Below is an outline intended to be general, providing a starting point for active use of scientific medical literature*.

Critical Reading of Scientific Medical Literature

Keeping informed, even in a narrow field, is difficult due, in part, to the quantity of material that is published. Scientists must be able to …

- sort through large amounts of published research,
- understand it,
- evaluate relevance and validity

The level of evidence that any particular study will be able to provide is linked to its design. In general, levels of evidence are considered to progress from expert observation, case studies, and observational designs to experimental evidence, and finally systematic review. NOTE: this is a general progression and some variation should be expected.

It is also important to consider the quality and validity of any one example in addition to its relative position on the ladder.

When reading a paper, consider the following questions, in this order.

What is the research question?

> The first step is to determine the objectives of the study – the question that the authors wish to address or the hypothesis that they wish to test.

If of suitable quality, are the results likely to be relevant to my work?

> If yes, keep reading.
>
> If no, start again with another paper.

What kind of study is this?

- Cross-sectional studies address questions about the prevalence of a condition or risk factor.
- Cohort studies address questions about natural history or prognosis and causation.
- Case-control and cohort studies identify *possible* causal factors.
- Randomized controlled trials are usually the most appropriate design for answering questions about the efficacy of treatment or other interventions.

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* This material is adapted from the World Health Organization's *Basic Epidemiology, 2nd Edition*. It is intended to be general, providing a starting point for active use of scientific medical literature. It is basic and makes generalizations where, later, more subtle distinction is important. For example, applications of study designs are oversimplified.

What is the study population?

- Who is included and who is excluded?
- Are the subjects a sample of the target population?
- If not, why not?
- How have the samples been selected?
- Is there evidence of random selection, as opposed to systematic, or self- selection?
- What possible sources of bias are there in the selection strategy?
- Is the sample large enough to answer the question being addressed?

For observational studies, are the methods well described?

- Was the data collection process adequate?
- What techniques were used to handle non-response and/or incomplete data?
- If a cohort study, was the follow-up rate sufficiently high?
- If a case-control study, are the controls appropriate, and adequately matched?

For experimental studies, are the methods well described?

- How were the subjects assigned to treatment or intervention: randomly or by some other method?
- What control groups were included (placebo, untreated controls, both or neither?
- How were the treatments compared?
- Were measurements supported by quality assurance procedures?
- Is the hypothesis clearly stated in statistical terms?
- Is the statistical analysis appropriate, and is it presented in sufficient detail?
- If this is a randomized controlled trial, was the study done with an “intention- to-treat” analysis - e.g. are all the people who entered the study accounted for?
- Were the outcome or effects measured objectively?

How are the data presented?

- Are there sufficient graphs and/or tables?
- Are the numbers consistent?
- Is the entire sample accounted for?
- Are both statistics and raw data presented adequately?

Evaluating and interpreting the results

If you have been persuaded so far that the study is valid and relevant, it is worth proceeding.

- Were the findings for untreated subjects consistent with what you would expect – are the averages similar to the general population?
- Did the authors find a difference between exposed and control groups or cases and controls?
- If the authors have found a difference, are you confident that it is not due to chance (a Type I error) or bias?
- If there is a statistically significant difference, is it enough of a difference to be clinically significant?

- If there is no difference, and you can rule out the possibility of a Type II error, then this is a negative study – which does not mean that the results are of no consequence.
- Could the results be important, even though the difference is not statistically significant? (This may highlight the need for a larger study.)

Final evaluation

In weighing the evidence, you should ask the following questions.

Was the research question worth asking in the first place?

Has the author made an adequate attempt to answer the question?

Could the study design have been improved?

Does missing information prevent you from fully evaluating the study?

Did the author account for results of previous studies?

Did the research provide suggestions for action?

If you are satisfied that the article provides you with valid and relevant information, then it is logical to use this information in your work, while keeping alert to any further developments.

Adapted from Bonita, et. al. (2006). *Basic Epidemiology, 2nd Edition.* Geneva: World Health Organization.