STRATEGIES FOR ANALYSIS AND SYNTHESIS OF MEDICAL RESEARCH

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Abstract: Using an evidence-based approach to practice requires "integrating the best evidence from research with clinical experience and patient values", where the best evidence can be gathered from randomized controlled trials, systematic reviews and meta-analyzes. The amount of research published in the biomedical literature, especially in healthcare, has increased many times over the recent decades. This vast abundance of literature makes clinical medicine increasingly complex and often requires knowledge from various studies to make a specific clinical decision. However, the available studies are often heterogeneous in terms of their design, operational quality, and research topics, and may address the research issue in different ways, which increases the complexity of the evidence and the synthesis of conclusions. The systematic review is a set of strategies for analysis and synthesis of the research literature on a given problem, while eliminating or limiting the impact of systematic error in individual studies and the data obtained from them. This evidence assessment tool is based on a clearly sound, understandable, and repeatable methodology aimed at critically analyzing, understanding, and explaining the available differences in scientific evidence on the specific research topic. This activity is complex and largely depends on what clinical trials are available, how they were performed (the quality of the study) and the health outcomes that are measured. Meta-analysis is a statistical technique for analyzing a large, complex, and sometimes contradictory amount of literature, the results of which are most often used to assess the effectiveness of different types of treatment. Conducting systematic reviews and meta-analyzes in medicine and healthcare can be difficult, especially for young researchers; therefore, understanding the basic steps is crucial. The aim of the present study is to acquaint with the main stages in conducting systematic reviews in accordance with the accepted international requirements for methodology.
Keywords: systematic reviews, critical analysis, evidence-based medicine

1. INTRODUCTION

The amount of research published in the biomedical literature, especially in healthcare, has increased many times over in recent decades. This vast abundance of literature makes clinical medicine increasingly complex and often requires knowledge from various studies to make a specific clinical decision. However, the available studies are often heterogeneous in terms of their design, operational quality and research topics and may handle the research issue in different ways, which increases the complexity of the evidence and the synthesis of conclusions (Bello, 2015). Due to the pursuit of timely and informed health and medical solutions, good clinical practice, and the rapid integration of new research results into routine practice, clinicians and practitioners should regularly read new literature and compare it with existing evidence.

In recent years, international institutions have been established in an attempt to standardize and update scientific knowledge. Probably the most famous example is the Cochrane Collaboration, founded in 1993 as an independent non-profit organization that now regroups more than 28,000 contributors worldwide and produces systematic reviews and meta-analyzes of health interventions. The methodology used to perform systematic reviews and meta-analyzes is crucial. In addition, systematic reviews and meta-analyzes have limitations that must be recognized and considered. Like any other scientific study, systematic review with or without meta-analysis can be done in a good or bad way. As a result, guidelines have been developed and proposed to reduce the risk of drawing misleading conclusions from poorly conducted literature search and meta-analysis (Borenstein, 2021).

2. SYSTEMATIC REVIEWS AND META-ANALYSIS

The Systematic Review (Systematic Review, SR) summarizes the results of available carefully designed health studies (controlled studies) and provides a high level of evidence for the effectiveness of health interventions. It serves to make decisions and make recommendations in health care (Elliott, 2017). The systematic review is a set of strategies for analysis and synthesis of the research literature on a given problem, while eliminating or limiting the impact of systematic error in individual studies and the data obtained from them. This evidence assessment tool is based on a clearly sound, understandable, and repeatable methodology aimed at critically analyzing, understanding, and explaining the available differences in scientific evidence on the specific research topic. This activity is complex and largely depends on what clinical trials are available, how they were performed (the quality of the study) and the health outcomes that are measured (Burns, 2011).

The main features of the systematic review are: 1) a clearly defined set of objectives with pre-defined eligibility criteria for studies; 2) clear, reproducible methodology; 3) systematic search, which tries to identify all studies that

meet the eligibility criteria; 4) assessment of the validity of the findings from the included studies and 5) systematic presentation and synthesis of the elements and findings from the studies used. Often, systematic reviews include a meta-analysis component - the use of statistical techniques to synthesize data from several studies into a single quantitative estimate or the size of the total effect (Popay, 2006).

Although systematic reviews are published in academic forums, there are organizations and databases specifically designed to promote and disseminate them. The Cochrane collaboration is a long-standing, rigorous and innovative leader in developing methods in this field. Their main contribution is the development of protocols that provide a structure for literature search methods, as well as new and expanded analytical and diagnostic methods for evaluating the results of meta-analyzes (https://www.cochranelibrary.com/). Conducting SR / MA in medicine and healthcare can be difficult, especially for young researchers; therefore, understanding the basic steps is crucial. The stages of the systematic review include a series of steps, which are shown in Figure 1:

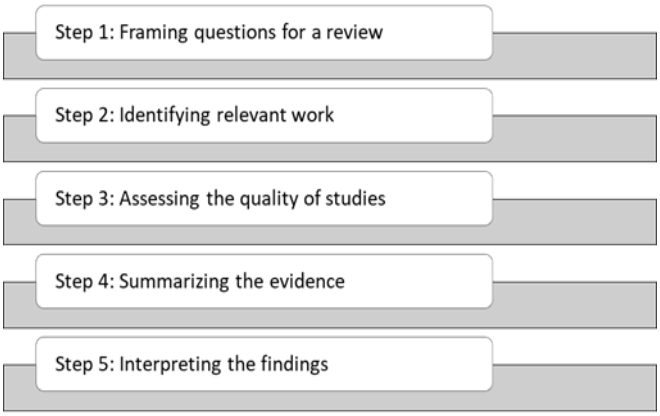

Fig 1. Stages of systematic review (adapted from Khan, 2003)

Meta-analysis (MA) as a method appeared in the medical literature after the late 1970s. It is a statistical technique for analyzing a large, complex, and sometimes contradictory amount of literature, the results of which are most often used to assess the effectiveness of different treatments (Tawfik, 2019). Meta-analysis is based on statistical methods that allow minimizing the total systematic error from individual results. The validity of the meta-analysis depends on the quality of the studies involved and on their synthesis. This is a quantitative, formal, epidemiological project and it is used to systematically evaluate the results of previous research in order to draw conclusions from these studies.

Proper implementation of SR / MA involves passing all these stages in accordance with the accepted international requirements for the methodology.

Each review must be approached strictly and with attention to details. The reporting rules for the various study designs are described in the EQUATOR network (http://www.equator-network.org/) and they are a useful starting point. The EQUATOR network is an international initiative that seeks to improve the reliability and value of published health research literature by promoting transparent and accurate reporting and greater use of reliable presentation guidelines.

The purpose of these scientific networks is to minimize the likelihood of errors, providing a basis for more reliable findings, conclusions, and solutions in medicine. Systematic reviews do not have to include a meta-analysis to summarize and analyze the statistical results of the studies included. The results of the meta-analysis can improve the accuracy of impact assessments, answer questions not raised by individual studies, resolve disputes arising from obviously contradictory research, and generate new hypotheses. Meta-analysis can also be used to summarize the results of diagnostic and prognostic tests. Recently, there is a tendency to combine the results of different meta-analyzes, known as a meta-epidemiological study, to assess the risk of deviation. Moreover, a useful guide to improve reporting of systematic reviews and meta-analyses is the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-analyses). A sound meta-analysis is characterized by a thorough and disciplined literature search. A clear definition of hypotheses to be investigated provides the framework for such an investigation. According to the PRISMA statement, an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS) should be provided (Schardt, 2007).

3. HIERARCHY OF EVIDENCE

Evidence-based medicine may be defined as a systematic, quantitative, preferentially experimental approach for obtaining and using medical information. The levels of evidence were originally described in a report by the Canadian Task Force on the Periodic Health Examination in 1979 (Canadian Task Force on the Periodic Health Examination, 1979). The report's purpose was to develop recommendations on the periodic health exam and base those recommendations on evidence in the medical literature. These hierarchies have used a range of different approaches to grading research (Stillwell, 2010). Therefore, meta-analysis, a statistical procedure that integrates the results of several independent studies, plays a central role in evidence-based medicine. In fact, in the hierarchy of evidence, where clinical evidence is ranked according to the strength of the freedom from various biases that beset medical research, meta-analyses are in the top. In contrast, animal research, laboratory studies, case series and case reports have little clinical value as proof, hence being in the bottom (Figure 2).

Figure 2. Hierarchy of evidence (Haidich, 2010).

4. CONCLUSIONS

The levels of evidence are an important component of evidence-based medicine. Understanding the levels of evidence and the reasons for assigning them to publications and abstracts helps the reader to prioritize information. The hierarchy of evidence provides a tool by which the research, addressing the many dimensions of an intervention, can be ranked at an appropriate level.

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