Methodological guidance for the conduct of mixed methods systematic reviews

Abstract

Introduction: Mixed methods systematic reviews (MMSR) provide a more complete basis for complex decision-making than that currently offered by single method reviews, thereby maximizing their usefulness to clinical and policy decision-makers. Although MMSR are gaining traction, guidance regarding the methodology of combining quantitative and qualitative data is limited. In 2014, the Joanna Briggs Institute (JBI) Mixed Methods Review Methodology Group developed guidance for MMSR, however, since the introduction of this guidance, there have been significant developments in mixed methods synthesis. As such, the methodology group recognized the need to revise the guidance to align it with the current state of knowledge on evidence synthesis methodology

Objective: To outline the updated methodological approach for conducting a JBI MMSR with a focus on data synthesis, specifically, methods related to how data is combined and the overall integration of the quantitative and qualitative evidence.

Methods: Between 2015 and 2019 the JBI Mixed Methods Review Methodology Group undertook an extensive review of the literature, held annual face-to-face meetings (which were supplemented by teleconferences and regular email correspondence), sought advice from experts in the field and presented at scientific conferences. This process led to the development of guidance in the form of a Chapter included in the JBI Reviewer's Manual, the official guidance for conducting JBI systematic reviews. In 2019, the guidance was ratified by the JBI International Scientific Committee.

Results: The updated JBI methodological guidance for conducting a MMSR recommends reviewers take a convergent approach to synthesis and integration whereby the specific method utilized is dependent on the nature/type of question(s) that is(are) posed in the systematic review. The JBI guidance is primarily based on Hong et al and Sandelowski's typology on MMSR. If the review question can be addressed by both quantitative and qualitative research designs, the convergent integrated approach should be followed which involves data transformation and allows reviewers to combine quantitative and qualitative data. If the focus of the review is on different aspects or dimensions of a particular phenomenon of interest, the convergent segregated approach is undertaken which involves independent synthesis of quantitative data and qualitative data leading to the generation of quantitative evidence and qualitative evidence which are then integrated together.

Conclusions:

The updated guidance on JBI MMSR provides foundational work to a rapidly evolving methodology and aligns with other seminal work undertaken in the field of mixed methods synthesis. Limitations to the current guidance are acknowledged and a series of methodological projects identified by the JBI Mixed Methodology Group to further refine the methodology are proposed. Mixed methods review offers an innovative framework for generating unique insights related to the complexities associated with healthcare quality and safety.

Keywords:

mixed methods; systematic review; integration; data transformation; synthesis

Introduction

Qualitative and quantitative systematic reviews each contribute to our understanding of the best available evidence on a topic, yet increasingly, both perspectives are required to inform clinical, policy or organizational decisions. Decision-makers who use systematic reviews increasingly argue for a more complete synthesis of the evidence than that currently offered by these single method reviews.[1] Mixed methods systematic reviews (MMSR) have therefore become an important development in evidence-based healthcare as they maximize the ability of review findings to assist in clinical and policy decision-making. This type of review is also referred to as mixed methods research syntheses[2], and mixed research syntheses[3].

The conceptual foundation of MMSR is informed by two research paradigms, namely positivism and constructivism. Positivism is associated with quantitative studies such as prevalence/incidence or descriptive studies, or an analytical study that examines associations between variables or a cause-and-effect relationship.[4] Conversely, constructivism is commonly associated with qualitative studies that explore a complex phenomenon of interest.[4] Through the development of well-structured MMSR, the objective numerical data inherent in the logical empiricist paradigm combines with the equally important subjective opinions and perspectives presented in the constructivist paradigm. For example, Classen and Lopez (2006) used a mixed methods review approach to achieve a better understanding of safety issues among older drivers. An initial quantitative synthesis identified risk and protective factors of older driver safety (i.e. etiologic studies), followed by a synthesis of qualitative studies that captured the perspectives of older adults relating to their driving ability and safety.[5] Without the integration of quantitative results and qualitative results, a complete overarching picture of the inherent complexities associated with older driver safety could not be obtained. More commonly, MMSR bring together the findings of effectiveness (quantitative evidence) and patient experiences (qualitative evidence) to allow better understanding of whether and how an intervention works (or does not work) and inform subsequent clinical decision-making. For example, although quantitative evidence suggests that the use of larval therapy is clinically and financially effective in the debridement of wounds[6-10], evidence from qualitative studies indicates that negative patient experiences and perceptions impact on the acceptability of the therapy.[11,12] Much like the first example, without "combining the power of stories and the power of numbers",[4] the understanding about the treatment of wounds using larval therapy is incomplete, which can preclude the development of best practice recommendations.

Depending on the review question(s) posed, MMSR can examine the degree of concordance between quantitative and qualitative data to validate or triangulate results/findings, identify discrepancies within

the available evidence, and determine whether the quantitative and qualitative data address different aspects of a phenomenon of interest (which can subsequently assist in highlighting gaps in research). Mixed methods systematic reviews also allow one type of data to explore, contextualize or explain the findings of the other type of data. The methodology for conducting MMSR is an emerging field of enquiry. While there is a degree of complexity in conducting MMSR, the core intention is to combine quantitative and qualitative data (from primary studies) or integrate quantitative evidence and qualitative evidence to create a breadth and depth of understanding that can confirm or dispute evidence and ultimately answer the review question/s posed. Although MMSRs are gaining traction among healthcare professionals due to their usefulness and practicality, guidance regarding the methodology of combining quantitative and qualitative data is limited and largely at the theoretical stage.[13-21]

In 2014, the Joanna Briggs Institute (JBI) Mixed Methods Review Methodology Group developed guidance for MMSR based on the segregated approach to mixed methods synthesis as described by Sandelowski et al. (2006), which consists of separate syntheses of the quantitative and qualitative component of the systematic review.[14,22] A Bayesian approach was then recommended to pool the findings from the individual syntheses. Since the introduction of this guidance, there have been significant developments in the area of mixed methods synthesis.[13,15,17,23-25] As such, the methodology group recognized the need to revise the guidance to ensure it was accurate and aligned with the current evidence base.

This article describes the methods utilized to revise the guidance and presents the updated methodological approach for undertaking such reviews. It focuses on the *conduct* of MMSR as opposed to the reporting of MMSR - the full official guidance (including reporting requirements) is available in the JBI Reviewer's Manual.[26] Mixed methods systematic reviews share features that apply to all types of reviews including formulation of review question/s, establishment of eligibility criteria, development of a search strategy, searching and retrieval of relevant studies, assessment of methodological quality and data extraction. Therefore, the focus of this paper is on illustrating the distinct features of MMSR as they relate to data synthesis, specifically, methods related to how data is combined and the overall integration of the quantitative and qualitative evidence.

Methods

In 2015 it became apparent to the JBI Mixed Methods Review Methodology Group that revision of the guidance was required. In the following year, the Group convened to re-visit the existing guidance and update the MMSR methodology. The Group was composed of a Chair (responsible for chairing the meetings and providing feedback on written work), two convenors (responsible for drafting and coordination of written work, organizing meetings and reporting progress to the JBI Scientific Committee) and six members (responsible for regular meeting attendance and provision of feedback on written work). All members were academics and experienced in conducting different types of systematic reviews. Group members were from Australia, Canada, Portugal, United Kingdom and United States of America. An extensive review of the literature was undertaken which focused on

locating all available methodological guidance in the area of MMSR as well as published examples of MMSR. Where needed, other experts in the field of mixed methods synthesis were contacted for support and clarification. A series of teleconferences and annual face-to-face meetings were also held between 2016 and 2018, and supplemented by regular email correspondence. Half-day face-to-face meetings were held on the: 10th November 2016 (Adelaide, South Australia), 15th September 2017 (Cape Town, South Africa) and 1st May 2018 (Antwerp, Belgium). Minutes were recorded to ensure a formal approach to tracking progress, allocating work and responsibilities, and completing milestones was maintained. The proposed guidance was presented at scientific conferences in South Africa (2017 Global Evidence Summit) and Belgium (2018 10th Biennial JBI Colloquium), during which, international researchers provided comments that were valuable in informing the methodology.

The final draft of the updated guidance (in the form of a Chapter included in the JBI Reviewer's Manual) was completed following a consensus among members, and on the 6th August 2018 was submitted to the JBI International Scientific Committee for consideration, discussion and approval. Following initial submission, the Committee approved the guidance pending minor revisions. Comments and feedback were formally addressed by the methodology group and a revised version was resubmitted to the Scientific Committee on the 31st January 2019. On the 13th February 2019, the JBI MMSR methodological guidance was ratified at a meeting of the Scientific Committee and thus supersedes all previous MMSR guidance produced by JBI.[14,22]

Results: The JBI methodological approach for conducting a MMSR

To avoid confusion in describing this approach it is important to outline a few core concepts related to MMSR in order to fully inform this approach (Table 1).

Table 1: Summary of core concepts related to MMSR

The JBI approach to MMSR is based upon the typology developed by Hong et al's review of systematic reviews which examined the different methods used to synthesize quantitative and qualitative data or integrate quantitative and qualitative evidence. Following the inclusion of 459 reviews, Hong and colleagues identified a number of frameworks used for integration. However, in their work, it became evident there were two frameworks that were predominant: the convergent approach (where the synthesis occurs simultaneously) and the sequential approach (where the synthesis occurs consecutively).[17] Based on minimal usage of the sequential approach by systematic reviewers (approximately 5%), the JBI MMSR methodology currently focuses exclusively on the convergent approach. The convergent design can be broken down into a series of methods that have been simplified into two groups – ***convergent integrated*** (which involves data transformation and allows reviewers to combine quantitative and qualitative data) and ***convergent segregated*** (which involves independent synthesis of quantitative data and qualitative data leading to the generation of quantitative evidence and qualitative evidence which are then integrated together). The decision as to which approach to use is dependent on the nature/type of question(s) that is(are) posed in the systematic review. If the review question can be addressed by both quantitative and qualitative

research designs, the ***convergent integrated*** approach should be followed; if the focus of the review is on different aspects or dimensions of a particular phenomenon of interest, the ***convergent segregated*** approach is undertaken. Some example review questions are provided below which delineate the different approaches.

Example 1:

'What are the barriers and enablers to the adoption of electronic health records to support self-management in adult patients with a chronic disease?'

- Here the focus is on barriers and enablers, which can be addressed through qualitative research (e.g. through a phenomenological study of healthcare professionals involved in supporting adult patients with a chronic disease through the use of electronic health records) as well as quantitative research (e.g. through a survey of healthcare professionals involved in the use of electronic health records conducted as part of a cross sectional study).

- Since this review question can be answered by both quantitative AND qualitative studies it would follow a **convergent integrated approach** to its synthesis and integration.

Example 2:

'What are the effects of canine-assisted interventions (CAIs) on the health and social care of older people residing in long-term care?' and 'What is the experience of older people residing in long-term care who receive CAIs?'

- Here both questions relate to a common phenomenon i.e. CAIs for older people but they are addressing two different aspects associated with it – namely what effects these interventions have on older people in terms of the effect of the interventions on outcomes such as stress and anxiety and how older people experience or perceive them. We know that questions of effectiveness are answered through quantitative research (e.g. through a randomized controlled trial comparing CAIs with standard interventions) and questions of experience/perception are answered through qualitative research (e.g. through an ethnographic study where the researcher undertakes fieldwork on a group of older people receiving these interventions).

- Since this review focuses on different dimensions of a phenomenon it would follow a **convergent segregated approach** to its synthesis and integration.

The methodological guidance for the synthesis and integration of these two approaches is presented separately in the succeeding sections.

MMSR questions that take a CONVERGENT INTEGRATED approach to synthesis and integration

The convergent integrated approach, outlined in example 1 above**,** refers to a process of combining extracted data from quantitative studies (including data from the quantitative component of mixed methods studies) and qualitative studies (including data from the qualitative component of mixed methods studies), and involves data transformation. In order for qualitative and quantitative data to be integrated and thus fully inform the topic, one approach is for the data to be transformed into a mutually compatible format.[27] Data transformation can occur either by converting qualitative data into quantitative data (i.e. quantitizing) or by converting quantitative data into qualitative data (i.e. qualitizing). Quantitizing is a process in which qualitative data are assigned numerical values, whereas qualitizing refers to quantitative data being converted into themes, categories, typologies or narratives.[2,3,23]

For data transformation, JBI recommends that quantitative data be 'qualitized', as codifying quantitative data is less error-prone than attributing numerical values to qualitative data.[22] 'Qualitizing' involves extracting data from quantitative studies and translating or converting it into 'textual descriptions' to allow integration with qualitative data. 'Qualitizing' involves a narrative interpretation of the quantitative results. At the simplest level, qualitized data might comprise describing a sample (or members of it) using word categories based on supplementary descriptive statistics such as average or percentage scores.[28] Qualitized data can also include profiling of the sample using cluster or factor analysis.[28] Data with a temporal or longitudinal component, [28] or those that examine associations and relationships using inferential statistics such as linear or logistic regression analysis also have narrative potential and can therefore be qualitized by identifying variables included in the analysis. By qualitizing, the reviewer converts the 'quantities' into declarative stand-alone sentences, in a way that answers the review question.

The textual descriptions ('qualitized data') from quantitative studies are then assembled and pooled with the qualitative data extracted directly from qualitative studies. Reviewers are then required to undertake repeated, detailed examination of the assembled data to identify categories on the basis of similarity in meaning, much like the process of meta-aggregation for qualitative synthesis.[29] A category will integrate two or more: qualitative data, 'qualitized' data or a combination of both. In some instances however, data may not have the same meaning as others (i.e. may not reciprocally translate across studies)[30] and therefore cannot be combined to form a category. Where possible, categories are then aggregated to produce the overall integrated finding(s) of the review. This process is illustrated in Figure 1.

Figure 1: JBI Convergent integrated approach where qualitized findings are assembled into categories with qualitative findings extricated directly from qualitative studies based on similarity of meaning.

MMSR questions that take a CONVERGENT SEGREGATED approach to synthesis and integration

A convergent segregated approach consists of conducting separate quantitative synthesis and qualitative synthesis, followed by integration of evidence derived from both syntheses. By integrating the quantitative and qualitative synthesized findings, a greater depth of understanding of the phenomena of interest can be obtained, compared to undertaking two separate component syntheses without formally linking the two sets of evidence. The guidance developed for this approach currently focuses exclusively on reviews addressing questions of meaningfulness/experience (qualitative) and effectiveness (quantitative).

In example 2 above, quantitative data is synthesized in the form of a meta-analysis (or a narrative summary if meta-analysis is not possible) to determine the effects of canine-assisted interventions on older adults residing in long-term care. Additionally, all the qualitative data is pooled (in the case of the JBI approach, through the process of meta-aggregation (or a narrative summary if a meta-aggregation is deemed inappropriate) to determine the experiences/perceptions of older adults receiving these interventions. There is no order to which synthesis is done first as they are independent; however, both must be completed before moving onto the next step, integration of quantitative evidence and qualitative evidence. This next step involves juxtaposing the synthesized quantitative results with the synthesized qualitative findings and organizing or linking the results and findings into a line or argument to produce an overall 'configured analysis.' This is where the reviewer considers how (and if) the results and findings complement each other by using one type of evidence to explore, contextualize or explain the findings of the other type of evidence. In this step, results and findings cannot be reduced but are organized into a coherent whole.[3] In this approach, the reviewer repeatedly compares the results of the quantitative synthesis with the findings of the qualitative synthesis, analyzing the intervention which had been investigated for effectiveness (quantitative) in light of the experiences of the participants (qualitative). The following questions act as a guide for this process:

- Are the results/findings from individual syntheses supportive or contradictory?
- Does the qualitative evidence explain why the intervention is/is not effective?
- Does the qualitative evidence help explain differences in the direction and size of effect across the included quantitative studies?
- Which aspects of the quantitative evidence are/are not explored in the qualitative studies?
- Which aspects of the qualitative evidence are/are not tested in the quantitative evidence?

In some instances, the reviewer may find that the results of the quantitative synthesis is not complementary or has no relationship with the findings of the qualitative synthesis, or vice-versa. In such cases the reviewer may identify gaps where further research may be useful to explain the contradictory findings or when there is no relationship between the qualitative findings and quantitative results. The JBI convergent segregated approach to synthesis and integration is illustrated in figure 2 while figure 3 provides a summary of both approaches.

Figure 2: JBI Convergent segregated approach where separate quantitative synthesis and qualitative syntheses are undertaken followed by integration of evidence derived from both syntheses.

Figure 3: The JBI Approach for Mixed Methods Systematic Reviews

Discussion

Mixed methods systematic reviews provide an innovative approach for addressing important questions in healthcare.[31] The increasing interest in this type of review and the variability and lack of clear detail in the methods to synthesize quantitative and qualitative data or integrate quantitative and qualitative evidence indicates the need for clear guidance for how MMSR should be undertaken. Based on a review of the international literature on MMSR and with input from experienced researchers in this field, JBI updated its methodological guidance and identified two synthesis designs for conducting MMSR: convergent integrated and convergent segregated.

The JBI methodological approach is based upon the typology developed by Hong et al (2017)[17] as well as the seminal work undertaken by Sandelowski and colleagues.[3,32] The convergent integrated approach is similar to Sandelowski's *integrated* design which involves direct assimilation, and is based on the assumption that quantitative and qualitative data can both address the same research question.[3,32] As such they can be combined once data have been transformed in the same format (i.e. 'quantitized' or 'qualitized'). Comparable to JBI's convergent integrated approach and Sandelowski's *integrated* design is the *data-based convergent* design identified by Hong et al (2017), which typically involves a broad systematic review question (that can be answered by both quantitative studies and qualitative studies) and a synthesis that occurs following data extraction and data transformation.[17] On the other hand, the convergent segregated approach is analogous to Sandelowski's *segregated* design. In contrast to the *integrated* design which allows direct assimilation, the *segregated* design involves the integration of evidence through a method referred to as configuration. Configuration refers to the arrangement of complementary evidence into a line of argument.[3,32] According to Sandelowski, complementarity is based on the assumption that quantitative and qualitative evidence address different research questions that are related to the same phenomenon of interest.[3,32] In other words, quantitative and qualitative evidence address different aspects or dimensions of a phenomenon of interest and therefore they can neither corroborate nor refute each other but rather only complement each other. As such, the quantitative evidence and qualitative evidence cannot be directly combined and can only be organized into a coherent whole. This approach to synthesis

corresponds to Hong et al.'s[17] *results-based convergent* design that typically involves an overall systematic review question with sub-questions (some that can only be addressed by quantitative studies and others that can only be addressed by qualitative studies); there is a separate and simultaneous synthesis of quantitative data and qualitative data, followed by the integration of the resulting quantitative and qualitative evidence.

Mixed methods systematic reviews appears to be the most complex and the least developed of all systematic review methods. The updated JBI guidance provides foundational work to this rapidly evolving methodology, however it provides only a starting point for developing methods for combining quantitative and qualitative evidence in MMSR which may be conceived as a narrow conceptualization of mixed methods. However, it is hoped that in future iterations of the JBI guidance, more sophisticated methods for integrating evidence are developed and explored.

The methodological approach outlined in this paper also does come with some caveats. In the convergent segregated approach, the current JBI guidance specifically focuses on intervention/treatment or effectiveness questions for the quantitative component and on meaningfulness or experience questions for the qualitative component. However, the JBI MMSR Methodology Group acknowledges that there are other types of review questions that lend themselves to a segregated approach. For example, a MMSR may ask a prevalence question or patterns of use of a specific treatment (which is quantitative in nature) along with the experiences of patients regarding that treatment (qualitative component). While the group believes that a segregated approach is broad enough to be applied to other types of MMSR questions, future iterations of the JBI methodology will provide explicit guidance on how such questions can be synthesized and integrated in a MMSR.

One of the distinguishing features of a MMSR is the inclusion of not only primary quantitative and qualitative studies but also primary mixed methods studies. For primary mixed methods studies included in a JBI MMSR, data are extracted such that they can be classified as quantitative or qualitative. In the integrated approach, quantitative data are then 'qualitized' to allow synthesis whereas in a segregated approach, data are kept separate which then go through either meta-analysis or meta-aggregation (as appropriate) followed by the integration of the resulting evidence. This approach of categorizing data into quantitative or qualitative, particularly for the segregated approach, is ideal for primary mixed methods studies in which the quantitative component is published separately from the qualitative component. This is usually the case for mixed methods research that applies a sequential explanatory design[33] (i.e. where qualitative findings are used to interpret or explain quantitative results).[34] However, for primary mixed methods research where the results presented represent the actual integration of the quantitative data and qualitative data (such as those found in realist evaluation), categorizing data into quantitative or qualitative may not be ideal and philosophically would negate the strength of mixed methods studies. It would seem intuitive that in such instances, data are classified into three streams, i.e. quantitative, qualitative and mixed methods, followed by a configurative analysis to allow integration. This will be future work for the JBI MMSR Methodology Group.

In addition to those identified above, the JBI MMSR Methodology Group has identified a number of methodological projects that need to be undertaken in order to advance this field. First, as with other systematic reviews, critical appraisal is an essential component of MMSR and currently JBI advocates the use of the appropriate JBI quantitative tool/s (for quantitative studies and the quantitative component of mixed methods studies) and the JBI qualitative tool (for qualitative studies and the qualitative component of mixed methods studies). It may be necessary to develop a bespoke tool for mixed methods primary studies or perhaps identify an already existing critical appraisal tool for use in JBI MMSR.[24,25,35,36] Additionally, in regard to critical appraisal in the integrated approach, further investigation into how the appraisal results of quantitative studies (in which findings have been qualitized) are incorporated into the synthesis is needed.

One of the strengths of a systematic review, particularly JBI systematic reviews, is its ability to provide actionable and explicit practice recommendations. These recommendations are based on review findings that have been assessed using a structured approach; GRADE for systematic reviews of effectiveness[37] and ConQual[38] for systematic reviews of qualitative studies. Due to the complexities associated with recommendations being derived from both streams of evidence and the impact of data transformation and/or integration on the grading process, an assessment of the certainty of the evidence using either the GRADE or ConQual approach is currently not recommended for JBI MMSR following either the convergent integrated or convergent segregated approach. Modification to existing systems that assess the certainty of evidence may need to be investigated or alternatively a new system developed for evaluating results or findings from a MMSR. Finally although this paper has focused on the conduct of reviews and not their reporting, it is evident that there is a lack of consensus in terms of reporting standards for MMSR. This may be due to the lack of universally agreed and specific guideline for such reviews. As the demand for this type of review increases along with significant methodological advancements in MMSR, work can now be initiated to improve the standards for reporting of MMSR.

Conclusion

This paper outlines an exciting development in the field of mixed methods synthesis. The update of the JBI methodological guidance for conducting a MMSR recommends reviewers take a convergent approach to synthesis and integration whereby the specific method utilized is dictated by the nature/type of question(s) that is(are) posed in the systematic review. If the review question can be addressed by both quantitative and qualitative research designs the convergent integrated approach should be followed which involves data transformation and allows reviewers to combine quantitative and qualitative data. If the focus of the review is on different aspects or dimensions of a particular phenomenon of interest the convergent segregated approach is undertaken which involves independent synthesis of quantitative data and qualitative data leading to the generation of quantitative evidence and qualitative evidence which are then integrated together. Limitations to the current guidance are discussed as are a series of methodological projects the Methodology Group will undertake to allow for further refinement of this methodology.

References

1. Dixon-Woods M, Agarwal S, Jones D, Young B and Sutton A. Synthesising qualitative and quantitative evidence: a review of possible methods. J Health Serv Res Policy 2005; 10(1): 45-53.
2. Heyvaert M, Maes B and Onghena P. Mixed methods research synthesis: definition, framework, and potential. Quality and Quantity 2013; 47(2): 659-676.
3. Sandelowski M, Voils CI and Barroso J. Defining and Designing Mixed Research Synthesis Studies. Res Sch 2006; 13(1): 29.
4. Pluye P and Hong QN. Combining the power of stories and the power of numbers: mixed methods research and mixed studies reviews. Annu Rev Public Health 2014; 35: 29-45.
5. Classen S and Lopez E. Mixed Methods Approach Explaining Process of an Older Driver Safety Systematic Literature Review. Topics in Geriatric Rehabilitation 2006; 22(2): 99-112.
6. Abela G. Benefits of maggot debridement therapy on leg ulcers: a literature review. Br J Community Nurs 2017; 22(Sup6): S14-S19.
7. Arabloo J, Grey S, Mobinizadeh M, Olyaeemanesh A, Hamouzadeh P and Khamisabadi K. Safety, effectiveness and economic aspects of maggot debridement therapy for wound healing. Med J Islam Repub Iran 2016; 30: 319.
8. Sun X, Jiang K, Chen J, Wu L, Lu H, Wang A, et al. A systematic review of maggot debridement therapy for chronically infected wounds and ulcers. Int J Infect Dis 2014; 25: 32-37.
9. Tian X, Liang X, Song G, Zhao Y and Yang X. Maggot debridement therapy for the treatment of diabetic foot ulcers: a meta-analysis. J Wound Care 2013; 22(9): 462-469.
10. Wilasrusmee C, Marjareonrungrung M, Eamkong S, Attia J, Poprom N, Jirasisrithum S, et al. Maggot therapy for chronic ulcer: a retrospective cohort and a meta-analysis. Asian J Surg 2014; 37(3): 138-147.
11. McCaughan D, Cullum N and Dumville J. Patients' perceptions and experiences of venous leg ulceration and their attitudes to larval therapy: an in-depth qualitative study. Health Expect 2015; 18(4): 527-541.
12. Menon J. Maggot therapy: a literature review of methods and patient experience. Br J Nurs 2012; 21(5): S38-42.
13. The Campbell Collaboration. Campbell Collaboration Systematic Reviews: Policies and Guidelines. Campbell Policies and Guidelines Series No. 1. 2019.
14. Pearson A, White H, Bath-Hextall F, Salmond S, Apostolo J and Kirkpatrick P. A mixed-methods approach to systematic reviews. Int J Evid Based Healthc 2015; 13(3): 121-131.
15. Noyes J, Popay J, Pearson P, Hannes K and Booth AobotCQRMG. Chapter 20: Qualitative research and Cochrane reviews. In: T HJP and Green S, eds. Cochrane Handbook for Systematic Reviews of Interventions, 2011.
16. Centre for Reviews and Dissemination. Chapter 6 Incorporating qualitative evidence in or alongside effectiveness reviews Systematic Reviews CRD's guidance for undertaking reviews in health care, CRD, University of York, 2009.
17. Hong QN, Pluye P, Bujold M and Wassef M. Convergent and sequential synthesis designs: implications for conducting and reporting systematic reviews of qualitative and quantitative evidence. Syst Rev 2017; 6(1): 61.
18. Harden A, Thomas J, Cargo M, Harris J, Pantoja T, Flemming K, et al. Cochrane Qualitative and Implementation Methods Group guidance series-paper 5: methods for integrating qualitative and implementation evidence within intervention effectiveness reviews. J Clin Epidemiol 2018; 97: 70-78.
19. Thomas J, Harden A, Oakley A, Oliver S, Sutcliffe K, Rees R, et al. Integrating qualitative research with trials in systematic reviews. BMJ 2004; 328(7446): 1010-1012.
20. Harden A and Thomas J. Methodological Issues in Combining Diverse Study Types in Systematic Reviews. International Journal of Social Research Methodology 2005; 8(3): 257-271.

21. Gough D, Thomas J and Oliver S. Clarifying differences between reviews within evidence ecosystems. Systematic Reviews 2019; 8(1): 170.
22. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2014 edition / Supplement Methodology for JBI Mixed Methods Systematic Reviews. Adelaide, Australia2014.
23. Frantzen KK and Fetters MD. Meta-integration for synthesizing data in a systematic mixed studies review: insights from research on autism spectrum disorder. Quality & Quantity 2016; 50(5): 2251-2277.
24. Hong QN, Gonzalez-Reyes A and Pluye P. Improving the usefulness of a tool for appraising the quality of qualitative, quantitative and mixed methods studies, the Mixed Methods Appraisal Tool (MMAT). J Eval Clin Pract 2018; 24(3): 459-467.
25. Hong QN, Pluye P, Fabregues S, Bartlett G, Boardman F, Cargo M, et al. Improving the content validity of the Mixed Methods Appraisal Tool (MMAT): a modified e-Delphi study. J Clin Epidemiol 2019.
26. Lizarondo L, Stern C, Carrier J, Godfrey C, Rieger K, Salmond S, et al. Chapter 8: Mixed methods systematic reviews. In: Aromataris E and Munn Z, eds. Joanna Briggs Institute Reviewer's Manual, The Joanna Briggs Institute, 2017.
27. Voils CI, Hassselblad V, Crandell JL, Chang Y, Lee E and Sandelowski M. A Bayesian method for the synthesis of evidence from qualitative and quantitative reports: the example of antiretroviral medication adherence. Journal of Health Services Research & Policy 2009; 14(4): 226-233.
28. Bazeley P. Integrative Analysis Strategies for Mixed Data Sources. American Behavioral Scientist 2012; 56(6): 814-828.
29. The Joanna Briggs Institute, Lockwood C, Porrit K, Munn Z, Rittenmeyer L, Salmond S, et al. Chapter 2: Systematic reviews of qualitative evidence. In: Aromataris E and Z. M, eds. Joanna Briggs Institute Reviewer's Manual 2017.
30. Melendez-Torres GJ, Grant S and Bonell C. A systematic review and critical appraisal of qualitative metasynthetic practice in public health to develop a taxonomy of operations of reciprocal translation. Res Synth Methods 2015; 6(4): 357-371.
31. Noyes J, Booth A, Moore G, Flemming K, Tuncalp O and Shakibazadeh E. Synthesising quantitative and qualitative evidence to inform guidelines on complex interventions: clarifying the purposes, designs and outlining some methods. BMJ Glob Health 2019; 4(Suppl 1): e000893.
32. Sandelowski M, Leeman J, Knafl K and Crandell JL. Text-in-context: a method for extracting findings in mixed-methods mixed research synthesis studies. J Adv Nurs 2013; 69(6): 1428-1437.
33. Fetters MD, Curry LA and Creswell JW. Achieving integration in mixed methods designs-principles and practices. Health Serv Res 2013; 48(6 Pt 2): 2134-2156.
34. Ivankova NV, Creswell JW and Stick SL. Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. Field Methods 2006; 18(1): 3-20.
35. Heyvaert M, Hannes K, Maes B and Onghena P. Critical Appraisal of Mixed Methods Studies. Journal of Mixed Methods Research 2013; 7(4): 302-327.
36. Long AF, Godfrey M, Randall T and Brettle A. HCPRDU Evaluation tool for mixed methods studies [internet]. [cited Available from: http://usir.salford.ac.uk/id/eprint/13070/ accessed 4th April 2019.
37. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008; 336(7650): 924-926.
38. Munn Z, Porritt K, Lockwood C, Aromataris E and Pearson A. Establishing confidence in the output of qualitative research synthesis: the ConQual approach. BMC Med Res Methodol 2014; 14: 108.