Systematic searching: practical ideas for improving results

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4 Choosing the right databases and search techniques

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4.1 Introduction

In this chapter we will explore how to choose resources and techniques to provide the best returns. Systematic searching is most often associated with systematic reviews in health care. However, systematic searching is also a key element of scoping reviews, systematic maps and realist reviews and the issues we describe here will certainly be useful when undertaking literature searching in any subject field including health, education and environment. By the end you will have confidence in how to plan for your search, how to select the best sources to search, and the best way to utilize those resources to maximize returns without increasing time pressures or workload.

The often cited rule for systematic review searching is that searches should be comprehensive and find all the available evidence relating to the research question. Chapters 2 and 3 have shown that a search may actually aim for representativeness rather than completeness. Focusing on the sensitivity of electronic database searches assumes that the best evidence is available on bibliographic databases. An important first step to take, therefore, is to ask which other techniques we might need to find the evidence, as well as deciding which databases we will search.

Advice on the most effective sources and best search techniques is readily available from librarians and other information specialists and it is particularly useful from those that have expertise in the relevant topic area. Despite a number of studies comparing the content and functionality of different databases, comparing which method of searching finds the most relevant studies, or those examining different searches across databases, the choice of resources to use in a search requires a combination of knowledge, intuition, availability and occasionally luck.

4.2 A rapidly changing world

Traditionally, systematic searching on health topics has focused on finding the best evidence, usually in the form of randomized controlled trials (RCTs), either published in journals or unpublished in registries of clinical trials. This model makes resource selection relatively straightforward. It is becoming increasingly common to see reviews take new approaches (see Chapter 2), include a variety of study types (e.g. qualitative evidence) or synthesize reports and other documents often found in the grey literature (see Chapter 5). Grant and Booth (2009) categorised 14 types of review, each with associated methodologies, and it is important to apply the techniques appropriate to the study that is being undertaken. This ballooning of the review world means that identifying and choosing resources is not as straightforward as perhaps it once was.

The rapid explosion in the amount and type of information available online (see Chapter 6) has led to an emergence of new technologies such as text

mining to find related or similar studies (see Chapter 7), and machine learning to reduce the screening burden (see Chapter 9). However, until databases become more closely integrated with text mining software, reference management systems and software for machine learning, and while the publishing world is made up of many organizations with their multitude of journals, databases and interface products, information specialists will need to choose carefully the databases and search techniques appropriate to their review.

4.3 Choosing the right sources

Choosing which resources should be searched, and what techniques should be used, is dependent primarily on three factors:

1. The research question
2. The time and resources available
3. Access to resources.

4.3.1 The research question

A well-structured research question is the most important factor to take into account when choosing databases and search techniques. It will tell you whether you need to focus on databases covering health, social sciences, education or a combination, if the question traverses disciplines. The research question will tell you whether the focus is on a profession (e.g. nurses or teachers) or on 'clients' (e.g. patients or school pupils), or on a condition (e.g. research on mental health). It will tell you whether location is important: is it a setting such as a hospital or care home, or a country or geographical region?

The research question will also tell you what type of evidence is required. The information specialist needs to consider the best places to find that type of evidence. Is the evidence available on bibliographic databases or would searching those waste our time when we could concentrate on something more productive? Questions that are seeking qualitative evidence about experiences or barriers to change will probably not need the same databases as when we need to answer a question asking if one medical intervention is more effective than another.

4.3.2 The time and resources available

It is important to prioritize your choice of databases and search techniques when resources are limited:

> 'Comprehensive searching is resource intensive, due not only to the time and cost required to physically carry out the searches, but also to the work invested in preparing the search strategies and managing and screening the results. If each source used produces unique eligible studies for the systematic review, then this represents an efficient use of resources, but may otherwise be a source of inefficiency' (Beyer, 2013).

To help with this planning process, experienced information specialists will carry out extensive scoping searches during the review planning stage. Scoping searches are a way of finding out:

- What literature is out there
- How much of it there is
- Broadly the number of records to screen
- The key papers on a topic
- Useful search terms, both free text and from the controlled vocabulary
- Relevant systematic reviews
- Other related studies
- Relevant databases to search
- Ideas on which supplementary search strategies to employ.

TIP:
Seek out high quality evidence first in scoping searches i.e. systematic reviews, either by searching databases of systematic reviews or using limits or filters in databases in the field of interest. Finding a number of systematic reviews could indicate there is a large body of primary studies; finding no existing systematic reviews may indicate a lack of evidence or gaps in our knowledge of the topic.

The information gathered during the scoping searches will provide details of how long the search could take and, therefore, the cost. Decisions can then be made on resource (time and cost) availability when planning the next steps.

4.3.3 Access to resources

An information specialist is limited by the tools available: the choice of resources used in a systematic review will always be restricted by access to them. Organizations do not always have access to all of the databases that might be identified during the scoping searches. The information specialist needs to understand the issues this may cause and consider whether a comprehensive search could still be performed. For example, a review examining the effects of healthy eating incentives in schools would benefit from using the freely accessible PubMed but it could be severely limited if the team did not also have access to education and social science databases.

Databases and journals are often supplied by subscription to institutions via an intermediate provider, or multiple providers. It is not unusual therefore for institutions to not have access to particular databases or journals, and the choices faced by the reviewer are subsequently curbed. This will be a limitation of the review that the information specialist will need to discuss with the rest of the review team (see Chapter 11).

4.4 Advice on sources

Handbooks and guidelines in specific fields can be useful in helping to choose your databases and search techniques. In health care, where Cochrane reviews are considered to be the high quality, there is plenty of advice. The Cochrane Handbook chapter on searching (Lefebvre, Manheimer and Glanville, 2011) says this on source selection: 'The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE and Embase (if access is available

to either the review author or the trials search co-ordinator) should be searched for all Cochrane reviews'. The Centre for Reviews and Dissemination handbook (2009) states 'MEDLINE and Embase are the databases most commonly used to identify studies'.

In the area of social sciences, the Campbell Collaboration (Kugley, 2017) are more general with their advice: 'decisions related to which subject-specific databases are to be searched, in addition to the main field-related databases, will be influenced by the topic of the review, access to specific databases, and budget considerations'. In the environmental field the Collaboration for Environmental Evidence Guidelines (2018) suggest: '…start the search using the source where the largest number of relevant papers are likely to be found'. These recommendations obviously require the information specialist to have done some scoping searches and to have some prior knowledge of the topic area. The review team needs an information specialist because it is unlikely that a core set of resources can be defined for all searches and it needs the appropriate expertise to test and define an appropriate list for the particular research question.

Of course, guidelines are just that and there is no better substitute for knowing your own area and having a broad experience of a selection of databases and what they contain. Published guidance can therefore be quite general. The Joanna Briggs Institute (http://joannabriggs.org) recommends that a search should be 'as broad and as inclusive as possible' and observes that there is 'insufficient evidence to suggest that searching a particular number or even particular databases will identify all of the evidence on a particular topic'. The number of databases to search is just as important as choosing the right ones and deciding how best to find grey literature and other information sources. We should never search a database just because we have access to it without thinking about its relevance to our research question, the type of evidence we need and the time available for the project. The number of databases that should be searched is covered in more detail later.

The key to choosing the best resources is good preparation. It is to be hoped that by the time of the main searches the information specialist will have helped the review team to reach a well-defined research question with clear expectations of the search. Scoping searches will have indicated how much literature might be returned by the searches. Experts will have been consulted on the key papers in the topic and the types of evidence required. Review authors should never proceed beyond this point without consulting an information specialist on what databases are relevant to the topic and whether they will return the study types required. Case study 4.1 describes in more detail how this process might actually work in practice.

Case study 4.1 Experiences of carers

Sandra is carrying out a qualitative evidence synthesis about the experiences of people who care for those with dementia. She carries out extensive scoping searches initially using PubMed and finds a handful of

useful studies. However, when she searches on Google Scholar she finds many studies that are not present on PubMed, and a rich source of information in the form of blogs and book chapters. On the advice of an information specialist she extends her search to PsycINFO, which includes books, and Cumulative Index to Nursing and Allied Health Literature (CINAHL), which has several subject headings for qualitative research. She finds many more relevant studies. In the subsequent protocol the search methods state that the databases MEDLINE, PsycINFO and CINAHL will be searched, along with blog sites, websites relevant to dementia and other sources of grey literature about carers. The protocol also shows that experts in the field will be consulted for additional studies and sources.

4.5 Practical issues to consider

We have discussed some of the principles underlying the choice of sources and the next section will look at some of the practical issues in selecting how to find the best evidence according to the topic and type of information required for the research question, the time and resources available and the access you have.

4.5.1 Topic area of the question

The database has to be relevant to the topic of the research question. There is no point searching a database just because you have used it before on a different review. A review on a surgical procedure would probably use MEDLINE but that does not mean it should automatically be added to the list of sources for a review on promoting physical activity in schools. In this example, the scoping search should establish the usefulness of MEDLINE and then consider whether it needs to be supplemented with education databases (such as Education Resources Information Center (ERIC)) and the sports science database SPORTDiscus (Hollis, 2017).

4.5.2 Type of information required

A research question that needs evidence from randomized controlled trials will not need the same sources as one that needs to understand qualitative evidence. A review requiring RCTs will certainly require a search of the Cochrane Central Database of Controlled Trials (CENTRAL), along with MEDLINE and Embase and clinical trials registries. However, qualitative evidence syntheses or mixed methods reviews will also require a search of CINAHL and possibly PsycINFO (if the question relates to mental health or psychology). This is why the information specialist should be tailoring the list of sources: a search for evidence on the clinical effectiveness of tests for HIV will not provide us with the evidence describing the barriers faced by service providers promoting HIV testing to vulnerable populations.

4.5.3 The time and resources you have available

There is no point planning a search that cannot be completed in the time available to the project. There is also no value in planning a search that would require the team to pay for more subscriptions, article downloads or other resources than the budget will allow. These factors must be balanced against

the risk of not finding the appropriate evidence and this section sets out some factors for information specialists to consider.

4.5.4 Functionality of the search platform and interface

If a database cannot be adequately searched because of poor functionality, then is it worth searching at all? This is worth considering, especially if the database is relatively small and unspecialized with no reason to suppose it has any unique content. Some database platforms are not designed for complex searching (Bethel, 2014) and searching the same database on different platforms may provide different results (Younger, 2009).

There is little doubt that most expert searchers have strong feelings about the functionality of the platforms they use and it is possible that databases are omitted because searching them in a systematic way is simply not possible via particular interfaces. At the time of writing there are no published studies investigating whether the functionality of the interface actually has a real impact on database selection but it is not a scenario that is difficult to imagine. Whether or not to search in these situations requires a little balancing of priorities. Does the possibility of finding relevant studies outweigh the difficulties faced with searching the database? If so, you could compromise by running a quick and simple search, e.g. by searching a few keywords in the title field, rather than by translating a long complex set of search strings from MEDLINE.

4.5.5 How many databases should we search?

It is usual to see variation in the number of databases included in different reviews. Specific topics with well-defined inclusion criteria may find sufficient evidence from searching only two or three databases. A study by Vassar (2017) found an average of 2.59 databases used in clinical neurology reviews. Other subject areas are more diverse and multidisciplinary, and the selection of databases will need careful consideration. We found (Bethel and Rogers, 2018) that, on average, 8.9 databases were searched for environmental systematic reviews, suggesting the subject area can affect the number of databases searched. Interestingly, Vassar also found that more databases were usually searched when an information specialist was on the review team, reflecting perhaps increased knowledge and expertise about which resources were best to use. Case study 4.2 describes the typical process of testing out sources and adapting a list of databases for a new review.

Other studies have looked at what was missed when just one database was searched, concluding that MEDLINE alone, for example, was not sufficient (Betran, 2005; Sampson, 2003). To add to the uncertainty, recent studies have examined whether it is necessary to search both PubMed and MEDLINE (Damarell, 2013 and Duffy, 2016), because PubMed has more content and is updated in advance of MEDLINE. Such decisions must be made bearing in mind time constraints, ease of adapting the search strategy from one database to another, and the probability of retrieving unique studies rather than just additional 'noise'.

Lists of valuable databases describing subjects and geographic coverage are easy to locate, for example in the Cochrane Handbook chapter on searching (Lefebvre, Manheimer and Glanville, 2011). The University of Massachusetts Medical School Lamar Soutter Library also produces a useful A-Z list of databases and descriptions
https://library.umassmed.edu/resources/databases

Case study 4.2 The physical health of surfers

Finlay is working on a review of the effect of pollution on the physical health of surfers. He plans to search PubMed but is unsure what other databases should be searched. He finds Environment Complete and CAB Abstracts via his university library so adds them too. Following some extensive scoping searches, he identifies some reviews in related areas of environmental research which searched BIOSIS, Web of Science, Scopus, GreenFILE, Aquatic Sciences and Fisheries Abstracts (ASFA) and GEOBASE. He realizes he doesn't have any sport databases listed but is not sure whether this is important. Finlay is short of time and there are only two reviewers to help with screening. After consultation with a librarian and investigation of coverage of the databases, he decides to search PubMed, Environment Complete, Web of Science, BIOSIS and CAB Abstracts. He decides not to retain ASFA but will include website searching. As Web of Science and Scopus are also citation databases he uses them to carry out citation searching of key references.

4.5.6 Non-English language and regional databases

It is worth remembering that MEDLINE is produced in the USA and Embase in Europe, even though they are both international in their scope. Geographically relevant databases also play a vital role in reviews that either focus on a specific country or region or which are about subjects that are more pertinent to specific regions. Examples of regional databases include African Index Medicus, IndMed (India) and KoreaMed.

The database LILACS (Latin American and Caribbean Health Sciences Literature) contains scientific and technical literature on health published by Latin American and Caribbean authors and so would be integral in a review of a treatment for an illness predominant in South America. CNKI (China National Knowledge Infrastructure) is the largest, continuously updated Chinese journals database in the world, and contains many studies in Chinese that are not present on databases more commonly used in the USA and Europe. LILACS and CNKI both contain non-English language content but they are searchable in English. Cohen (2015) compared two different systematic reviews on diagnosing rheumatoid arthritis and found there was little overlap in the studies they had included since one had used Chinese databases and the other had not done so.

The jury is still out as to whether a failure to include non-English language papers in reviews has a negative impact on their findings. Interestingly, most reviews do not restrict by language when searching but non-English papers

are then rarely included (Hartling, 2017), either because there are far less of them, or because they are later dropped due to lack of translation resources. Is it worth searching a database if the review team cannot read its results? This is the kind of question that the information specialist needs to be raising with the review team in the early planning stages and not when the searches are underway. On the other hand, it may be costly to ignore databases because their content is predominantly non-English language, such as reviews of the effectiveness of Chinese medicine, or treatments for diseases prevalent in tropical regions. It might be advisable to include a researcher on the team that can speak the language used in the databases vital to the research question.

Regional databases also play a role in non-health related fields and where contextual evidence is required. ERIC, which is sponsored by the Institute of Education Sciences at the US Department of Education, claims to be the largest education database and, as expected, returns a vast amount of literature pertaining to research carried out in schools in the USA. In education, and other fields, culture and policy may mean interventions that are successful in the USA may have different effects when they are applied elsewhere. It would be advisable therefore to include the British Education Index or the Australian Education Index if the findings of the review are intended to be implemented in those countries. It is the responsibility of the information specialist to be thinking about the appropriate sources for the evidence required instead of just using the biggest or the most well-known databases.

4.5.7 Topic-focused databases

Topic-focused databases can be incredibly useful. Operating like a large scale search filter, they often index only those journals that are relevant to their domain, meaning that relatively simple searches can be run without generating too much 'noise'. Examples of small useful databases are Physiotherapy Evidence Database (PEDro) (https://www.pedro.org.au), which contains randomized trials, systematic reviews and practice guidelines for evidence-based physiotherapy or physical therapy, and OT seeker (http://www.otseeker.com), holding similar records in the field of occupational therapy. Similar small databases may be both topic-focused and geographically relevant, which can make them particularly useful in reviews that focus on practices or conventions held within in particular country. An example is the British Nursing Index (BNI), which would be useful in a review of nursing practices specific to the National Health Service in the UK. Allied and Complementary Medicine Database (AMED) is a useful source when reviewing topics in complementary medicine.

4.5.8 Databases with grey literature

Smaller databases can also be a rich source of grey literature indexing reports, occasional papers, conference proceedings and government documents. One example in the UK is the Health Management Information Consortium (HMIC) database, which contains reports from the government, hospitals, charities and advocacy groups as well as from conventional peer-

reviewed journals. Another is Social Policy and Practice (SPP), which is made up of five social care collections covering ageing, child health and social care.

These are particularly useful sources to provide contextual information for qualitative reviews. In-house surveys, reports of findings from questionnaires or focus-groups may never be published in journals and so they are often unlikely to be indexed on conventional databases. If the review question, for example, is about ways to improve a health service then a valuable piece of evidence might come from a survey of how people from ethnic minority groups have experienced the current services. Collections of small databases which index this type of data can suddenly seem a lot more useful than at first glance. The results would be much richer and more meaningful than a search that had used a standard list of, say, MEDLINE and CENTRAL.

4.5.9 Access to databases

Databases are often supplied by subscription to libraries as part of a package and not all intermediaries have access to all databases. Other databases may be purchased only as part of a bundle with others and cannot be accessed individually. Libraries make decisions based on cost of the database, availability through existing suppliers and the likely benefits to their core users (who might be students rather than review teams with an interest in a particular topic).

Some information specialists will be able to access resources from outside their own organization, such as from national libraries, networks of researchers or by contacting other review teams. Chapter 11 provides further details on the importance of collaboration to systematic searching. The collaboration must always comply with licensing, copyright and other restrictions when accessing resources provided by other organizations.

To summarise, deciding what databases to choose is a trade-off between time and resources. It is worth keeping these questions in mind when making these decisions:

- Will I find anything unique on this database?
- Does it hold vital information that I won't find easily by searching one large database?
- Will the results be accessible to the review team?
- Do I have access to the database?
- Can I search it effectively?

If the answer to all of these questions is yes, the database should be included in your list.

4.6 Other search techniques

It is commonly accepted that searching bibliographic databases alone is not enough to allow a search to be considered properly 'systematic'. Supplementary searching may be considered to be so crucial to the review process that the term supplementary is misguided, and individual non-database search techniques such as citation searching, handsearching or

pearl growing, should be referred to alongside database searching, as methods in their own right. A case study by Cooper (2017) found that from the 21,409 references identified by database searching for a systematic review on public health and environmental enhancement only two were included in the qualitative synthesis, whereas the supplementary search techniques found an additional four qualitative papers out of 453 screened.

Studies can be picked up by supplementary search techniques for several reasons, including:

1. The reference is not indexed on the databases searched.
2. The reference has a descriptive or 'non-scientific' title, for example, qualitative studies often use a quotation from a study participant so free-text searching does not pick it up.
3. The study is inaccurately indexed so using controlled vocabulary searching does not pick it up.
4. The database searching was kept precise rather than sensitive for a valid reason e.g. time or cost constraints therefore potentially includable studies might have been missed.

The choice of other techniques is influenced by the same factors as when we are choosing databases. The technique has to return evidence relevant to the research question, in the time available and be accessible to the review team. The information specialist also needs to get the balance right between the databases and the other techniques so that they complement each other effectively. It might be tempting to search one more database just in case it finds another study but what if that uses up the time that might have been available for a different technique? The aim of each database and each technique should be to find something new and not to duplicate what has already been found. The scoping searches will be a guide to the gaps in the evidence that the non-database techniques could aim to fill. It can be time consuming to use the other techniques and the information specialist needs to accommodate this when they are planning the searches. Examples of non-database search techniques are as follows.

4.6.1 Citation searching

Citation searching is a commonly used search technique and it can be done 'forwards' or 'backwards'. Forwards citation searching means looking for references that cite key references; this can be done using databases such as Google Scholar, Web of Science or Scopus which provide links to papers that have cited the publication of interest.

Backwards citation searching can be carried out by scrolling through reference lists at the end of studies, using citation databases such as Web of Science or Scopus, or via the website hosting the journal.

Related techniques include 'pearl growing' (Ramer, 2005) and 'snowballing' (Greenhalgh, 2005), techniques whereby the researcher starts with one or two key papers and seek citations from those papers via references lists and

website links. Further details of the reviews where this might be a particularly fruitful approach are provided in Chapter 2.

4.6.2 Handsearching

Handsearching is an extremely useful technique if a journal or a number of journals are pertinent in the topic area, particularly if the journal is not indexed in any of the databases being searched. Although the term brings up the image of hours in the library searching through rows of old bound journals and their indexes, in reality and thanks to technology, handsearching usually involves scrolling through the online contents of the relevant journals. This is particularly useful for finding studies that appear in journal supplements, or special editions that might not make it onto databases.

4.6.3 Web-searching

The internet hosts a wide variety of information not available to us via databases and provides a point of access to useful organizations that might publish relevant papers or documents. Despite this, there is little guidance available as to how to incorporate it into a systematic search. Guidelines are vague: the new Cochrane MECIR standard states: 'report the search terms used to search any sources other than bibliographic databases (e.g. trials registers, the web), and the dates of the searches' (Cochrane Collaboration, 2016). Web-searching is perhaps trickier than this recommendation suggests.

The process is often exploratory, starting with one or two search terms in a search engine, and then maybe clicking on a relevant link, finding one or two names, then searching for them until eventually you happen upon a key document with only the vaguest idea of how you eventually came upon it. Nevertheless, in the interests of keeping the process fully transparent, it is advisable to record at the very least the initial terms typed into a search engine, the date searched, the browser used, the number of results, the number of pages scrolled through, and any subsequent websites that were used to access relevant information. Further information on the details to record from websites and search engines are available in Briscoe (2015).

4.7 Recording the sources and techniques

It is important to record the sources and techniques used to retrieve the evidence for a review. It is generally understood that literature search methods should be explicit and replicable (Lefebvre, 2011). They should therefore be written as such. When recording search methods it is always worth bearing this in mind: 'could someone else do what I have done based on what I have recorded and get the same result?' PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) advises: 'describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched' and 'present full electronic search strategy for at least one database, including any limits used, such that it could be repeated'. The whole review risks being less transparent if it is not known how the included studies were located because the search methods are not adequately reported.

Atkinson and colleagues (2015) have attempted to produce their own guidelines for search reporting.

It is advisable for the information specialist to retain the results of their scoping searches, test searches and anything else that might help to justify their choice of databases and search techniques. It is unlikely that all of these details would be reported in the review itself but they are useful if the review team receives any queries about its methods how the evidence was identified and selected. The notes are also useful in the future if the evidence is to be updated or a new review in a similar topic area is being planned.

4.8 Future directions

It would be helpful if information specialists assessed the impact of their decisions on the outcomes of the review. How do we know if we searched the right sources? Should we search a different set of sources next time we update this review? Can we learn any lessons from the reviews that have been done in this topic area before?

The transparency and reproducibility of reviews is greatly aided by the use of search summary tables (Bethel, 2015). The template enables the information specialist to log which databases and other techniques were used and which ones retrieved studies that were included in the final review. The completed template shows which sources retrieved unique studies, which ones found relevant studies that were already known and which ones did not lead to any relevant studies. The completed template in Figure 4.1 shows that, in this project on outdoor spaces (Whear et al., 2014), 6 of the 17 publications included in the systematic review were found on MEDLINE out of the 180 records downloaded from this database.

In the future, search summary tables will allow searchers to streamline the resources they choose, based on previous reviews, and will cut down the time and costs wasted searching resources unlikely to contribute to the review. In other words, the choices we make become more evidence based, transparent and reliable. This is the kind of data we need to be able to strike the right balance between databases and other search techniques when time and resources are limited. The long-term aim would be to move towards a repository of completed search summary tables that can be consulted by any information specialist.

Figure 4.1 Example of a completed search summary table

Whear R, Coon JT, Bethel A, Abbott R, Stein K, Garside R. What is the impact of using outdoor spaces such as gardens on the physical and mental well-being of those with dementia? A systematic review of quantitative and qualitative evidence. Journal of the American Medical Directors Association. 2014;15(10):697-705.

***Project title** : What is the impact of using outdoor spaces such as gardens on the physical and mental well-being of those with dementia? A systematic review of quantitative and qualitative evidence*

Included references	*Format*	Databases searched, Feb 2013. Re-run, Feb 2016											*Supplementary searches*				
		amed	assia	bni	cinahl	cochrane	embase	hmic	medline	psycinfo	sco	wok	*fcs*	*bcs*	*hs*	*wss*	*org*
Bengtsson 2006	jnl						n		n	n							x
Calkins 2007	jnl		x				n		n	n							
Cohen-Mansfield 1998	chapt						n		n	n							x
Connell 2007	chapt						n		n	n				x			
Cox 2004	jnl	x					x		x	n		x					
Detweiler 2009	jnl		x				x		x	x		x					
Detweiler 2008	jnl						x		x	x		x					
Edwards 2013	jnl						y		y	n							x
Hernandez 2007	jnl	x	x				n		n	n							
Innes 2011	jnl		x				y		x	x							
Luk 2011	jnl		x				x		x	x							
Mather 1997	jnl		x				n		n	x							
Mooney 1992	jnl						z		z	n				x			
Morgan 1999	jnl		x				x		x	x							
Rappe 2007	jnl						n		n	n				x			
Raske 2010	jnl						z		z	z	x						
Vuolo 2003	rpt						n		n	n							x
No. included refs		2	7	0	0	0	5	0	6	6	1	3					
No. unique refs			1								1			3			4
Total no. refs downloaded		5	48	7	0	282	548	5	180	288	243	26					
No. refs screened		3	24	0	0	0	382	0	176	212	237	10					
Sensitivity		11.76	41.18	0.00	0.00	0.00	29.41	0.00	35.29	35.29	5.88	17.65					
Precision		40.00	14.58	0.00	0.00	0.00	0.91	0.00	3.33	2.08	0.41	11.54					
No. database searches carried out =				11													
Total no. refs found from searching =				1632													
No. refs screened at Ti&Ab =				1044													
No. of included refs from searching =				10													
Total no. of included refs =				17													

Codes	**Supplementary search codes**	**Format codes**
x = found from the search	fcs = forwards citation search	jnl = journal
y = in the database and found from the search strategy when re-run	bcs = backwards citation search	rpt = report
n = not in the database	hs = hand search	ths = PhD thesis
z = in the database but not found using the search strategy	wss = web site search	WeS = website
(red) = those databases where the searches were re-run	org = from contacting organisations	chapt = book chapter

Advances in text mining and machine learning are likely to impact on the way information specialists practice searching in the future. Factors about which databases to choose may become less about context and content and more about their compatibility with other software e.g. for reference management or automated screening. In practice we should continue to share, train and work collaboratively. Specifically, we could share and cite our search strategies more widely, work collaboratively with database providers to ensure our voice is heard as they develop new tools and technologies, and take on new tasks such as peer reviewing. These actions will help us to develop our collective knowledge about resources and our continued influence over their development

It is safe to suppose that, for some time at least, expert information specialists will continue to be required to navigate through the selection of databases and their hosts, and other online sources. Supplementary search techniques such as checking reference lists and handsearching key journals remains imperative as all content cannot be found by database searching alone.

4.9 Conclusion

It would come as no surprise that a novice to the search process would feel utterly daunted by the selection of databases available, confounded by their content and unable to comprehend why in the age of digital data that there isn't a straightforward algorithm or automated search process using one interface that would just return the studies required. This is an exciting time to be an information specialist with the knowledge and skills to carry out complex searching and to influence the development of new technologies such as text mining and machine learning. As a professional group we need to keep up the

dialogue with providers and continue to share and publish our research and findings.

4.10 Suggestions for further reading

Mark Pettigrew and Helen Roberts Systematic Reviews in the Social Sciences: A Practical Guide

An Introduction to Systematic Reviews – 5 Apr 2012 by David Gough (Author, Editor), Sandy Oliver (Author, Editor), James Thomas (Author, Editor)

4.11 References

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