Review

Research synthesis in veterinary science: Narrative reviews, systematic reviews and meta-analysis

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A R T I C L E   I N F O

A B S T R A C T

Reviews of the scientific literature are critically important for synthesizing the state of knowledge and are used extensively in teaching, clinical practice and public policy. Despite the importance of literature reviews, in veterinary science little attention has been paid to the science of research synthesis. In the same manner that diverse study designs address diverse research questions, different approaches to combining scientific literature serve different and valid purposes. However, and again reflective of the underlying primary research, the potential for bias in a review should also be considered when interpreting the results. This article introduces some basic concepts in research synthesis and discusses some of the basic forms of reviews including narrative reviews, systematic reviews and meta-analysis. Also discussed are potential sources of bias and design features that can be incorporated into reviews to either reduce, or at least acknowledge, the potential for bias.

Introduction

Literature reviews are an integral part of veterinary science. Combining research information to enable end users to quickly understand a body of scientific literature is not novel in veterinary education, professional development, or research. A literature review is a product from the science of research synthesis. There are many types of research synthesis, the most common being the narrative reviews found in thesis projects, grant submissions, textbooks, and peer-reviewed publications. Risk assessment, systematic reviews, and meta-analysis are also forms of research synthesis, in that they do not generate new data, but use pre-existing data.

Like primary (i.e. original) research, research synthesis is a scientific endeavor with methodologies, terminologies, and biases. Despite the common use of literature reviews in veterinary science, little attention has been paid to the science of research synthesis, when compared to other disciplines such as sociology, education, and medicine (Chalmers et al., 2002). The first edition of *The Handbook of Research Synthesis*, the foundational text for research synthesis science, was published two decades ago (Cooper and Hedges, 1994) and updated in 2009 (Cooper et al., 2009). Given the importance of research synthesis tools in clinical practice, education, food safety policy and animal welfare policy, it is important that those writing or using reviews are aware of the approaches to summarizing the literature and approaches to mitigating bias in those summaries.

This article briefly introduces research synthesis as its own research endeavor and discusses how the purpose of a review can influence the approach to the type of research synthesis employed. We also discuss sources of bias in this research endeavor. The approach to conducting systematic reviews in veterinary science is discussed because the research synthesis approach is newer to veterinary science than narrative reviews. We discuss meta-analysis only in the context of it being an approach employed to increase statistical precision that can be incorporated into systematic reviews. Numerous texts and publications are available for meta-analysis. The PubMed search 'Meta-Analysis as Topic'[MAJR] AND (introduction OR tutorial) provides a good starting point for identifying papers that describe how to perform meta-analysis.

What is research synthesis?

A useful definition of research synthesis is provided by Cooper et al. (2009): *'Research syntheses attempt to integrate empirical research for the purpose of creating generalizations'*. It is necessary to conduct research syntheses because the results of primary research are probability based. This means that, given the variability inherent in selecting a study population, the results of any one study are essentially a random event, and replication is key to understanding the phenomena investigated. Research synthesis is key to describing the results of replication, looking for consistency or lack of consistency, to enable the end user to draw conclusions. Further,

research syntheses are necessary because it is inefficient (and perhaps impossible) for students, clinicians and policy makers to read all the relevant primary research.

As the science of research synthesis is a relatively new one, precise terminology is still developing. We use the term 'research synthesis' to mean a summary of research studies, and the term 'knowledge synthesis' to mean a broader tool that includes non-research based sources such as local knowledge. Some groups consider research synthesis, evidence synthesis, and knowledge synthesis to be synonyms; others suggest they differ (Whittemore et al., 2014). Given the inconsistency in the use of these terms, we see no harm in referring to a research synthesis simply as a literature review, while acknowledging that a review could be conducted in many ways and for different purposes.

What is the purpose of the literature review?

An approach to differentiating reviews that we have found useful is based on the aim of the review. One goal of a review might be to integrate all the science and 'make sense of it'. Such reviews have a configuring aim, with the authors often presenting the results of the review within a conceptual model or theoretical framework. These reviews almost always aim to provide an overview of the area. The authors might also offer an opinion of the topic and how the literature supports that opinion, or how in the review author's opinion the 'dots join up'. Such a review might also seek to explain controversies; therefore such reviews are not necessarily dismissive of the diversity of findings in the literature. Reviews of this nature are often called narrative integrative reviews (Whittemore et al., 2014) and often cover broad topics, such as the pathogenesis of an organism, the epidemiology of a disease, the ecology of an organism, or control and treatment options for a disease. Many reviews in veterinary science, including those used in textbooks and conferences and journals, have this integrative aim. Experts are frequently invited to write narrative integrative reviews for journals and conference proceedings. Students are also often required to write narrative integrative reviews for thesis projects or other educational activities (Gough et al., 2012). This article is an example of a narrative integrative review designed to introduce the area of research synthesis and includes our interpretation of prior work and how it relates to veterinary science.

A different goal for a review might be to summarize what is in the literature without inserting a perspective. The review authors might aim to summarize all the literature rather than espouse a view or, as described by Cooper et al. (2009), the aim of such a review is to provide *'evidence that is neutral in perspective . . . less likely to be affected by bias or by their own subjective outlooks'*. Gough et al. (2012) refer to this type of review as an aggregative review. The most commonly recognized forms of aggregative review are systematic reviews, meta-analyses, and scoping reviews. Aggregative reviews are often focused by necessity because the aim is to summarize everything. Examples of aggregative reviews often describe the comparative efficacy of treatment(s), the magnitude of association of an exposure with a disease, the characteristics of a diagnostic test(s), estimates of prevalence of disease, or the topics that had been studied in an area. If the purpose of this review was to conduct an aggregative review of research synthesis, we would most likely have compiled a list of the papers about research synthesis in veterinary science and described their scope without seeking to guide the reader on how we view the approaches i.e. just describe what is available. Such an aggregative review would not, however, serve our purpose. Given that a systematic review is a common example of an aggregative review, the steps of a systematic review are provided in Table 1 and compared to a narrative integrative review.

There are several proposed approaches to classifying reviews and descriptors for reviews including systematic reviews (with or without meta-analysis), quantitative syntheses, mixed-studies reviews, scoping reviews, integrative reviews, and umbrella reviews (Cooper et al., 2009; Grant and Booth, 2009). Currently, the distinctions between these classifications are too overlapping and rapidly

Table 1
Steps in a systematic review and comparison of steps for systematic reviews with narrative reviews.

The steps in systematic review	Systematic reviews	Narrative integrative review
Pre-step: Assemble a review team and develop a systematic review protocol	Required. Methodological content experts required to ensure sources of heterogeneity are identified. Research synthesis experts ensure that bias reduction tools are employed	Not required but likely a good practice. Useful reviews can be done by a single person
Step 1: Define the review question	Required that the question is defined as if a primary study: PICOS: P, Population; I, Intervention; C, Comparator; O, Outcome; (optionally) S, Study design. PECOS: P, Population; E, Exposure; C, Comparator; O, Outcome; S, Study. PIT: P, Population; I, Index test(s); T, Target. PO: P, Population; O, Outcome	Often not applicable as the review is either an expert opinion or the scope is broad, such as the epidemiology of, the pathogenicity of, treatment options for, etc.
Step 2: Conduct an extensive search for studies.	Required	Not required but likely a good practice. Authors should still report how the data were obtained even if based on expert opinion.
Step 3: Selecting relevant studies from the results of the search	Required	Not required but likely a good practice. Difficult to do if scope is not defined
Step 4: Collecting data from relevant studies	Required. Feasibility often limited by reporting approach used in primary studies.	Not required but likely a good practice.
Step 5: Assess the risk of bias in relevant studies	Required. Feasibility often limited by reporting approach used in primary studies.	Not required but likely a good practice.
Step 6: Synthesize the results	Required. Quantitative approaches required, and qualitative approaches strongly recommended and based on the definition of the review question. Feasibility limited by reporting approach used in primary studies, when narrative approaches are then used.	Usually qualitative and narrative as quantitative assessment is not applicable. For example, reviews that aim to summarize the epidemiology, pathogenicity or treatment options of a disease are not answering a particular testable question and therefore do not lend themselves to a quantitative synthesis.
Step 7: Presenting the results	Required, a list of the characteristics of the included studies and sources of heterogeneity	Often limited to listing citations, and readers would need to obtain the papers to be aware of sources of clinical or methodological heterogeneity.
Step 8: Interpret the results and discussion	Required, but rarely as extensive or prescriptive as narrative reviews. For example, studies might indicate that a treatment is effective but not that it should be used.	Often extensive, as this is the main purpose of the review.