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Systematic Reviews of Systematic Quantitative, Qualitative, and Mixed Studies Reviews in Healthcare Research: How to Assess the Methodological Quality of Included Reviews?

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Abstract

Conducting a review of systematic reviews can be challenging, especially when combining systematic quantitative, qualitative and mixed studies reviews. In this methodological discussion paper, we propose (a) a typology for categorizing various types of review of reviews and (b) an exploration of criteria pertaining to three existing critical appraisal tools (ROBIS, AMSTAR 2, MMSR) to identify those that could be adapted for qualitative and mixed studies reviews. Further work has to be done to develop methodological guidance in conducting, interpreting, and reporting reviews of reviews that combine qualitative and quantitative data.

Keywords: methodological quality assessment; systematic reviews of systematic reviews; systematic mixed studies reviews; systematic qualitative reviews; systematic quantitative reviews.

Background

More and more healthcare researchers are interested in combining qualitative, quantitative and mixed methods studies and their evidence into systematic reviews. The healthcare field of research has a long tradition in producing systematic reviews (Hong & Pluye, 2018b). With the number of published systematic reviews increasing each and every day, researchers are now interested in combining many systematic reviews into one single document, i.e. systematic reviews of systematic reviews (SRSRs) (Hartling et al., 2012; Page et al., 2016; Pieper et al., 2012; Pollock, Fernandes, Becker, Featherstone, & Hartling, 2016). SRSRs provide a wide picture of the topic under consideration; they are “one-stop shopping for decision makers” (Hartling et al., 2014 p. 488) because all systematic reviews are synthesized together. SRSRs can be fine-tuned to focus on particular populations and/or interventions; they can combine various outcomes, and they are efficient (Aromataris et al., 2015; Becker & Oxman, 2011; Hartling et al., 2014).

There are challenges in conducting SRSRs including : the overlapping between systematic reviews (primary studies appearing in more than one review, leading to potential duplication of some findings in SRSRs); the misalignment between the scope of the systematic reviews and SRSRs question(s); the variable quality of reporting and methodological quality within systematic reviews; the lack of granularity in reported information; and the assessment of methodological quality of included systematic reviews (Ballard & Montgomery, 2017; Lunny et al., 2016; Pieper et al., 2012; M. Pollock et al., 2016). One of the key steps when conducting SRSRs is to assess the methodological quality/risk of bias in the included systematic reviews (Lunny et al., 2018). We will focus only on the methodological quality at the systematic reviews level because we are

interested in the tools required to assess the methodological quality when various types of systematic reviews are included in an SRSR.

This paper builds on the literature on SRSRs and methodological quality (e.g., Jimenez et al., 2018a; Lunny et al., 2017, 2018; Shea et al., 2017; Whiting et al., 2016a) and is based on our experiences of conducting systematic reviews of systematic qualitative, quantitative, and mixed studies reviews (Rouleau et al., 2015, 2019; Rouleau, Gagnon, Côté, Payne-Gagnon, Hudson, Bouix-Picasso, et al., 2017; Rouleau, Gagnon, Côté, Payne-Gagnon, Hudson, & Dubois, 2017) and of undertaking methodological, empirical, and conceptual works in the field of systematic reviews and mixed methods (Hong et al., 2017; Hong & Pluye, 2018a; Pluye et al., 2016).

From these sources of knowledge, we observed the following issues: (a) there is no attempt to provide simple and clear typology in the field of tertiary level of research to describe SRSRs that includes systematic quantitative, qualitative, and/or mixed studies reviews; and (b) there is little explicit guidance in assessing the methodological quality in systematic qualitative and mixed studies reviews compared to quantitative systematic reviews which are included in SRSRs.

Practical guidance is explicit for authors of SRSRs who assess methodological quality in systematic quantitative reviews that include randomized and non-randomized designs (Shea et al., 2009, 2017; Whiting et al., 2016a). In fact, three critical appraisal tools are commonly used: A Measurement Tool to Assess Systematic Reviews (AMSTAR, Shea et al., 2009) and AMSTAR 2 (Shea et al., 2017); as well as Risk of Bias in Systematic

Reviews (ROBIS, Whiting, 2016b; Whiting et al., 2016a). Recently, one tool was published for assessing methodological quality of mixed studies reviews: the Mixed Methods Systematic Reviews appraisal tool (MMSR, Jimenez et al., 2018b, 2018a). These developments in systematic mixed studies reviews are still in their infancy. To our knowledge, no tool exists for assessing the methodological quality in systematic qualitative reviews: that is why we claim that guidance is needed for different types of systematic reviews included in SRSRs.

Aim and scope

This methodological discussion paper will address the aforementioned knowledge gaps. The aim of this paper is twofold. The first is to describe a typology of SRSRs including the combination of various systematic reviews (quantitative, qualitative, and mixed studies reviews) and their corresponding evidence (quantitative and qualitative). Here the focus is not to describe in detail all types of SRSR methodologies and synthesis approaches but rather to define what is meant by SRSR and their different types in a simple manner. The second aim is to explore all criteria pertaining to three critical appraisal tools (AMSTAR 2, ROBIS, and MMSR) and their potential applicability and limitations for assessing methodological quality of systematic qualitative and mixed studies reviews. We will also propose recommendations for all criteria used in these tools that could be adapted to match with qualitative and mixed studies reviews. This paper does not focus on the quality of how well an SRSR is conducted (the *reporting* quality), appraisals which would involve other levels of assessment and guidance (M. Pollock et al., 2019).

Levels of research related to three types of systematic review of systematic reviews

SRSR, considered as the tertiary level of research (Biondi-Zoccai, 2016), refers to a review of reviews guided by a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant systematic reviews and to collect and synthesize findings pertaining to these reviews (adapted from Booth et al., 2016). It differs from the secondary level of research (Biondi-Zoccai, 2016) referring to a review guided by a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research and to collect and analyse findings deriving from primary studies. One of the differences between SRSRs and systematic reviews is the level of synthesis: the former synthesizes findings from systematic reviews - while the latter synthesizes the findings from primary research studies (Gough, Oliver, et al., 2012; Smith et al., 2011). The primary level of research (Biondi-Zoccai, 2016) refers to research based on observation, experiment, or simulation rather than on reasoning or theory alone (Abbott, 1998; Porta et al., 2014). Each level of research contains and produces their own set of *data*. In a SRSRs, *data* are the findings of included systematic reviews (Hong et al., 2017). In a systematic review, *data* are the findings of included primary studies. For Gough, Thomas and Olivier (2019), a review, whether narrative or numerical, is *systematic* as long as it meets the tenets of research, i.e., rigor and transparency. Other systematic-related adjectives are used, including explicit, reproducible, comprehensive, detailed, and transparent (Krnjic Martinic et al., 2019). These adjectives are applicable to primary studies, reviews of studies, and review of reviews (Gough et al., 2019).

SRSRs can differ depending on the systematic reviews included. We are proposing the following three types of SRSRs (Table 1 and Figure 1) using descriptive typology, partially informed by Hong et al. (2017): 1) Systematic review of systematic qualitative reviews; 2) Systematic review of systematic quantitative reviews; 3) Systematic review of systematic quantitative, qualitative, and mixed studies reviews. Many reasons justify the use of a typology: a) to define and illustrate the main concept of this paper, i.e. SRSRs, and to highlight a novel type of SRSRs: *Systematic review of quantitative, systematic qualitative and mixed studies reviews*; b) to understand at a glance (with the figure 1) the included type of systematic review pertaining to each type of SRSRs to lay the groundwork of the assessment of methodological quality; c) to help readers distinguish the levels of research; and d) to understand where the challenges are encountered. Currently, the existing critical appraisal tools to assess the quality of systematic reviews were mainly developed for *systematic quantitative reviews*. However, the typology clearly shows that there exist other types of systematic reviews (*systematic qualitative reviews and systematic mixed studies reviews and*) for which there is a need to adapt existing tools or develop new ones.

The assessment of methodological quality in systematic reviews as a key step for authors of SRSRs

For authors of SRSRs, their judgment about methodological quality refers to a concern about how well (the included) systematic reviews are conducted (Pieper et al., 2012). The terms *risk of bias*, *threats to validity*, *critical appraisal*, and *quality assessment* are also commonly used to refer to methodological quality. *Risk of bias* can be defined as the systematic flaws in the design or conduct of a systematic review that can bias the results of both the systematic review and the SRSRs and that can occur at all steps of the systematic

review process (Whiting et al., 2016a). The assessment of methodological quality of included systematic reviews is a critical step when undertaking SRSRs. The results of such assessment, i.e. low, moderate and high quality, are an important element allowing to interpret findings and drawing conclusions from an SRSR (Pollock et al., 2016).

Methodological quality is considered as one of the three dimensions of *quality*, together with conceptual and reporting quality (Hong & Pluye, 2018a). *Conceptual quality* is associated with a clarity of concept/construct and a clear understanding of a concept and a phenomenon given the depth of description provided. *Reporting quality* concerns the extent, if any, to which a paper offers sufficient details and information about the design, conduct, and analysis of the primary study, systematic reviews, or SRSRs (adapted from Huwiler-Müntener et al., 2002). The Enhancing the QUALity and Transparency Of Health Research Network (EQUATOR Network, 2019) website proposes more than 400 reporting guidelines and checklists to support authors in improving transparency in the reporting of various types of health research (studies, systematic reviews and SRSRs). All reporting guidelines that have been published (Bougioukas et al., 2018, 2019) or are being developed at the tertiary level of research (M. Pollock et al., 2019) are for systematic reviews of quantitative systematic reviews. There are reporting guidelines available for authors conducting qualitative syntheses methodologies, such as the eMERGe (France et al., 2019) and the ENTREQ (Tong et al., 2012). However, these reporting guidelines for systematic reviews of quantitative systematic reviews and for qualitative syntheses methodologies do not capture the dimension of critical appraisal that is of interest in this paper, namely, the *methodological quality* of systematic reviews included in a SRSRs.

Assessing such methodological quality requires to determine how to perform this endeavour, i.e. selecting the appropriate tool to do so (Lunny et al., 2018). We faced challenges when we assessed and compared the quality of systematic quantitative, qualitative and mixed studies reviews included in SRSRs (Rouleau, Gagnon, Côté, Payne-Gagnon, Hudson, & Dubois, 2017). These challenges were due to the lack of unequivocal practical guidance, and insufficient tools, to assess the quality of systematic qualitative and mixed studies reviews.

Two examples supporting challenges in assessing the methodological quality in systematic quantitative, qualitative, and mixed studies reviews

We present here two examples in which we conducted SRSRs. These examples supported the experienced challenges in assessing systematic quantitative, qualitative and mixed studies reviews included in an SRSRs. These challenges were the “cue to action” to initiate a reflection about how we can leverage on existing tools to apprehend the assessment of methodological quality of various types of systematic reviews included in an SRSRs.

The first example targets an SRSRs aimed to summarize the effects of information and communication technologies on nursing care. We included 22 systematic reviews that were of different types: mixed studies reviews (n=12); quantitative reviews (n=9); and qualitative reviews (n=1) (Rouleau, Gagnon, Côté, Payne-Gagnon, Hudson, & Dubois, 2017). We used the AMSTAR (Shea et al., 2007, 2009) to assess the methodological quality of systematic qualitative, quantitative, and mixed studies reviews, even if the AMSTAR was only designed for systematic reviews including randomized controlled trials. At that time, no other tool was designed to assess the methodological quality of systematic qualitative and mixed studies reviews. Consequently, some criteria of the

AMSTAR did not fit into the specificities of systematic qualitative and mixed studies reviews. Thus, we slightly adapted some of these criteria. However, this process was still disadvantageous for systematic qualitative and mixed studies reviews as they started with a lower score (i.e., low methodological quality). The systematic reviews with the highest methodological quality, represented by an AMSTAR score of 9 or higher on 11, were mostly the systematic quantitative reviews (except one mixed studies review).

In another SRSR, we used two tools to assess the methodological quality and risk of bias in systematic quantitative and mixed studies reviews: the ROBIS (Whiting et al., 2016a) and the AMSTAR 2 (Shea et al., 2017). The AMSTAR 2 and the ROBIS were applied to 22 SRs, including 11 systematic quantitative reviews and 11 systematic mixed studies reviews (Rouleau et al., 2019). Out of 22 SRs, a total of 9 (41%) were at low risk of bias; 8 (36%) were at high risk of bias; and 5 (23%) had an unclear risk of bias. Again, all the systematic mixed studies reviews assessed with ROBIS had an unclear or a high risk of bias and 10/11 scored a critically low or low level of confidence with AMSTAR 2. By the time we published this paper, the MMSR tool had been published (Jimenez et al., 2018a). This tool is designed to critically appraise systematic reviews that integrate quantitative and qualitative evidence to answer various questions regarding the effectiveness of development interventions (Jimenez et al., 2018a). The description of ROBIS, AMSTAR, AMSTAR 2 and MMSR are presented in Textbox 1 and their criteria are described in Table 2.

Here is the summary of what we found in our SRSRs: 1) In both of them, half of the systematic reviews included were mixed studies reviews (and one was a qualitative

review); 2) This led to suggest a new type of SRSR, which is *systematic review of systematic quantitative, qualitative and mixed studies reviews*; 3) Given this novel type of SRSRs, there is a need of guidance of how to assess the methodological of qualitative and mixed studies reviews, such guidance being still embryonic (especially for qualitative reviews) compared to quantitative reviews; 4) Some criteria pertaining to the AMSTAR, AMSTAR 2 and ROBIS were inadequate for appraising the quality of systematic qualitative and mixed studies reviews and demonstrated flaws in application.

Indeed, the criteria underpinning these tools come with their own set of epistemological and methodological assumptions and reasoning that are meaningful for systematic reviews aligned with those positions. For example, ROBIS and AMSTAR 2 tools include a criterion in which review authors make a judgment on whether appropriate methods were used for statistical combination of results if meta-analysis was performed. This criterion is well suited for quantitative reviews but is not adapted to fit with the specificities of qualitative and mixed studies reviews.

Textbox 1. Description of critical appraisal tools

The ROBIS contains 21 signaling questions divided into the following three phases: i) the assessment of relevance (optional); ii) the identification of concerns with the review process, in which bias can be introduced in four domains: study eligibility criteria; identification and selection of studies; data collection and study appraisal; and synthesis and findings; and iii) overall judgment about risk.

The AMSTAR is an 11-item tool used to assess the methodological quality of quantitative reviews using mainly randomized controlled trials (RCT) designs.

The AMSTAR 2 is a 16-item instrument that provides detailed and comprehensive assessment of SRs that include randomised or non-randomised studies of healthcare interventions.

The MMSR tool has been developed to “categorise and critically appraise systematic reviews that incorporate quantitative and qualitative evidence to answer different questions about the effectiveness of development interventions (Jimenez et al., 2018a p. 411)”.

Comparison of criteria pertaining to three critical appraisal tools and their applicability for appraising qualitative and mixed studies reviews

We are now entering the main argument of our paper (i.e. the second aim of the paper). The contribution of this methodological discussion paper is to compare three critical appraisal tools and their criteria to show the gaps when applying them to qualitative and mixed studies reviews; and to make suggestions that would allow adapting those criteria to make them usable for qualitative and mixed studies reviews.

This approach was undertaken in three steps: 1) listing and regrouping all the criteria pertaining to AMSTAR 2, ROBIS, and MMSR, and classifying them according to the eight main steps of conducting a systematic review (Becker & Oxman, 2011; Liberati, 2009); 2) examining each criterion and making a judgment about their applicability and limitations for appraising the quality of systematic qualitative and mixed studies reviews; 3) making preliminary recommendations and adding commentaries to adapt some criteria so as to make them potentially applicable for systematic qualitative and mixed studies reviews (see Table 2). At the first step, the classification of criteria in main steps of a systematic review

reflects our interest in providing guidance for authors of SRSRs who have to perform the assessment of methodological quality at the secondary level of research, and not at the tertiary one.

We discussed issues around the approach of comparing the tools and their criteria until consensus had been reached within our group, composed of qualitative, quantitative, and mixed methods researchers (mentors and trainees) who have a background in nursing, occupational therapy, public health, community health, and family medicine. Our assumptions were as follows: some criteria and their corresponding bias (e.g., unambiguousness of eligibility criteria) described in existing tools, such as ROBIS, pertain to “generic” steps of conducting SRs (e.g., defining the review question and eligibility criteria), regardless of whether they are qualitative, quantitative, or mixed studies reviews. In this case, the unambiguousness of eligibility criteria is applicable for systematic qualitative and mixed studies reviews.

Insert Table 2 about here

Summary of preliminary observations and recommendations

Most criteria pertaining to steps 0 through 4 (see Table 2) are applicable to qualitative and mixed studies reviews: assessment of relevance, definition of the review question and identification of eligibility criteria; application of extensive and comprehensive search strategies; identification and selection of SRs; and data extraction. However, one criterion retrieved from MMSR suggests a multicomponent review which is the mix of methods (Gough et al., 2019) that is operationalized in the MMSR tool for answering different sub-questions: “specification of a separate systematic review question for each review

component such as the intervention design, the implementation processes, the participants, and the intervention/program effects (Jimenez et al., 2018a).” This criterion is then partially applicable to all types of systematic reviews depending on the review questions, and subsequently, methods and corresponding data that would or would not help explain the effectiveness of interventions/programs.

Some criteria from AMSTAR 2 and the ROBIS contain vocabulary that is not adapted for qualitative and mixed studies reviews, such as pre-defined analysis, risk of bias, heterogeneity, meta-analysis, and publication bias (see the criteria pertaining to step 5, step 6, and step 8 in Table 2). We recommend renaming/adapting existing criteria to fit with the epistemological and methodological tradition of systematic qualitative and mixed studies reviews so as to include all types of systematic reviews. For example, the criterion “Justification of meta-analysis” could be renamed “Justification of the synthesis approach for the combination of results.” The MMSR tool also includes criteria for integrating qualitative and quantitative evidence (see Step 7 and corresponding criteria in Table 2), which are applicable for authors interested in answering different systematic review questions about the effectiveness of programs using a logic model.

Contribution to the Field of Mixed Methods Research Methodology

Over the past few years, researchers have shown interest in conducting SRSRs. However, existing methodological guidance is predominant for conducting, interpreting, and reporting systematic reviews of systematic quantitative reviews (Hunt et al., 2018; Lunny et al., 2017, 2018; A. Pollock et al., 2017; M. Pollock et al., 2016, 2020). Tools to assess methodological quality have been developed for quantitative reviews included in a SRSRs.

This guidance is still lacking and is imperative for systematic reviews of systematic qualitative reviews (Typology 1, Table 1) and for systematic reviews including systematic quantitative, qualitative, and/or mixed studies reviews (Typology 3, Table 1), thereby highlighting the contribution of our paper to the field of mixed methods research methodology in identifying these gaps and needs for further work. Such type-3 SRSRs would be challenging to conduct, interpret, and report considering the combination of qualitative and quantitative findings involved. The step of synthesizing, presenting, and summarizing the qualitative and quantitative findings of systematic reviews would need special consideration. We strongly recommend building this reflection based on previous works (Frantzen & Fetters, 2016; Hong et al., 2017; Hong & Pluye, 2018a; Sandelowski et al., 2012) related to systematic mixed studies reviews in order, for example, to adapt the synthesis methods at the tertiary level of research. In other words, we have something to learn from works that have been done at the secondary level of research in combining various types of primary studies (quantitative, qualitative and mixed methods); to expand the field at the tertiary level of research, i.e. systematic reviews combining the findings of quantitative, qualitative and mixed studies reviews.

Our methodological discussion paper is original and contributes to this field for the following two reasons: First, it provides a typology centered on SRSRs including the combination of various types of systematic reviews and their corresponding mixed types of evidence. Second, it enables an analysis of common and distinctive criteria of three critical appraisal tools by making a judgment about their potential applicability to systematic qualitative and mixed studies reviews.

Our paper contributes to one of the three dimensions of quality: the methodological quality of systematic reviews included in a SRSRs, specifically of systematic quantitative, qualitative, and mixed studies reviews. The other dimensions of quality related to SRSRs (Hong & Pluye, 2018a), i.e., the reporting and conceptual dimensions, could be the subject of further research. For example, how should we report systematic reviews of systematic qualitative, quantitative, and mixed studies reviews? Based on our past experience, it is very challenging to evaluate and compare the quality of systematic reviews from different epistemological and methodological traditions. To do so clear guidance is needed in two ways. There is a need to develop or adapt a critical appraisal tool to assess the methodological quality of systematic qualitative reviews. There is also a need to explore whether the criteria of the MMSR tool (Jimenez et al., 2018a, b) could be expanded to answer research questions other than those pertaining to impacts and program evaluation. This paper could be useful to feed methodological support organizations and any other research teams interested in this novel type of tertiary level research, i.e. systematic reviews of systematic qualitative, quantitative, and mixed studies reviews.

Other authors are invited to continue the reflection so as to eventually adapt or develop a unified/integrated tool that could enable the assessment of systematic qualitative, quantitative, and mixed studies reviews on a common ground. This tool could include a set of criteria named in a generic way (e.g., pre-published protocol, justification of synthesis method) that could be applicable regardless of the types of systematic reviews in question. A guidance document could be made available for authors of SRSRs to explain how to apply and to interpret the methodological quality based on the specificities of each type of systematic review, as provided by Whiting et al. to facilitate the use of the ROBIS tool

(2016b). Considering that there are existing and available tools, we should use them and adapt the criteria and their rating guidance as needed.

Limitations and opportunities

In this paper, we focused on typology of SRSRs that include various types of systematic reviews, themselves including various empirical studies with quantitative and qualitative data. We used a “classical/traditional” way of categorizing the various levels of research (Figure 1), i.e. by types of studies: empirical studies, systematic reviews and SRSRs.

However, we considered that systematic reviews of systematic quantitative and qualitative reviews must include systematic mixed studies reviews (Table 1 and Figure 1) in order to extract and synthesize, respectively, quantitative and qualitative findings from the second level of research (systematic reviews). We are aware that recent developments suggest that we should consider not only the types of reviews/SRSRs, but also the broader context of the evidence ecosystem in which the reviews are produced and used, including a consideration of key dimensions as mentioned earlier (e.g., aims, methodologies, and structure of systematic reviews /SRSRs) (Gough et al., 2019; Gough, Thomas, et al., 2012).

These authors suggest that *“for all of the many types of review question and types of systematic reviews, there can be many levels of evidence standards for making different evidence claims based on those reviews (Gough et al., 2019, p.7).”* Indeed, the quality and relevance of evidence claims can be assessed within a “dimensions of difference framework”: 1) the SRSR method used in the selection and synthesis of the research evidence; 2) systematic reviews included in an SRSR; and 3) evidence produced in the SRSRs (Gough, 2016). We acknowledge that this methodological discussion paper illustrates only a small portion of the complexity of SRSRs that are embedded in a dynamic

and changing evidence ecosystem. Otherwise, it has covered only empirical evidence (i.e. synthesizing research evidence from systematic reviews in SRSRs) as part of the typology and the methodological quality while many other ways of knowing exist (such as theoretical knowing and administrative and individual participant data) (Gough et al., 2019; Nutley et al., 2013).

Putting together the criteria deriving from three existing critical appraisal tools was a first attempt to provide an initial structure in order to reflect on their applicability to appraise the quality in systematic qualitative and mixed studies reviews. What could be done in further work is to use the template suggested in Tables 2 and 3 and to systematically analyze the systematic review variations included in an SRSR based on these key dimensions: aims or question, approaches (e.g., ontological and theoretical assumptions), methodologies, structure, and components of the systematic reviews (Gough et al., 2019; Gough, Thomas, et al., 2012). This exploration should be done at the systematic review level while assessing methodological quality of included systematic reviews for authors of SRSRs.

There are also opportunities for further works in developing reporting guidelines for systematic review of systematic qualitative, quantitative and mixed studies reviews by considering existing published checklists, as mentioned previously (e.g. ENTREQ, eMERGE). We also recommend to expand the works surrounding methodological quality for other fields outside health care (e.g. social science).

Conclusion

This paper has emphasized the importance of using a descriptive and simple typology for eliciting the different types of systematic reviews included in SRSRs. Having a clear and consistent typology is the foundation to extend a wider application of SRSRs, to address broad research synthesis questions, and to assess methodological quality. We have argued that researchers need to consider the combination of systematic qualitative, quantitative, and mixed studies reviews and the integration of qualitative and quantitative evidence for planning, conducting, and reporting SRSRs. For example, we considered that the effects of information and communication technologies on nursing care can be studied through quantitative and qualitative lens (Rouleau, Gagnon, Côté, Payne-Gagnon, Hudson, & Dubois, 2017). These effects may be perceived by nurses as support for their practice and provision of nursing care. Depending on the scope of SRSRs and the question(s) of interest, we have also argued that integrating many types of systematic reviews and a combination of evidence can help increase the understanding of a given phenomenon and provide a comprehensive answer to a complex review question. Finally, our work can help advance the field of assessing the methodological quality of systematic qualitative, quantitative, and mixed studies reviews on a common ground. We have no doubt that the development and validation of a consolidated critical appraisal tool for authors of SRSRs will be of great value.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Table 1. Three types of Systematic Reviews of Systematic Reviews

Typology^a	Definitions^b
1) Systematic review of systematic qualitative reviews	The use of systematic and explicit methods to identify, select, and critically appraise relevant systematic qualitative and mixed studies reviews and to collect and synthesize qualitative findings pertaining to these systematic reviews. Some authors also used the terms “Meta-review of systematic reviews of qualitative studies” (May et al., 2016) and “Meta-Review of Qualitative Systematic Reviews” (Pearce et al., 2015). Toye et al. (2017) referring to “mega-ethnography”, representing a method of synthesis rather than a type of SRSR.
2) Systematic review of systematic quantitative reviews	The use of systematic and explicit methods to identify, select, and critically appraise relevant systematic quantitative and mixed studies reviews and to collect and synthesize quantitative findings pertaining to these systematic reviews.
3) Systematic review of systematic quantitative, qualitative, and mixed studies reviews	The use of systematic and explicit methods to identify, select, and critically appraise relevant systematic quantitative, qualitative, and/or mixed studies reviews and to collect and analyse quantitative and qualitative findings pertaining to these systematic reviews. Examples of this type of SRSR have been published (Rouleau et al., 2019; Rouleau, Gagnon, Côté, Payne-Gagnon, Hudson, Bouix-Picasso, et al., 2017).

Note:

^a The typology is partially informed by Hong et al. (2017)

^b These definitions have in part been adapted from Booth et al. (2016): The use of systematic and explicit methods to identify, select, and critically appraise relevant systematic reviews and to collect and synthesize findings pertaining to these systematic reviews.

Table 2. Perceived Applicability of Critical Appraisal Tools to Assess Methodological Quality of Systematic Qualitative and Mixed Studies Reviews

Criteria included in 8 steps of a SR ^a	ROBIS and criteria (Whiting et al., 2016a, b)	AMSTAR 2 criteria (Shea et al., 2017)	MMSR criteria (Jimenez et al., 2018a, b)	Is the criterion perceived as applicable for systematic QUAL reviews?	Is the criterion perceived as applicable for systematic MSRs?
0. Assessing the relevance					
Does the question addressed by the review SR match the SRSRs question (e.g. for the PICO or the SPICE)?	Phase 1	No	No	Yes	Yes
1. Defining the SR question and eligibility criteria for including SRs					
Pre-published protocol	1.1	2	A1	Yes	Yes
Definition of the SR questions and eligibility criteria	1.1	1	A2, A3, A4.1	Yes	Yes
Appropriateness of eligibility criteria for SR question	1.2	No	A3, A4.1	Yes	Yes
Specification of a separate SR question for each review component, including the intervention design, the implementation processes, the participants, and the intervention/program effects	No	No	A2	Partially yes	Partially yes
Unambiguousness of eligibility criteria	1.3	No	No	Yes	Yes
Appropriateness of all restrictions in eligibility criteria based on SR characteristics	1.4	3	A3, A4.2	Yes	Yes
Appropriateness of any restrictions in eligibility criteria based on sources of information	1.5	No	A4.2, A5	Yes	Yes
2. Applying extensive and comprehensive search strategies using a variety of information sources					
Comprehensiveness of the search strategies	2.1, 2.3	4	A4.2	Yes	Yes
Appropriateness of restrictions based on date, publication format, or language	2.4, 2.5	4	A4.2 et A.5	Yes	Yes
3. Identifying potentially relevant SRs and selecting the relevant ones					
Screening of title/abstracts and/or full texts by two independent reviewers	3.1	5	A6	Yes	Yes

4. Extracting data					
Data extraction performed by two independent reviewers	3.1	6	B1	Yes	Yes
List of all included SRs	No	No	A6	Yes	Yes
List of all excluded SRs as well as their justifications	No	7	A6	Yes	Yes
Use of methods to address dependency in findings at the between study level and within individual studies (e.g. multiple outcomes reported)	3.2	No	A7	Yes	Yes
Use of all relevant SR results in the synthesis	3.3	No	D4,D5,D6	Yes	Yes
5. Collecting and presenting data on risk of bias/methodological quality of pertinent individual studies within included SRs					
Use of an appropriate technique and/or appropriate criteria by authors of SRs for assessing the risk of bias/methodological quality of pertinent individual studies within included SRs	3.4	9	B.2, C.4	Yes	Yes
Assessment of risk of bias/methodological quality by two independent reviewers	3.5	No	B.2, C.4	Yes	Yes
6. Synthesizing and presenting findings					
Description and presentation of detailed characteristics of SRs	3.2	8	B.1, C.2	Yes	Yes
Inclusion of all studies in the synthesis	4.1	No	No	Yes	Yes
Pre-defined analyses are reported (e.g. in a protocol) or departures are explained	4.2	No	No	Partially yes	Partially yes
Appropriateness and clarity of synthesis approach	4.3	No	B.3, C.5	Yes	Yes
Heterogeneity addressed in the synthesis	4.4	11, 14	B.4	No	Partially yes
Justification of meta-analysis (if applicable) for the combination of results	4.5	11, 12	B.4, B.5	No	Partially yes
Robustness of findings with funnel plot or sensitivity analyses	4.5	15	B.7	No	Partially yes
7. Integrating qualitative and quantitative evidence					
Use of a program theory and/or logic model	No	No	D.1	Partially Yes	Partially yes

Incorporation of qualitative evidence in SR design	No	No	D.2	Partially yes	Partially yes
Analysis of intermediate and endpoint outcomes along causal chain	No	No	D.3	Partially Yes	Partially yes
Use of qualitative evidence in causal chain analysis	No	No	D.4	Partially yes	Partially yes
Incorporation of qualitative evidence in other aspects of the analysis	No	No	D5	Yes	Yes
Integration of quantitative and qualitative evidence to form conclusions and suggest implications	No	No	D6	Yes	Yes
8. Interpreting findings and drawing conclusions					
Impact of heterogeneity on the results of SRs	4.4	13, 14	No	No	Partially yes
Investigation of publication bias and discussion of its likely impact on results	4.1, 4.5	15	No	Yes	Yes
Risk of bias/methodological quality (of individual studies contained within included SRs) are discussed when interpreting/discussing the results of the SRs	4.6, C	9, 12	E.2	Yes	Yes
Potential sources of conflict of interest are reported	No	16	E.1	Yes	Yes
Sources of funding reported for the studies included in the review	No	16	E.2	Yes	Yes

Note: QUAL = qualitative; QUANT= quantitative; MSRs= mixed studies reviews; RCTs = randomized controlled trials; SRs= systematic reviews.

* Authors of systematic reviews of systematic reviews assess the methodological quality and risks of bias in included SRs. We could also assess risks of bias/methodological quality and other dimensions of quality, such as reporting, at a systematic review of systematic reviews level, but this is beyond the scope of this methodological discussion paper.

Table 3. Recommendations to Adapt Criteria of Critical Appraisal Tools in Assessing Methodological Quality of Systematic Qualitative and Mixed Studies Reviews

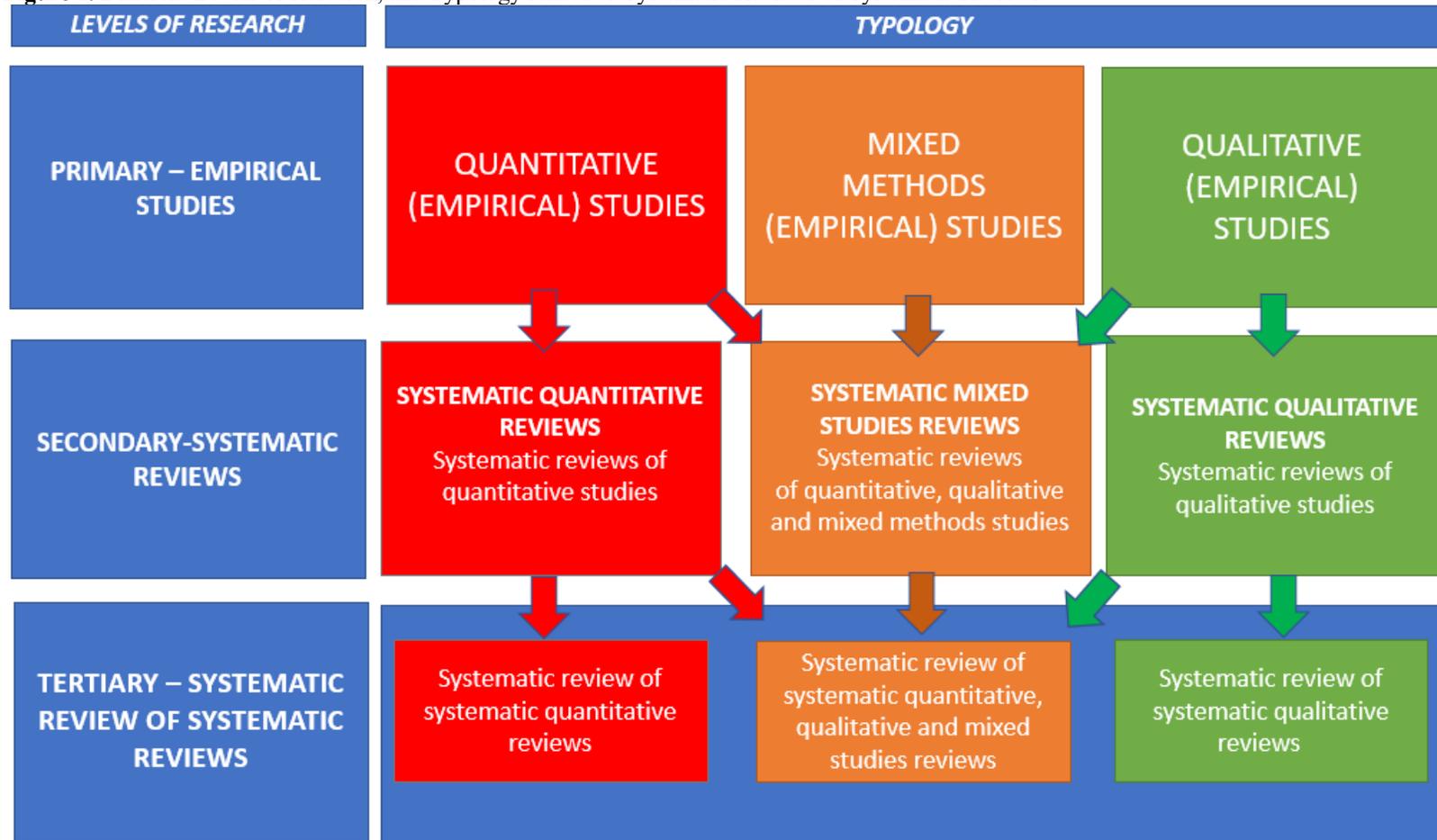
Criteria included in steps of a SR ^a	Recommendations
1. Defining the SR question and eligibility criteria for including SRs	
Specification of a separate SR question for each review component, including the intervention design, the implementation processes, the participants, and the intervention/program effects	<ul style="list-style-type: none"> - If it is a multicomponent review (Gough et al., 2019) that includes broad questions and a combination of methods and data making it possible to explain the effectiveness of interventions/programs, then this criterion can be applicable for all types of SRs depending on the review questions. If the SR question(s) fall outside the program evaluation field, this criterion would need to be formulated in a more inclusive way so that other SR questions can fit in.
5. Collecting and presenting data on risk of bias/methodological quality of pertinent individual studies within included SRs	
Use of an appropriate technique and/or appropriate criteria by authors of SRs for assessing the risk of bias/methodological quality of pertinent individual studies within included SRs	<ul style="list-style-type: none"> - We suggest avoiding the exclusive use of the term "risk of bias" and refer to "methodological quality" in order to avoid disciplinary or worldview jargon. <ul style="list-style-type: none"> o Bias is commonly understood to be a concept drawn from the quantitative research paradigm and to be incompatible with the philosophical underpinnings of qualitative enquiry (Jimenez et al., 2018a).
Assessment of risk of bias/methodological quality by two independent reviewers	<ul style="list-style-type: none"> - We recommend a clear and consistent use of terms. <ul style="list-style-type: none"> o For example, in the MMSR tool, the term "risk of bias" is used interchangeably both for systematic QUANT (criterion B.2) and QUAL reviews (criterion C.4), along with the term "quality or critical appraisal".
6. Synthesizing and presenting findings	

<p>Pre-defined analyses are reported (e.g. in a protocol) or departures are explained</p>	<ul style="list-style-type: none"> - We recommend renaming this criterion to make it more neutral and inclusive for all types of SRs: "Planned analyses are reported (e.g., in a protocol) and differences between planned and performed analyses explained." <ul style="list-style-type: none"> o The planning of pre-defined analyses or departures relies on a quantitative tradition. The word "departure" underlines that deviations from a protocol are sources of bias or errors, introduced by reviewers during the selection of analyses and analysis methods. o As currently named, this criterion is appropriate for SRs of RCTs with meta-analysis but not for systematic QUAL reviews such as meta-ethnography.
<p>Heterogeneity addressed in the synthesis</p>	<ul style="list-style-type: none"> - We recommend adapting the term "heterogeneity" when referring to systematic QUAL reviews in order to fit with this particular epistemological and methodological tradition. <ul style="list-style-type: none"> o For example, Pearce et al. (2015) suggests this question: Do authors discuss convergence and divergence within the QUAL primary study findings?
<p>Justification of meta-analysis (if applicable) for the combination of results</p>	<ul style="list-style-type: none"> - We recommend renaming this criterion retrieved from the three tools to make it more neutral and inclusive for all types of SRs: "Justification of the synthesis approach for the combination of results." <ul style="list-style-type: none"> o Meta-analysis is a synthesis approach used in QUANT reviews. In QUAL reviews, other approaches are used, such as meta-synthesis. In MSR, convergent and sequential synthesis designs are used (Hong & Pluye, 2018a).
<p>Robustness of findings with funnel plot or sensitivity analyses</p>	<ul style="list-style-type: none"> - We recommend adapting the criterion to match with the vocabulary and tradition of systematic QUAL reviews and appropriate methods to ensure the "robustness" of findings. <ul style="list-style-type: none"> o In systematic QUAL reviews, some other terms can be used to refer to the robustness of findings, such as credibility, congruity, relevance, adequacy of data, credibility, dependence, and trustworthiness (e.g. see (Hong & Pluye, 2018a; Lewin et al., 2015; Munn et al., 2014).
<p>7. Integrating qualitative and quantitative evidence</p>	
<p>Use of a program theory and/or logic model</p>	<ul style="list-style-type: none"> - We recommend adapting these criteria to take into account different synthesis designs (i.e. sequential exploratory, sequential explanatory, convergent) (Pluye et al., 2016) and research questions outside of the program evaluation field. The way these criteria are formulated are applicable for authors interested in answering different SR questions about the effectiveness of
<p>Incorporation of qualitative evidence in SR design</p>	
<p>Analysis of intermediate and endpoint outcomes along causal chain</p>	
<p>Use of qualitative evidence in causal chain analysis</p>	

	programs/interventions using a program theory/logic model and when a sequential explanatory design is used (i.e. results of the quantitative synthesis inform the qualitative synthesis).
Incorporation of qualitative evidence in other aspects of the analysis	<ul style="list-style-type: none"> - These criteria are applicable for MSRs. However, it could be reformulated to also consider the incorporation of quantitative evidence because a mixed studies review can also start with collecting qualitative evidence, and then, incorporating quantitative evidence (sequential exploratory).
Integration of quantitative and qualitative evidence to form conclusions and suggest implications	
8. Interpreting findings and drawing conclusions	
Impact of heterogeneity on the results of SRs	<ul style="list-style-type: none"> - As suggested earlier, the term "heterogeneity" needs to be adapted when referring to systematic QUAL reviews.
Investigation of publication bias and discussion of its likely impact on results	<ul style="list-style-type: none"> - We recommend developing and/or adapting specific guidance to make this criterion applicable for systematic QUAL reviews and MSRs. <ul style="list-style-type: none"> o The guidance provided in ROBIS and in AMSTAR is formulated under a QUANT lens. o The examination of publication bias and its impact is a practice mainly seen in QUANT tradition. In health sciences, QUAL research and mixed methods are often rejected for publication given their perceived "low priority" (e.g., see Greenhalgh et al., 2016). o The impact of publication bias for systematic QUAL reviews and MSRs can be even higher, compared to systematic QUANT reviews. Considering the hypothesis that few QUAL studies are included in a SR, missing one or more of these QUAL studies may seriously undermine the trustworthiness of the systematic QUAL reviews or MSRs due to unpublished papers that would contain meaningful results.

Note: QUAL = qualitative; QUANT= quantitative; MSRs= mixed studies reviews; RCTs = randomized controlled trials; SRs= systematic reviews.

Figure 1. Different Levels of Research, and Typology related to Systematic Reviews of Systematic Reviews



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