Systematic reviews

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Abstract
Despite the increasing popularity of systematic reviews, there remains a need to ensure that they are conducted rigorously and provide an objective critical summary of research findings. The strength of a systematic review is its rigorous methodological approach to interrogating a body of literature. Both authors and readers should be familiar with the methodology used to conduct and evaluate systematic reviews. By way of introduction, this article explains and explores the steps that make up the systematic review process.

Keywords
Critical appraisal, data extraction, meta-analysis, meta-synthesis, narrative synthesis, review protocol, systematic review

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Keywords: Critical appraisal; Data extraction, Meta-analysis, Meta-synthesis, Narrative synthesis, Review protocol, Systematic review
Abstract

Despite the increasing popularity of systematic reviews, there is a need to ensure that reviews are conducted rigorously to provide an objective critical summary of research findings. The strength of a systematic review lies in its rigorous methodological approach to the body of literature that it reviews. Both authors and readers need to be cognizant of the methodological underpinnings of the systematic review process in order to conduct and evaluate such reviews. This paper focuses on exploring the steps that make up the systematic review process.

Introduction

In the current health care environment there is increasing onus on professional accountability and allocation of limited resources for the greatest gain. Evidence-based practice (EBP) has been adopted as a strategy for integrating the “the best available evidence from systematic research” with individual clinician expertise and individual / societal values (Sackett et al., 1996).

Despite the emphasis on evidence-based practice the theory-practice gap remains (Dadgaran et al., 2012). The literature has identified a range of barriers which impede the implementation of evidence-based practice in nursing. These include, but are not limited to; insufficient access to appropriate literature, time constraints, an inability to analyse and interpret results, and lack of support for implementation of research findings (Maaskant et al., 2013, Kim et al., 2013, Geurden et al., 2012). To achieve truly evidence-based clinical practice nurses must be able to access, critique, interpret and integrate research findings into their clinical practice (Rew, 2011).

Systematic reviews have become increasingly popular in the nursing and health care literature as a strategy to increase the accessibility of research findings to both clinicians and policy makers (McGowan, 2012). A systematic review provides a rigorous synthesis of research within a particular field following a structured protocol. Systematic reviews synthesise the literature and present the best available evidence in an easily understood format. In order to confidently and appropriately apply this methodology or critically appraise a systematic review, readers need to have a clear understanding of systematic review protocols and how these are applied in the conduct of a review. Therefore, this paper will explore the systematic review process and identify the key considerations in undertaking a systematic review.
What is a systematic review?

A systematic review is an objective summary of the best available evidence to answer a clearly defined research question (McGowan, 2012). In the hierarchy of evidence quality, systematic reviews of randomized controlled trials are the gold standard of evidence (Kowalczyk and Truluck, 2013). Similar to a primary intervention study, the systematic review follows a formal process that is transparent and reproducible. This process extends from the question to be answered, to the intended methods for identification, critique and analysis of the studies (Figure 1)(Kowalczyk and Truluck, 2013, Hammick et al., 2010). It is this compliance with a standard protocol that differentiates a systematic review from other types of literature reviews and defines it as a piece of original research (Kowalczyk and Truluck, 2013). In the reporting of systematic reviews, the methods used should be described in sufficient detail to allow replication of the review process (Rew, 2011). To ensure the quality of the review, the protocol is often subject to peer review prior to the commencement of the data collection.

Figure 1. Steps to completing a Systematic Review

Steps to completing a systematic review

Several key organisations, including the Cochrane Collaboration and the Joanna Briggs Institute, facilitate the conduct of systematic reviews in the area of health care research. To support those undertaking systematic reviews, each of these groups has its own well defined review process. Whilst there are some minor differences in these processes, all systematic reviews follow the same basic steps.
Table 1 provides an example of the application of the steps in conducting a systematic review.

**Table 1. Example of the Steps of a Systematic Review (Rice et al., 2013)**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Example: Rice et al. (2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research question</td>
<td>What is the effectiveness of nursing-delivered smoking cessation interventions?</td>
</tr>
<tr>
<td>Inclusion criteria</td>
<td>Randomized trials of smoking cessation interventions delivered by nurses or health visitors with follow-up of at least six months.</td>
</tr>
<tr>
<td>Participants</td>
<td>Adult smokers aged over 18 years recruited in any healthcare or other setting.</td>
</tr>
<tr>
<td>Outcome</td>
<td>Smoking cessation</td>
</tr>
<tr>
<td>Search strategy</td>
<td><strong>Databases:</strong> (1) Tobacco Addiction Review Group Specialized Register for trials - includes trials located from systematic searches of MEDLINE, EMBASE and PsycINFO and hand searching of specialist journals, conference proceedings, and reference lists of previous trials and overviews. (2) CINAHL on OVID. Date range: 1983 to June 2013. Search terms: 'nursing' and 'smoking cessation'. All trials with 'nurse*' or 'nursing' or 'health visitor' in the title, abstract, or keywords for relevance.</td>
</tr>
<tr>
<td>Critical appraisal</td>
<td>The authors extracted data from the published reports independently. Disagreements were resolved by a third person. Cochrane Collaboration ‘Risk of bias’ tool used.</td>
</tr>
<tr>
<td>Data collection &amp; synthesis</td>
<td>Randomized trials of smoking cessation interventions delivered by nurses or health visitors with follow-up of at least six months.</td>
</tr>
<tr>
<td>Process</td>
<td>Search (n=103) Excluded after reviewing full-text (n=54) Included studies (n=49)</td>
</tr>
</tbody>
</table>
| Results         | • Meta-analysis of 35 studies (>17 000 participants) demonstrated that, compared to usual care, a nursing intervention improved the chance of quitting (RR 1.29; 95%CI 1.20 to 1.39).  
• Limited indirect evidence demonstrated that interventions were more effective for hospital in patients with cardiovascular disease than for inpatients with other conditions.  
• Evidence of benefit was also seen in non-hospitalized adults.  
• Six studies of nurse smoking cessation counselling conducted during a screening health check or as part of secondary prevention in general practice, which were not included in the main meta-analysis, showed that nursing intervention was less effective under these conditions. |
Step 1 Planning the review

a) Establishing a review team
Composition of the review team is an important consideration in commencing a review. The review team should combine both clinical experience in the topic under consideration and experience in the systematic review process (Littell, 2008).

b) Development of the research question
A key component of the proposal is the formulation of a clear and concise research question. This question will guide the search, selection and synthesis of studies (Rew, 2011). If the research question is too narrow, too few studies may be identified or the generalisability of the results may be limited. Conversely, if the question is too broad it may be difficult to draw applicable conclusions or too many studies may be identified making the review too cumbersome to finish. A well-designed research question is a precise statement, based on the characteristics of the Patient/Population, Intervention, Comparison and Outcome (PICO)(Richardson, 1998). Studies have shown that the use of the PICO framework improves the specificity and breakdown of clinical problems and leads to more complex search strategies and more precise search results (Boudin et al., 2010). Therefore the research question must be carefully and deliberately constructed (Hammick et al., 2010).

c) Development of the review protocol
As in any scientific endeavour, a protocol should be established to guide the conduct of the review. A protocol for a systematic review is equivalent to a proposal for an original research study. The aim of developing a review protocol is to clearly articulate the inclusion/exclusion criteria, methods for location the literature, screening, data extraction, and analysis in order to minimize bias before commencing the literature search. Both the Cochrane Collaboration and the Joanna Briggs Institute have a system of reviewing protocols for systematic reviews and registering protocols and/or project titles. These repositories should be checked prior to commencing a review to ensure that a similar review is not currently underway.

d) Inclusion/exclusion criteria
The inclusion and exclusion criteria, are essential parts of the systematic review process as they define the specific literature that will be included as part of the review. The eligibility criteria should logically flow from the review question and specify the types of participants/population, and the interventions, comparisons and outcomes of interest that are to be included and excluded from the review.
Step 2: Data collection - Locating and selecting studies

An advantage of the systematic review method is that all of the data is contained in the published literature. This allows greater flexibility in the process of data collection that if data had to be collected from individual participants.

a) Development of a search strategy

The ability to access electronic bibliographic databases via the internet enables individuals to extensively search the literature from the comfort of their own computer. However, knowing which databases to search, how to construct the search and how to access relevant studies can be a daunting process. Where available, the services of a research librarian with experience in conducting systematic reviews can be invaluable to assist in creating a search strategy. A search strategy defines the process used to undertake a literature search and needs to consider; which databases will be included, the search terms to be used, and the limiting factors (e.g. publication dates, language).

The choice of databases will vary depending on the topic under investigation. Typically, in nursing research, databases such as PubMed, CINAHL and Medline are good starting points. The search terms used should be drawn from the research question and inclusion criteria. Looking at the keywords in identified publications can also assist in identifying alternative search terms relevant to each database. Boolean logic, such as and / not / or, can be used to combine search terms.

Limiting factors commonly include publication date range and type of research. The date range chosen will be dependent upon the topic. For example; given that technology is rapidly evolving a systematic review of telemonitoring may be restricted to the last five or ten years, whilst a systematic review of interventions for hypertension may have a larger window of publication dates. Following initial searches it may be necessary to revise search terms, databases searched or time limits applied to either reduce or increase the number of citations retrieved. Searches may also be limited by the type of research, for example randomised controlled trial only.

A comprehensive search will also include hand searching of journals that are likely to publish relevant papers, searching of the reference lists of retrieved papers for additional references (Hammick et al., 2010) and searching the grey literature. The term “grey literature” refers to information that has not been formally published, such as policy documents, position papers, research reports. Inclusion of these data can be important in overcoming publication bias (Hopewell et al., 2007).

b) Selecting included studies

It is likely that a search will retrieve many potentially relevant papers (Hammick et al., 2010). The use of bibliographical software such as Endnote or Procite can assist in the management of a large numbers of citations. The process of selecting included studies should be both systematic and
transparent (Hammick et al., 2010). Two reviewers should independently assess each citation and abstract to determine if the paper meets the pre-determined inclusion or exclusion criteria for the review. It may be necessary to retrieve the full paper before a final decision about inclusion can be made if the abstract provides insufficient details. Where there is any disagreement, the advice of a third reviewer may be sought to reach consensus.

c) Reporting search results

Accurate recording of the results of searches of various databases using a flow diagram is an essential component of a good quality systematic review as it provides an audit trail for the reader. The PRISMA statement (Moher et al., 2009) (Figure 2) provides a model that is widely accepted as the gold standard for reporting these information. The rationale for excluding any study that was identified in the search should be documented to provide an auditable decision trail (Hammick et al., 2010).

Figure 2. PRISMA flowchart (Moher et al., 2009)
Step 3: Analysis and Interpretation

a) Extracting data

Data collection involves extracting key information from the included studies and entering it into a data collection matrix (Hammick et al., 2010). A variety of matrices are freely available to guide the extraction of data from various types of research papers. Whilst the specific data to extract will vary slightly depending on the types of included studies and review topic, data extraction tools share common characteristics.

A summary table is a very useful way of presenting data from various studies and allowing the reader to visually draw comparisons between studies and can be built specifically from the extracted data. The summary table also assists in the data analysis. Figure 3 provides a sample summary table used in a systematic review of lifestyle risk factor modification interventions. Each row of the summary table would provide data from a single publication, whilst the columns provide data from each study about a particular attribute. Presenting data in this way provides a means of drawing comparisons between studies with similar characteristics.

Figure 3. Sample Summary Table (Halcomb et al., 2007)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Unit of measurement</th>
<th>Reference</th>
<th>Participant type</th>
<th>Follow up</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>g/week</td>
<td>Woolard et al.27</td>
<td>Risk factor</td>
<td>18 weeks</td>
<td>$&lt; 0.05$ (low intensity group)</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Mean BP</td>
<td>Woolard et al.72-75</td>
<td>Risk factor</td>
<td>12 &amp; 18 months</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>% Excessive alcohol use (units)</td>
<td>Oxcheck Study2-46</td>
<td>Community</td>
<td>1 &amp; 4 years</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(\Delta)systolic &amp; diastolic change</td>
<td>Assist Trial10\text{1,2}</td>
<td>Risk factor</td>
<td>18 months</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Change from baseline</td>
<td>Change of Heart Study10,42</td>
<td>Risk factor</td>
<td>4 &amp; 12 months</td>
<td>2.4 (0.1-4.8) systolic BP at 4 months</td>
</tr>
<tr>
<td></td>
<td>systolic &amp; diastolic BP</td>
<td>Jewell and Hope35</td>
<td>Risk factor</td>
<td>12 months</td>
<td>$\downarrow$ 8 mmHg systolic NS</td>
</tr>
<tr>
<td></td>
<td>systolic &amp; diastolic BP</td>
<td></td>
<td></td>
<td></td>
<td>$\downarrow$ 0.4 mmHg diastolic NS</td>
</tr>
</tbody>
</table>

b) Assessing study quality

Assessment of the methodological quality of the individual studies using reliable and systematic methods are imperative. Quality assessment provides the reader with an assessment of the potential bias within each study. Depending on the number of included studies, the scope of the review and the resources of the project team, studies of low methodological quality may be excluded from the analysis.

Various tools are available for the assessment of study quality (e.g. Jadad scale). The choice of tool should consider the type of study that is being evaluated as each study design has somewhat different markers of quality. Many of these tools provide a list of criteria on which the paper is given a score which is then combined to give a total quality score. The Cochrane Collaboration now discourages the use of tools, in favour of “domain-based evaluation”(Higgins et al., 2011).

Regardless of the method used, it is important that the authors clearly articulate the methods used to assess the quality and risk of bias in included studies.
c) Analysing results

The strategies used to analyse the data are dependent upon the types of data available in the included studies. Quantitative data are most often analysed using either meta-analysis or narrative review, whilst qualitative research is most frequently analysed using meta-synthesis (Korhonen et al., 2013). Each of these strategies explained in briefly below. Further reading around the specific strategy to be employed is essential to guide implementation of the analysis.

Meta-analysis

A meta-analysis is a statistical method of combining the results of multiple studies in order to develop conclusions about a specific research question (Gallin and Ognibene, 2012). When the data from various studies are combined the sample size is increased and the power to detect differences enhanced (McGowan, 2012). This analysis provides a summary estimate of effect. The effect is summarised in different ways with relative risks (RR) or odds ratios (OR) calculated for dichotomous data and weighted mean difference (WMD) for continuous data (Egger et al., 2008).

Meta-analysis can only be carried out if the studies included in the review are sufficiently homogeneous (Higgins et al., 2011). Studies are assumed to be homogeneous if they are similar in design, population and outcomes (Gallin and Ognibene, 2012). Meta-analysis can be undertaken using the Review Manager (RevMan) software available from the Cochrane Collaboration or other commercially available software.

Meta-narrative

When quantitative data are heterogeneous, the findings of various studies can best be combined using narrative synthesis. In some instances, a narrative synthesis can also be complementary to a meta-analysis or meta-synthesis. In a narrative synthesis the findings are explained in a textual format and may or may not involve statistical data (Popay et al., 2006). Care must be taken by authors of narrative reviews to ensure that there is a clear and transparent trail for the reader to follow the analysis process.

Meta-synthesis

A range of terms have been used in the literature to describe the synthesis of qualitative data, including; qualitative meta-synthesis, qualitative meta-analysis, meta-ethnography, narrative synthesis and meta-aggregation. Whilst some authors use these terms interchangeably, others highlight subtle differences between the techniques. It is generally recognised, however, that a meta-synthesis involves the integration of results across comparable qualitative studies (Korhonen et al., 2013, Barnett-Page and Thomas, 2009).
Step 4: Dissemination of the Review

The Preferred reporting Items for Systematic Reviews (PRISMA) statement provides a 27-item checklist that should be used by authors when reporting a systematic review (Moher et al., 2009). A key consideration in reporting of reviews is choosing an appropriate place in which to publish a review. Both the Cochrane Collaboration and the Joanne Briggs Institute provide the opportunity to publish a full report of the review. However, the large word count of such full reports means that this is unsuitable for publication in many journals. When presenting a review as a journal publication care needs to be taken to ensure that the PRISMA guidelines are followed as much as practical within the word limits of the publication.

Given the focus of systematic reviews as a strategy to synthesise and disseminate the best evidence, review authors should also consider how they can best communicate their findings to clinicians, policy makers and other stakeholders to maximise the impact of their work.

Challenges and critiques of systematic reviews

Systematic reviews are open to critique like any method of research. A key criticism of SRs is that they are reductionistic and do not sufficiently consider the context of interventions (McGowan, 2012). Additionally, the quality of included studies needs to be clearly communicated to the reader. Synthesising several weak studies does not produce robust research. The researcher needs to address these criticisms by clearly articulating the scope and quality of the included research and the specific limitations of the review.

A common misconception is that systematic reviews are straightforward and not resource intensive. Systematic reviews are not solo endeavours (Hammick et al., 2010). Aside from individuals with specific expertise such as research librarians and statisticians who can undertake meta-analysis, a team of reviewers is required to facilitate the data extraction, quality assessment and interpretation of included studies (Hammick et al., 2010). The resources required to undertake a good quality review should not be underestimated.

Conclusion

There is no doubt that systematic reviews can make a significant contribution to nursing knowledge and practice. If a nurse wants to know whether or not a particular treatment is effective, or what evidence is available about a particular issue, then systematic reviews offer a robust method of synthesising this information (Khan et al., 2003, McGowan, 2012). Care must be taken, however, to ensure that the reader understands the limitations of the methodology and critically appraises the methods used in the review before applying the findings in their clinical practice.
References


