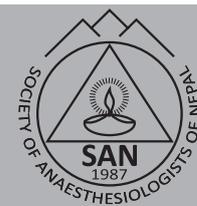




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Review Article

The art and craft of scientific writing and critical appraisal of a research paper

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Abstract

Writing is an art and like any art form, it needs perseverance, dedication and practice. However, to write a good quality paper, the habit of reading scientific articles and analyzing them is very important. With the advent of internet and online publishing, we have access to colossal research articles on myriads of subjects making extraordinary conclusions. Evidence based practice requires us to rely on literature for our clinical practice, and we have abundant publications on all aspects claiming to justify all sides of the argument. In this context it becomes more important for all in clinical practice to be able to dissect an article and analyze it in details.

Keywords: Bias; Journal metrics; Research; Research question; Study design.



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Introduction

With the advent of internet, the scientific world is flooded with publications. It has been almost 350 years since scientists have been publishing in journals.¹ It is estimated that the number of journal articles published since that time is about 50 million.² PubMed, an index of biomedical abstracts published by the National Center for Biotechnology Information has a collection of 19 million citations while PubMed Central, a full text archive of

journal holds 1.7 million articles.³ Publication on PubMed amounts to one page per minute added on to the database on average and that excludes the large volumes of articles published but not added on the indexing service.³

With such a large amount of publication, it becomes very difficult to identify good research articles. It requires the readers to be able to perform critical appraisal of the literature instead of taking them at their face value. Critical

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appraisal is regarded as a systemic process used to identify the strengths and weaknesses of a research article in order to assess the usefulness and validity of research findings.⁴ It has been defined as the “ The application of rules of evidence to a study to assess the validity of the data, completeness of reporting, methods and procedures, conclusions, compliance with ethical standards, etc. The rules of evidence vary with circumstances.”⁵

Analysis of the Journal

It starts with the analysis of the journal where the article is published. There are various types of journal metrics such as speed, reach and impact factor. Speed implies review speed and online publication time. Unnecessary delay in publication might diminish the significance of the research. The term ‘reach’ corresponds to the geographic location and accessibility of the corresponding authors and the journal.

Impact factor of a journal is one of the widely used measures of assessing its quality. Conceived by Eugene Garfield in 1970’s, Journal’s Impact factor is from Journal Citation Report (JCR), a product of Thomson ISI (Institute for Scientific Information).⁶ JCR provides quantitative tools for evaluating journals. It is a measure of the frequency with which the “average article” in a journal has been cited in a given period of time. The impact factor for a journal is calculated based on a three-year period, and can be considered to be the average number of times published papers are cited up to two years after publication. (Figure 1) Impact factor helps to clarify the significance of absolute

citation frequencies and eliminates bias associated with larger and older journals and those published frequently. None the less, the larger the number of previously published articles, more citations it will receive. The pattern of citation distribution has been found to be skewed that an analysis in 1992, showed only 15% of papers in a journal accounted for half the total citations implying that majority of the journals papers had less than average citation. Journal citation counts in JCR do not distinguish between letters, reviews, or original research. So, if a journal publishes a large number of letters, there will usually be a temporary increase in references to those letters. Self citation has been observed in around 13% of the citation a journal receives and to reduce its influence, a ‘Revised Impact Factor’ has been devised. However this might lead to biasness in article selected for publication in Journals. Hence, though impact factor is the only established measure of a journal’s eminence, an article has to be assessed on individual merit.

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- A = Total cites in 2014
 - B = 2014 cites to articles published in 2012-2013 (this is a subset of A)
 - C = number of articles published in 2012 – 2013
 - D = B/C = 2014 impact factor
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Figure 1: Calculation for Journal Impact Factor

Other several impact metrics in use are SNIP, IPP, SJR and Eigenfactor. (Table 1)

Table 1: Other impact metrics in use

	SNIP	IPP	SJR	Impact factor	Eigenfactor
Full name	Source-Normalized Impact per Paper	Impact per Publication	SCImago Journal Rank	-	-
Measures	Citations relative to average for discipline; SNIP > 1 means journal is cited more than average for field	Average citations per article, review and conference paper. This is the numerator of SNIP	Average prestige per publication, depending on the SJR of the citing journal	Average citations per publication	Importance of a journal within its network
Availability	Free of charge (from Elsevier at journalmetrics.com)			Thomson Reuters	Free of charge (at eigenfactor.org)

Predatory journals

With the advent of online publishing, research and publication has been made accessible to all. However, it has also made easy for unscrupulous activities to flourish by establishing fake journals asking for hefty sums to publish just anything. These days email inbox is also filled with request for submission from a multitude of journals and for a price, publishing at the earliest.

It was in 2010 when librarian and researcher Jeffrey Beall from the University of Colorado Denver coined the term ‘predatory publishing’ and later came up with a list and criteria for evaluating publishers.^{8,9} The problem imposed by predatory journals is exposed by an experiment often termed ‘the bohannon’s experiment’. In 2013 Staff writer of the journal science, John Bohannon evaluated the open access system by

submitting a fake and flawed paper which was accepted by majority of the journals (60%).¹⁰

Any journal that frequently sends email requests for submission should raise suspicions especially if it charges a fee for publication. Identifying predatory journals involves scrutinizing the website for details such as invalid links, inappropriate address, the identity of the editors and editorial board which cannot be verified etc. Most fake publishers have a homepage that does not provide access to previous issues of the journal. Authors should practice caution while submitting articles to publishers and also while citing articles from these journals.

Analysis of the research setting

When and where the study was done bears an immense significance. Research publications from an academic institute might be less biased than those from private institutions. Delay in the publication of a paper from the time the study was concluded might indicate the lack of importance given by the authors to the study. Time between acceptance and publication of articles depends on the journal. Analysis of 2700 papers published in 135 journals sampled from Scopus citation index found the delay to be 9 to 18 months and varied according to the subject matter with the shortest delay in science technology and medical field.⁷

Relevance of the research question

The most important reason for any publication is its relevance to mankind and its contribution to the knowledge. A study of utmost methodical rigor has little significance if it has no bearing to its own field of work. Since relevance is a subjective opinion, the reader should understand the research question of an article. Landmark papers leading to paradigm shift in science are a rarity. Most papers tend to validate previous studies and make incremental advancement in research by extending research findings to new population or clinical context.

An ideal research question identifies three components: the group or population of patients, the studied parameter (e.g. a therapy or clinical intervention) and the outcomes of interest.¹¹ In general, clinical research questions fall into two distinct categories:

1. **Effectiveness of treatment:** This relates to whether one treatment is better than another in terms of clinical effectiveness (benefit and harm) or cost-effectiveness.
2. **Frequency of events:** This refers to the incidence or prevalence of disease or other clinical phenomena,

risk factors, diagnosis, prognosis or prediction of specific clinical outcomes and investigations on the quality of health care.

Structure of the research paper

Over the last century, in health sciences, research has evolved from descriptive to well structured form. Articles were organized like a chapter in a book with headings associated with the subject matter until 1945. Since 1950's the IMRAD (Introduction, Methods, Results and Discussion) came into use and has been widely adopted after the guidelines were set by the International committee of Medical Journal Editors, formerly known as the Vancouver Group.¹⁷ The IMRAD format promotes uniformity and facilitates modular reading such that the reader can browse to the area of interest. It also facilitates the peer review process. Though critics of the IMRAD structure claim that it is too rigid and simplistic as it limits creativity and may not give realistic representation of the thought process of the scientist, however, at present it is the only universally accepted and adopted format in biomedical publication.¹⁸

Title of an article entices the readers. It should be catchy, reflect the content clearly and be specific. An ideal title identifies the article's main issue, begins with the subject matter, and is short but complete, accurate and unambiguous. The language should be simple with preferably short sentences and active writing when possible. Tense is important in scientific writing. All known facts and hypothesis should have present tense and past tense should be there for description of the results. Illustrations and figures should be contextual, legible and properly labeled.

Appropriateness of the study design

The main strength of any research is its study design. With the journals flooded with hundreds of articles on the same subject, it is always difficult to identify the important ones. Careful scrutiny of the study design helps to isolate the researches whose conclusions can be relied upon. With the numerous types of researches published ranging from retrospective series to randomized controlled trials, there are wide variations in the format of the study design. To bring uniformity in these designs and to avoid biasness, guidelines have been proposed for these studies. These guidelines specify the minimum information that should be included in a research report to allow readers to judge the quality of the study. (Table 2)

Table 2: Research types and reporting guidelines

Type of study	Guide lines	
Randomized trials	CONSORT	CONSORT 2010 Statement: updated guidelines for reporting parallel group randomized trials
Observational studies	STROBE	The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies
Systemic reviews	PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement
Case reports	CARE	The CARE Guidelines: Consensus-based Clinical Case Reporting Guideline Development
Qualitative research	SRQR	Standards for reporting qualitative research: a synthesis of recommendations
Diagnostic/prognostic studies	STARD	STARD 2015: An Updated List of Essential Items for Reporting Diagnostic Accuracy Studies
Quality improvement	SQUIRE	SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process
Economic evaluations	CHEERS	Consolidated Health Economic Evaluation Reporting Standards (CHEERS) Statement
Animal pre-clinical studies	ARRIVE	Improving bioscience research reporting: the ARRIVE guidelines for reporting animal research
Study protocols	SPIRIT	SPIRIT 2013 Statement: Defining standard protocol items for clinical trials

(Further details can be accessed at: <http://www.equator-network.org/toolkits/teachers/key-reporting-guidelines-for-the-main-types-of-research-studies/>)

To alleviate the problems arising from inadequate reporting of randomized controlled trials (RCTs), CONSORT Group laid out the CONSORT (consolidated standards of reporting trials) statement.¹¹ It is an evidence-based minimum set of recommendations for reporting RCTs. It offers a standard way to prepare report of trial results facilitating completeness and transparency. The CONSORT Statement comprises a 24-item checklist focusing on how the trial is designed, analyzed and interpreted and a flow diagram is used to display the progress of participants through the trial. As it is an important tool for critical appraisal and interpretation of results of RCTs, CONSORT Statement has been endorsed by prominent general medical journals. Similarly, for observational studies in epidemiology (cohort, case-control studies, cross-sectional studies), the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist should be followed.¹³ These guidelines have been endorsed by quality developing country open access journal.¹⁹

Biasness in a research

In simple terms, it means that the results of a study have deviated from truth. It can be attributed to chance (e.g. a random error) or to the study methods (e.g. systemic bias). Random error affects the precision of the study but does not influence the results in any particular direction.

The systemic bias results during participants' selection, data collection, analysis of results and its interpretation.

Bias can emanate from the author's background, institutional affiliation, grant or funding etc. Publication bias leads to failure of publication of important research with negative results that might have contributed a lot for the science.

Statistical analyses performed

While critically analyzing, for non statisticians, it might be difficult to assess the appropriateness of the statistical tools used in the study. Factors such as appropriate sample size, data collection tools, data analysis methods chosen should be properly stated. The results should be stated clearly and fully supported by the analysis.

Missing data and the loss to follow up that can occur in a study should be properly mentioned since these might greatly influence the results and add bias to the study. In RCT, patients' data should primarily be analyzed on the basis of random allocation regardless of them receiving the treatment or not according to the principle of intention-to-treat (ITT). Any protocol violation in the study should be properly stated. Data should be presented in such a way that a reader can verify the statistical accuracy if required.

In a research, statistical significance may not always translate to clinical significance and the reader has to be aware of the implications. There is always a tendency to extrapolate elaborate conclusions not backed up by

evidence presented by the results and these should be identified while analyzing a research article.

Ethical issues

The Belmont Report (1974) summarizes three basic ethical principles relevant to research involving human subjects.¹⁵

- Respect for persons
- Beneficence
- Justice

Each individual in a study should be treated as autonomous agent. The investigator must ensure that the subject has received a full disclosure of the nature of the study, the risks, benefits and alternatives, with an extended opportunity to ask questions. Persons with diminished autonomy are entitled to protection. Persons with diminished autonomy such as prisoners, students, children, etc should not be coerced to participate in a research. The investigator should aim to maximize the benefits and reduction of risks that might occur from the research.

Justice implies fairness in distribution such that benefit to which a person is entitled is not denied without good reason or a burden is not imposed unduly. This is achieved by equitable selection of participants and it should be clearly mentioned.

According to the U.S. Department of Health and Human Services Office of Research Integrity (ORI), research misconduct is defined as the “fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.”¹⁶

The ICMJE recommendations (Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals) includes a set of guidelines produced by the International Committee of Medical Journal editors for standardizing the manuscripts published by biomedical journals and are called the Uniform Requirements for Manuscripts submitted to Biomedical Journals (abbrev. Uniform Requirements : URM’s).¹⁷ It requires manuscripts involving human trials to register in a clinical trial registry (e.g. ClinicalTrials.gov) before the enrollment of the first participant and to include the registration ID in the manuscript as well.

Ethical issues regarding sample size calculation is also a major concern. The issues related to inadequate sample size making clinical trial unethical dates back to 1978.²⁰ If a study has too small sample size it will not be able to detect clinically important effects where as large sample size might make unrelated effects significant and the study may become scientifically useless leading to unethical use of subjects and resources.²¹ Calculation of sample size will always remain a contentious issue as the sample size calculation is always the best possible approximation for a study. The methods used to calculate the sample size should be properly mentioned so that it can be

crosschecked while analyzing an article.

Common ethical issues in research are;

- Authorship disputes: deliberately misrepresenting a scientist’s relationship with published work
- Informed consent
- Misconduct in research
 - Plagiarism
 - Simultaneous submission to more than one publication at the same time
 - Research fraud including fabrication (of research data) and falsification (manipulating research data, tables or images)
 - Salami slicing: ‘slicing-up’ of research that would form one meaningful paper into several different paper
- Disclosure of competing interests
- Sample size calculation

Finally, to help researchers make sense of evidence, there is a critical appraisal skills program (CASP) that offers training, workshop and tools (assessed at www.casp-uk.net). CASP is a part of better value healthcare, a training organization led by Professor Sir Muir Gray. It grew out of the Critical Appraisal Skills Program in Oxford in 1993 to help health care decision makers understand scientific evidence and since then it has conducted critical appraisal workshops in 30 other countries in South America and Central Europe. The CASP has separate checklist for the appraisal of systematic reviews, RCTs, cohort studies, case-control studies, diagnostic test studies, economic evaluations and qualitative research that each comprise 10 questions. They have been developed from the Users’ guides to the medical literature series of articles that were originally published in the Journal of the American Medical Association.

Critical Appraisal is an important skill that enables a clinician not only to assess the reliability and relevance of published research papers but also to prepare a good research article. It requires frequent browsing of research articles and their analysis.

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References

3. Oldenburg H. Epistle Dedicatory. *Philosophical Transactions* 1665;1:1-22. <https://doi.org/10.1098/rstl.1665.0001>

4. Jinha AE. Article 50 million: an estimate of the number of scholarly articles in existence. *Learned Publishing* 2010;23:258-63. <https://doi.org/10.1087/20100308>
5. MEDLINE® Citation Counts by Year of Publication (as of mid - November 2015)* [Internet]. U.S. National Library of Medicine. National Institutes of Health; [cited 2016Aug10]. Available from: https://www.nlm.nih.gov/bsd/medline_cit_counts_yr_pub.html
6. Young JM, Solomon MJ. How to critically appraise an article. *Nat Clin Pract Gastroenterol Hepatol* 2009;6(2):82-91. <https://doi.org/10.1038/ncpgasthep1331> [PMid:19153565]
7. Porta MS, Greenland S, Last JM. *A dictionary of epidemiology*. 5th ed. New York: Oxford University Press; 2008.
8. Garfield E. The history and meaning of the journal impact factor. *JAMA* 2006;295(1):90-3. <https://doi.org/10.1001/jama.295.1.90> [PMid:16391221]
9. Bjork BC, Solomon D. The publishing delay in scholarly peer-reviewed journals. *Journal of Informetrics*. 2013;7(4):914-23. <https://doi.org/10.1016/j.joi.2013.09.001>
10. Butler D. Investigating journals: The dark side of publishing. *Nature* 2013;495(7442):433. <https://doi.org/10.1038/495433a> [PMid:23538810]
11. Beall J. Predatory publishers are corrupting open access. *Nature* 2012;489(7415):179. <https://doi.org/10.1038/489179a> [PMid:22972258]
12. Bohannon J. Who's afraid of peer review? *Science* 2013;342(6154):60-65. <https://doi.org/10.1126/science.342.6154.60> [PMid:24092725]
13. National Health and Medical Research Council (2000). *How to Review the Evidence: Systematic Identification and Review of the Scientific Literature*. Canberra: NHMRC.
14. Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. *BMC medicine* 2010;8(1):18. <https://doi.org/10.1186/1741-7015-8-18> [PMid:20334633] [PMCID:PMC2860339]
15. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *Ann Intern Med* 2007;147(8):573-7. <https://doi.org/10.7326/0003-4819-147-8-200710160-00010> [PMid:17938389]
16. Spittlehouse C, Acton M. Introducing critical appraisal skills training in UK social services: Another link between health and social care? *Journal of Interprofessional Care* 2000;14(4):397-404. <https://doi.org/10.1080/13561820020003946>
17. Vollmer SH, Howard G. Statistical power, the Belmont report, and the ethics of clinical trials. *Science and engineering ethics* 2010;16(4):675-91. <https://doi.org/10.1007/s11948-010-9244-0> [PMid:21063801]
18. Steneck NH. ORI Introduction to the responsible conduct of research. Washington: US government printing office. 2007. p. 164.
19. International Committee of Medical Journal Editors. Uniform requirements for manuscripts submitted to biomedical journals. *N Engl J Med* 1997;336:309-16. <https://doi.org/10.1056/NEJM199701233360422> [PMid:8995096]
20. Medawar P. Is the scientific paper fraudulent? *The Saturday Review* 1964;1:42-3.
21. Sharma A, Aryal D. Guidelines for reporting health research: what authors should check before submitting an article. *Journal of Society of Anesthesiologists of Nepal (JSAN)* 2016;3(2):53-4. <https://doi.org/10.3126/jsan.v3i2.15606>
22. Newell DJ. Type II errors and ethics. *Br Med J* 1978;2(6154):1789. <https://doi.org/10.1136/bmj.2.6154.1789> [PMCID:PMC1610052]
23. Altman DG. Assessing new methods of clinical measurement. *Br J Gen Pract* 2009;59(563):399-400. <https://doi.org/10.3399/bjgp09X420905> [PMid:19520023] [PMCID:PMC2688042]