

Methodological Briefs on Evidence Synthesis Brief 4: Collating and analysing studies for synthesis

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This series of eight briefs, produced by the UNICEF Office of Research – Innocenti, is intended to provide guidance on how to undertake, commission and manage evidence synthesis products such as systematic reviews, rapid evidence assessments and evidence gap maps. Evidence synthesis can play an important role in UNICEF's knowledge management and evidence translation efforts by collating knowledge from multiple studies on what interventions work, and why and how they work. It makes research more accessible and therefore can contribute to evidence-informed programming and policy decisions. The primary audience for these briefs is professionals, including UNICEF staff, who conduct, commission or interpret research and evaluation findings in development contexts to make decisions about policy, programming and advocacy. These briefs cover topics including:

- What is evidence synthesis? What kinds of questions can evidence synthesis products help to answer and how can they contribute to decision-making?
- How to design and undertake a systematic review, a rapid evidence assessment or an evidence gap map
- How to commission and manage an evidence synthesis product
- The future of evidence synthesis and key innovations for making the process faster and more efficient

These briefs have been written by Shivit Bakrania with input from some of the world's leading evidence synthesis experts. The other briefs in this series can be accessed at www.unicef-irc.org.

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To consult and download the Methodological Briefs on Evidence Synthesis and a glossary of key terms, visit the website <www.unicef-irc.org>.

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FURTHER GUIDANCE ON EVIDENCE SYNTHESIS

This series of methodological briefs is part of broader efforts by UNICEF Innocenti to support UNICEF staff to appraise, commission, generate, communicate and use research to drive change for children.

For further guidance on evidence synthesis, or to ask about anything covered in these methodological briefs, please contact the author, Shivit Bakrania, or Kerry Albright, Chief of Research Facilitation and Knowledge Management, at <research@unicef.org>.

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1. INTRODUCTION

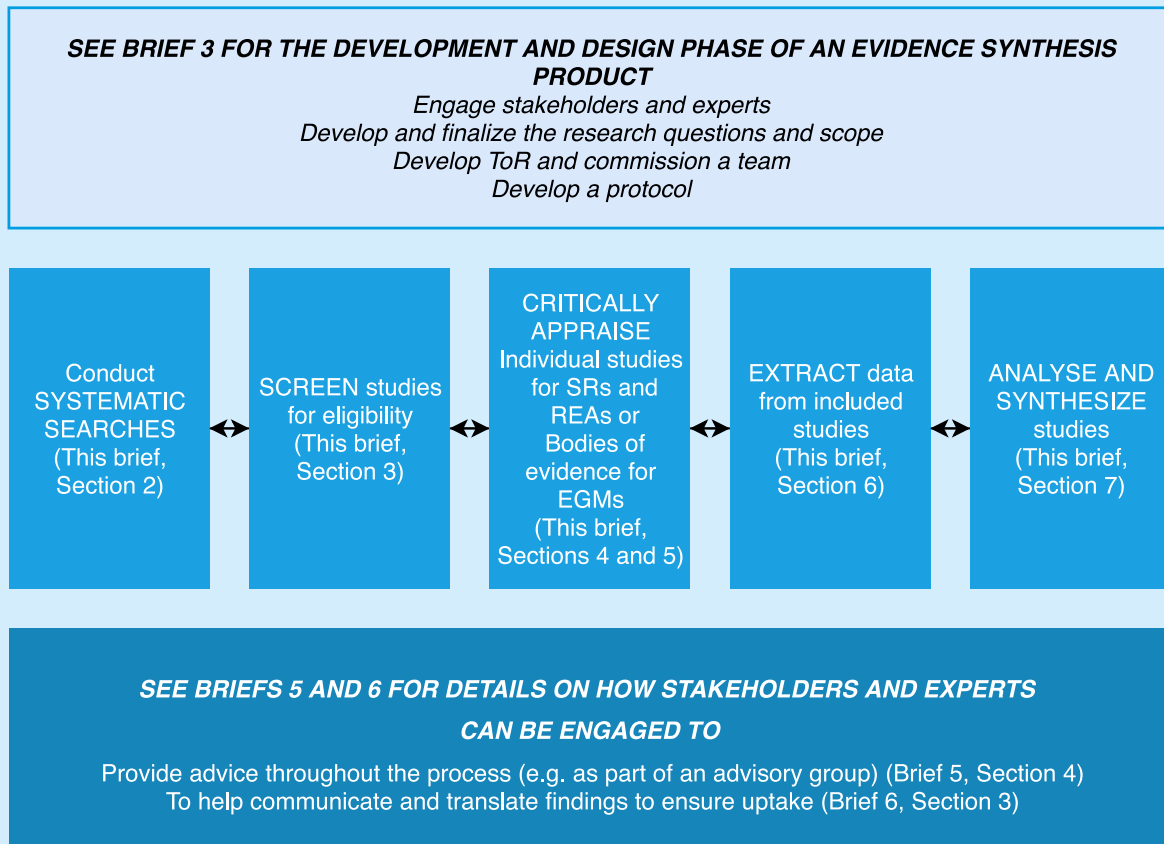
Brief 3 looked at the development and design stages of an evidence synthesis product, including the activities that contribute to drafting and refining the research questions and scope, the development of inclusion criteria and a search strategy, and the development of the research protocol. This brief addresses the actual process of collating studies and the synthesis and analysis of these. It also includes a brief overview of tools and applications that can be used to help manage the process. Box 1 lists the key questions addressed in this brief.

Box 1. Key questions addressed in this brief

- How is a systematic search for evidence conducted?
- How are decisions made to include or exclude studies as part of the screening process?
- What is data extraction/coding and how should it be done?
- What is a quality appraisal and how is it conducted?
- What kinds of analysis are possible and how does this range differ among the various types of evidence synthesis products?
- What are the tools and applications that can help to manage the process and make it more efficient?

Box 2 illustrates the various stages involved in the collation and analysis of studies for an evidence synthesis product. It emphasizes how the stages (searching, screening, quality appraisal, and data extraction and synthesis) may not necessarily proceed in a linear fashion, especially for those evidence synthesis products that attempt to answer ‘how’ or ‘why’ type questions. Rather, the production of an evidence synthesis product may be an iterative process and some stages may overlap. The diagram links the collation and analysis phase of an evidence synthesis product to the development and design stages covered in Brief 3. It also emphasizes the involvement of stakeholders throughout the process, either in terms of providing consultation and feedback (e.g., as part of an advisory group; *see Brief 5, section 4*) or in the communication or translation of findings for policymakers (*see Brief 6, section 3*).

Box 2. The collation and analysis stages involved in an evidence synthesis productⁱ



ⁱ Adapted from Gough, David, Sandy Oliver and James Thomas, [An Introduction to Systematic Reviews, 2nd ed.](#), Sage, London, 2017. The diagram also reflects personal comments made by Sandy Oliver.

2. CONDUCTING SYSTEMATIC SEARCHES

A research team conducts systematic searches by applying a search strategy to a series of databases to generate hits or a list of references. In practical terms, there may need to be some flexibility in how the search strategy is applied, as individual databases have different levels of functionality. For example, bibliographic databases that hold academic journal articles often have complex and advanced search functionality, which allows complex search strings to be entered to specify the search. In contrast, many institutional and non-governmental organization (NGO) databases that hold grey literature have limited functionality, which will require the search strategy to be adapted (*see Brief 3, section 4.2, which contains more information on search strategies, search strings and databases*).

3. SCREENING

Once the systematic searches have been conducted, the references surfaced need to be screened to determine which studies are eligible for inclusion and which are not. This is usually the most labour-intensive part of the process and is done by comparing each study to the inclusion criteria and making decisions on whether to include or exclude the study (*see Brief 3, section 4.1*). This is usually done in two or three stages: by title and abstract (together or in two consecutive stages); and then by full text. The studies are usually screened in duplicate and independently by at least two researchers (this is known as double screening; *see Box 3*). At each stage, the number of studies to be screened reduces but the level of detail involved in screening increases. For example, at title screening stage, the research team will likely just screen for thematic or geographic relevance to quickly exclude studies, as limited detail can be deduced from a title.

At abstract stage, the screening entails making decisions on more criteria, such as the intervention, outcome and research design type. At full-text stage, studies are read in full to deduce whether all inclusion criteria are satisfied. Box 3 summarizes how to maintain screening consistency and accuracy when two or more researchers are involved in screening studies.

Sometimes a screening protocol or checklist is used to aid decisions to include or exclude studies. This provides screeners with a step-by-step method for making decisions on whether to include or exclude studies (*see Box 4*). The results of the screening, including the number of studies included/excluded and the reasons for excluding studies, are usually reported in a table or diagram.

Electronic text searches can provide a useful means of locating information within a report, for example, using search facilities in PDF viewers, internet browsers and word processing software. Text searching should not be considered a replacement for reading the study, however, since information may be presented using variable or uncommon terminology, which may lead to the incorrect exclusion of studies.

Box 3. Screening consistency and accuracy

As research teams usually consist of two or more screeners to minimize bias, the accuracy and consistency of decisions made by different screeners is a critical issue. There are several ways in which this can be done. Double screening is usually recommended, whereby two researchers independently screen every study. Any differences in decisions between the two screeners are then discussed and reconciled. Double screening has obvious time and resource implications and there are other, less rigorous ways in which consistency and accuracy can be checked. For example, double screening may be applied only to the final full-text stage of screening, to ensure that the best possible decisions are made in regard to studies included in the final product. Alternatively, a third researcher (such as a senior or lead researcher) may review a portion of the studies screened at each stage and discuss decisions with all the screeners.

Box 4. Example screening protocol/checklistⁱⁱ

Below is a portion of the screening checklist used to aid screening decisions for the [UNICEF Evidence Gap Map on Adolescent Well-being in Low- and Middle-income Countries](#). The full checklist is contained within the [Evidence Gap Map study protocol](#).

SCREENING QUESTIONS	NO	YES	UNCLEAR
<p>TITLE</p> <ul style="list-style-type: none"> • Make quick judgements to exclude documents based on the following screening questions. • If you cannot exclude, or if you're unclear after checking against all criteria, then it must be forwarded for abstract screening. 			
1. Was the study or review published before 2000?			
IF YES, THEN EXCLUDE			
2. Is the study written in English, French or Spanish?			
IF NO, THEN EXCLUDE			
3. Is this a biomedical trial of a product, medication or procedure?			
IF YES, THEN EXCLUDE			
<p>4. Is the study ONLY focused on treating or preventing physical health conditions</p> <p>For example:</p> <ul style="list-style-type: none"> • The prevention and treatment of purely physical ailments and physical health conditions, including obesity and infectious disease • The prevention and treatment of HIV/AIDS and other sexually transmitted infections • Early/adolescent pregnancy and pregnancy-related health (including antenatal and post-natal care) • Mortality 			
IF YES, THEN EXCLUDE			
5. Is the study ONLY focused on the prevention and treatment of mental health conditions, such as depression?			
IF YES, THEN EXCLUDE			
<ul style="list-style-type: none"> • INCLUDE for now if focused on psychosocial interventions with reported changes related to self-confidence, emotional skills, self-efficacy and pro-social behaviour. • INCLUDE for now if focused on the prevention of and changes in attitudes towards harmful practices such as child marriage, female genital mutilation/cutting and sexual violence. <p><i>Note: In practice, it may be difficult to exclude some studies that focus on mental health-related interventions because there is some crossover with the protection and participation domains. If unclear, then include for now.</i></p>			

ⁱⁱ For the full version of this checklist, see: Bakrania, Shivit, and Anita Ghimire, *An Evidence Gap Map on Adolescent Well-being in Low- and Middle-income Countries: A focus on the domains of protection, participation, and financial and material well-being. Study protocol*, United Nations Children’s Fund, Office of Research – Innocenti, Florence, 2018. Available at: <www.unicef-irc.org/publications/932-bridging-the-gap-to-understand-effective-interventions-for-adolescent-well-being.html>, accessed 27 January 2020.

4. APPRAISING THE QUALITY OF INDIVIDUAL STUDIES

An appraisal of the quality and relevance of included studies is undertaken to different degrees in systematic reviews (SRs) and rapid evidence assessments (REAs). All studies in SRs are quality appraised, whilst a more limited quality appraisal may be conducted for studies in REAs.

Quality appraisal for quantitative studies focuses on the extent to which the study protects against bias. Studies judged to be of a low quality can be excluded from the SR or REA – and the decision to include or exclude low quality studies will need to be made at the protocol development stage. Quality appraisal of qualitative studies focuses on the extent to which the study reflects the meaning of the data. These judgements may be used to provide the reader with an indication of the utility of individual studies and of the SR or REA as a whole.¹

Quality appraisal is often done using one of a range of scales and checklists (*see Box 5*). These help to assess different aspects of a study, including: the conceptual framework and its relevance; methodological clarity and transparency; validity, reliability and consistency; clarity of reporting/ findings; and the extent to which the authors critically engage with the literature.

Box 5. Scales/checklists for appraising the quality of individual studies

There are many scales and checklists for the quality appraisal of individual studies for inclusion in SRs and REAs. There are different types of checklists for studies with different research designs. Examples include:

- [Cochrane risk of bias tool for randomized controlled trials](#) (RoB 2 tool)
- [Cochrane risk of bias tool for non-randomized studies of interventions](#) (ROBINS-I tool)
- [Department for International Development \(United Kingdom of Great Britain and Northern Ireland\) How to Note on Assessing the Strength of Evidence](#) – which includes a section on assessing the quality of individual studies
- [Critical Appraisal Skills Programme \(CASP\) appraisal tools for qualitative studies](#)

5. CRITICALLY APPRAISING A BODY OF EVIDENCE

Bodies of evidence, such as those contained in SRs and REAs, can also be appraised to assess how much confidence can be placed in the findings or conclusions. A judgement can then be made on the recommendations for decision-making stemming from these findings or conclusions. This is done at the end of the evidence synthesis process. A range of scales exist for doing so and these are also used for critically appraising the SRs that are included in an evidence gap map (EGM).² Those SRs that are judged to be of a low quality can be included or excluded from the EGM – a decision will need to be made on this at the protocol development stage.

Scales that assess the evidence used in SRs of effects (those that review the effectiveness of interventions and which include quantitative studies) focus on the effect sizes used in meta-analysis. Scales that assess the synthesis of qualitative evidence focus on the design of individual studies included in the synthesis, the way they have been conducted, their applicability to the context specified in the research question, the fit between data from the individual studies and the findings of the SR, and the quantity of data supporting the SR. Box 6 lists some examples of scales and checklists for appraising the quality of different types of bodies of evidence.

1 Gough, David, Sandy Oliver and James Thomas, *Learning from research: Systematic Reviews for informing policy decisions – A quick guide*, A paper for the Alliance for Useful Evidence, Nesta, London, 2013.

2 Ibid.

Box 6. Scales/checklists for appraising the quality of a body of evidence

There are several scales and checklists for appraising the quality of the body of evidence contained within an SR or REA. There are different systems for quantitative and qualitative bodies of evidence. Examples include:

- For systematic reviews of effects: [The International Initiative for Impact Evaluation \(3ie\) checklist for making judgements about how much confidence to place in a systematic review](#) (see appendix 2 of this working paper).
- For systematic reviews of effects: [GRADE \(Grading of Recommendations, Assessment, Development and Evaluations\) Approach](#)
- For systematic reviews of randomized controlled trials and observational studies: [AMSTAR 2 \(A Measurement Tool to Assess Systematic Reviews\) for assessing the methodological quality of systematic reviews](#)
- For systematic reviews of qualitative research: [GRADE Confidence in the Evidence from Reviews of Qualitative Research \(GRADE-CERQual\)](#)

6. EXTRACTING DATA FROM STUDIES (CODING)

'Data' can be any information from a study that is useful for answering the research question (in the case of SRs and REAs) or for the mapping of evidence (in the case of an EGM). Data extraction (or coding) essentially means collecting these data from studies or categorizing the studies. The categories of data to be extracted should be planned in advance and defined in the study protocol. For research that answers 'what works' type questions, the data extracted will usually include descriptive data that describe what was done in the study as well as numerical data that report the measure of effect. For research that answers 'how' or 'why' type questions, the data extracted will usually include descriptive data, as well as passages of text relating to the research question or objectives.

The type of data to be extracted from a study will usually include information on the:

- research design and methods
- participants
- setting and context
- interventions and outcomes
- measure and size of effects (for answering 'what works' type questions)
- perceptions of or attitudes towards an intervention (for 'how' or 'why' type questions).

7. ANALYSIS AND SYNTHESIS

7.1 Approaches to synthesis for SRs and REAs

Various means of analysis can be used depending on the type of research question, the aims of the review and the type of evidence included.

For 'what works' type questions

Brief 2 discussed how SRs that set out to test a hypothesis about the effects of an intervention, to help determine what kinds of intervention work, are sometimes referred to as 'aggregative'. In these reviews, (usually quantitative) data from multiple studies are combined or pooled to determine the aggregate effect of interventions.

Meta-analysis is predominantly used for aggregative SRs. This is a statistical method for combining numerical evidence from multiple experimental and quasi-experimental studies to produce an overall summary of knowledge on a given topic. In this process, the results of independent studies are converted into metrics called 'effect sizes', which are then combined to produce an overall average effect size.³ The effect size is a way of quantifying the size of an effect of an intervention between two different groups, usually the group receiving the intervention and another group receiving no intervention or a different intervention.⁴

3 Littell, Julia H., Jacqueline Corcoran and Vijayan Pillai, *Systematic Reviews and Meta-analysis*, Oxford University Press, Oxford, 2008. Available at: <www.oxfordscholarship.com/view/10.1093/acprof:oso/9780195326543.001.0001/acprof-9780195326543>, accessed 27 January 2020.

4 Coe, Robert, 'It's the Effect Size, Stupid: What effect size is and why it is important', Paper presented at the British Educational Research Association annual conference, Exeter, 12–14 September 2002. Available at: <www.cem.org/attachments/ebe/ESguide.pdf>, accessed 27 January 2020.

Content analysis is a less commonly used approach, which involves transforming qualitative data into quantitative data by counting the frequency of words or terms in the text. This allows the classification of large amounts of text into categories to identify themes or patterns.⁵ Box 7 describes an SR that used content analysis.

A common method is thematic synthesis, which involves a process of constant comparison between studies to draw out key themes and then to arrange these themes into a theory. Box 8 summarizes the approach and findings of an SR that set out to answer a question on how or why an intervention works and used thematic synthesis.

Box 7. A systematic review and content analysis of bullying and cyberbullying measurement strategiesⁱⁱⁱ

The aim of [this SR](#) was to conduct a content analysis of bullying measures administered to youth, teachers and parents, to gain a better understanding of the strategies employed and the specific components of bullying being measured. Through this process, the authors identified various strategies of measuring of bullying behaviours among youth and provided suggestions for standardizing measurement for research and surveillance purposes.

Content analysis was conducted, whereby the appearance of particular content within the items was coded and all similar content in each measure was grouped together. The findings suggest that there are important discrepancies between bullying measurement strategies (such as the time frame used to assess when bullying occurred), the components included in bullying definitions, and the behavioural content of measures provided to participants. The authors conclude that the inconsistent use of terminology between measures is problematic. They also found that ‘cyberbullying’ was not assessed by most of the measures included in this study.

iii Vivolo-Kantor, Alana M., et al., ‘A Systematic Review and Content Analysis of Bullying and Cyber-bullying Measurement Strategies’, *Aggression and Violent Behavior*, vol. 19, no. 4, 2014, pp. 423–434. Available at: <<https://doi.org/10.1016/j.avb.2014.06.008>> accessed 27 January 2020.

Box 8. A qualitative evidence synthesis on the barriers and facilitators to the implementation of lay health worker programmes to improve access to maternal and child health^{iv}

[This SR](#) explores the factors affecting the implementation of lay health worker (LHW) programmes for maternal and child health.^v It is an example of an SR that sets out to answer how or why an intervention works (or indeed how or why it does not work). This SR was carried out alongside another SR on the effectiveness of LHWs for maternal and child health.

The SR included qualitative studies that focused on and described the experiences and attitudes of stakeholders regarding LHW programmes for maternal or child health in a primary or community health care setting. The authors used a framework thematic synthesis approach to synthesize the findings. This is a form of thematic synthesis that draws on a pre-existing theoretical framework as a basis for analysing, rearranging and categorizing the qualitative data into themes.

The review found that the key barriers to implementation of LHW programmes were: mothers’ concerns about the confidentiality of home visits; perceptions that services were not relevant or sufficient to needs; difficulties experienced by LHWs in managing emotional relationships and boundaries with mothers; fear of blame if health care was unsuccessful; and demotivation of LHWs because their services were not appreciated.

iv Glenton, C., et al., ‘Barriers and Facilitators to the Implementation of Lay Health Worker Programmes to Improve Access to Maternal and Child Health: A qualitative evidence synthesis’, *Cochrane Database of Systematic Reviews*, no. 2, 2013. Available at: <<https://doi.org/10.1002/14651858.CD010414.pub2>> accessed 27 January 2020.

v Lay health workers perform functions related to health care delivery. They receive some level of training but have no formal professional or para-professional certificate or tertiary degree. They provide care relating to a range of issues, including maternal and child health.

For ‘how’ or ‘why’ type questions

Brief 2 explains how some SRs aim to generate theories or concepts and add contextual or descriptive analysis to answer questions about how or why an intervention works. This is sometimes referred to as a ‘configurative’ approach, whereby data, usually qualitative, from multiple studies are collated, configured and interpreted using qualitative data analysis techniques to infer a theory or to build a line of argument.

5 Hsieh, Hsui-Fang, and Sarah E. Shannon, ‘Three Approaches to Qualitative Content Analysis’, *Qualitative Health Research*, vol. 15, no. 9, 2005, pp. 1277–1288. Available at: <<https://doi.org/10.1177/1049732305276687>> accessed 27 January 2020.

Another method of analysis is meta-ethnography, which entails examining key concepts within and between studies, comparing these to highlight similarities and differences, and then organizing them into conceptual categories to develop a conceptual framework.⁶

Yet another method is realist synthesis. This is used for generating theory or synthesizing theories (such as theories of change) that underlie interventions. Realist synthesis focuses on the causal mechanisms underpinning why an intervention may or may not work and explores how they work (or do not work) under what conditions. It involves searching for relevant theories in the literature and then grouping, categorizing or synthesizing these theories.⁷

7.2 Analysis of an EGM

EGMs are usually accompanied by a report that presents analysis and findings on the distribution of evidence. The analysis draws from the EGM itself and usually includes the following:

- descriptive analysis of the key evidence clusters (where evidence is relatively abundant) and the gaps
- descriptive findings on the characteristics of the evidence base, reporting on categories such as the geographical distribution of interventions, the research designs used, and the populations targeted
- recommendations on where future research can most usefully be focused (drawing from the descriptive analysis): new primary studies could be initiated in themes or topics where there are complete gaps; further evidence synthesis (such as SRs or REAs) could be commissioned where there are clusters of primary studies but no existing synthesis.

8. TOOLS AND APPLICATIONS

There are several applications that are used for managing and undertaking evidence synthesis. Note that it is useful to factor the costs of these applications into the overall budget for evidence synthesis products (For more information on cost and time considerations, see Brief 5, section 6).

8.1 Reference management applications

Reference management applications such as [Zotero](#) and [Mendeley](#) are both free up until a certain storage limit is exceeded, which is likely to occur because of the number of records needed for an evidence synthesis product.⁸ Use of [EndNote](#) requires a paid licence.⁹ These applications are useful for storing and managing the large quantities of references retrieved from searches of databases. They all have a similar purpose, which is to provide a fast and efficient way to import bibliographic information from different databases. In many instances, entire lists of results (which may run to thousands of documents) and corresponding PDFs from a search can be imported into these applications in one action. Common 'libraries' of documents and studies can be shared amongst the research team, even if researchers are based in different locations. While the screening process can feasibly be undertaken within these applications, other software is specifically designed for this task (*see section 8.2*).

8.2 Dedicated evidence synthesis software

There are also several applications that are specifically designed for the development of evidence synthesis products, from storing the results of systematic searches (reference management), to screening, to data extraction and synthesis. Importantly, they help to manage the process and workflow, which is important when several researchers are working concurrently as part of a team.

6 Cahill, Mairead, et al., 'Qualitative Synthesis: A guide to conducting a meta-ethnography', *British Journal of Occupational Therapy*, vol. 81, no. 3, 2018, pp. 129–137. Available at: <<https://doi.org/10.1177/0308022617745016>> accessed 27 January 2020.

7 Rycroft-Malone, Jo, et al., 'Realist Synthesis: Illustrating the method for implementation research', *Implementation Science*, vol. 7, no. 33, 2012, p. 33. Available at: <<https://doi.org/10.1186/1748-5908-7-33>> accessed 27 January 2020.

8 Zotero is open source and provides free storage up to 300 MB, after which storage fees apply: US\$20/year for 2 GB and US\$60/year for 6 GB. Prices correct at time of publication. For more information, visit: Zotero, 'Zotero Storage', <www.zotero.org/storage>, accessed 27 January 2020.

Mendeley storage is free up to 2 GB and offers the ability to create one shared group with up to three members. Additional space or groups require an upgrade to a premium plan, which costs from US\$55/year for 5 GB to US\$165/year for unlimited storage. Prices correct at time of publication. For more information, visit: Mendeley, <www.mendeley.com/?interaction_required=true>, accessed 27 January 2020.

9 Use of EndNote requires a paid licence, which costs US\$250. Price correct at time of publication. For more details, visit: EndNote, <<https://endnote.com>>, accessed 27 January 2020.

A commonly used application is [EPPI-Reviewer](#), which requires a paid subscription but, as a web-based tool, does not require a licence.¹⁰ There are other examples such as [Covidence](#)¹¹ and [DistillerSR](#),¹² which both require institutional subscriptions.

These packages also include features that help to make the process more efficient. One such feature is ‘text mining’, which uses machine learning technology to aid the screening process by sorting studies by order of relevance (For more information on the use of machine learning and artificial intelligence for screening studies, see Brief 6, section 2.3). Many of these applications also include analytical functions for the synthesis and analysis stage, including tools to aid quantitative meta-analysis and qualitative thematic synthesis. Some of these advanced features are explored further in Brief 6, section 2.

8.3 Planning and resource allocation tools

One helpful tool to estimate time required for project completion is [PredicTER](#). This free tool allows users to enter the number of citations captured by the searches. It then estimates the number of hours that must be allocated to conduct the work and generates an estimate of the time needed to complete each step of the project.

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- 10 EPPI-Reviewer is ‘not-for-profit’ but requires a subscription. There is a user fee of £10/month/per person and a shareable review fee of £35/month/per review (for evidence synthesis products where there is more than one researcher). Prices correct at time of publication. For more details, visit: EPPI-Centre, EPPI-Reviewer 4, ‘Introducing: EPPI-Reviewer Web’, <<https://eppi.ioe.ac.uk/cms/Default.aspx?tabid=2937>>, accessed 27 January 2020.
- 11 Covidence does not have standard institutional prices but will offer a quote. For more information, visit: Covidence, ‘Better systematic review management’, <<https://www.covidence.org/institutions>>, accessed 27 January 2020.
- 12 DistillerSR offers custom pricing packages upon request for not-for-profit organizations. For more information, visit: Evidence Partners, ‘Better, Faster, Systematic Reviews’, <<https://info.evidencepartners.com/custom-pricing-request>>, accessed 27 January 2020.