Literature Searching

3

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3.1 Introduction

Conducting a good literature search enables you to take a broad view and to interpret your research findings in light of existing knowledge. This chapter explains the need for searching literature sources of information and provides guidance on how to conduct a search, extract information, and how to manage this information.

3.2 Why Should Literature Searches Be Undertaken?

There are many reasons why it might be important to do a literature search, both for academic work such as essay writing and dissertations and in clinical radiographic practice. Literature searches can be used in many ways, to give the following:

- A supporting background and source of evidence to help justify arguments in an essay.
- A literature review chapter covering previous published findings within a research project (dissertation), to 'set the scene' and provide comparisons with new results.
- The content material for a systematic review. More will be said on systematic reviews in Chap. 12. A systematic review is a form of 'secondary research' which provides a methodical overview of previously published research data in order to

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answer a research question. For example, what is the most effective imaging modality for staging breast cancer?
- An update of current evidence to inform best clinical practice.
- Evidence to support clinical guidance documents, recommendations, and policies.
- A background section of a journal article.

So, it can be seen that everyone, from a first-year diagnostic imaging or radiotherapy student to the head of the National Health Service, has reasons to search the literature. Literature searching is not a skill that can be packed away at the end of an undergraduate degree.

3.3 Types of Literature Sources

The sources of available literature are many and include the following:

- Journal articles
- Systematic reviews (such as Cochrane)
- Textbooks
- 'Grey literature' (unpublished material such as theses and conference proceedings)
- Media articles (newspapers, magazines, Internet sites)
- Internet sites
- Government and other official publications

In fact, there is such a wide array of available material these days that it can appear bewildering. Accessing evidence electronically, via web-based search engines and library databases, has never been easier but is important to have the right tools for the job and to screen out stuff that is not relevant.

3.3.1 Journal Articles

The majority of medical imaging and radiotherapy researchers would regard journal articles as the most important source, as they tend (usually) to be reliable, of good quality, and widely read by clinical practitioners. These journal articles are peer reviewed whereby they are written by experts in the field and blind reviewed by other experts in the field in order to assure the quality of the publication. Journal articles contain new research as well, although the key content may have been reported earlier at conferences. Useful journals in medical imaging and radiotherapy include *Academic Radiology*, *The British Journal of Radiology* (BJR), *Clinical Imaging*, *Clinical Radiology*, *The European Journal of Radiology*, *The Journal of Diagnostic Radiography and Imaging*, *The Journal of Radiotherapy in Practice*, *The International Journal of Radiation Oncology, Biology and Physics*, *Radiology*,

Radiography, and *Radiotherapy and Oncology*. There are many others. Journals are available online as e-journals and full text articles can be easily accessed via databases such as Scopus and Web of Science, especially if your university library subscribes to the journals you need. Online databases which are indexes of the published literature like PubMed (including MEDLINE) are valuable as a tool for finding journal articles and their use is highly recommended.

The advantages of using journal articles are that they are up-to-date, usually peer reviewed for quality, and generally based on new original data, except for discussion papers and commentaries, which are focused on a specific topic. Some of the disadvantages are that they may provide a narrow focus and may be subject to bias.

3.3.2 Systematic Reviews

Systematic reviews, such as those produced by the Cochrane Collaboration in the UK, see Chap. 12, provide a thorough overview of published primary research in a clinical topic area at the date of publication, with an overview of findings and full assessment of research quality. There may be some summated statistical analysis, termed meta-analysis, which is valuable for assessing the effectiveness of a therapy or test. Systematic reviews are not available for every speciality; for example, there are more existing reviews in therapies than in diagnostic testing.

The advantages of using systematic reviews are that they are authoritative; for example, Cochrane reviews are unbiased, provide thorough quality assessment of included studies, and are regarded as the highest form of evidence. The disadvantages are that they may not be up-to-date, depending on publication and may not be available in all topic areas.

3.3.3 Textbooks

Textbook content tends to lag slightly behind new research developments, due to unavoidable delays in writing and publication, but may provide a useful overview of a subject area. Popular textbooks are also more accessible to the reader than research papers and provide good background material which allows a complex topic to be better understood. There are also some ‘classic’ textbooks which contain important theories and principles, written by their original authors. It is often important to refer to these, especially in subjects such as research methods, science, psychology, and social studies. But although reading textbooks can be a useful first step in a literature review, textbooks should not be the main source of references for an undergraduate essay or dissertation. Journal articles are preferred since they provide more detailed research material.

The advantages of using textbooks are that they provide reader-friendly overviews of topics, as well as good sources of references. However, some of their disadvantages may be that they are not be up-to-date and may lack depth and detail when reporting research findings.

3.3.4 Grey Literature

Grey literature refers to items which may not reach full publication status, such as conference abstracts and proceedings, or theses. Conference material tends to be very current and often contains topical new material of interest to an audience, as well as interesting debates. These sources provide good material for a state-of-the-art essay or review in clinical imaging or radiotherapy but may only include summary data rather than full accounts and may also be hard to locate. Unpublished theses and student projects tend to provide in-depth explorations of a topic and may be good references to add to a dissertation. The OpenGrey database provides a source of European grey literature. In medical imaging and radiotherapy, it may be useful to search conference abstracts, such as those of the United Kingdom Imaging and Oncology (UKIO), European Congress of Radiology (ECR), or the Radiological Society of North America (RSNA) annual meeting.

The advantages of using grey literature are that it is often up-to-date, may be highly topical, and contain alternative perspectives. The disadvantages, however, are that it may be incompletely presented and hard to reference.

3.3.5 Media Articles

Media articles from Internet news sites, popular magazines, and newspapers are useful for providing interesting scene-setting and quotations for essays or research projects but should not be relied on too heavily for factual accuracy, since the stories they contain may be biased or only partly reported.

The advantages of using media articles are that they are topical and interesting and may provide good material for debate and quotation. However, the disadvantages may be that they are inaccurate or 'sensationalist' and contain facts which are hard to verify.

3.3.6 Internet Sites

This section concerns specialist Internet sites, not electronic journal (e-journal) sites. Although Internet sites can be used as references in some circumstances, they are not always a reliable source. This is because the material found on most personal, 'special interest,' and corporate Internet sites is not subject to the same process of academic peer review and quality assessment that takes place before publication in journals. It is thus more likely to be of a variable standard and may be subject to bias. However, some sites, such as those of manufacturers, organisations, and societies, may contain very useful information which is not available elsewhere.

The advantages of using Internet sites are that they are easy to access online, may contain a wide breadth of resources and links, and are often up-to-date and highly

topical. The disadvantages, however, may be that the content may vary a lot in terms of quality and accuracy, and they may present narrow or biased viewpoints (see Chap. 10).

3.3.7 Government and Other Official Publications

Government and other official publications, such as those produced by professional bodies and colleges, provide useful material for an essay or the introduction/background section of a dissertation or journal article. It would not be usual to include such publications in a systematic review, unless they are officially sponsored primary research reports. Some types of research reviews may be based on a study of official documents.

The advantages of using these publications are that they may contain useful reference lists, provide good background material, help present the broader context, and may be written by expert panels. The disadvantages, however, may be that they are selective in the use of source material and data and may not present detailed research findings.

3.4 How Thorough Should a Literature Search Be?

Searching the published literature within a chosen research topic is vital, both in primary research (e.g., a new experiment or survey) and secondary research (a review of existing findings), or in an essay. Research may be weak and ill-informed if it shows lack of awareness of the findings of others working in the same topic area. This runs the risk of producing narrow discussions and reaching biased conclusions, without consideration of alternative evidence. This point applies to all research work, ranging from novice to expert. Undertaking a thorough literature search enables researchers to take a broad view and to interpret their own research results fully in the light of existing knowledge. It also gives researchers more to say within the analysis of findings, as the new data can be compared with that previously gathered by others elsewhere. A very thorough search of literature would not normally be expected for an essay, but even so there should be an awareness of key and up-to-date publications in the topic area, showing a balanced and well-informed perspective. Reference lists for essays are sometimes selective and may reflect a personal viewpoint or argument, depending on the essay title that has been set. References included in the background sections of published journal articles may be limited by available space, although once again it is important to show freedom from bias and awareness of relevant previous published studies.

The breadth of a literature search depends on the task in hand. Some suggestions are given in Table 3.1 below.

Suggestions for the numbers of references in Table 3.1 apply to typical student work at undergraduate degree level. For postgraduate or funded research, the expectations would be greater. But there are always some topics, perhaps very recent,

Table 3.1 Examples of numbers of literature references typically needed within common research tasks at undergraduate level

Research task	Suggested number of references	Reasons for the literature search
1. Writing a research proposal	About 10 should suffice These should be recent key references in the topic area	To set the background To show awareness of the topic To justify the proposed research To identify issues and opportunities
2. Doing a literature review chapter within a primary research project	The number depends upon how many references are available on the topic. However, fewer than about 30–40 would be disappointing to most tutors	To set the background To identify other relevant work on the topic To provide comparisons with our own findings To inform our method, discussion, and conclusions
3. Doing secondary (a systematic review of literature)	All recent relevant research in the topic area should be included But limitations will include language of publication (if other than English), type of publication, personal resources The number depends upon how many references are available on the topic, but it should be larger than in (2) above About 80+ would typically be expected for an undergraduate review in a topic area where ample literature is available	To provide a rigorous overview of recent available research in the topic area, without major omissions To portray the current state of knowledge and/or clinical practice in the topic area To synthesise the available research evidence and reach informed conclusions regarding current issues, trends, and practice

specialist, or obscure, in which little published research is available. In such cases it would be accepted that fewer references might be used—provided that the researcher really has done a thorough literature search. It is quite common for students to report, rather despondently, that they "can't find anything on the subject", when a subsequent online search brings up several journal articles which they have missed. It is important to search widely when looking for literature and to use the right tools for the job. These issues are discussed below.

Researching in an area where little previous work is available can restrict the literature review section of a research project, but it can be a positive advantage too. There is probably more chance that the research findings will be novel and original. It may also help with publication, provided that the topic is not so obscure that it is of no interest to others.

How recent should literature references be? The pace of technological change in medical imaging and radiotherapy means that older clinical references may be outdated and no longer relevant to current practice. As a guide, it can be recommended that literature sources should be from within the last five years (normally) in any topic area which is experiencing rapid change. Examples might include computed tomography and intensity modulated radiotherapy. Even in subjects like these, there

may be earlier research which should be included because it is key to understanding in the subject or contains evidence which was, and still is, of vital importance. It is sometimes suggested that research from countries which have technically advanced healthcare systems (the USA is often quoted in this regard) may be slightly 'ahead of its time' and that this should be taken account of too when thinking of a five years cut-off point for useful sources.

As mentioned above, secondary research consisting of a full literature review makes the most extensive use of literature searching. A systematic review (see Chap. 12) is the term used for a really thorough appraisal of available and relevant research evidence in a topic area, applying a specific methodology for including, excluding, and appraising studies, in order to answer a research question. Full systematic reviews are time-consuming and would not be expected within an undergraduate degree. But a reasonably complete overview of recent published evidence (in English) is achievable within a timeframe of about six to nine months for an undergraduate review.

Medical imaging and radiotherapy research is not only about physics, biology, and technology. It is also concerned with people—patients, clients, the general public, and staff. Thus, researchers need to think laterally, also considering sources within general health, psychology, social sciences, and even economics. 'Search widely' is good advice. It is important to look at research in other fields such as nursing, physiotherapy, and general industry, if exploring topics such as manual handling, job satisfaction, or anxiety (for example), which have a huge literature but not much that is specifically about radiography. In such situations useful comparisons can be made between experiences in radiography and other professions. Of course if research is being undertaken in a very 'radiographic' area such as radiation doses, it is unlikely that there will be much relevant material outside the radiological and medical physics literature—but even in this case it may be worth looking at sources in medical health, oncology, molecular biology, epidemiology, and immunology, to name just a few.

A literature source is the original published article, book, or conference proceeding. Although people sometimes find and use abstracts (which are short summaries) of published articles, because it is quicker and easier to do so, this is never a good idea. A 200–300 word abstract cannot convey the full findings of a journal article, and although there are usually some summary results, many important details, complexities, and 'angles' will be missed. Similarly, it is best to look for an author's views within their original book or article, rather than relying on secondary quotations in other sources. Secondary quotations may be selective when using an author's words, in order to support other arguments.

3.5 Writing a Literature Search Methodology

Although a method is associated in many people's minds with traditional research or an experiment in the laboratory, methodology is a vitally important (and sometimes forgotten) part of a systematic literature search too. A good literature search

for a systematic review will include details of the search strategies used, in the same way that a primary research project will have a methods chapter. Components of the search strategy should include:

- Names of the databases used (sources of information)
- Database search terms (keywords, which should hopefully allow related articles of interest to be found)
- Inclusion and exclusion criteria (justifiable reasons for leaving literature in or out of the review)
- Data extraction (details of the types of information that we want to get from the literature)
- Numbers of results (hits)
- Quality assessment of studies

A rigorous method such as this would not be expected for a literature search in an essay but might be employed to some extent (leaving out a formal quality assessment of studies), for a literature review chapter in a research dissertation.

Literature searching needs to be planned and methodical just like other aspects of research. It needs to ask clear questions, have aims and objectives, gather selected information, and report findings.

3.5.1 Approaches Used in a Literature Search

Although it is possible to search for articles within individual printed journals or their online home pages, the most efficient approach is to use an online database which indexes the content of a wide range of journals. Some of these are freely available and others are subscribed by libraries. Electronic copies of articles can be easily downloaded, provided that the institution subscribes to the journal in question or the article is free of charge. There are a number of information databases available online, which index health and related subjects, and include the following.

- PubMed (including MEDLINE), the most widely known, covering most aspects of medical and health literature and produced by the US National Library of Medicine
- CINAHL, which includes nursing and allied health
- EMBASE, for biomedical and pharmaceutical literature which includes MEDLINE
- PsycINFO, for literature in psychology
- CancerNET UK, a good resource for oncology, from the National Cancer Institute
- International Cancer Research Partnership (ICRP), a collaborative indexing of cancer research

- The Cochrane Library, a valuable source for health interventions and therapies, especially randomised controlled trials (see Chap. 12), as well as systematic reviews in health care. It contains several individual databases, such as:
  - CDSR (The Cochrane Database of Systematic Reviews)
  - DARE (The Database of Abstracts of Reviews of Effectiveness)
  - CENTRAL (The Cochrane Central Register of Controlled Trials)
- Scopus, a large database of peer-reviewed literature across all subjects
- OpenGrey: The System for Information on Grey Literature in Europe, which covers unpublished (grey) literature, categorised by country and subject area.

The large number of databases available may seem a bit confusing and many people just use a single database, such as PubMed. But it is important to know that each database may find articles that are not indexed in the others and that no single database covers everything. Sometimes it is possible to do a combined search using more than one database, but beware that this may give duplicate "hits" for the same article via different databases, giving a very long list of references. Both PubMed and EMBASE usefully combine the MEDLINE resources.

There are other sources which can be used on the web to find research articles, including those from the journal publishers, such as:

- Blackwell Synergy
- Ingenta Connect
- SpringerLink
- Sage Journals Online
- ScienceDirect, from Elsevier
- Wiley Online Library

The content of these depends on each publisher's range of journal titles, but they are a useful extra source in many cases. The web search engine Google Scholar can also bring up useful journal articles and other material such as electronic book extracts (often available on OpenAccess) and provides Advanced Search options. The term OpenAccess refers to resources that are freely available for legal download and usage. Access to these research outputs in the form of book chapters or journal articles is open to all and unrestricted. Increasingly, even a simple Google search provides journal articles that are OpenAccess.

Table 3.2 below gives an indication of the amount of material available via the various web-based search tools and gives some indication of their potential usefulness to diagnostic imaging and radiotherapy:

Additional search approaches include visiting a specialist library, such as that of the British Institute of Radiology in London, which contains student projects and subject-specific literature. It is worth contacting the librarian of such a centre before the visit, in order to check whether there are likely to be any materials which are relevant to your research, especially if a long trip is involved. Major national libraries, like the British Library, contain journals that might not be available locally, but

Table 3.2 Numbers of "hits" for the search word "radiotherapy" using various electronic databases and journals

Database, web search engine, or electronic journal	Number of hits	Comments
MEDLINE (PubMed)	202,000	This database contains over 18 million citations, dating back to the 1950s
CINAHL Plus	10,600	Articles from over 3200 journals
PsycINFO	430	Consists of several parallel databases covering different date ranges
Allied and Complementary Medicine Database (AMED)	660	Contains articles relating to alternative and complementary therapies
International Cancer Research Portfolio	580	Search for the period 2007–2008
Cochrane Library	5400	For the Cochrane Database of Systematic Reviews
Science Direct (from Elsevier)	25,700	Articles from over 1000 journals
Radiology	2000	The journal *Radiology*
British Journal of Radiology (BJR)	820	For a search within abstracts of articles in the journal BJR

access to such institutions is restricted. Most university and hospital libraries offer an interlibrary loan service whereby electronic copies of articles can be ordered, often free of charge to students or staff.

Not all original research gets published and a thorough literature search may also include unpublished material (often referred to as "grey literature") such as master's or doctoral theses and dissertations, reports of meetings, and conference proceedings. This is often to be found in university libraries and repositories such as the British Institute of Radiology Library.

The search approaches used should all be listed in the literature review methodology.

3.5.2 Database Search Terms

Within the literature search methodology, the search terms which you have used when hunting for articles via online databases should be listed. Search terms are words and phrases which we hope will score 'hits' by bringing up relevant articles of interest. The terms are entered in a search box within the database. The precise choice of words and phrases will very much affect the number and type of 'hits' that we get—the results can be a bit surprising. The database will usually look for matches between our search terms and keywords contained in the title, abstract, and text of journal articles. Sometimes, even when we know for sure that there are articles available in a topic area, a database would not seem to retrieve them for us and this can be frustrating. Possible reasons for this include:

1. The database we are using does not include these articles (no database contains everything ever written).

2. The database does contain the articles but the search terms we are using are not recognised or are not precise enough. The search phrase "X-ray" might well be a useful one to include, but just entering it on its own might bring up a huge number of hits from non-radiographic fields such as X-ray astronomy, X-ray crystallography, general physics, and so on (depending on the type of database we are using). More advice is given on issues like this later in the chapter.

3.5.3 Inclusion and Exclusion Criteria

It is necessary to have some protocol (or set of rules) in your methodology for deciding whether each piece of published research should be included in the written literature review or excluded. Every researcher needs to produce their own protocol and there is no universal guidance for this. This is because each research topic is unique and so a set of universal rules would not work. But generally, you are likely to leave out articles which are the following.

1. Irrelevant
2. Out of date
3. Unreliable

Irrelevant evidence is that which is not applicable to your research—examples might be research from other countries (where the healthcare system is very different from your own), or studies of diagnostic imaging in children when you are researching radiography of adults.

Research from many years ago might have become out of date if there have been rapid changes in clinical practice since then. This means that circumstances have changed so that the situation presented within the old research is no longer applicable today. Each researcher needs to decide a cut-off date for inclusion, before which point the research is not to be included. The date chosen will very much depend on the topic area—human anatomy does not change over the years, but chemotherapy does.

Deciding whether research evidence is reliable is often the hardest decision to make when considering whether or not to include it. More is said about literature appraisal in Chap. 4, but it is best to exclude articles which you feel are of poor quality. Poor quality research articles (as seen by you as the reviewer) might be ones with small sample sizes, flawed methods, obvious bias, weak statistics and analysis, and so on. A randomised controlled trial (see Chap. 12) is usually regarded as the best quality clinical research evidence, but such trials are rare in medical imaging (although there are more in cancer therapies). Thus, a researcher writing a review in radiology might need to compromise a bit when considering articles for inclusion (or risk having none!). When writing a literature review it may be wise to pay more attention to the findings of research which compares the effectiveness of one diagnostic test (or cancer therapy) with

another on the same set of patients. Most research will only look at a single intervention, however.

Typically, inclusion and exclusion criteria will include the following: date range, geographical location, language, age group, and type of publication. To give an example of a set of inclusion and exclusion criteria for a literature review, let us suppose that you are doing a systematic review looking at the usefulness of magnetic resonance imaging (MRI) in diagnosing suspected adult brain tumours.

Inclusion criteria in this example might consist of articles that:

- Are written in English
- Have been published within the last 5 years
- Are original primary research
- Use commonly available MRI technologies
- Have symptomatic adults as their sample group
- Involve first presentation of disease or symptoms
- Use a sample size of at least 25 clinical cases
- Are felt to be reliable and of good quality

Exclusion criteria would mostly follow on from this and might be articles that:

- Are in languages other than English (unless we have language skills)
- Are older than 5 years
- Are reviews of other work
- Involve MRI technologies not generally available elsewhere
- Include asymptomatic adults (such as volunteers and health screening cases)
- Involve recurrence of disease or symptoms
- Have a sample group of less than 25 clinical cases
- Are felt to be unreliable as evidence, due to poor quality

3.5.4 The Data Extraction Process

One very valuable, but often omitted, part of a literature search method is the data extraction form. This lists the key information that the researcher is aiming to extract from the literature. It is a good idea to complete a form for every research article, since this gives a valuable summary of major findings and also acts as a reminder about what information was found where. Otherwise you might be left later on with a lot of articles and have no recollection about which one contained a particular important finding.

An example of a data extraction form is included below in Table 3.3, for the previously mentioned review of MRI in diagnosing adult brain tumours. This is not a rigid template, just an example—every literature review will be different.

Table 3.3 Example of a data extraction form

Key data categories	Entries
Title of article	
Authors	
Year of publication	
Country of publication	
Type of MRI scanner	
Field strength of MRI scanner	
Type of research study (randomised trial, observational study, review, etc.)	
Is MRI compared with any other test and if so with what?	
Is a "gold standard" test used?	
Number of patients in the study	
Are sensitivity and specificity data included? If so state the values	
Are cost data included?	
Is there any mention of patient outcome measures, such as survival, quality of life, alteration of treatment or diagnosis, satisfaction, etc.?	

3.6 Tips and Tactics for Doing the Literature Search

Doing a literature review can either proceed smoothly or be very frustrating. The following tips and tactics may help you.

- Consider all of the possible words and phrases that might commonly be used by authors when they are writing articles in your chosen topic area. Using these words as search terms should help you find related articles. It is often a good idea to see which words are used in the reference lists of the first articles that you find. Be broad-minded in your choice of search terms.
- When using a database, look for search terms in the abstract and body of articles, not just in their titles. Many authors use rather odd or 'catchy' phrases as article titles, which do not connect well with the actual subject area. It would be easy to miss these articles if you only searched for words in their titles.
- When using the PubMed/MEDLINE database, an initial search can often bring up loads of articles that are not connected with your subject area. You can get around this problem by using the Medical Subject Headings (MeSH) tool to see what keywords and phrases PubMed/MEDLINE recognises in your topic. A repeat search using these recognised words usually gives more 'hits'.

The following steps demonstrate how you might apply a search strategy for the review of MRI in diagnosing adult brain tumours.

- Break the question down into its three main concepts: in this case MRI, brain tumours, diagnosis.
- Note down any possible alternative keywords for the same concept, such as brain neoplasms as another term for brain tumours.

- In the chosen database, search for each concept separately and then combine searches together. This gives you more flexibility if you want to adapt your search strategy as you go, according to whether you are getting appropriate results or if you want to add other keywords from abstracts or MeSH headings.
- Use Boolean operators (the words AND, OR, and NOT) to combine your terms or searches together. Remember that OR is used to combine alternative keywords and broadens out your search. AND is used to combine more than one concept together and narrows down the search results. NOT excludes a term or concept.
- Another useful technique is to use inverted commas around multiple words to search them together as a phrase.
- This example shows how the three concepts are searched separately and then finally the three searches are combined, which narrows the results down to only those articles which contain information about all of the concepts together.
  - Search 1. MRI OR "magnetic resonance imaging"
  - Search 2. "Brain tumours" or "brain neoplasms"
  - Search 3. Diagnosis
  - Search 4. 1 AND 2 AND 3
- If you find that an author or team of authors research quite frequently in your topic area, try doing a search using that author's name.
- Do not just rely on PubMed/MEDLINE as a search engine. You may find that other databases such as Scopus or Google Scholar give you more returns. No database covers all of the available literature and each will have good coverage in some specialist areas.
- Always click on the "related articles" that appear when you do a search using a database such as PubMed/MEDLINE. These in turn will lead you to other related articles in the subject area.
- If you find that articles from your topic area often appear in the same published journal, try doing a search through all of its content for the last few years. This can be done electronically via a journal homepage. You will often find that you come across other relevant articles, editorials, and correspondence that you would otherwise have missed.
- It may seem a bit obvious but do look through the reference lists of those journal articles which you have already identified as useful. Sometimes authors will quote references which do not appear in your database searches.
- Several of the above tips are "snowballing" techniques, by which finding one reference leads to locating many others in turn and is helpful if you are finding too few results.

3.7 Problems with Literature Searches

We do not want to dwell on negatives, but it is best to be pre-warned about possible problems. It can sometimes be difficult to find all of the relevant research that has been written in your chosen topic area, even with the help of databases like PubMed/

MEDLINE. Having a thorough search method will increase your chances of success.

But is the published material an accurate picture of research in medical imaging and radiotherapy? The answer is "well, yes sometimes—but not necessarily". Often there is a tendency for research which shows positive benefits (from treatments or diagnostic tests) to get published, while negative findings may end up filed in a drawer. Also, definite or statistically significant results (whether positive or negative) may be more attractive to a publisher than findings which are null or equivocal. Although journals are not like newspapers, there may still be pressure to print material which is likely to excite the readership. This tendency is called publication bias and is present in many areas of health research, including funded work. This bias can skew clinicians' perceptions of the usefulness of treatments, and there have been situations where the effectiveness of certain therapies (e.g., certain chemotherapies) has been over-exaggerated. Since most clinical staff get their updates from journal articles and conferences, this is hard to avoid.

Definite or positive findings are not only more likely to be published—they are also more likely to be published quickly. This means that the first rush of publications in a developing clinical technique may tend to give a rosy picture, while delayed reports may be more cautious. This is called time-lag bias.

Increasingly, researchers are using social media to promote their research findings as an immediate form of communication. Data about the number of tweets, blog posts, likes, bookmarks, and so on are made available through Altmetrics, which are widely added to database citations and can skew search results.

Someone searching the literature will often find several articles on a topic which are from the same group of authors. This may sometimes be essentially one piece of research, written up in slightly different ways and presented in several journals. It can lead to "multiple publication" bias. Multiple publication can be attractive to researchers since producing more "outputs" not only increases their "street credibility" but can bring in promotions and other rewards. If the articles are from widely different years, it is more likely that each is a separate piece of research, and some authors are very prolific in producing original work, even within a single year. No one would accuse authors of cheating where multiple publication of the same findings takes place—but someone undertaking a literature review should record the findings as one piece of research evidence, not several.

In technology-driven fields like medical imaging and radiotherapy, there can also be another effect, which could perhaps be termed one-upmanship bias. This means that hospital centres with the most advanced new scanners or linear accelerators may be more likely to get their research published. It is true that cutting-edge research is more likely to be achieved using the newest equipment, and active clinical researchers are attracted to the best-funded centres (hence more publications from these sites). But someone undertaking a literature review should reflect that the technologies might be unavailable at most hospitals and might not reflect the real-world situation for most of the health service. This is an example of weak generalisability or external validity.

The above-mentioned biases will be present in the research literature, and the available evidence will be influenced to some degree. A researcher cannot escape this fact but can be aware of possible biases and reflect accordingly. It may be useful to consider the following criteria for evaluating what you find.

- Who?
- Can you identify who has written the information? What are their experience and qualifications? Who do they work for? Is the work sponsored by an organisation? What else have they produced?
- What?
- Is the information biased in favour of one view? Can you locate a counter-argument? Are there obvious omissions? Can you easily distinguish between fact and opinion? Is the emphasis of the topic appropriate for your needs?
- Why?
- What is the intended audience? Is the material at a suitable academic level?

What if you are undertaking historical research, for example looking at the development of radiography during the period from the 1920s to the 1960s? Most journal articles are not available electronically in full text for those years and this can cause a problem. In these situations, it may be necessary to visit a national collection such as the British Institute of Radiology library and do a hand search of the printed copies of journals. The problem also applies to older out-of-print books. A researcher living in a large city like London is more conveniently placed to visit specialist science and medical libraries. The limited availability of older sources is not normally a problem in medical imaging and radiotherapy research, since most (but not all) older publications are no longer relevant to current clinical practice.

To access a wide range of literature you need to use an institutional library and there can be a problem if your institution does not pay to subscribe to the electronic full text version of the key journals you need. In such cases it will be necessary to order copies of articles from elsewhere. This is possible but might have cost and time implications. It is a good idea to check the library's holdings of full text journals as soon as possible, not in the last few weeks before a review has to be submitted. Remember that databases such as PubMed/MEDLINE will help you to find the title and citation (journal, year, volume, page number) of articles needed, but may not link to the full text, unless the library subscribes to the journal or it is available free to non-subscribers (OpenAccess). Abstracts are usually available via databases; do not rely on these alone.

Once you have found relevant articles, do not forget that you will eventually have to reference any that you use in your review. Saving full citations as you do your searching will save you time at the writing-up stage. It is important to have some system for keeping and organising your references, for example creating a file or folder on your computer, or making use of one of the many online reference management tools such as EndNote, Zotero, Mendeley, etc.

3.8 Getting Support

Consult your supervisor if you are undertaking a research project, as they will be able to guide you with your literature searching. Also contact your librarian for advice on online database use and other resources. Most universities have online help tutorials available to guide your literature search.

3.9 Conclusion

There are a number of ways in which you can search for information; the most popular being the online databases. It is good practice to develop a literature search strategy or method so that this plan can guide you through your searches and keep you focused on your aims and objectives of the study. Most literature reviews will need you to submit an indication of the search strategies or methods used. This forms the methodology of the literature review and would include the main inclusion and exclusion criteria for literature searching. Searching the literature can be an exciting quest, as it always provides fresh insights to the person undertaking it themselves for the first time. No matter that hundreds of other people have done the job previously—since new things are constantly being published, each search is unique. Literature searching can be frustrating too but use of the right tools and the right method eases the journey.

Further Readings

Greenhalgh T. How to read a paper: the basics of evidence-based medicine and healthcare. 6th ed. London: Wiley-Blackwell; 2019.

Hart C. Doing a literature review: releasing the research imagination. 2nd ed. London: Sage; 2018.

Straus S, Richardson WS, Glasziou P, Haynes RB. Evidence - based medicine: how to practice and teach EBM. 5th ed. London: Elsevier; 2018.