; ED – emergency department; ICU – intensive care unit; NP – nurse practitioner; OR- operating room; PA – physician assistant; RN – registered nurse

Table 2 Literature Searching

	Total	Clinical Role				Clinical Setting				
	n (%)	Attending	Trainee	NPP	Other	Outpatient	OR	Hospital Floor	ICU	ED/Other
Frequency of literature searches										
Rarely/almost never	25 (5.6)	6 (4.9)	3 (1.7)	7 (7.3)	9 (17.6)	11 (6.1)	9 (8.3)	4 (4.3)	1 (2.8)	0 (0.0)
<50% of patient interactions	210 (46.7)	83 (67.4)	48 (26.7)	51 (53.1)	28 (54.9)	92 (51.1)	66 (60.6)	21 (22.5)	19 (52.8)	12 (37.5)
>50% of patient interactions	189 (42.0)	30 (24.4)	109 (60.6)	37 (38.5)	13 (25.5)	71 (39.5)	31 (28.4)	54 (58.1)	15 (41.6)	18 (56.2)
Every patient interaction	26 (5.7)	4 (3.3)	20 (11.0)	1 (1.1)	1 (2.0)	6 (3.3)	3 (2.7)	14 (15.1)	1 (2.8)	2 (6.3)
Timing of literature search										
Before patient interaction	191 (42.6)	55 (44.7)	69 (38.5)	49 (51.0)	18 (36.0)	70 (39.5)	60 (55.0)	29 (31.2)	20 (55.6)	12 (36.4)
During patient interaction	67 (15.0)	20 (16.3)	11 (6.1)	18 (18.8)	18 (36.0)	42 (23.7)	11 (10.1)	6 (6.5)	5 (13.9)	3 (9.1)
Within 2–3 hours following patient interaction	150 (33.5)	34 (27.6)	80 (44.7)	25 (26.0)	11 (22.0)	47 (26.6)	29 (26.6)	47 (50.5)	10 (27.7)	17 (51.5)
Within 24 hours following patient interaction	40 (8.9)	14 (11.4)	19 (10.7)	4 (4.2)	3 (6.0)	18 (10.2)	9 (8.3)	11 (11.8)	1 (2.8)	1 (3.0)
Location of literature search										
Workstation/office computer	368 (81.8)	106 (86.2)	146 (81.1)	70 (72.9)	46 (90.2)	157 (87.8)	75 (68.9)	77 (82.8)	30 (83.3)	29 (87.9)
Bedside/patient room computer	34 (7.6)	10 (8.1)	2 (1.1)	20 (20.8)	2 (3.9)	14 (7.8)	20 (18.3)	0 (0.0)	0 (0.0)	0 (0.0)
Mobile device	28 (6.2)	6 (4.9)	17 (9.4)	5 (5.2)	0 (0.0)	4 (2.2)	7 (6.4)	9 (9.7)	6 (16.7)	2 (6.1)
Home computer	19 (4.2)	1 (0.8)	15 (8.4)	1 (1.0)	2 (3.9)	4 (2.2)	7 (6.4)	7 (7.5)	0 (0.0)	1 (3.0)
Other	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.0)

Note: Percentages do not include missing values
Abbreviations: ED – emergency department; ICU – intensive care unit; NPP – non-physician practitioner; OR – operating room

Table 3 Barriers

	Total	Clinical role				Clinical setting				
	n (%)	Attending	Trainee	NPP	Other	Outpatient	OR	Hospital Floor	ICU	ED/Other
Barriers to online searches										
Takes too much time	139 (32.9)	38 (34.9)	75 (37.3)	20 (22.0)	6 (27.3)	65 (39.9)	21 (19.8)	34 (37.7)	6 (17.6)	13 (43.3)
Non user-friendly search processes	89 (21.0)	28 (25.7)	36 (17.9)	20 (22.0)	5 (22.7)	43 (26.4)	22 (20.8)	16 (17.8)	6 (17.6)	2 (6.7)
Too many resources	79 (18.7)	17 (15.6)	37 (18.4)	17 (18.7)	8 (36.4)	30 (18.4)	17 (16.0)	17 (18.9)	7 (20.7)	8 (26.7)
Limited bedside access to online resources	78 (18.4)	12 (11.0)	39 (19.4)	24 (26.4)	3 (13.6)	15 (9.2)	31 (29.2)	15 (16.7)	10 (29.4)	7 (23.3)
Other	35 (8.3)	14 (12.8)	12 (6.0)	9 (9.8)	0 (0.0)	10 (6.1)	14 (13.2)	6 (6.7)	5 (14.7)	0 (0.0)
Prefer printed/paper sources	3 (0.7)	0 (0.0)	2 (1.0)	1 (1.1)	0 (0.0)	0 (0.0)	1 (1.0)	2 (2.2)	0 (0.0)	0 (0.0)
Preferred point-of-care link frequency										
Ready access (via link) to a single source	180 (41.0)	49 (40.5)	86 (42.4)	36 (38.7)	9 (40.9)	81 (45.8)	39 (37.1)	31 (34.1)	18 (50.0)	11 (36.7)
Multiple links to various sources	155 (35.3)	35 (28.9)	70 (34.5)	46 (49.5)	4 (18.2)	62 (35.0)	38 (36.2)	36 (39.6)	9 (25.0)	10 (33.3)
Search for own answer	104 (23.7)	37 (30.6)	47 (23.1)	11 (11.8)	9 (40.9)	34 (19.2)	28 (26.7)	24 (26.3)	9 (25.0)	9 (30.0)

Note: Percentages do not include missing values
Abbreviations: ED – emergency department; ICU – intensive care unit; NPP – non-physician practitioner ; OR – operating room

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