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ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/wser20>

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Lilian Hoffecker

To cite this article: Lilian Hoffecker (2020) Grey Literature Searching for Systematic Reviews in the Health Sciences, *The Serials Librarian*, 79:3-4, 252-260, DOI: [10.1080/0361526X.2020.1847745](https://doi.org/10.1080/0361526X.2020.1847745)

To link to this article: <https://doi.org/10.1080/0361526X.2020.1847745>



Published online: 19 Jan 2021.



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Grey Literature Searching for Systematic Reviews in the Health Sciences

Lilian Hoffecker

Strauss Health Sciences Library, University of Colorado Anschutz Medical Campus, Aurora, Colorado, USA

ABSTRACT

The growing volume of scholarly information makes it difficult for professionals to keep up with pertinent research literature. In the health sciences, standard bibliographic databases like PubMed that compile published articles are essential for the health care researcher and practitioner to obtain the latest peer-reviewed information. Many research results are available outside the formal publication process through unpublished reports, conference abstracts, preprints, and more, which are widely distributed across the internet. The *systematic review*, a type of publication that pulls together and then appraises findings from multiple individual clinical trials, helps inform health-care providers in their practices. Clinical information changes with each new trial or reanalysis, making recency of the findings to be especially important. Grey literature is not peer-reviewed and omitting this time-consuming step may have the advantage of accelerating the process, which sometimes takes priority in rapidly evolving medical topics. On the other hand, cursory reviews have their costs as seen in the rise of preprints discussing the coronavirus pandemic in 2020. In this paper, the author discusses the unique needs of grey literature searching in the health sciences with a focus on the systematic review and similar publication types. A well conducted literature search for these reviews must be carefully managed in a replicable manner, thoroughly documented, and transparently reported, all challenges for grey literature searching. As an alternative to a highly sensitive strategy that a searcher commonly applies using standard bibliographic databases, the paper offers recommendations on a targeted approach specifying what grey document types to search and its resources, that balances practicality while maintaining methodological rigor. Finally, it includes a brief primer on using Google to find grey information.

KEYWORDS

Grey literature; systematic reviews; health sciences; literature searching; databases; replicability; reproducibility; Google

Introduction

Evidence-based practice relies on three sources of information: the patient's values and interests; the clinician's expertise; and health care research findings.¹ While the first two are centered on individuals, the third takes the practitioner to the literature for research conducted by many specialists. Instead of the experience of one clinician, evidence-based practice incorporates the well considered findings and conclusions from numerous investigations and their experts.

Health sciences librarians regularly collaborate with clinical researchers as the literature searching specialists. One type of publication that requires thorough searching is the systematic review, a special type of review with a formal procedure that ensures orderly and unbiased assessment of the evidence.² This paper provides an overview of the role of grey literature in the health sciences focusing in particular on the systematic review. It describes different types of grey literature, problems that searchers may face, and guidance on how to search for this sort of resource. It also describes literature searching as a replicable but not a reproducible process.

What is grey literature?

Finding and incorporating grey literature into a study is difficult because of its poorly defined nature and the documents it could include varies considerably by discipline. The term originates from the York Seminar of 1978 that assembled 30 participants from libraries and publishers at the University of York in the U.K., with the goal of better defining “grey literature” and putting in place plans to collect and distribute these documents. Regarded as a key event in Europe, it led to the development of SIGLE (System for Information of Grey Literature in Europe), and ultimately to the OpenGrey repository used today.³ Its definition went through several iterations, until 2001 when Schöpfel offered the Prague definition, now regarded as the standard, emphasizing its non-commercial characteristic produced by academia, government, and scholarly societies, all organizations in which publishing is not among their primary activities.⁴ In the health sciences, the Prague definition of grey literature includes conference abstracts, preprints, clinical trial registrations, systematic review protocols, practice guidelines, dissertations, and white papers among other literature.

While defined as non-commercial, grey literature may have a commercial infrastructure. For example, Proquest which provides a platform for dissertations requires a subscription; Elsevier’s SSRN, a social science repository, includes a mix of free-to-download preprints with subscription-based e-journal articles; and the Web of Science, also subscription based, provides a platform for conference abstracts.

One characteristic of grey literature that distinguishes it from published research literature is the absence of peer review. While many grey documents are subject to some review – e.g., theses are examined by faculty mentors, society practice guidelines are vetted by its members – they do not approach the methodological consistency that the peer-review process involves. The advantage of omitting the peer-review step is acceleration of the timeline from submission to availability. For topics where recency of findings is of utmost importance, a detailed and prolonged peer-review may be secondary in consideration compared to a quick editorial review followed by immediate dissemination.

Grey literature in systematic reviews

In the health sciences, the systematic review (or meta-analysis, a quantitative re-analysis of clinical trial data, which may be part of a systematic review) is an essential resource that clinicians rely on to make patient care decisions. Rather than using the findings from individual clinical studies, a systematic review provides the clinician with conclusions and recommendations based on the best research evidence, and therefore understood to be among the most authoritative.⁵

Producing a systematic review is a painstaking process, one goal of which is to avoid bias at every step. For the literature searcher, key features include:

- following systematic methods,
- thoroughly documenting the search in a replicable manner, and
- transparently reporting the search strategies.⁶

Every systematic review involves a team of specialists including the searcher. The literature search takes place near the beginning of the process and the studies it retrieves form the data that researchers analyze. Careful searches with high sensitivity (i.e., broadly approached) are necessary to ensure that no major study is left out of the investigation. In most systematic reviews, thoroughness of the search is accomplished by developing a detailed search strategy and applying it to major bibliographic databases, most notably PubMed and Embase where most biomedical and clinical articles are indexed. Depending on the topic, it may be necessary to search beyond the aggregated citation databases to the grey literature.

In the health sciences like other scholarly fields, grey literature types and their value as a source of relevant information varies by discipline. While conference abstracts are the primary type for many clinical fields (such as, cardiology, infectious diseases, oncology and others), public health or health

policy reviews may involve a variety of literature types requiring wide-ranging searches in an assortment of websites.⁷ For example, grey literature in public health may additionally include surveys, technical reports, blogs, newspaper articles, social media posts, public opinion pieces, and more.⁸

The representation of grey literature in health sciences articles varies widely. For example, 10.4% of cited references in nursing journals were grey, while one study on non-drug emerging health technologies reports 47% of information being grey including documents from the device manufacturer, regulatory agencies, and clinical trial registries.⁹ Some studies indicate that non-inclusion of grey literature in systematic reviews or meta-analyses may risk publication bias since published studies found in major bibliographic databases tend to have positive treatment effects, while studies with negative results more frequently remain unpublished.¹⁰ Publication bias refers to the failure to publish the findings based on the strength or direction of the study results.¹¹

However, one investigation analyzing meta-analyses that searched for unpublished clinical trials through trial registrations, conference abstracts, or dissertations, found that the inclusion of these studies did not change the results in a statistically significant way.¹² Another study found that unpublished studies tended to be of lower methodological quality than published studies and that inclusion in a meta-analysis in fact may influence the conclusions in a misleading direction.¹³ In contrast though, a different study by Bellefontaine et al. which also examined quality of the unpublished studies, did not find statistically significant differences in psychological meta-analyses comparing them to published studies.¹⁴

All studies chiefly involved clinical topics, which may be less dependent on grey literature than topics in other disciplines. Adams et al., for example, conclude that public health information may be largely, or for some types of information, only, found in grey literature sources.¹⁵ Tyndall states that public health research on obesity that relies only on published randomized controlled trials may miss information found in grey literature with practical and potentially successful approaches to weight loss.⁸ Conn et al. notes that externally funded research compared to institutionally supported research, tends to get published. Nursing research, which is not commonly supported by major grants, may be more frequently reported in grey documents than results for example from clinical trials.¹⁶

The implication of these divergent conclusions is that decisions around grey literature searching must be made on a topic-by-topic basis.

Challenges: Replicating, updating and downloading

The searcher for a systematic review strives to make it as wide-ranging as possible, and a grey literature search with a large variety of information types and ever-changing resources, poses unique challenges. How do you methodically search for this kind of information, accurately record the search strategy, and transparently report the methods in a way that others can *replicate* the results?

The National Academies of Sciences, Engineering and Medicine (NASEM) recently defined replicability in the context of computational science to mean results that are consistent – not identical – while asking the same scientific question, applying the same methods, using similar data and similar tools.¹⁷ Literature searching steps do not perfectly match the computational tasks used to develop the NASEM definition, but roughly the analogy may be applied in the following way: searchers with the same scientific question, using the same search strategies (methods), retrieve similar records (results), using similar databases (tools). For example, two searchers given the same research question, using PubMed, develop similar search strategies that produce similar results.

Replicability differs from *reproducibility* in that the latter as defined by NASEM, involves the same steps, same input data, same code, and same conditions of analysis, a standard meant principally for computational science, and narrower compared to replicability.¹⁸ In literature searching, the tools to obtain the data, i.e., the resources and databases to obtain citation records, are not under the control of the searcher and they can be highly dynamic even for curated bibliographic databases. In this context, therefore, replicability is achievable, though reproducibility is not. The

confusion over the definition and application of these concepts to literature searching specifically and library services generally have been addressed by several papers.¹⁹

The most difficult task in grey literature searching is precise record-keeping of the methods even when using search engines that were designed for only basic queries. Search engines embedded in websites or even within specialized databases do not perform predictably with anything more than an inputted word or phrase, and the next-best tool may be the advanced features of an internet search engine such as Google. As any user knows, these searches lead to overwhelming volume of hits sorted in inexplicable ways. For systematic review searchers and researchers, whose goal is to not miss anything relevant, it is never clear how much to screen (the first 10 pages, 100 pages, or more?) and whether their queries are adequate.

Systematic reviews should be updated as findings from new studies become available, a recommended practice for Cochrane systematic reviews.²⁰ The Cochrane organization is among the best known producers of these reviews whose rigorous standards result in trusted publications. But replicating a grey literature search to retrieve similar records as past searches for an update of the topic may be complicated at best. The searcher cannot assume that the same search strategy is performing in a comparable manner to earlier strategies because of the highly variable nature of web pages and similar information sources, and again, the unpredictability of the search engine.

Finally, conducting a broad search with high sensitivity could mean a large retrieval of citations that have to be efficiently downloaded into a citation management application or spreadsheet. Many bibliographic databases incorporate tools for exporting hundreds or even thousands of records at once into applications like Endnote, whereas websites where much of grey literature resides, usually do not offer that convenience. It is a time-consuming undertaking with no easy solution though a few tools that may expedite the process are described below.

Locating grey literature

For disciplines such as public health where grey literature is valuable, searching may be approached with a limited rather than a highly sensitive search, targeting specific types of information, in specific places.²¹ The goal of the approach is to produce a replicable search while making the practice pragmatic without sacrificing rigor. It contrasts with the way searches are conducted in standard bibliographic databases where the searcher may choose to construct highly sensitive searches with comparatively low expenditure of time and effort.

Recommendations offered here should be assessed within the goals and purposes of the review. Importantly, full and transparent reporting is imperative. Because grey literature is not peer-reviewed in the same way that published journal articles are, retrieved documents should be closely examined before making decisions about including them in a review.

Table 1 summarizes recommendations on what types of grey literature to search in a systematic review, and where to look. The resources are not exhaustive. For example, there are multiple databases that include conference abstracts and dissertations.

Under the Highly Recommended category are four grey literature types that can be searched using familiar subscription or openly available databases. Conference abstracts are indexed in major databases like the Web of Science and Embase, and searches here can be approached with very sensitive and complex strategies. Other resources in this category – Clinicaltrials.gov, WHO ICTRP, Proquest, Networked Digital Library of Theses and Dissertations, Open Dissertations, ECRI, Guidelines International Network, and Trip – should be searched with simple strategies involving a limited number of terms.

In the Recommended category are protocol registries. Both the PRISMA guidelines and the Cochrane Handbook recommend or even require protocols to be registered before getting too deeply into the systematic review.⁵ Prospero has been the chief registry for systematic reviews while recently the databases of the Open Science Framework accepts protocols for systematic and other types of reviews.

Table 1. Grey literature types and resources for health science systematic reviews.

| Recommendation Level | Grey Literature Types | Resources |
|--|---|--|
| Highly Recommended for all subjects | Conference abstracts | Web of Science* A general science and social science bibliographic database of scholarly articles |
| | Clinical trial registrations | Embase* A biomedical database of scholarly articles Clinicaltrials.gov A U.S.-based registry for ongoing clinical trials WHO International Clinical Trials Registry Platform The World Health Organization's international registry of ongoing clinical trials including Clinicaltrials.gov |
| | Dissertations | Proquest Dissertations and Theses* A database of worldwide PhD dissertations and Masters theses Networked Digital Library of Theses and Dissertations An international database of electronic theses and dissertations Open Dissertations An open access database of dissertations |
| | Unpublished practice guidelines | ECRI Guidelines Trust* A database of health care practice guidelines. Some content is open with registration. Guidelines International Network An international database of health care practice guidelines Trip Database A clinical search engine health care research information including practice guidelines |
| Recommended for all subjects | Review Protocols | Prospero A registry for systematic review protocols. Open Science Framework A database of preprints, conference papers, posters and protocols of systematic and other review types. |
| | Preprints | medRxiv A preprint repository for medical research bioRxiv A preprint repository for biological research |
| Recommended subject-specific resources with examples | Reports from government agencies | Department of Health and Human Services and its subagencies (e.g., Centers for Disease Control and Prevention, Agency for Healthcare Research and Quality, National Institutes of Health) Individual state and local governments |
| | Reports from non-governmental organizations | Scholarly Societies (e.g., American Public Health Association, American Cancer Society, Infectious Diseases of America) Not-for-profit organizations (e.g., Rand Corporation, Robert Wood Johnson Foundation) |
| | Industry reports | Pharmaceutical Companies (e.g. GSK Clinical Study Reports, Novartis Clinical Trials) |

*Paid subscription required

Also, under the Recommended category are preprints, or working papers that have not been peer-reviewed. The best known preprint archives are medRxiv and bioRxiv, both of which have risen to prominence in 2020 owing to the COVID-19 pandemic, and bringing attention to both the advantages and disadvantages of preprints as a source of pressing evidence-based information. On the one hand preprints compared to published journal articles, are quickly accessible, but with no peer-review and, therefore, limited checks, they may provide potentially biased or even incorrect study results.²² Like other grey literature, preprints must be closely scrutinized. It is obvious that clinical trial registrations or conference abstracts are not peer-reviewed scholarly articles, on the other hand, preprints may have the *look* of a published article, and yet they too have not been peer-reviewed.

The final section of Table 1 includes subject-specific grey literature and resource types with a brief list of examples. The resources here, typically websites, will vary in importance according to the subject of the reviews. The Canadian Agency for Drugs and Technologies in Health maintains a list of relevant health care organizations.²³

Focused searching in Google

The massiveness and volatility of the Google database make structured, replicable searches a difficult task. Sometimes it is unavoidable to prevent overwhelming numbers of records, the searcher can apply a targeted approach that leads to a more manageable retrieval and a realistically replicable strategy.²¹ For detailed descriptions of the nuances of Google's search algorithms, see Russell's course, "Power Searching with Google," and the blog post by Tay.²⁴

Many common literature searching techniques do not work in Google and Google Scholar in the same way they do in other databases. Here are a few recommendations and details on how to approach the searches:

- the searches should be simple; if there are synonyms or related terms, conduct multiple searches instead of using OR to string together the terms;
- Google interprets spaces as AND;
- Google ignores parentheses;
- term order makes a difference; for example, *definition reproducibility systematic reviews* is not the same as *definition systematic reviews reproducibility*;
- limit the search by date using Tools > Any Time > Custom Range in Google, or date limits in the left sidebar in Google Scholar.

Listed below are suggestions on how to conduct targeted or focused Google and Google Scholar searches:

1. Use search operators and limits. The closest to a complete list is an informal document written by Daniel Russell, a senior research engineer at Google.²⁴ The list includes the most useful operators in italics, followed by descriptions and examples. The operators are italicized here only to set them apart from other text; they do not need to be italicized in the search. All but *site:** works for Google Scholar as well.

a) ***intitle:/allintitle:***

After the colon, add words to find in the title of the record. *intitle:* finds only one word or a quoted phrase, while *allintitle:* finds multiple words and not necessarily as a phrase.

intitle:Covid-19

intitle:"rural health"

allintitle:

b) ***site:***

Provide an internet domain or country code after the colon.

site:cdc.gov

site:who.int.org

site:.gov

site:.uk

c) ***site: * ****

Insert a word with periods before and after the search word, between the asterisks to search for it within a domain URL.

site:.health*.gov*

site:.library*.edu*

d) ***filetype:***

Provide a suffix to a file or document type.

filetype:pdf

filetype:pptx

2. Google's Advanced Search

Instead of typing the operators, the Advanced Search helps build a search in different fields.

3. Google's Programmable Search Engine

You can customize a Google search engine to limit it to specific domains or languages, and other more technical features.

Exporting records from a Google search

Exporting search results from the general Google or Google Scholar databases into a bibliographic management application can be a time-consuming task that grey literature searchers must face. In Google Scholar, members can collect up to 25 records in the member's My Library by clicking the star next to a record. The user can download the saved records at once to Endnote or another application.

For the general Google database, there are a few tools that could assist the searcher with this step. Endnote's Capture Reference is a free bookmarklet for web browsers that will download basic data from a single web page into its online or desktop application. The Zotero Connector is a browser extension that can also save key metadata from a single webpage. Finally, a more customizable and technical Google Chrome extension, Data Miner, allows the user to specify which fields to scrape from a webpage. It is helpful if the user has experience with web development though the pre-built public tools (called "recipes") that the Data Miner community created is for anyone to use.

Note, however, that even with these tools, the searcher inevitably has to edit the records and/or enter some records manually one at a time into the bibliographic management software.

Conclusions

Grey literature searching is a challenge, even for the expert searcher. The degree of reliance on this class of literature varies from discipline to discipline, and it is up to the searcher and others on the review team to determine how much of it should be searched. A targeted and replicable approach and transparent reporting are key objectives in grey literature searching.

Health sciences librarians who join a systematic review team are collaborators tasked with the specialized responsibility of finding the information that forms the basis of the review. Some librarians have had multiple opportunities to collaborate on systematic reviews often making them the most experienced on the review team, a potentially influential position with opportunities for teachable moments. The data of systematic reviews are the studies retrieved and analyzed, which places any librarian, experienced or novice, who searches for this information in a crucial position. Becoming familiar with the difficult task of grey literature searching makes them especially valued partners.

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Disclosure statement

No potential conflict of interest was reported by the author.

Geolocation information

United States