Evidence for Policy and Practice
Information and Co-ordinating Centre

The EPPI-Centre is part of the Social Science Research Unit, Institute of Education, University of London

EPPI-Centre Methods for Conducting Systematic Reviews

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Contents

Approaches to reviewing

Involving representatives of all those who might have a vested interest in a particular systematic review helps to ensure that it is a relevant and useful piece of research.

User involvement

Everyone has a vested interest in public policy issues such as health, education, work and welfare. Consequently everyone, whether they wish to be actively engaged or not, has a vested interest in what research is undertaken in these fields and how research findings are shared and put to use.

Reviews are driven by the questions that they are seeking to answer. Different users may have different views about why a particular topic is important and interpret the issues within different ideological and theoretical perspectives.

Involving a range of users in a review is important as it enables reviewers to recognise and consider different users' implicit viewpoints and thus to make a considered decision about the question that the review is attempting to answer. The aim is to be transparent about why a review has the focus that it does, rather than assuming it is, or is attempting to be, everything to everyone.

In terms of potential users of research, experience in health sector research suggests that users of health services may play a role throughout the process of conducting and managing systematic reviews (Oliver, 2004).

Service users have participated in debates about the purpose of reviews, in co-ordinating review teams, identifying review topics, prioritising reviews, identifying salient outcomes, refining review questions, conducting reviews, editing review protocols and final reports, disseminating review findings and getting findings into practice.

In considering 'user' involvement we have in mind a broad definition of users. The list below provides an example of some specified groups that reviews would need to involve:

- users of services, or those experiencing a particular phenomenon or intervention (e.g. students, patients, parents);
- practitioners (e.g. teachers, nurses, social workers);
- policy makers in local and central government (e.g. education managers);
- researchers;
- employers;
- members of the public;
- a diverse range of users in terms of gender, age, and ethnic minorities

All these people bring different kinds of expertise which is a vital complement not only to individual systematic reviews, but also the working practices of organisations, such as the EPPI-Centre, involved in developing methods and training for systematic reviews.

Further information about user involvement is also available on the EPPI-Centre page *User-Driven Evidence-Informed Policy and Practice*[1] and via the website of the Cochrane Consumer Network.[2]

Different types of review

Although all systematic reviews use formal, explicit methods to describe and synthesise evidence, they can vary considerably in the types of questions they aim to answer. As a result, different types of evidence will be suitable for answering different questions and,

[1] http://eppi.ioe.ac.uk/cms/Default.aspx?tabid=65
[2] http://www.cochrane.org/consumers/homepage.htm

and different methods will be appropriate for describing and synthesising different types of evidence.

Questions, evidence and methods

A major use of systematic research synthesis is to inform policy and practice about the effectiveness of health care interventions and medicines. Organisations, such as the Cochrane and Campbell Collaborations, are interested in combining numerical data from experimental studies in the form of meta-analyses to answer questions about 'what works'.

More recently, the logic of systematic reviews has been increasingly applied to a greater variety of:

- research questions asked (e.g. how does it feel to receive this intervention? Why does this phenomenon occur?)
- primary study designs included (a diverse range collecting both numerical and textual data, e.g. qualitative interview data)
- methods for synthesis (e.g. narrative conceptual synthesis, meta-ethnographic synthesis, statistical meta-analysis)
- approaches to being systematic (e.g. a pre defined method of reviewing or a more emergent or iterative method of reviewing which is still explicit, rigorous and thus systematic)
- types of evidence included in the review (e.g. some systematic reviews contain information that goes beyond research evidence, such as practitioner surveys and overviews of current policy)

Breadth versus depth

The formal and explicit methods of systematic research synthesis have also been used to produce different review outputs.

Breadth
Review questions can be broadly or narrowly focused. If they are broadly focused then they may need to include methods for coping with the diversity of issues and evidence being considered. These strategies may include:

- Clear conceptual framework (or theoretical or logic model) to review and interpret the evidence.
- Two stage reviews with a descriptive map of the research followed up by one or more syntheses on parts of this map of research.
- Mixed methods reviews where broad questions that are then addressed though a number of sub questions. These sub-questions may be addressed through different methods of review and different types of evidence before being brought together again to address the overall review question (for example see Thomas et al 2004).
- Methods of quality and relevance appraisal and analysis that can cope with diverse evidence types within the same review.

Depth
Some systematic maps can be in-depth with a large degree of analysis of the research field. Syntheses are nearly always in-depth, as detailed scrutiny of the available research is necessary to be clear about the trustworthiness of that research and the relevance and direction of the findings. This time-consuming, but essential, activity means that systematic reviews including a synthesis often answer a more narrowly focused question. Reviews asking complex questions may be theory testing reviews using more iterative methods of review such as in critical interpretative and realist synthesis.

As the EPPI-Centre has developed over the years we have encountered a number of challenges. The challenges facing all those conducting systematic reviews include those related to the methodology of systematic reviews, the support and infrastructure needed to

conduct this type of work and ideological resistance to, and misunderstanding about, the nature of systematic research synthesis.

Methodological challenges and developments

Developing new techniques to address a broader range of questions than is typical of systematic reviews has meant facing a range of methodological challenges, for example, integrating data from experimental studies with data from other study types (see for example Harden and Thomas 2005) and conducting qualitative syntheses.

Structural challenges

A lack of infrastructure to support this type of research, in terms of training and sustainable funding, has been a second challenge for those wishing to undertake systematic reviews. Systematic reviews are pieces of research and need staff training and staff time just as for large primary research studies. The ESRC-funded National Centre for Research Methods[3] has a node in Methods for Research Synthesis at the EPPI-Centre which contains both research for methodological development and a training programme to address some of these capacity issues.

Ideological and political challenges

Vociferous resistance to the conduct of systematic reviews has emerged from those who fear it leads to central political control of the research process rather than its democratisation. However, one of the key approaches used here at the EPPI-Centre is to involve a range of users including members of the public, to move the setting of the research agenda away from simply researchers and policy-makers.

Often, ideological resistance is linked to confusion between experimental methodologies and systematic reviews (i.e. the myth that randomised controlled trials are the only type of research evidence that is accepted, and that 'what works' questions are the only ones addressed by reviews). In recent years the flexible nature of systematic research synthesis has been illustrated, with a huge variety of types of questions being answered with syntheses of a broad range of study types. (See Oakley 2006).

[3] http://eppi.ioe.ac.uk/cms/Default.aspx?tabid=188

Getting started

Review team and advisory group

Reviews are likely to be more relevant and of a higher quality if they are informed by advice from people with a range of experiences, in terms of both the topic and methodology. Organising and making the most of available support is key to a successful review.

Review team

The members of the 'review team' are responsible for the day-to-day conduct of a review or series of reviews, and may come from a range of backgrounds, some with methodological skills in undertaking reviews and some with subject area expertise.

The review team may need advice and support in terms the methodology or topic of the review. This can be provided through consultants or through members of an advisory group. For many of the reviews we support at the EPPI-Centre we provide training and advice on methodological issues, monitor the progress of the review, ensure that EPPI-Centre materials and procedures can be developed further to fit the needs of each review, and quality assure different stages of the review.

An advisory group can also provide the range of user perspectives necessary to inform the review as described in our methods page on user involvement.

Advisory group

Advisory groups can include methodological and subject area expertise, and include potential review users, e.g. teachers, pupils, employers. In addition to methodological support advisory groups can also help review teams make necessary but difficult decisions in relation to the reviews topic. For example, setting the review question or refining a review's scope once the size of the relevant literature becomes known. Such decisions can benefit from input from a variety of perspectives. An international perspective may also be useful, and people new to reviewing can benefit from working alongside more experienced reviewers.

Setting the scope and strategies for the review

The research question

As with any piece of research, defining the research question for a systematic review is the most important stage of the process, as it provides the framework for all the other stages.

The question being asked by a review will determine the method of review and the studies that are considered by the review. The question is likely to include implicit assumptions about the topic and this and any underlying conceptual framework (or logic model) that will be used to interpret and understand the research evidence in the review should be made explicit.

In most types of systematic review, explicit inclusion and exclusion criteria are developed for specifying which studies will be included in the review. For example, criteria in terms of study topic, population and setting and, of course, study design. Time and effort spent on this stage is likely to save time and trouble later. A poorly conceptualised research question will lead to difficulties making decisions at later stages of the review, for example when designing search strategies, or when deciding how relevant studies should be summarised. A clearly defined review question also helps readers in deciding whether or not a review is likely to contain information of relevance to them. In some reviews, the question and method is not so pre-specified, so allowing for a more iterative method of review. These reviews tend to have broader questions and take a more investigative approach to examining the evidence rather than pre specifying every aspect of the review.

Protocol development

In reviews with a priori methodologies, the methods for review are made explicit in a 'protocol' before it starts. A protocol helps reviewers to describe and explain their methods

for answering the review question in an explicit and approachable way. The protocol includes the review question, the underlying assumptions and conceptual framework and the methods to be undertaken in the review.

A protocol is one component of an open, consultative approach to undertaking reviews. It is also argued that if the review's methods are defined explicitly at the start of the review, reviewers are less likely to be influenced by, for example, their knowledge of study authors or by study findings. Publication of accessible details of planned reviews can encourage constructive criticism from other researchers and research users at the stage at which it is most likely to help improve the final review.

If changes are needed to the protocol as the review progresses, these needed to be noted in the review's final report and the rationale for making changes made clear. The protocol is developed by the review group, with involvement of users, and is sent out to be peer refereed by individuals interested in policy, practice or methodological aspects of the review.

For examples of developing and setting the scope of a review, please explore the methods sections of EPPI-Centre reviews, which are fully available via the Knowledge Library.[4]

Administrative systems

Since systematic reviews aim to be comprehensive syntheses of research literature, it is vital that reviewers keep track of the reports they find and are able to present a full account of how each report is dealt with as the review progresses.

Reviewers can expect to deal with several hundreds, if not thousands, of references and keeping track of them efficiently and safely is, therefore, of paramount importance. To update a review, reviewers need to be able to see which reports were dealt with in the review's previous versions.

There are various systems that will need to be set up to deal with the large volume of research including those for:

- managing references
- recording decisions about whether studies meet the scope of the review
- managing copies of research reports (both paper and electronic)
- collating data on studies in the review – describing/coding
- analysis of the data
- reporting of the results

Once searches have been carried out, electronic records of the results (i.e. the studies found) can be downloaded from databases and imported into reference management software such as EndNote or Reference Manager. The results from all databases searched can be downloaded into one place and can be supplemented by the manual inputting of the details of literature identified through other methods such as hand searching, to produce a single complete list of all reports found in the search. Notes on the location and availability of research reports can be recorded here for each reference along with a whole host of other details, such as the results of screening for inclusion or exclusion and codes to describe the attributes of included studies, for example the country in which a study was carried out or the age of the study participants. Many reviews use some kind of database, such as Microsoft Access, to hold detailed information about studies to be included and specialist software to conduct syntheses (e.g. RevMan for statistical meta-analyses or qualitative analysis packages, such as NVivo and NUD*IST for thematic syntheses). The EPPI-Centre has its own software, EPPI-Reviewer,[5] that handles data throughout the lifecycle of a review, from screening and mapping to undertaking meta-analyses and meta-ethnographies.

[4] http://eppi.ioe.ac.uk/cms/Default.aspx?tabid=60
[5] http://eppi.ioe.ac.uk/cms/Default.aspx?tabid=1913

Assuring quality

As in primary research it is important for reviews to be useful and credible, high quality and relevant for answering the questions that they are addressing.

There are several ways in which the quality of a review can be enhanced. Different dimensions of quality assurance can be applied throughout the different stages of conducting a review. Some of the dimensions are these:

- **Internal review appraisal** – Engaging a team of people with different expertise to work on and support a review can help ensure both relevance and quality. Those working on a review are often provided with support from advisory groups who provide input at key stages of the review.
- **External review appraisal** – As with many primary research proposals and academic publications, systematic reviews may call on peer-referees to appraise the review at the protocol and final report stage. Indeed, at any point the review it may be beneficial to call on the expertise of relevant external consultants to provide an independent appraisal of the quality and relevance of particular aspects of the review.
- **Good processes** – At various stages in a review, such as coding and appraising studies, it may be necessary to check these processes are understood and applied consistently amongst the team. At the EPPI-Centre we build in time for moderation exercises with the aim of reducing any ambiguity about how to execute tasks such as coding, before the task begins for real. In addition, it is common practice, and a requirement for EPPI-Centre reviews, that for each study included in a synthesis the data are extracted by two independent reviewers and their results compared.
- **Maintaining database records** at each stage is a real strength of the review for three reasons. Firstly, it enables the review's conclusions to be transparent. For example, readers can refer back to databases to check if a particular paper was found at the search stage, if and why it was excluded, and therefore can be sure if the results of this study should have influenced the reviews findings or not. Secondly, as the database develops it becomes a resource in its own right, and the detailed coding of each study enables sustainability for updates and new reviews. Thirdly, it provides users of reviews with detailed information on particular studies of interest.

Gathering and describing research

Searching for studies

To reduce the risk of bias (e.g. only reviewing the most accessible research) systematic research synthesis requires explicit methods to search for literature for inclusion in a review

An explicit search strategy needs to be developed and systematically applied to a range of resources. In most approaches to systematic reviewing the aim is to produce a comprehensive and unbiased set of research relevant to the review question. Being comprehensive means that the search strategy attempts to uncover published and unpublished, easily accessible and harder to find reports of research studies. Bias can creep in if the search is not exhaustive in this way as, for example, statistically significant positive results are more likely to be published and cited by others.

One very effective component of a comprehensive search strategy is electronic database searching. When carrying out the process of identifying relevant terms with which to search electronic databases, it is necessary to strike a balance between sensitivity (e.g. finding all articles in a topic area) and specificity (e.g. finding only relevant articles). Some terms may locate tens of thousands of articles.

However, searching of databases will not locate all research reports, as some may not be referenced in databases, and others may be missed in the searches. It is important therefore to use a combination of the following approaches:-

- electronic database searching
- hand searching of key journals
- searching of specialist websites
- using general search engines on the internet such as ‘Google’ and ‘Google scholar’
- asking personal contacts, authors and experts in the field

There is no single systematic search that can be carried out for every review; searches need to be developed, and will vary depending on the nature of the research question, and the nature of the topic area.

Some reviews explicitly do not aim to have comprehensive searches, using instead selective methods such as saturation sampling. The aim is to identify sufficient examples of different types of evidence rather than all examples of that type. Also, in some iterative reviews the aim may be to seek out specific examples of evidence for consideration with no attempt at either saturation or comprehensiveness of searching,

Whatever, the approach to searching, it is important that reviewers keep a 'search log' to record the detail of how searching was undertaken. For example, which journals, websites and databases were searched and how and when, along with the list of search terms used and the combinations in which they were applied to the databases. Enough detail should be reported so that the search process could, in theory, be replicated. Keeping a record of all this information will make the review methods explicit and transparent in the final report, so that readers can make a judgement about the quality of the reviews findings.

Searching electronic databases

Systematic searching uses free text and thesaurus terms (also known as controlled terms, MESH terms, descriptor terms), to help identify all articles in a database that may be relevant to a review. Systematic searching of databases will not locate all articles, as some articles may not be referenced in databases, and others may be missed in the searches. It is important therefore to combine systematic database searching with hand searching of journals, searching of specialist websites, personal contacts and citation tracking (checking the reference lists in relevant reports). There is no one systematic search that can be

carried out for every review; searches need to be developed, and will vary depending on the nature of the research question, and the nature of the topic area.

This section provides a few suggestions on how to start thinking about searches. Each of the stages in developing a search is outlined; identification of topic areas (1) and databases (2), development of free text and thesaurus terms (3-5), use of truncation and wild cards (6), building up searches (7-8) and importing searches into reference software (9)), as well as what the EPPI-Centre expects. A simple example of a search strategy and a completed EPPI-Centre search log are given at the end of this document.

Stages in a systematic search

1. A well-defined review question and inclusion/exclusion criteria will enable more successful searches. If we consider a review asking 'what are the effects of secondary school size?', two broad areas can be identified that all relevant articles should consider: secondary age and school size; if the question is more focused, e.g. 'what is the effect of secondary school size on student achievement?' then there is also a third area that all relevant articles need to consider: student achievement. It is these broad areas (often relating to the population, intervention and outcomes) that need to be captured in your search strategy.
2. Having identified the topic areas, the next stage is to identify the databases that you need to search and decide how these will be supplemented with other searchable sources. For example, think about the different disciplines that are involved in the area (e.g. ERIC contains educational research, but some educational research will only be found in psychological or sociological databases). Find out which databases index papers from key journals in the area. If key journals are not captured by the databases available, you may need to search them by hand.
3. Searches are built up using a combination of free text and thesaurus terms. Free text searches look for terms across a record (so will find papers where a term appears in the title for example). Therefore to guide free text (sometimes called keyword) searching, develop a list of terms that might be used in the titles or abstracts of relevant articles. The types of terms used will be words synonymous or related to the broad areas identified in stage 1. Practitioners/ academics looking at the topic from different perspectives can offer suggestions; also useful are specialist dictionaries or thesauri for that broad topic, or the indexes of standard texts. Bear in mind that language varies from culture to culture, and American terminology may be quite different from British. This type of search will also find papers where terms have been used in passing (think of abstracts you've seen that finish by saying 'work is now needed on x' where x is the thing you're really interested in).
4. Papers in databases are classified using thesaurus terms. Trained indexers attach these terms to papers by deciding on the main foci of a paper and following explicit rules. Looking through the subject/thesaurus term indexes can help you work out which thesaurus terms might identify papers of interest. This is one of the best ways of making a search more specific to your needs (see below). A good way of identifying possible terms is to take one or more papers that you know meet your inclusion criteria and find the thesaurus terms that have been used to classify them in the database. These terms can then be built into your search (a technique called 'pearl growing'). Note that databases need to be instructed to treat thesaurus terms as such. If not instructed in this way, databases will treat the terms as a free text terms, and look for the general occurrence of the term in the record.
5. When carrying out the process of identifying relevant terms it is necessary to strike a balance between sensitivity (i.e. finding all articles in a topic area) and specificity (i.e. finding only relevant articles). Some free text terms may locate tens of thousands of articles, as can very broad thesaurus terms. For example, school size is one aspect of school organisation, but a large number of other topic areas are also included under the term school organisation, which would not be relevant to a review of the effects of school size. It is suggested that preliminary searches are used to identify those terms most relevant to the review. For example

if you enter the term school organisation, screen a proportion of the citations and find that all relevant articles have also been coded school size, then it may be prudent not to use the term school organisation in the final searches. Similarly a free text search of the word 'inclusion' will not just identify articles about inclusion in education, but also any articles that mention inclusion criteria or inclusion of fruit in school dinners. It is important to remember that different databases are classified in different ways, so thesaurus terms will need to be adapted to suit each database you use.

6. Most online databases do not automatically search for all variations of a word, so if you carry out a free text search for 'inclusion', you will not retrieve 'inclusive education'. To achieve this, it is necessary to use a truncation symbol (* in the example at the end). This instructs the search engine to look for all words with the specified beginning. Truncation should be used with care, preferably using a meaningful root (e.g. educ* will find all words related to education, but mon* will find not only money and monetarism, but monkeys and monotheism). It is also possible to look for variant spellings by inserting a wild character (e.g. behavio?r or wom?n), which indicates any character or none. These characters will vary according to the database you use and the host on which you search it. Different databases will also have different ways of searching for phrases and numbers. It is therefore essential to read the Help file carefully before you start searching on any new database, and to do some test searches to ensure that you are getting the type of results you expected.

7. Once relevant terms have been identified, searches can begin. To be efficient it is necessary to build up the searches initially using OR before using AND. OR enables you to add extra terms to increase the size of your results set (I want anything about cats OR dogs – either will do). AND requires both terms to be present (or one term from each set if you are combining sets), i.e. I want something about cats AND dogs – it must include both. To take the example of the searches regarding school size, initially all the school size terms (thesaurus, and free text) were entered into the database and combined using OR. This identified all the articles in the database considering school size. Then all the terms regarding secondary age were entered, and again combined using OR. This identified all the articles in the database considering secondary age students. The two lists were then combined using AND, which identified all the articles considering both school size and secondary age (this is illustrated in the search strategy at the end of this document).

8. When undertaking a systematic review, it is tempting to include search statements relating to research methodology – at its simplest, the requirement that the report describes research rather than, for example, administrative guidance. However, previous studies and the experience of other systematic review groups is that this is unwise. Apart from Medline, which has a policy of careful description of research methodology, indexing tends to be patchy and imprecise. It is better therefore, not to search for methodological terms, even though this substantially increases the number of irrelevant results.

9. Having identified all the articles classified as both secondary school age and school size, the final list is saved and then imported into reference management software (e.g. Endnote, Procite, Reference Manager), and the process completed for the other databases. It is wise to import each search initially into a separate database – it is quite normal for the import to fail or be incomplete on the first attempt, and this allows several attempts to be made without corrupting your previous data. It may be necessary to modify the import filters to match your data, or to modify your data to match the filters. Once a good database has been established for your new reference set, you can use the reference management software to enter the name of the database searched into a user-defined field, for future reference, and then the data can be copied and pasted into your main database. Once all databases have been searched and citations downloaded, the reference management software can be used to highlight duplicates; it is good practice to select one copy of each record, then transfer any relevant information from the others (the database searched field, for example, and any missing data, such as

issue number or abstract). Then the screening can start. Each of the references is screened against the inclusion criteria and where an item is rejected, a note is made of the first criterion in the list which caused it to fail. This means that each of the studies identified in the database searches can be accounted for.

In some instances it may be necessary to further reduce the number of citations identified through the searches. This can be done in a number of ways, but please contact EPPI-Centre staff to discuss the most appropriate way off doing this, if there are any difficulties:

- Using NOT: It is generally not advisable to limit searches using NOT. There are only two safe reasons for using NOT – 1) to exclude references already seen (e.g. you have already searched for School AND Size; now you decide to search for School AND Number of pupils. You can exclude Size with NOT, because you have already seen the results; 2) to exclude terms which are totally inappropriate to the search in hand e.g. Pupils AND Records NOT Gramophone, or Nurseries NOT Agriculture.
- Using only thesaurus terms: If free text terms lead to large numbers of articles that are irrelevant for the purposes of the review, maybe because the terms have a range of meanings (e.g. inclusion, integration), it may be necessary to use thesaurus terms without using free text terms. Searches only using thesaurus terms are dependent on the indexing of the databases; since this may not be comprehensive and is prone to human error and interpretation, it is important to remember that there is a risk that relevant studies will not be identified. It is wise to test this strategy by doing small searches with free text and thesaurus terms and with thesaurus terms only, and comparing the results – if using thesaurus terms only results in a significant loss of relevant records, then a different strategy to reduce numbers would be advisable. Some databases produce better results from thesaurus-only searches than others.
- Scanning a selection of the records retrieved and noting descriptors (thesaurus terms) which are linked to totally irrelevant records; creating a search set of these descriptors and excluding them using NOT. Note: these should be terms which definitively exclude the records, not just ones which are not relevant. For example the descriptor 'Teaching of reading' would appear to be irrelevant, but the article could possibly be about the effects of school size on the teaching of reading; however, 'Porpoises as a descriptor would indicate the size of a very different kind of school and could safely be excluded.

EPPI-Centre expectations regarding systematic searching

- A list of databases, journals to be hand searched and other sources should be defined initially, with reasons for the selection.
- A list of search terms and the way they will be combined should be established before formal searching begins; if the experience of searching results in any significant changes in this, they should be recorded.
- The actual terms used and their combination for each database search should be recorded, along with the date upon which the search was run (databases get updated) and the host that provided access to the database (e.g. Cambridge Scientific Abstracts, Web Of Science). Databases usually allow you to save a copy of the actual search run.
- Where records are retrieved and subsequently excluded, the reason should be recorded for each one (though not necessarily in the database – for the abstract screening, a marked-up printout is sufficient). This level of detail is required for the completion of the search results flow chart in the final report of a review.

See Appendix I for an example of a search strategy and Appendix 2 for an example of a search log.

Screening studies to ensure they fit the scope of the review

Explicit criteria, based on the reviews scope and question(s), are used to include and exclude studies. Clear criteria and records of which studies meet these criteria make it clear to users of the review what research is informing the conclusions.

A large number of references (study titles and abstracts) will have been found at the searching stage of the review. A proportion of these will look as though they are possibly of relevance to the review's research questions.

Each study needs to be compared against the inclusion criteria developed when scoping the review. To be included in the review, a study needs to meet all inclusion criteria and not meet any exclusion criteria. 'Excluded' studies may have a very useful contribution to make elsewhere, even though they are not considered relevant to the current review.

Having explicit criteria against which to assess studies makes the process efficient in terms of time. More importantly, it also helps to avoid hidden bias, by having clear consistent rules about which studies are being used to answer the review's specific research questions. By appraising each study against the same criteria and recording the results, the basis for the reviews conclusions is made transparent. In non-systematic reviews it is often hard to know what evidence the authors are drawing on, and what they have discarded and why. Iterative reviews can be systematic in having clear macro rules for inclusion but the specific detailed criteria for meeting those rules may only become apparent in the process of doing the review.

Describing studies

Describing studies for mapping

Studies are described and analysed in different ways for different purposes in systematic reviews. One of the first ways in which studies are described is in order for the reviewer to understand the scope of current research activity in a given area. This is often described as 'descriptive mapping'. In order to map studies descriptively, they are described using a standard keywording (coding) strategy such as the EPPI-Centre Education keywording strategy, which is designed to capture information on generic variables such as the country in which a study took place, the population focus and study design. Generic keywording strategies are often supplemented with additional keywords defined to capture information on the topic area of an individual review.

A standard and well-defined set of keywords is vital whenever classifying studies. Deciding which of a set of keywords to assign helps reviewers seek out key aspects of each study in a systematic way. Furthermore, once the keywords are entered on to reference management software, such as EPPI-Reviewer, subsequent keyword searches can retrieve them for further study.

Describing studies for synthesis

A synthesis involves pooling the details and results of a group of studies. The findings and detailed characteristics of studies are summarised beforehand (in a process that is sometimes called 'data extraction'). In most methods of systematic review, each study is scrutinised systematically, using the same set of pre-determined questions and answers on: (i) general descriptive information on the studies; (ii) the results of the studies; (iii) data on research methods to allow quality and relevance assessments of the studies' results.

Once these extracted data are ordered in one place it becomes easier to synthesise the whole. This collection of questions and extracted data also acts as a record of what reviewers have done. If it is made accessible, it can also be analysed further, or differently, by future reviewers. Accessible storage of data extracted from individual studies can also make individual study findings more available: people interested in the detail of any individual study have a structured summary of that study to call upon, as well as the original report.

In iterative reviews, the data used from each individual study may not be pre specified in the protocol, but the data can still be recorded in a transparent and systematic way which is detailed in the review report.

A synthesis may take many forms, but all require the extraction of some kind of data from primary studies. A range of data types can be collected from studies, including the following:

1. Numeric data. Often these take the form of ‘effect sizes’ for inclusion in a meta-analysis, but numeric data also includes, for example, numbers of study participants, intervention costs and numbers in specific sub-groups.
2. Categorical data. When standard answers accompany the set of standard questions, characteristics of studies can be summarised easily (e.g. by location of intervention or its theoretical framework).
3. Free-text narrative data. Much information of interest cannot be summarised numerically, and is too detailed and varied for categories to be useful. These data are extracted in ‘free-text’ form and may take the form of, for example, summaries of interventions, the verbatim accounts of participant quotations, or key concepts and themes that were identified by authors of the original studies.

Mapping and refining the scope of the review

Descriptive mapping

Most systematic reviews describe in some way the range of literature encountered during the review as a whole. That is, readers are usually provided not only with in-depth detail and quality assessment of studies that meet all of the review's inclusion criteria and are synthesised but also with some overall description of the studies. Classification and description that aims primarily to illustrate the kinds of studies that exist has been termed a 'descriptive map' by the EPPI-Centre. A clear distinction needs to be made between the aim of describing the available literature and the aims of a synthesis, which are to assess the validity of studies' findings and assess the direction of findings of the pool of studies as a whole.

‘Systematic descriptive maps’ can answer questions about what research is available on a given topic, and identify future directions for research in the area by uncovering gaps in the research field. By simply describing, rather than scrutinising in-depth and critically appraising the research, reviewers can address a much broader field of research than is possible when conducting a narrower synthesis of research findings.

Descriptive maps can serve various purposes, depending on the stage of the review at which studies are classified for the map (and thus the set of studies that is described) and the degree of detail with which these studies are classified. Mapping is achieved by an analysis of the keywording results in terms of variables such as language, population focus, study design and key characteristics related to the review topic. A map provides: (i) a resource in its own right, providing a systematic description of research activity in a topic area; (ii) a basis for any narrowing of inclusion criteria where only part of the map is synthesized (see Refining the Scope in Two Stage Reviews); (iii) a context for interpreting the results of the synthesis, including the nature of any need for further primary research.

A review’s scope may need refining after the identification of the available evidence, it is important that the reasons for this and the methods used are made explicit.

Refining the scope of the review (in two-stage reviews only)

Once reviewers have a clear picture of the body of research on their review topic, perhaps through producing a descriptive map they may have developed further ideas about the literature that is available and can therefore develop a more refined or specific question. Furthermore, if the review group does not have the capacity to review in-depth a very large number of studies, time and effort may be better invested focusing on one area of the topic in question.

It is important to note that this stage may not necessarily be required. It may be a necessary stage if the review's research question was initially very broad in order to produce a descriptive map or if an unmanageable number of studies meet the review's inclusion criteria.

If a review's scope needs to be refined, it is important that this is done, as is the case for the initial definition of scope, with the help of potential users of the final systematic review. A full justification for any modifications will need to be made in the review's final report, under the heading of 'modifications to the review's initial protocol'.

If the synthesis is narrower than the map then the map's inclusion and exclusion criteria need to be narrowed to identify the sub-set of studies for the synthesis in a systematic and explicit way. See the pages on setting the scope and screening for further information on these stages.

Appraising and synthesising the data

By assessing the quality and relevance of studies, reviewers are able to ensure that only the most trustworthy and relevant studies are used to develop the conclusions of the review.

Quality and relevance appraisal

A systematic research synthesis is attempting to answer a question using the findings of research evidence. It is therefore important that the evidence is both trustworthy and relevant.

There are many approaches to assessing studies and these vary depending upon the type of research design concerned. There are a large number of published quality appraisal tools which are concerned with the issue of trustworthiness of the studies in themselves with little reference to the review question. This assessment is made independently from considerations about the review question, i.e. Is the study well conducted according to the norms for this type of study?

In addition, the relevance of aspects of individual studies for answering the review question may be considered when appraising their potential contribution to a review's conclusions.

One of these 'review specific assessments' is a consideration of the appropriateness of the methodology used in an individual study for answering the reviews question. Several different study designs may be included in the synthesis, with some being more appropriate than others.

The other 'review specific' assessment is in terms of the relevance of focus of individual studies in relation to the review question, such as differences in topic focus, population focus or setting.

A composite result taking into account assessments on all three criteria can be used to summarise the 'weight of evidence' each study can contribute to the review's findings (see Gough 2007). For some reviews it may be appropriate to use just one or two of the criteria, for example if there is little variability in the study designs, or in the focus of the studies. If more than one criterion is used to produce a composite judgement, however, reviewers need to make clear how this was done.

A = The trustworthiness of the results judged by the quality of the study within the accepted norms for undertaking the particular type of research design used in the study (methodological quality)

B = The appropriateness of the use of that study design for addressing the systematic review's research question (methodological relevance)

C = The appropriateness of focus of the research for answering the review question. (topic relevance)

D = Judgement of overall weight of evidence (WoE) based on the assessments made for each of the criteria A-C.

A synthesis brings together the findings of studies reviewed so that the conclusions of the review are based upon the studies as a whole.

Synthesising study findings

The main product of many systematic reviews is a synthesis of research findings to answer the review question.

The manner in which the synthesis is undertaken varies considerably across reviews. In reviews asking 'what works' questions using data from controlled experimental studies, the analysis is likely to be statistical. With other questions and other data, the method of synthesis will depend upon text and will be analysed according to the conceptual framework underpinning the review question.

Like other stages in the review, the synthesis needs to be presented systematically. It is valuable to be explicit about how studies are singled out for description in a review and to

be systematic when presenting detail of different studies so that each study is given standard treatment at write-up. It is even more valuable if the rationale for presenting certain studies and their results includes a measure of the quality and relevance of the studies producing those results. The synthesis is usually presented in the form of a structured narrative, summary tables or a statistical combination (meta-analysis).

This synthesis is then used to formulate conclusions and recommendations. The aim is to make the links between the detail of the studies found and the reviewers' conclusions clear.

Synthesis is the combined findings of all the different included studies in a review. It should be more than a listing of the results of individual studies and may take a variety of forms.

Statistical meta-analysis

Statistical meta-analysis is a set of statistical procedures designed to combine the numerical results of primary research studies addressing similar research questions.

Narrative empirical synthesis

This type of synthesis brings together the results of empirical research that are in a narrative form to provide an accessible combination of results from individual studies in structured narratives or summary tables. Results from different types of empirical research can be synthesised in this way, including experimental evaluative research and survey research.

Conceptual synthesis

Conceptual synthesis is where different understandings or concepts about the World are brought together to create new concept or concepts. For example, meta ethnography combines the results of different ethnographic studies to create an understanding of the phenomena under study greater than the individual ethnographic studies.

Drawing conclusions and making recommendations

Being able to make recommendations for the development of policy and practice is usually the reason the review was carried out in the first place. These recommendations will help people take action or see what can be done.

The synthesis provides the basis for reviewers to make conclusions in relation to their review question. These conclusions then enable reviewers, with support from users, to make recommendations for future research, policy and practice.

Recommendations must be clearly linked to the findings of the synthesis so that readers can see the basis on which each recommendation is made. Reviewers must be wary of over interpretation of the reviews findings, and be very specific about the potential limitations in the generalisability or transferability of findings. The aim is to make ‘evidence-based’ recommendations with a clear link to the results of trustworthy research.

Developing the final report

While the results of a review are communicated in a variety of ways, the production of a written report is usually an essential part of doing a systematic review.

A full 'technical report' is necessary to provide transparency and enables readers to see in detail how the review was conducted. This provides accountability of the process of the review, the potential for its replication, and the information necessary for any updating of the review. This technical report can be used as the basis for developing other types of report to communicate the reviews findings to different audiences.

The standard structure followed by EPPI-Centre technical reports provides guidance on the requirements for reporting the methods and results of a systematic review. Transparency is a key feature of systematic research synthesis since it allows readers to be sure how the studies that go in to the synthesis were found, coded and assessed; these are crucial elements of the process that readers will need to have information on. The standardised

structure allows clearly identifies the methods for each stage of a review. It also enables users of our reviews to become familiar with the style of the reports, therefore helping different types of report users to access the information they require, be it aspects of methodology, results, mapping or synthesis.

Making use of the review

Communication of review findings

An important part of the process is the communication of review findings in order to reach everybody who may have a stake in those findings.

Communicating the findings of research is often described as 'dissemination'. However, since many reviews aim to aid practical decision-making in practice, systematic reviewers must consider broader issues, such as the way a report's findings are communicated, interpreted and ultimately applied. Clarity over whom the report is intended for at the very start of the review will make this stage easier. It can be helpful to look at this process from a variety of perspectives: those who will use it for policy development; those who will use it to lobby for change or improved resourcing in an area; those with an academic interest who might wish to carry out research to fill gaps identified by the review; those such as research funders who are trying to identify research priorities; practitioners, who may want to apply some of the findings to their own work; users of services that have come under scrutiny in a review, who want to know what practices are available and/or suitable; and politicians.

At the EPPI-Centre, we produce our reports in three formats.

1. A short one page summary leading on the findings of the review is a useful and easily accessible overview.
2. A short report which again, concentrates on the findings and context of the review but gives more detail for those who want a thorough description of the findings but are not interested in the fine detail of the methods.
3. The technical report of approximately 100 pages including all the detail about methods.

There is a further fourth level of web-based access to the database of codings used in undertaking the review. These codings provide transparency of process of the review, enable sustainability in any updating of the review, and allow people to find out more about any particular study included in a review.

Our Knowledge Library enables users to search the entire body of EPPI-Centre reviews for information across broad topic areas, specific issues or populations.

Communication of methods development

Since the methods for conducting many types of review are still in their infancy, reviewers often innovate during the course of conducting a review. For example, conducting separate syntheses of experimental research and views research and integrating the results has been a novel approach developed here at the EPPI-Centre (Thomas et al 2004).

In addition to communicating the findings of the review itself, reflection on the methods used and innovations developed during the course of the review may also be communicated via additional publications and papers.

Interpretation and application

In order to move between recommendations based on research evidence and their application in the real world a certain amount of interpretation will need to occur. Just as with all stages of the review, it is important to be clear about how this is done.

Interpretation

Interpretation of the findings of a review involves the use of information beyond the review. A review's conclusions may imply recommendations for policy and practice, however, other types of knowledge may be used for further interpretation, such as tacit practice knowledge or user experiences needed for interpretation in specific contexts. The nature of this information and how it is used needs to be explicit just as within the review.

Application

Similarly, the implementation/application of these interpreted findings will be affected by further sets of information and contextual realities. For example, organisations such as schools or care institutions will need to pragmatically apply a review's recommendations within the scope of their established internal processes and procedures; again the use of such information should be explicit.

Updating the review

A systematic review can only be as good as the research it contains and can become out of date when new relevant research is published

It is important for reviews to be updated regularly to ensure they incorporate evidence from new research, though this is not always possible due to a lack of resources. Updating a review usually involves re-running the original search strategy, limited to the time period after the original review, and updating its findings accordingly. It is possible that the issues that the review was addressing change over time so new versions of the review also need to change their question and inclusion criteria and conceptual framework and thus also searching. For this reason, some 'updates' effectively involve conducting a whole new review.

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Appendices

Appendix 1: An example of a search strategy

An example of a search strategy

The following is a systematic search carried out to identify articles that considered the impact of secondary school size. Initially 'descriptor' (thesaurus terms (marked de)) and free text (keyword) terms (marked KW) for (i) secondary age and then (ii) school size were combined using OR. The two groups (#27 (for secondary age terms) and #57 (for school size terms)) were then combined with AND (#58) and the resulting 2500 hits downloaded into reference software and then screened against the inclusion criteria.

ERIC
ERIC 1980-2003

Searched: Mon Sep 15 14:35:58 2003

Cambridge Scientific Abstracts

#1: KW=((year* 10) OR (year* 11) OR (year* 12))

#2: KW=((year* 7) OR (year* 8) OR (year* 9))

#3: KW=((grade* 7) OR (grade* 8) OR (grade* 9))

#4: KW=((grade* 10) OR (grade* 11) OR (grade* 12))

#5: KW=((secondary modern) OR (grammar school*))

#6: KW=((middle school*) OR (six* form*) OR (comprehensive school*))

#7: KW=((secondary educat*) OR (secondary school*) OR (high school*))

#8: #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7

#9: (de=(middle school students))

#10:(de=(secondary education))

#11:(de=(high school freshmen))

#12:(de=(high school seniors))

#13:(de=(high schools))

#14:(de=(high school students))

#15:(de=(junior high school students))

#16:(de=(secondary school teachers))

#17:(de=(middle schools))

#18:(de=(middle school teachers))

#19:(de=(secondary school teachers))

#20:(de=(secondary education))

#21:(de=(secondary schools))

#22:(de=(secondary school students))

#23:(de=(elementary secondary education))

#24:(de=(junior high schools))

#25:(de=((grade 7) or (grade 8) or (grade 9) or (grade 10) or (grade 11) or (grade 12))

#26: #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25

#27: #8 OR #26

#28: KW=(facility expansion)

#29: KW=(develop* institution*)

#30: KW=(transition* school*)

#31: KW=(one teacher school*)

#32: KW=(school expansion)

#33: KW=(house plan)

#34: KW=(consolidated school*)

#35: KW=(multiunit school*)

#36: KW=(school with a special*)

#37: KW=(minischool*)

#38: KW=(subschool*)

#39: KW=(small scale school*)

#40: KW=(school downsiz*)

#41: KW=(autonomous unit)

#42: KW=(school size)

#43: KW=(small school)

#44: #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43

#45: (de=(multiunit schools))

#46: (de=(transitional schools))

#47: (de=(facility expansion))

#48: (de=(comprehensive school reform))

#49: (de=(small schools))

#50: (de=(school size))

#51: (de=(house plan))

#52: (de=(school expansion))

#53: (de=(consolidated schools))

#54: (de=(one teacher schools))

#55: (de=(developing institutions))

#56: #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55

#57: #44 OR #56

#58: #27 AND #57

Appendix 2: An example of a search log

Electronic databases

Database searched	**Date & person searching**	**Search strategy**	**Time period of search**	**No. of hits**	**Downloaded file saved as**	**Config (filter) file used**	**Imported into which database**
ERIC	15.09.03 Zoe Garrett	Saved in document ERIC1.txt	1976 - June 2003	2563	ERIC1.txt ERIC2.txt ERIC3.txt	ERIC Cambridge Scientific Abstracts	1. School size 2. ERIC
PsycInfo	19.09.03 Mark Newman	Saved in document psycinfo1.txt	1872-2003/09 wk3	623	Psycinfo1.txt	OVID (ONLINE)	1. School size 2. PsycInfo
Social science citation index	10.09.03 Zoe Garrett	Printed from web	1981-2003	126	Search history SSCI.wos	Imported from website	1. School size 2. SSCI