Learning how to undertake a systematic review: part 1


Summary
This article, the first of two, provides an overview of the processes involved in writing a systematic review. The article describes the differences between a systematic and a literature review, how to write an answerable review question and how to prepare the background for the review. The second of the two articles will focus on search strategy and the presentation of data.

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Aims and intended learning outcomes
This article aims to provide an overview of how to write a systematic review and the processes involved. A case study is used to demonstrate a step-by-step approach. A systematic review cannot be undertaken superficially or quickly and it is assumed that guidance followed here will be linked to the reader’s enquiries over several weeks. It is also assumed that readers have a basic understanding of research terminology and basic undergraduate research skills. After reading this article and completing the time out activities you should be able to:

- Define a systematic review.
- Identify a topic for research and create a realistic research question.
- Ascertain what type of study design is best suited to answer a particular research question.
- Understand the steps involved in writing a protocol.
- Plan and write the background for the review.
- Summarise how the researcher defines criteria that will be used to choose which articles are reviewed.

Introduction
This article uses a case study, discussed in relevant sections, to clarify the processes involved in writing a systematic review. The case study is about a staff nurse, Isabelle, who has just qualified. It should be read in conjunction with the time out activities, and this process will assist the reader in formulating a question to be researched in a systematic review.

A systematic review is a particular type of literature review. It is a summary of the research literature related to a single question. It involves identifying, selecting, appraising and synthesising all high quality research evidence relevant to that question. In this context, high quality research includes all studies with an explicit and rigorous design that allow the findings to be questioned. Those involved in conducting systematic reviews accept that there is a hierarchy of evidence and that what can confidently be stated empirically about the world is derived from studies in which the design is explicit and rigorous. Distinctions are therefore made between evidence and
experience. Evidence will have been rigorously obtained and scrutinised, while experience is simply noted, organised and reported. It is important that those involved in the delivery of health care have an understanding of systematic reviews and how to implement them in practice to improve patient outcomes (Torgerson 2003).

A systematic review should be based on a peer review protocol (or plan) so that it can be easily replicated if necessary. The review itself will include a background or introduction section, in which authors explain the scientific background or context of their study. It also includes the rationale for the systematic review, indicating why it is necessary. The specific objectives and a summary of how the reviewer defined the criteria used to choose research articles are then stated. Once a thorough assessment of the quality of each research article or report is carried out, the individual studies are synthesised in an unbiased way. The findings are then interpreted and presented in an objective and independent summary (Hemmingway and Brereton 2009).

### Time out 1

Access these two articles:
- Wathen NC, MacMillan HL (2003) Interventions for violence against women: scientific review. *JAMA*. 289, 5, 589-600. Using Table 1, identify which article is a systematic review and which a literature review.

### Systematic or literature review?

A literature review (sometimes known as a narrative) review is typically conducted by an expert or well known figure in the field of interest. However, these reviews may be subject to bias (Glassziou *et al* 2001, Petticrew and Roberts 2006). For example, if the reviewer believes that only aspirin is effective for treating headaches, he or she could select articles that demonstrate the benefits of aspirin in treating headaches while ignoring the benefits of other medications, such as ibuprofen.

Experts and literature reviewers can also be influenced by personal theories, needs and beliefs. It is important to remember that literature reviews are usually driven by a general interest in a topic and not directed by a specific question. These types of reviews do not state the criteria that determine the search undertaken. For example, Pauling (1974), a doctor and Noble prize laureate, having conducted a non-systematic review, concluded that people should be getting 100 times the amount of vitamin C that the food and nutrition board recommended at the time. He even suggested such doses could prevent a cold. However, 30 years later Douglas *et al* (2004) conducted a systematic review and concluded that high doses of vitamin C did not prevent individuals from getting a cold, although they could reduce the duration of illness by one or two days. Douglas *et al* (2004) found that Pauling had failed to include 15 relevant studies in his review. It is therefore important to remember that ‘a haphazard review, even one carried out by an expert, can be misleading’ (Torgerson 2003).

A systematic review uses a rigorous research methodology in an attempt to minimise bias. Khan *et al* (2003) suggested that ‘a systematic review is a research article that identifies relevant studies, appraises their quality and summarises their results using a scientific methodology’. A summary of the main differences and similarities between systematic and literature reviews is shown in Table 1.

### Case study: identifying a topic

Isabelle, a newly qualified staff nurse, would like to conduct a systematic review as part of her professional development. Isabelle is interested in the area of domestic violence, but is unsure of her specific research question. Since starting her new role in a general practice six months previously she has seen a number of women come into the surgery whom she suspects are experiencing domestic violence. Before she became a nurse she had been a volunteer for a women’s network that supported battered women and she also has friends who have experienced such violence. Isabelle performs an internet search using Google to obtain a general idea about what information is available. She finds a literature review on the ‘prevalence of domestic violence’ and a systematic review on ‘interventions for violence against women’.

### Choosing literature research topics and developing review questions

Key points to consider when choosing a research topic include:

- Selecting an area of interest or one related to practice.
- Deciding on a question that will give rise to an answer of interest.
- Identifying why the topic is interesting and worthwhile investigating.

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### Time out 2

Identify which article is a systematic review and which a literature review.
Recognising issues related to the question.

Questioning what will be gained by investigating the question.

Clarifying the rationale for asking the question.

Assessing the significance of the answer.

Identifying the conceptual or theoretical framework.

Blaikie (2007) suggested that the use of research or review questions is a neglected aspect in the design and conduct of research. He claimed that formulating research questions ‘is the most critical, and, perhaps the most difficult, part of any research design’ (Blaikie 2007). The main functions of review questions are highlighted in Box 1. Bailey (1997) outlined six steps to developing a review question:

1. Write down questions that have been in your mind from your area of practice. Choose questions about which you are curious and to which you want to know the answer.

2. Look over your list and decide which question interests you the most. Rank your questions in order of fascination. Write down the number one question.

3. Why does it excite you?

4. Is it a simple question or does it have several parts? If there are several parts, what are they?

5. Is there an obvious theory base for this question? If so, what is it?

6. In your opinion does the question address a significant problem?

Case study: developing a review question Isabelle follows the six steps outlined by Bailey (1997) and produces the following initial questions:

A. Why do women stay in violent relationships?

B. Are community advocacy programmes effective, compared with GP visits, in improving women’s quality of life?

Define the nature and scope of the review.

Identify the key words together with the scoping search.

Determine the search strategy and the search to be undertaken.

Provide guidance for selecting the primary research articles needed.

Guide the data extraction and synthesis of results.

**TABLE 1**

<table>
<thead>
<tr>
<th>Similarities in and differences between systematic and literature reviews</th>
<th>Systematic review</th>
<th>Literature review</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question</strong></td>
<td>Focused on a single question.</td>
<td>Not necessarily focused on a single question, but may describe an overview.</td>
</tr>
<tr>
<td><strong>Protocol</strong></td>
<td>A peer review protocol or plan is included.</td>
<td>No protocol is included.</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>Both provide summaries of the available literature on a topic.</td>
<td></td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td>Clear objectives are identified.</td>
<td>Objectives may or may not be identified.</td>
</tr>
<tr>
<td><strong>Inclusion and exclusion criteria</strong></td>
<td>Criteria stated before the review is conducted.</td>
<td>Criteria not specified.</td>
</tr>
<tr>
<td><strong>Search strategy</strong></td>
<td>Comprehensive search conducted in a systematic way.</td>
<td>Strategy not explicitly stated.</td>
</tr>
<tr>
<td><strong>Process of selecting articles</strong></td>
<td>Usually clear and explicit.</td>
<td>Not described in a literature review.</td>
</tr>
<tr>
<td><strong>Process of evaluating articles</strong></td>
<td>Comprehensive evaluation of study quality.</td>
<td>Evaluation of study quality may or may not be included.</td>
</tr>
<tr>
<td><strong>Process of extracting relevant information</strong></td>
<td>Usually clear and specific.</td>
<td>The process of extracting relevant information is not explicit and clear.</td>
</tr>
<tr>
<td><strong>Results and data synthesis</strong></td>
<td>Clear summaries of studies based on high quality evidence.</td>
<td>Summary based on studies where the quality of articles may not be specified. May also be influenced by the reviewer’s theories, needs and beliefs.</td>
</tr>
<tr>
<td><strong>Discussion</strong></td>
<td>Written by an expert or group of experts with a detailed and well grounded knowledge of the issues.</td>
<td></td>
</tr>
</tbody>
</table>
learning zone research methods

- C. What are women’s perceptions of domestic violence?
  Isabelle ranks her questions in order of fascination to her: B, C, A, and writes down the number one question: Are community advocacy programmes effective, compared with GP visits, in improving women’s quality of life?
  The question excites Isabelle because she feels strongly about the issue on both personal and professional levels. It also has several parts:
  - Domestic violence.
  - Effect on women’s lives.
  - Community support networks for women.
  - Effectiveness and ineffectiveness of GP treatment.

There are a number of theories from different disciplines, such as sociology and psychology, which may help to explore the question. Isabelle is unsure of these, but makes a mental note to investigate.

Isabelle thinks her question addresses a significant problem. If advocacy programs are more effective than no treatment or usual care then this could improve women and children’s physical and mental health, wellbeing, and quality of life and possibly decrease violence towards these victims.

When formulating a research question, it is important to avoid making a statement and to ensure that an open question is asked – for example ‘what are the reactions of women to mastectomy?’ rather than ‘women demonstrate their loss in a number of ways following mastectomy’. Questions that can be answered with a simple yes or no should also be avoided. For example, it is better to ask ‘what influences the way patients respond to pain?’ rather than ‘do all patients respond to pain in the same way?’.

There are a number of different types of review questions, and considering these will help the reviewer to identify what type of evidence he or she needs to look for in the research articles reviewed (Table 2). To assist in the development of the review question, it is important to determine what kind of question is being asked. From this point on, the individual can work out what type of evidence he or she is seeking.

**Case study: selecting the review question**

Isabelle tries to think of a question on her area of interest, domestic violence, related to the categories in Table 2. She notes that more philosophical questions are not deployed in systematic reviews. None of the questions, for example, include the word ‘should’.

- 1. Treatment or therapy: how effective is advocacy on behalf of the victim in countering domestic violence?
- 2. Prevention: how to reduce the risk of disease?
- 3. Diagnosis: how to select and interpret diagnostic tests?
- 4. Prognosis: how to anticipate the likely course of the disease?
- 5. Causation: what are the risk factors for developing a certain condition?
- 6. Experiences: how do people feel about this treatment or disease?

**TABLE 2**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Treatment or therapy</td>
<td>Which treatment is most effective? Does it do more good than harm?</td>
<td>Is the use of drug A better than drug B in the treatment of lung cancer?</td>
</tr>
<tr>
<td>2. Prevention.</td>
<td>How to reduce the risk of disease.</td>
<td>Does decreasing population levels of smoking, decrease the incidence of lung cancer?</td>
</tr>
<tr>
<td>3. Diagnosis.</td>
<td>How to select and interpret diagnostic tests.</td>
<td>Is a chest X-ray as effective as a magnetic resonance imaging scan in diagnosing lung cancer?</td>
</tr>
<tr>
<td>4. Prognosis.</td>
<td>How to anticipate the likely course of the disease.</td>
<td>Do patients who have never previously smoked have longer-term survival, compared with previous smokers, once diagnosed with lung cancer?</td>
</tr>
<tr>
<td>5. Causation.</td>
<td>What are the risk factors for developing a certain condition?</td>
<td>Does exposure of children to parental tobacco smoke increase the risk of lung cancer in later life?</td>
</tr>
<tr>
<td>6. Experiences.</td>
<td>How do people feel about this treatment or disease?</td>
<td>How do patients experience life with lung cancer?</td>
</tr>
</tbody>
</table>
Next Isabelle selects the question for which she would most like to conduct a review. The question that Isabelle arrives at is: ‘For women who have experienced domestic violence, how effective are advocacy programmes as compared with routine general practice treatment for improving women’s quality of life (as measured by the Short Form 36 Health Survey (SF-36) scale)?’

**Formulating the review question**

Once the review question has been selected, the next step is to separate it into parts, as shown in Table 3. The formation of the question usually includes identifying all the component parts; the population, the intervention, the comparative intervention and the outcomes that are measured. The acronym for this is PICO (population, intervention, comparative intervention, outcomes) (Flemming 1998). A separate framework is usually applied for qualitative studies: PEO (population, exposure, outcomes) (Khan et al 2003).

PICO is important because it determines the types of research articles in which those undertaking systematic reviews are interested. In the case study, for example, included articles might compare different techniques to prevent domestic violence, but might exclude articles about a person’s testimony, which described a woman’s experience of violence. PICO is designed mainly for questions related to therapeutic interventions (Khan et al 2003). Table 3 provides advice on how to formulate a PICO question.

Although inclusion criteria can be developed for all types of research questions, for the purposes of simplicity the case study in this article will be limited to the discussion of a question related to treatment or therapy outcomes only.

**Case study: formulating the question**

Table 3 demonstrates how Isabelle’s question comparing advocacy programmes to routine treatment for women who have experienced domestic violence can be split into PICO components.

**Time out 3**

With your general area of interest in mind, think of a question related to each of the following categories:

- Treatment or therapy.
- Prevention.
- Diagnosis.
- Prognosis.
- Causation.
- Experiences.

Select the question that you would wish to conduct a review on and then, using Table 3 as a guide, divide your question into PICO components.

**Relating the question to the research design**

The next step is to think about how the chosen question relates to the research design of the studies to be included in the review. Once the question has been formulated, a search for articles that attempt to answer the question is required. Khan et al (2003) recommended thinking about the type of study designs of the proposed primary articles to be searched while formulating the review question. Usually, questions on therapies or interventions are answered by experimental studies, such as

**TABLE 3**

<table>
<thead>
<tr>
<th>Component</th>
<th>P (population)</th>
<th>I (intervention)</th>
<th>C (comparative intervention)</th>
<th>O (outcomes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>State the disease, age and gender, if appropriate, of the population.</td>
<td>State the intervention and specifics related to it.</td>
<td>A therapeutic question always has a comparator (even if it is standard care).</td>
<td>What is being looked for or measured?</td>
</tr>
<tr>
<td>Isabelle’s responses</td>
<td>Women who have experienced domestic violence</td>
<td>Advocacy programmes</td>
<td>General practice or routine treatment</td>
<td>Quality of Life (measured by the SF-36 scale)</td>
</tr>
</tbody>
</table>
there are no systematic reviews available, or in progress, which have already addressed the same question (Box 2).

If a similar systematic review does exist, a number of strategies can be followed. If an answer to the proposed question already exists in systematic review format, the clinician could examine how to implement the findings in clinical practice. If the researcher is a student, he or she can look to see if the review found in the scoping search was conducted a number of years previously; if so, and if a number of articles have since been published, the review can go ahead because it will contribute new knowledge.

However, if the review was carried out recently (in the previous two to three years) there is little value in conducting a review that is exactly the same. The best thing to do in this case is to change the population group, the intervention or the outcomes so that the research question will differ.

**Writing the protocol**

Writing a protocol or plan of what will be included in the review before proceeding with the project is important. A protocol describes in advance a description of and rationale for the review question as well as the proposed methods. It includes details of how different types of studies will be located, appraised and synthesised (Petticrew and Roberts 2006).

Writing a protocol in advance is a way of trying to minimise bias: the researcher cannot change how he or she reviews articles once they see the results of the identified studies.

In summary, the protocol usually includes:

- An answerable review question.
- The background to the review (briefly).
- The objectives or purpose of the review.
- The inclusion and exclusion criteria for considering the studies in the review.
- The search strategy.
- Identification of how the articles for the review will be selected.
- Identification of how the quality of the articles will be assessed.
- Identification of how data will be extracted from the articles to answer the research question.

The first four points in the list are discussed in this article; the second four in the next article (Part two).
Background to the protocol

The role of the background section in the protocol (and later in the review itself) is to provide the reader with the setting and context of the area of research, the importance of the topic and the reasons why it has been chosen (The Cochrane Collaboration 2002). There may be a number of reasons for the choice of topic, including the need to evaluate the effectiveness of a particular treatment. Other reasons could include the need to replicate a recent and important review in a particular area of practice carried out in another country, or a number of years previously.

A well written introduction should allow the reader to be clear about the direction of the study. In the background, it is also important to explain what reviews, if any, have already been carried out in this area, discuss their strengths and limitations, and describe how the proposed review will address any gaps in the literature, providing new information that could advance practice (The Cochrane Collaboration 2009). It is also important not to be too anecdotal in detailing the reasons for conducting the review. Back up the rationale with facts and figures where possible. For example, for an intervention study, the background could:

- Cite research papers or government documents, with statistical figures to highlight the importance of the study.
- Describe the signs and symptoms (or consequences) of the disease, illness, problem or issue.
- Provide details of the patient’s age, gender and other pertinent details
- Describe the course of the disease or pathophysiology.
- Discuss how the disease or issue is usually managed in practice (if the review is related to the effectiveness of any type of intervention)
- Describe the general outcome measures.

Once the problem has been discussed, including incidence, effect on patients’ lives and management, a gap in the evidence or literature needs to be identified. References should be used to support how the proposed review is different.

Objectives and title of the review

The objectives of the review should include all the PICO elements in the same way as they are included in the review question. For instance, if the area of interest is domestic violence and the research question is ‘For women who have experienced domestic violence, how effective are advocacy programmes compared with routine general practice treatment for improving women’s quality of life (as measured by the SF-36 scale)?’ the objective should be similar to the question. In this instance, the objective would be to evaluate the effectiveness of advocacy programs as compared with routine general practice on the quality of life of female victims of domestic violence. The population, intervention, comparative intervention and outcome have then been stated in both the question and the objectives. As regards outcome measures, it is important to think about what will be examined or measured.

Case study: writing the objectives

Isabelle begins to write up her objectives. She needs to state clearly what it is she intends to do. Isabelle has decided to look at women’s quality of life measures using the SF-36 quality of life scale. Her review will include quantitative research articles only.

**Her research question:** For women who have experienced domestic violence, how effective are advocacy programmes compared with routine general practice treatment for improving women’s quality of life (as measured by the SF-36 scale)?

**Her objective:** The purpose of this review is to evaluate the effectiveness of advocacy programmes as compared with routine general practice on the quality of life of women who have experienced domestic violence.

**Her title:** The effectiveness of advocacy compared with routine general practice treatment for women who are or have previously experienced domestic violence: a systematic review of women’s quality of life.

It is important when writing the review to make sure that the title, the question and the objectives are all saying the same thing.
Inclusion and exclusion criteria

An example of how Isabelle might compile her inclusion and exclusion criteria for the PICO components is shown in Table 4.

The researcher needs to identify the criteria that will be used to determine the research studies to be included. Torgerson (2003) suggested that a high quality systematic review should have inclusion and exclusion criteria that are 'rigorously and transparently reported a priori (before you start the review)'. This is important to ensure that the search targets articles that will provide an answer to the review question, excluding any irrelevant ones.

The criteria should be explicit and should be applied stringently (Torgerson 2003). They should follow from the research question, keeping in mind the identified PICO (or PEO) components. A description of the type of studies to be analysed, the participants, interventions, comparative groups, if any, and outcome measures should be included.

**Type of studies**
It is important to select articles with an appropriate design for the research question. For example, if the review aims to evaluate the effectiveness of an intervention, the appropriate type of studies will be randomised controlled trials or clinical controlled trials.

**Type of participants**
The population in the case study example is women over 18 years of age who have experienced domestic violence. Isabelle has decided to exclude women over the age of 60 years, disabled women and pregnant women (as these populations are different and therefore not comparable).

If the review focuses on patient population, it is also important to define their diagnosis, severity and duration of disease, as well as any other relevant factors.

**Types of intervention**
The background will have already included a description of the intervention. However, this section should include a more detailed description of the intervention.

Using the case study, Isabelle would first need to provide a brief explanation of what is meant by 'community advocacy programmes' and then state the different types of programmes that will be included.

Isabelle may also identify whether the articles to be included involve all types of programmes or only those with particular characteristics, for example those run by women who have themselves experienced domestic violence and not those run only by healthcare professionals. She may also want to consider whether to include interventions carried out all over the world or just in the UK. The Cochrane Collaboration (2009) recommends finding all available studies from all over the world. As before, the interventions that are to be excluded may also need to be described here.

**Types of comparative interventions (PICO format only)**
If the review involves a comparative intervention, the inclusion and exclusion criteria for all the comparative groups to be included will need to be identified.

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**Table 4**

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population</strong></td>
<td>Women aged 18 to 60 years who are experiencing or have experienced domestic violence in the past.</td>
</tr>
<tr>
<td></td>
<td>Men, children, teenagers, women aged over 60 years, women in same sex relationships, disabled women and pregnant women.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>Advocacy programmes (conducted in or outside health settings). Community programmes (include a clear definition of these).</td>
</tr>
<tr>
<td></td>
<td>Formal cognitive behavioural therapy.</td>
</tr>
<tr>
<td><strong>Comparative intervention</strong></td>
<td>Usual general practice treatment (usually this means no treatment for women who have experienced domestic abuse).</td>
</tr>
<tr>
<td></td>
<td>Formal mental health interventions. Alternative therapies.</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>Validated quality of life scales (quantitative) (specify which ones).</td>
</tr>
<tr>
<td></td>
<td>Scales that measure other outcomes.</td>
</tr>
<tr>
<td><strong>Type of studies (quantitative)</strong></td>
<td>Randomised controlled trials. Clinical controlled studies.</td>
</tr>
</tbody>
</table>
Types of outcome measures

Outcome measures usually refer to measurable outcomes or ‘clinical changes in health’ (Khan et al 2003). For example, these could include body structures and functions like pain and fatigue, activities as in functional abilities and participation or quality of life questionnaires.

Referring back to the case study and Isabelle’s example question ‘effectiveness of advocacy as compared to routine general practice treatment for women who are or have previously experienced domestic violence: women’s quality of life’, the measurable outcome, quality of life, can be assessed using the SF-36. There are numerous types of validated tools to evaluate quality of life. One other alternative is the health-related quality of life scale (HRQOL).

Conclusion

Part one of this two-part article has provided an overview of how to approach conducting a systematic review. It is essential to develop an answerable research question and to relate the question to the appropriate study design. Consideration should be given to the background, objectives and the inclusion and exclusion criteria for the review. A successful systematic review always includes a peer-reviewed protocol.

Part two, in next week’s issue, will focus on how to undertake a comprehensive literature search, as well as the methodology involved in performing a systematic review. The key principles of writing the results and discussion sections, as well as the presentation of data, will also be described NS.

References


Kahn KS, Kunz R, Kleijnen J


9. When choosing a topic for a systematic review, it is important to:
   a) Focus on answering several different questions
   b) Clarify the rationale for asking the question
   c) Ignore any other issues related to the question
   d) Disregard the significance of the answer to the question

10. Writing a protocol for a systematic review involves:
    a) Developing an answerable review question
    b) Describing the background
    c) Identifying review objectives
    d) All of the above