Users' guide to the surgical literature: how to perform a high-quality literature search

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SUMMARY

The article "Users' guide to the surgical literature: how to perform a literature search" was published in 2003, but the continuing technological developments in databases and search filters have rendered that guide out of date. The present guide fills an existing gap in this area; it provides the reader with strategies for developing a searchable clinical question, creating an efficient search strategy, accessing appropriate databases, and skillfully retrieving the best evidence to address the research question.

Surgeons must always ensure that the care they provide is rooted in the best available evidence.¹ Finding the best evidence, one of the cornerstones of evidenced-based medicine (EBM), however, can be a difficult task for a practising surgeon, who often faces a high volume of potential sources from which to extract answers. Without the proper skills and approach, performing an effective literature search can be an arduous and time-consuming task that may not yield the best quality of evidence.

Literature searches have become a prerequisite for providing the most effective surgical care.² With the monumental advancements in electronic database searching, a once resource-intensive and difficult process can now be done easily and expeditiously.

The article "Users' guide to the surgical literature: how to perform a literature search" by Birch and colleagues³ was published in the *Canadian Journal of Surgery* in 2003, but the continuing technological developments in databases and search filters have rendered that guide out of date. The present guide fills an existing gap in this area; it provides the reader with strategies for developing a searchable clinical question, creating an efficient search strategy, accessing appropriate databases, and skillfully retrieving the best evidence to address the research question. Table 1 outlines these steps. As in previous users' guide articles, we provide clinical scenarios to illustrate the concepts.

We caution readers that the purpose of the present guide is not to accept the validity of the articles discussed in our examples, which should be appraised using the techniques published in earlier users' guides.⁴⁻¹¹

CLINICAL SCENARIO

One hour after undergoing bilateral prophylactic simple mastectomy for breast cancer and Stage I breast reconstruction with insertion of tissue expanders in both breasts, a 40-year-old patient is returned to the operating room (OR) to evacuate a hematoma from the left breast. The surgical team was not aware that just before extubation in the OR the anesthesiologist gave the patient ketorolac to provide postoperative pain control. You are the surgeon involved with the case, and you believe the ketorolac is the cause of the hematoma. The anesthesiologist was not aware of the potential association. You promise to review the literature to determine if ketorolac was the culprit. You are unsure, however, how best to go about the search.

FORMING A RESEARCH QUESTION

It is important to ensure that your research question is well defined, as it will provide the foundation for the literature search. A well-designed research question addresses several components of the clinical scenario, conveniently summarized as PICO(T): incorporating the patient population (P), the intervention (I), any comparative interventions (C), the outcome of interest (O), and the time period for data collection (T).¹² Note that a time period is not always necessary for a research question, such as in cases where you do not wish to restrict your observations to a specific point in care. Once all components of the PICO(T) have been addressed, you should be able to synthesize it into your research question, from which you can ultimately derive keywords.

From the clinical scenario, we format the PICO(T) with its components, as depicted in Table 2. Using the components of our PICO(T) formulation, we then pose a searchable research question: In surgical patients, does the use of ketoralac compared with other postoperative pain control agents cause postoperative hematoma?

DEVELOPING A SEARCH STRATEGY

Keeping in mind that surgeons are likely at different levels in their literature searching skills, this section emphasizes basic principles for developing a search strategy. The resulting strategy attempts to ensure that key articles are not missed owing to varying vocabularies and that all results are relevant. However, surgeons who are comfortable with these principles wishing to further decrease the time required to complete a search can use a simpler organization of search terms and proceed to the section on choosing appropriate databases.

A search strategy is a list of discrete search terms, which can be arranged into groups of related search terms or so-called concepts. Each of these concepts will repre-

sent a component of your PICO(T). You can determine the keywords in your clinical question and use them as your initial concepts. For example, it might not be necessary to include an all-encompassing list of pain medications used to treat acute pain postsurgery unless you are interested in specific comparators. Moreover, it is important to avoid the use of too many words for a single search term, opting instead to use more direct terms to designate your search. For example, instead of using “patients who are having surgery” in the population concept, simply specifying “surgery” or “operation” provides an appropriate and sufficient setting in which the population would belong. Multiple-word phrases threaten to limit your search inappropriately, as the indexed terms from most search engines or the direct wording from the article text may differ.

Ultimately, you want to limit the number of irrelevant articles while ensuring that your strategy does not restrict potentially relevant ones. Notice that in Table 3, additional terms have been added below the original search terms, which were considered based on the research question. Consider any synonyms or related terms germane to each concept that may also contribute to your search strategy. You do not need to exhaust the list of similar terms in order to develop a comprehensive search; the example in Table 3 is a good starting point. The initial search may determine whether you need to expand your search vocabulary with additional terms, thus increasing the number of articles returned, or vice versa. For our clinical scenario, the keywords can be selected as illustrated in Table 3.

Truncation/wildcard operators

You may want to ensure that your keywords include all appropriate variations of the root word (e.g., bleed, bleeds, bleeding), if applicable. Instead of including every variation of a keyword under each concept, you can expedite the search by adding an asterisk (*) at the end of the root (e.g., bleed*); the asterisk is known as a wildcard operator. Be mindful that truncations on roots with too many variations may produce an overwhelming search of many inappropriate articles. For example, using “surg*” instead of “surgery” or “surgical” would include thousands of additional terms, many of which would be irrelevant to the intended topic. Adding wildcard operators can ease the process of choosing search terms, but they must be used with caution in the case of broader search terms.

Table 1. Steps to performing a literature search

1	Forming a research question
2	Developing a search strategy
3	Choosing appropriate databases
4	Executing a search
5	Implementing filters to narrow a search
6	Optimized search filter: Clinical Queries

Table 2. The PICO(T) method for developing a research question

Population	Surgical patients
Intervention	Ketoralac
Comparison	Any other pain control medication or no medication
Outcome	Postoperative hematoma
Time period	Any time after surgery

Table 3. Clinical scenario: keywords chosen from the research question

Concept 1	Concept 2	Concept 3	Concept 4
Surgery	Toradol	Hematoma	Postoperatively
Surgical	Ketoralac	Bleed*	Post-surgery
Operation	—	Hemorrhage	Following surgery
Operative	—	—	After surgery

Boolean operators

Boolean operators can be used with most database search engines to organize and connect each key search term appropriately. The primary Boolean operators are AND, OR, NOT and parentheses. AND will narrow your search by ensuring that the articles extracted contain all of the terms connected by this operator. OR will broaden your search by including articles that use any 1 or more of the search terms connected by this operator. NOT will narrow your search by making sure that no article extracted contains the term following this operator. Finally, parentheses allow you to group individual terms together, so that all of those terms can be connected to additional terms using an operator.

Search field tags

Search field tags can be added at the end of each search term to specify where you want the database to search for it. These tags are also helpful for filtering your search and will be discussed in greater detail in the section of this guide on effectively filtering your search. Each search engine has its own format for tags, which can be found under the help section of the respective search interfaces. For convenience, the popular tags and their function with PubMed are included in Appendix 1, available at canjsurg.ca.

After developing the search strategy for the clinical scenario, you produce a text version ready to be used in database search engines consisting of the following:

(Surgery OR surgical OR operation OR operative) AND Toradol OR Ketorolac) AND (Hematoma OR Bleed* OR Hemorrhage) AND (Postoperative OR Post-surgery OR Following surgery OR After surgery).

Figure 1 explains how this search strategy operates as an organized grouping of concepts. Notice that in our case, terms belonging to the same concept were connected via the OR operator to allow the search to include any combination of these terms. Also, each set of terms belonging to a concept were grouped together via parentheses, with each concept being connected to each other via AND to

ensure that all 4 concepts are included in the articles extracted by the search engine.

Text words versus controlled vocabulary

Although text word searches should be a familiar concept, it is important to be aware of any “controlled vocabulary” used by a search engine and to understand its attributes and limitations. Text words intuitively search for those specific words in the text of the article, whereas controlled vocabulary encompasses standardized subject terms that have been assigned by indexers for each article based on relevant topics and keywords. Controlled vocabulary can include synonyms and associated subjects central to your original search terms. MEDLINE and EMBASE have employed medical subject headings (MeSH) and Emtree vocabulary thesauri, respectively, each of which have their own distinct index.¹³ Controlled vocabulary terms are organized hierarchically, from broad to more detailed topics. Each article added to the database is assigned a series of appropriate controlled vocabulary terms. Both in PubMed and the Cochrane database, search terms are automatically searched as both a text word and a MeSH; putting quotation marks around a term will search only for the text word.¹³

The caveat with these terms is that each article available in MEDLINE or the Cochrane database needs to be indexed within the relevant categories. As such, you risk missing articles if they haven’t been indexed appropriately.

In PubMed, the MeSH database can be accessed under “more resources” on the advanced search page or at www.nlm.nih.gov/mesh. Observing the terms involved in the MeSH tree associated with a term may help you choose additional search terms. For example, searching the term “bleed” from the third concept in the clinical scenario will yield “hemorrhage” as the first result. By clicking on that result and navigating to the MeSH tree at the bottom of the page, you will see a full hierarchy of vocabulary associated with this concept. Note that the terms provided in Table 3 are all included in this tree. Searching a term on this page will yield a list of different MeSH terms, which, if indexed, should be relevant to your search term. You

Fig. 1. Search strategy operating as an organized grouping of concepts.

can choose to include an exclusively MeSH-searched term by appending the term with [mh]. Omitting text word searching for a term can act as a filter to include only articles that were specifically indexed under that term.

CHOOSING APPROPRIATE DATABASES

The search strategy discussed previously can now be used in a database search engine to extract relevant articles. The following guidelines focus on databases relevant to a surgical practice. The databases discussed in this guide consist of both unfiltered and filtered sources.

Unfiltered and filtered sources

For surgeons or any physician, 2 of the most common databases for conducting routine literature searches are MEDLINE and EMBASE. These are examples of unfiltered sources. The articles indexed here may have gone through a peer-review process, but this does not guarantee high quality. Filtered databases, on the other hand, include articles that have been reappraised by experts in health research methods.¹⁴ Thus, it is up to surgeons to recognize entries of lesser quality or relevance to their research questions.

Although MEDLINE and EMBASE are unfiltered databases, for most surgical queries, they are still very useful; we have found that most surgical interventions have not been reappraised to the same degree as medical interventions. Despite EMBASE containing a more exhaustive number of journal records, including all of those from MEDLINE, surgeons may not find the additional pharmacology databases included in EMBASE beneficial to their searches. A notable benefit to the MEDLINE database is its open access through the Internet via PubMed. Google Scholar is another Internet source that searches a variety of databases. It has been shown to yield twice as many relevant clinical articles as PubMed, while providing access to a larger number of free full-text articles; however, the large number of articles retrieved may be tedious for literature searching purposes.¹⁵

Filtered sources can save time for surgeons by reducing numerous aspects of the literature search process, potentially resulting in better patient outcomes owing to the high-quality review articles that can be accessed. Moreover, authors of publications within filtered databases often make recommendations for surgical practice.

Thus, filtered sources are often the best place to start, with unfiltered sources being the next step in finding an answer to a research question.

6S pyramid of hierarchical evidence

As a surgeon using EBM at point of care, it is critical for you to ensure you are taking advantage of the best sources for making clinical and surgical decisions. One method of organization of the available sources of evidence is the 6S

pyramid developed by Haynes and colleagues.¹⁶ We provide a summary of this model and sources from each level that is of particular relevance to the surgeon. Table 4 summarizes all surgically relevant sources under the 6S.

The 6S (systems, summaries, synopses of syntheses, syntheses, synopses of single studies, single studies) pyramid (Fig. 2) denotes a hierarchy of evidence wherein the top of the pyramid encompasses the best available evidence for making clinical decisions. As you move toward the bottom of the pyramid, it may become more difficult to make decisions using the evidence therein. Critical appraisal will guide you in arriving at conclusions for the lower evidence on the pyramid, such as primary studies.

Systems represent the prototypical evidence for evidence-based surgery, wherein a surgeon is able to access the best available research integrated into an individual patient's health record; an integrated system would offer the surgeon evidence of utmost quality and relevance. The system's role would be to ensure that the cumulative research evidence concerning a surgical patient's problem is immediately at hand.¹⁴ A resource for this level of evidence is not currently available in either surgical or medical domains, and thus we do not discuss it further. Although not applicable in surgery presently, we anticipate it will be relevant in the future.

Summaries provide the surgeon with expert review and summary of the literature germane to many common surgical problems. One can view these online sources as dynamic textbooks, wherein a comprehensive review on a particular topic in surgery is included; articles are not focused on a single research question, but rather attempt to cover all aspects of a procedure, technique or condition. Examples of summaries include evidence-based clinical practice guidelines (CPGs; there are many CPGs that are not evidence-based, so be sure to look for the details of whether/how evidence is incorporated) as well as a general review of evidence-based medicine and surgery. The CMA Infobase and National Guideline Clearinghouse are 2 clinical practice guideline sources that cover surgical practices; UpToDate, DynaMed and Best Practice offer EBM summaries. A caveat to keep in mind with sources for summaries is that these resources appear to be geared toward medical literature presently and may not have comprehensive coverage of many surgical topics; for example, we noted a particular paucity in entries regarding the surgical specialties within CMA Infobase. Moreover, although these resources have expert reviewers responsible for presenting the information, the sources used are not always critically appraised in the standardized fashion expected from other filtered sources. UpToDate, for example, is incorporating GRADE (www.gradeworkinggroup.org/publications/) and DynaMed uses explicit evidence criteria and GRADE.

Synopses of syntheses are brief structured summaries of systematic reviews. They offer the benefit of a concise abstract of a detailed article, with the added advantage of having the evidence coming from literature that reviews

all available single studies on a given topic. Surgically relevant sources in this category include the Database of Abstracts of Reviews of Effects (DARE), Cochrane Summaries, ACP Journal Club, OrthoEvidence, NHS Economic Evaluation Database (NHSEED) and BMJ Clinical Evidence.

Syntheses are systematic reviews of all single studies germane to a particular question. Syntheses can fall under both filtered and unfiltered sources. Sources include the Cochrane Database of Systematic Reviews and systematic reviews published in other journals (Cochrane reviews make up less than one-third of all published reviews), almost all of which are available through ACCESSSS and TRIP, which include both preappraised and nonpreappraised databases, such as MEDLINE.

Synopses of single studies will provide an expert review and brief summary of a single entry in the primary literature, often providing a clearer and more expeditious inter-

pretation of what that literature means in the context of making surgical decisions. The ACP Journal Club, OrthoEvidence, and Evidence-Based Obstetrics and Gynecology offer articles within this level of evidence.

Finally, single studies largely come from unfiltered sources, such as MEDLINE, EMBASE and the Central Register of Controlled Trials (CENTRAL).

Access to resources

Many of the sources discussed thus far do not provide free full-text access to their material. Sources such as PubMed, the Cochrane Library and UpToDate will allow you to search their databases free of charge; however, access to most of the full-text articles will still require a subscription to the respective database. PubMed and the Cochrane Library do, however, allow you to view abstracts to virtually all of their articles, and some full-text articles can be

Table 4. Sources of evidence in the 6S pyramid

Summaries	Evidence-based summaries
	UpToDate (www.uptodate.com)
	DynaMed (dynamed.ebscohost.com)
	Best practice (bestpractice.bmj.com)
	Clinical practice guidelines
	CMA Infobase (www.cma.ca/EN/Pages/clinical-practice-guidelines)
	National Guideline Clearinghouse (www.guidelines.gov)
Synopses of syntheses	
	BMJ Clinical Evidence (clinicalevidence.bmj.com)
	Cochrane Summaries (summaries.cochrane.org)
	ACP Journal Club database (www.acpjc.org)
	The Database of Abstracts of Reviews of Effects (DARE) (www.cochrane.org/editorial-and-publishing-policy-resource/database-abstracts-reviews-effects-dare)
	OrthoEvidence (www.myorthoEvidence.com)
	NHS Economic Evaluation Database (NHSEED) (www.cochrane.org/editorial-and-publishing-policy-resource/nhs-economic-evaluation-database)
Syntheses	
	McMaster PLUS (in ACCESSSS and Evidence Updates)
	The Cochrane Database of Systematic Reviews (www.thecochranelibrary.com)
	MEDLINE (Unfiltered Source); PubMed (www.pubmed.com)
	EMBASE (Unfiltered Source); OvidSP (gateway.ovid.com)
Synopses of single studies	
	McMaster PLUS (in ACCESSSS and Evidence Updates)
	ACP Journal Club (www.acpjc.org)
	OrthoEvidence (www.myorthoEvidence.com)
	Evidence-Based Obstetrics and Gynecology (www.sciencedirect.com/science/journal/1361259X)
Studies	
	McMaster PLUS (in ACCESSSS and Evidence Updates); MEDLINE (Unfiltered Source); PubMed (www.pubmed.com)
	OvidSP (gateway.ovid.com)
	EMBASE (Unfiltered Source); OvidSP (gateway.ovid.com)
	The Central Register of Controlled Trials (Unfiltered Source) (www.cochrane.org/editorial-and-publishing-policy-resource/cochrane-central-register-controlled-trials-central)

accessed for free; UpToDate allows you to access sample portions of their articles. These resources can allow you to find a potential article without a subscription.

Institutions, such as academic centres, hospitals, and clinics, as well as organizations, such as the Canadian Medical Association and provincial and territorial medical associations, often subscribe to a number of relevant databases for their workers. These institutions use online, searchable interfaces, such as OvidSP and EBSCOhost, to provide full-text access to databases and comparable strategies for finding an article to that of PubMed. Owing to the wide variety of institutional access interfaces that exist, our guide cannot provide a detailed commentary for each. Fortunately, these interfaces tend to incorporate many of the same organization and search engine tools as that of PubMed. For more information regarding institutional access, we recommend contacting your institution's librarian.

Google Scholar: Should you use it?

Google Scholar is frequently used by practising surgeons to access the literature. There are several advantages and disadvantages to using Google Scholar. If you know exactly what you are looking for (e.g., a specific article, articles by a specific author), Google Scholar provides the best results. Conversely, if you are unsure that you can recognize the "right answer" (e.g., the current best evidence concerning a treatment) or if you lack the skillset or time to appraise individual items, Google Scholar provides no direction. Perils in the latter situation include millions of hits, search optimization (i.e., gaming the system to push items to the top of the search retrieval based on characteristics other than quality), and the lack of quality

filters to help sort the wheat from the chaff in a database that is almost all chaff for a given question. Unfortunately, most relevant clinical questions are ones for which the clinicians do not know the best answer. Using preappraised evidence resources, such as the ones discussed in this guide, is much more likely to be productive than using Google Scholar for these questions.

Too many resources and not enough time: the role of federated search engines

We have listed a number of resources that cater to surgeons for the sake of completeness; however, you often will not need to go through all of them in search of your answer. A group from McMaster University has created a federated search engine known as ACCESSSS (plus. mcmaster.ca/accessss). A federated search facilitates simultaneous searching of more than 1 database from a single convenient search query; ACCESSSS allows you to enter your search strategy and simultaneously search multiple sources from all available levels of the 6S pyramid below the systems level, presenting the results under their respective level of the pyramid. The sources within each 6S category include filtered sources, and unfiltered sources are included at the very bottom. Currently, although the site is free, you are required to register to use it. The TRIP database (www.tripdatabase.com) has a similar function. These resources offer an expedited search, consulting only 1 site for results. However, you may find yourself overwhelmed with the number of results despite the intelligent filters used by the creators; TRIP yielded 198 hits with our example search strategy, and ACCESSSS provided 106 results and hundreds of unfiltered hits;

Fig. 2. The 6S (systems, summaries, synopses of syntheses, syntheses, synopses of single studies, single studies) pyramid.

fortunately, the results are ranked for both search engines, and you are encouraged to “cherry pick” the best items from the top.

EXECUTING A SEARCH

Based on the sources discussed, there are plenty of resources that can be used to carry out an effective literature search. For our clinical scenario, a search was performed using ACCESSSS by copying our search strategy into the main search bar of the website (Appendix 1, Fig. S1, available at cansurg.ca) This search yielded hits within summaries and synopses of syntheses, with no further results from other filtered sources (Appendix 1, Fig. S2). At the time of this search, there were no entries within these categories that effectively answered the research question. However, 1 of the synopses of syntheses articles briefly reports on some association of ketorolac with bleeding complications (Appendix 1, Fig. S3). You decide to pursue an answer further in the unfiltered results from PubMed and PubMed Clinical Queries, from which 1 study²⁰ provides compelling evidence specifically regarding your research question (Appendix 1, Fig. S2). To ensure your search of the unfiltered literature is comprehensive, you decide to conduct your search in PubMed.

A lack of results from filtered sources will likely be a common occurrence. The pace of new information from unfiltered sources moves much quicker than from filtered sources; as such, you will need to defer to databases such as MEDLINE to acquire your evidence. Our search in ACCESSSS provided unfiltered results as well; however, you may wish to search databases such as PubMed directly. This guide will hereafter provide instruction on how to optimally search these databases to ensure that you are confident with and in control of the results. MEDLINE searches are currently the most common technique within the surgical community. Although you can access MEDLINE through your institution (i.e., OvidSP), we proceed using the PubMed search engine; the methods discussed are applicable to all database interfaces.

After navigating to PubMed, click on “advanced” to access the advanced search options (Appendix 1, Fig. S4). The advanced search itself can also be used in much the same way as the Cochrane search engine: individual search terms can be added to each search box (combined with AND, OR, and NOT operators). As with the other example in the Cochrane database, concepts in the same search query box will be automatically grouped with parentheses, which are thus not required. Alternatively, there is a search builder at the top of the page, where you can manually add your search strategy along with Boolean operators and parentheses to easily group all terms from each concept. Again, we recommend that you limit your keyword search to titles and abstracts, either via the dropdown menu to the left of each search bar, or via search field tags if you are

using the search builder to manually input your search strategy. Both methods are shown in Appendix 1 (Fig. S5), but only 1 is required to carry out the search.

Conducting the aforementioned search from the clinical scenario yields 116 articles. Even the most assiduous of clinicians would agree that the volume of results is unmanageable for searching on a day to day basis. Fortunately, several techniques exist to appropriately limit your search by focusing it toward certain qualities that are desirable for use as clinical evidence.

USING FILTERS TO NARROW YOUR SEARCH

Search engine filters

All the search engines discussed have built-in tools to limit your search results. Within PubMed, you can access all of the search filters on the left side of the search results page. However, it is important to note that the filters built into these search engines have limitations. For example, the filters used by MEDLINE rely on the indexed MeSH terms to filter the search. Owing to the risks associated with missing viable articles as a result of inappropriately indexed or nonindexed articles, the “additional filter method” has been included for the filters most affected by this phenomenon. Nevertheless, the built-in search filters offer a rapid way to reduce the number of records yielded by your search.

Study design

In order to be confident with any clinical decision rooted in EBM, it is critical to ensure the best quality evidence. Thus, it is ideal to initially filter for the highest level of evidence. The hierarchy of evidence has been discussed in previous users’ guide articles.^{9,10} In brief, systematic reviews and meta-analyses of randomized controlled trials (RCTs) represent the best evidence, as they are unbiased in their acquisition of multiple articles and provide statistical analysis and quantitative measures of these articles. In particular, RCTs are considered the highest form of single-study evidence owing to their robust methodologies; single RCTs should also be considered when searching for articles to answer your research question. However, it is important to ensure that your particular research question can be answered through this study type. For instance, if your research question deals with a scenario wherein a study population couldn’t be randomized (e.g., owing to harmful exposure, patient preference), then you will not be able to yield RCTs or systematic reviews of RCTs in your search. Because surgical studies in particular are plagued with issues regarding randomization more often than medical studies, there is all the more reason to conduct a full search of the primary literature.

For an additional filtering method, you can include the study design filter as its own concept, including each study

type twice, once with the search field tag [pt] and once with the tag [tiab], or the equivalent for other search engines. For example, if you wanted to limit your search to include only RCTs and meta-analyses, you would add the following to your search query:

AND (randomized controlled trial[pt] OR meta-analysis[pt] OR randomized controlled trial[tiab] OR meta-analysis[tiab])

Including the study type as part of a concept ensures that the search engine will not only search exclusively these article types as indexed under publication type [pt], but also the article type in the title and abstract [tiab] in the event that the publication type is not indexed appropriately. You must ensure that for those terms appended with [pt], the exact wording of the study type is used. Otherwise the search engine will not properly apply this filter.¹⁶ A list of study types that are relevant to surgeons are included in Table 5.

Publication date

Depending on your research question, you may want to specify a range for the publication date. In surgical practice, where procedures and technology are ever-changing, you want to ensure that your results take all of these changes into account, and thus filtering for up to date articles is a reasonable filter.

In the case of the clinical scenario, you might choose to limit your search by article type. Aiming for the highest levels of evidence, you choose to limit your search to “meta-analysis” and “randomized controlled trials” using the additional filtering method. This filter alone cuts your search down to 47 articles. Further filtering to reveal only the meta-analysis study type yields only 1 article, the first meta-analysis on this topic, entitled “Ketorolac does not increase perioperative bleeding: a meta-analysis of randomized controlled trials” by Gobble and colleagues.²⁰

Optimized search filter: Clinical Queries

Clinical Queries incorporates a number of filters targeted toward clinical questions using the MEDLINE database.¹⁷ As with PubMed searching, results from Clinical Queries

are also presented in ACCESSSSS. However, this section provides a more in-depth explanation of this filtering tool, as well as a description of how to use it.

Available through PubMed and OvidSP, Clinical Queries provides an optimized filter that allows you to limit your search not only to clinically relevant articles, but also to specific subsets of clinical articles to appropriately address your question. In effect, Clinical Queries seeks to provide the best balance between sensitivity and specificity based on analysis of many popular strategies.¹⁶ Studies have shown that the Clinical Queries tool continues to provide an effective methodological and topical filter for searching literature related to clinical care.¹⁸ Clinical Queries can be accessed at www.ncbi.nlm.nih.gov/pubmed/clinical, or in the same resources menu as MeSH. You can enter your search strategy into the search bar near the top of the page. Once entered, you will notice results are displayed under 3 columns: “clinical study categories,” which includes individual clinical studies; “systematic reviews,” which includes all systematic review articles related to your search query; and “medical genetics,” which is perhaps not as applicable to surgical literature. The clinical study categories column contains further filters that can be applied and are discussed in detail.

Category

The category option contains 5 different categories from which to filter your search: “therapy” will retrieve clinical studies that involve disease treatment, “diagnosis” yields diagnostic articles, “etiology” searches articles dealing with causes of disease or pathology, “prognosis” will search for articles associated with prognostic factors and “clinical prediction guides” retrieves clinical studies that deal with methods for predicting outcomes.

Scope

The scope option allows you to adjust the sensitivity and specificity of your search. Choosing “broad” increases the sensitivity of your search results, finding all articles relevant to your query, including less relevant ones that may not include all of your concepts. Choosing “narrow” increases the specificity of your search, changing the scope to include only the most relevant articles by incorporating as many of your concepts as available.

Applying our original search strategy to Clinical Queries yields the results shown in Appendix 1, Figure S6. It is evident that the meta-analysis discovered from the previous search filtering has shown up under systematic reviews, organized in the middle column of the results page. However, we also see 103 results from other clinical studies on the left; changing the scope to “narrow” cuts the results roughly in half to 46 articles. By clicking “see all” at the bottom of the results section, you could apply additional filters specific to your requirements, as discussed previously, to reduce that number even further.

Table 5. Common study types for evidence-based surgery

Case report
Clinical trial
Controlled clinical trial
Meta-analysis
Observational study
Randomized controlled trial
Review
Systematic review
Validation study

AN ESSENTIAL FRAMEWORK FOR YOUR LITERATURE SEARCH

Our guide has provided many different tools to conduct a literature search in order to cater to the preferences of all readers. It is not, however, necessary to exhaust all of these tools to answer your research question. Rather, we encourage you to consider the methods discussed, their strengths and weaknesses, and determine what methods address your needs.

For the surgeon looking to distill this process into its most basic form, we propose the essential steps necessary for completion of a literature search. These steps include generating a research question, developing a search strategy and applying that strategy using an appropriate search engine. Since no additional filters or adjustments to your search are involved in this basic formula, using an appro-

priate search engine, such as the federated search engine ACCESSSS, is critical. Figure 3 provides a basic framework to guide your search from start to finish, using the clinical scenario provided in this guide.

Resolution to the clinical scenario

By incorporating the search strategy along with any of the sources discussed (Federated Search Engine, PubMed, PubMed Clinical Queries) you find the article by Gobble and colleagues.²⁰ This is the first meta-analysis of its kind, which examined 27 RCTs on postoperative bleeding occurrences with ketorolac compared with a control group in a variety of different surgical settings, including plastic surgery. The study indicates that ketorolac does not increase bleeding risk and recommends considering its use as a pain control therapeutic agent postoperatively.

Fig. 3. Basic framework to guide a literature search from start to finish.

You inform the anesthesiologist of the evidence provided by this article, and ketorolac remains a consideration for future use to control pain postoperatively.

CONCLUSION

The surgical literature continues to grow at a breakneck pace. Although the wealth of knowledge available to surgeons offers greater opportunities to provide optimal surgical care, the weight of this knowledge can become crippling to busy surgeons if they are unable to effectively and efficiently access it. However, the search strategies outlined in this guide will allow surgeons to execute successful literature searches which will provide robust and clinically meaningful data to improve patient care. The Royal College of Physicians and Surgeons of Canada makes a point of professionalism in recommending that every physician and surgeon stay current with the literature in clinical topics associated with his or her practice, and the new CanMEDS competencies recommend use of preappraised resources.¹⁹ A combination of the ability to identify clinically relevant questions in your practice, routine exploration of these questions in your schedule and the appropriate skills for seeking out answers obtained from this guide will strengthen your role in honouring this requirement. Once again, we encourage readers to consult earlier users' guides when appraising the chosen literature.⁹

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