Review Article

Indian Journal of Medical & Health Sciences
Volume 9 Number 2, July – December 2022
DOI: https://dx.doi.org/10.21088/ijmhs.2347.9981.9222.7

Healthcare Research Applications in Meta-Analysis: A Review

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How to cite this article:
Dhiraj Kumar Mane, Satish V Kakade, Jayant Pawar/Healthcare Research Applications in Meta-Analysis: A Review/Indian Journal of Medical & Health Sciences. 2022;9(2):75–79.

Abstract

Every new day come up with different challenges in healthcare sector in developing country like us. So this review article tells us the role of meta-analysis in current healthcare share and current health problems dealing with 'Evidence Based Medicine Practices'. This article is the combination of healthcare practices and meta-analysis in the field of medicine. Consideration of current trends and scenario demonstrates a consistently increase in use of meta analysis especially in randomized controlled trials and interventional studies. Meta analyses look for new information in existing data. Comparing the results of meta analyses with subsequent findings from large scale, well conducted, randomised controlled trials (so called RCT's) is one way to assess the validity of this new knowledge. Such comparisons have yielded mixed findings thus far, with good agreement in the majority of cases but notable inconsistencies in others. One such exercise, for example, resulted in the publication of a paper titled "Lessons from a "successful, safe, simple intervention" that wasn't" misleading meta analysis (use of metformin after diabetes mellitus). The inadequacies in meta analyses that have been later challenged by data from RCT's can often be discovered with the benefit of hindsight. So this article directly or indirectly helps to researchers to adopt new knowledge in Meta analysis especially for current healthcare practice. We can't separate them as healthcare and meta analysis both are the two sides of a same coin.

Keywords: Meta-analysis; Healthcare Sector; MA; Evidence Base Medicine.

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Received on: 18.07.2022

Accepted on: 20.08.2022

INTRODUCTION

Current Healthcare Problems/Challenges: in India

Invention of new drug/molecule for new disease in short duration is biggest challenge of many of developed and developing countries. The rapid change of India's public healthcare system over the last few decades has not only been progressive, but also serves as an example for other developing countries. The Indian healthcare system can be divided into two parts: urban and rural areas, and

both have a major treatment disparity, not because of uncommon diseases, but because of a lack of suitable infrastructure and health professionals, among other issues. The goal of this paper, however, is to highlight the issues that both public and private healthcare systems are currently facing. In India, not enough money is allotted for public healthcare, and there is a well-known disparity between urban and rural institutions. People prefer private healthcare since the public sector lacks modern, high quality healthcare, which is out of reach for the majority of the rural population due to poor income and a lack of basic insurance coverage. In India, private healthcare is a high cost option for a big portion of the population. Although a high priced medical gadget has been purchased, the public healthcare system lacks essential infrastructure. Insurance as a concept and its use are still poorly understood in India, resulting in a generally under penetrated insurance sector. The current condition is mostly due to a lack of awareness. Preventive treatment can help patients save a lot of money and relieve the strain on the country's limited healthcare infrastructure. Despite government run initiatives on virus prevention, many people are disregarding lockdown restrictions and not even wearing the most basic masks and gloves in the current COVID 19 outbreak. The general health advice may not address the underlying cause of the sickness and, as a result of the lengthier treatment procedure, may result in increased costs. Non communicable diseases, or NCDs, are becoming important public health issues affecting both urban and rural populations. Although urban residents were aware of NCDs, the death rate from such diseases increased dramatically in rural areas due to the lack of early detection. Government health facilities in most sections of the country lack crucial healthcare infrastructure, making them unprepared to manage ordinary demand, let alone emergencies.[1]

Although use of IOT technology in medicine practices need to adopt more and more. So targeting such healthcare problems is now a days is very important aspect to reduce the economic burden of the nation. The most significant aspect, and certainly the one that most of us are concerned about, is the treatment's cost and transparency. In an ideal circumstance, it would be similar to a menu card at a restaurant, with ingredients and service charges listed in advance so that the patient is not startled when the bill arrives.[2]

ROLE OF META-ANALYSIS: IN HEALTHCARE SECTOR

Role of MA is to test statistical significance in research with contradictory findings, establish a more accurate estimation of the magnitude of the effect, also to give a more in-depth examination of risks, safety information, and advantages and investigate subgroups with non-statistically significant individual numbers. If the individual studies used randomized controlled trials (RCT), aggregating the results of numerous selected RCTs would represent the highest level of evidence on the evidence hierarchy, followed by systematic reviews, which examine all known studies on a given issue.[3]

Meta-analysis: Steps

Meta-analysis is defined as the statistical synthesis of the data from separate but similar (comparable) studies, leading to a quantifiable summary of the pooled results to identify the overall trend. Meta-analysis differs from most medical and epidemiological studies in that no new data are collected. Instead, results from previous studies are combined.

Steps in carrying out meta-analysis include

- Formulating the problem and study design.
- Identifying relevant studies.
- Excluding poorly conducted studies or those with major methodological flaws.
- Measuring, combining and interpreting the results and conclude.

Which studies are identified and whether they are included or excluded from the meta-analysis are crucial factors. Another important step is measuring the results of the studies on a single scale. This allows comparisons to be made between studies even if they used different measures of outcome. Meta-analysis is a relatively new scientific method; research into the best techniques to use is

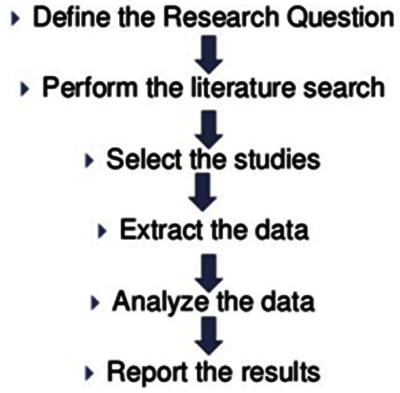

Fig. 2: Steps in Meta-Analysis

still ongoing and expanding into new areas. It is not yet as well accepted as other statistical techniques that have a longer tradition of use. The use of meta-analysis in medicine and epidemiology has increased in recent years for ethical reasons, cost issues, and the need to have an overall idea of effects of a particular intervention in different population groups. This is particularly true in the area of clinical trials, where the sample size of individual trials is often too small to permit conclusions to be drawn from any one trial, although conclusions can be drawn from aggregated results. For example, meta-analysis showed that aspirin has a significant effect in preventing a second heart attack or stroke, even though no single study had convincingly shown this.[4,5]

APPLICATIONS OF META-ANALYSIS

There are several advantages to meta-analysis. It allows investigators to pool data from many trials that are too small by themselves to allow for secure conclusions. Although ideally any clinical trial should plan an adequate sample size, historically most trials have been underpowered. In 2002, a study of 5503 clinical trials identified 69% as having fewer than 100 subjects. Small trials make it more difficult to reject the null hypothesis because they lead to larger standard deviations and standard errors. There is also a risk of bias. A small trial that does not show a significant effect might not be submitted for publication, whereas the same sized trial that reached significance (whether warranted or not) will probably be published. On an average unpublished trial underestimate treatment effects by 10%.

Currently, Meta-analysis is the most commonly used approach for quantitatively combining results of the same outcome from different studies.[7] Meta-analysis (MA) can be accomplished using either an aggregate data (AD) or individual participant data (IPD) approach. Using an AD approach, summary data for the same outcome from each study are pooled for statistical analysis. In contrast, an IPD

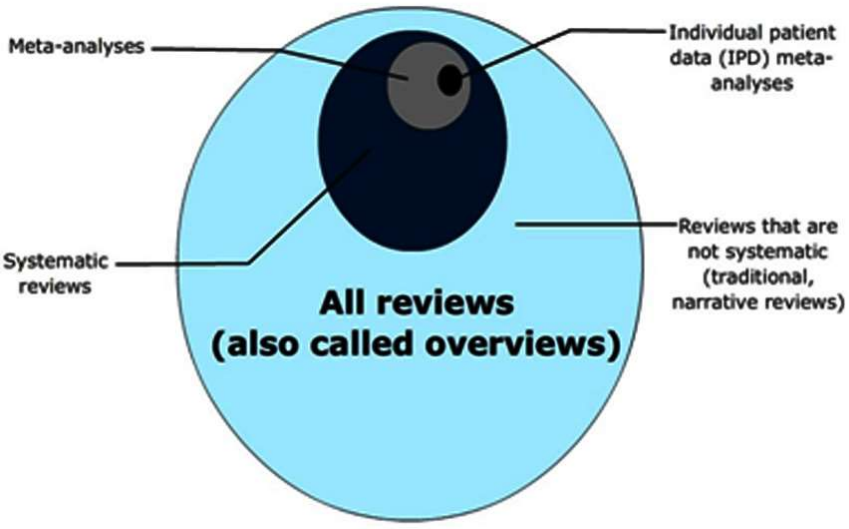

Fig. 3: Types of reviews[6]

meta-analysis includes the pooling of raw data for each participant from each included study.[8] Though, the main interest in meta-analysis is often the overall result[9,10] both the IPD and AD approaches yield similar findings.[9,10] In fact IPD-MA approach has many advantages over AD-MA, but the wide range of methods used for analysis of IPD-MA and the lack of a standardized data analysis plan are serious drawbacks of IPD-MA.[11,12] Hence, the AD approach continues to be the most commonly used method for pooling the findings of separate studies. In addition it is also important to realize that when conducting a meta-analysis, studies are not randomly assigned to covariates.[13]

The two main categories of statistical models for meta-analysis are the fixed effects model and random effects model. The fixed effects model assumes that the true effect size for all studies is identical and the effect sizes estimated in studies are different only due to errors in estimating the effects size. The random effects model is based on distribution of effects, no a common identical effect size and assumed that the summary effect size is an estimate of mean of distribution of true effects.[14]

Now a days, Meta-analysis is an especially

important tool in clinical practice and medical research, where evidence based information is preferred.[15]

TRENDS OF META-ANALYSIS

Many journals encourage researchers to submit systematic reviews and meta-analyses that summarize the body of evidence on a specific question, and this approach is replacing the traditional narrative review. Meta-analyses also play supporting roles in other papers. For example, a paper that reports results for a new primary study might include a meta-analysis in the introduction to synthesize prior data and help to place the new study in context. The significant increase in knowledge creation mentioned in below Fig. 5 was showed that one of the major strength of this MA technique.

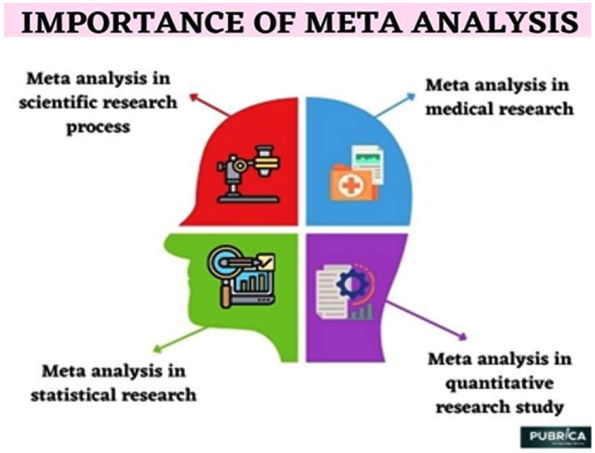

Fig. 4: Importance of Meta-Analysis[16] (***Soucre:*** https://pubrica.com/services/research-services/meta-analysis/)

OPPORTUNITIES IN META-ANALYSIS

The goal of doing meta-analyses is to arrive at more accurate and reliable findings about a treatment's effect. Thus, role of efficacy and effectiveness is reliable on MA. Efficacy relates to how well an intervention works in ideal and controlled conditions, whereas effectiveness refers to how well it works in real-world situations.[17] Meta-analysis is a set of techniques used "to combine the results of a number of different reports into one report to create a single, more precise estimate of an effect". The aims of meta-analysis are "to increase statistical power; to deal with controversy when individual studies disagree; to improve estimates of size of effect, and to answer new questions not previously posed in component studies". While meta-analysis would be an important technique for increasing sample size and hence statistical power, it comes with a slew of methodological difficulties. The first is what is known as "publication bias." This could be due to the fact that trials that demonstrate significant outcomes in favor of a new treatment are more likely to be published than those that are inconclusive or favor the existing treatment. Also, the funnel plot is a tool for determining the impact of publication bias. It's a graph that shows the relationship between sample size and treatment effects.

Because of the greater sample size obtained by considering numerous trials, efficacy conclusions from a meta-analysis should be more powerful if done correctly. This sample size is frequently far larger than what we could obtain in a single clinical trial, which is limited by funding and resources, including patient availability. This larger sample size also enhances the precision of our estimate in terms of how closely the trial results are related to overall efficacy.[18]

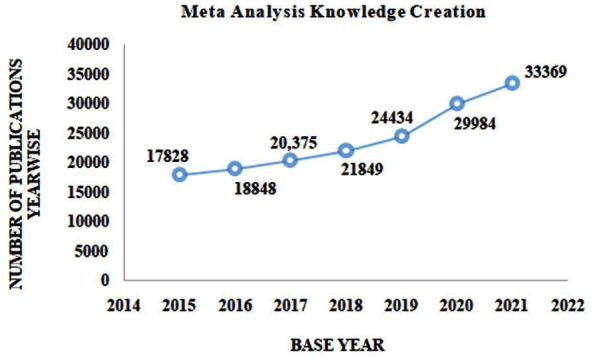

Fig. 5: Meta-analysis Knowledge Creations of Last 7 Years.

CHALLENGES OF META-ANALYSIS

Heterogeneity is another major problem and biggest challenge in meta-analysis. This is the difference in results between the studies that were included in the analysis. Changes in trial design, study population, or inclusion/exclusion criteria between studies, as well as differences owing to chance, must be taken into account by investigators. The motivation for meta-analysis is high levels of heterogeneity, because pooling trials with widely disparate results will result in a shaky pooled treatment effect, lowering our confidence in making treatment recommendations.[19,20]

CONCLUSION

The goal of evidence-based medicine is to combine

the finest scientific data with clinical and patient knowledge. Systematic reviews and meta-analyses are important methods for synthesizing information for clinical decision making and policy. The reality of messy dependency is addressed by meta-analysis approaches such as robust meta-analysis and multilevel modelling. Before beginning a meta-analysis, researcher must decide whether they want to investigate sources of heterogeneity or generate a summary effect size. Meta-analysis has the potential of appearing to provide more exact and decisive conclusions than are necessary. Meta-analysis is a very useful methodology for making sense of research studies and making findings from individual studies more applicable to clinical practice. Evidence based practice entails combining and integrating the best available evidence from research with clinical expertise and patient values to achieve optimal patient outcomes.

Future Perspective

As researcher, I would be happy if such techniques publically acceptsespecially to increase the effect size and power of the test towards all research topics. The Future of Meta-Analysis brings together expert researchers for an in-depth examination of this new methodology not to promote a consensus view, but to explore the theories, tensions, and concerns of meta-analysis from a variety of perspectives, and to illustrate the rationale behind meta-analytic decisions through concrete examples.

Recommendation

I would suggest all young researcher to go for such meta-analysis technique to reach early goals in evidence based medicine.

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