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Revealing the faults in medical journals*

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Abstract

Medical journals hold an exalted position in medicine, but have many shortcomings. This perspective reviews some of the shortcomings of medical journals which are primarily related to inexperience, bias, and commercialism. The issues discussed include the uncertain mission of the traditional medical journal in the modern digital age, the inherent inexperience of voluntary editorial boards, the weaknesses and capricious nature of decisions made by the peer-review process, the uneven value of most journal articles, the bias in what gets submitted and published in journals, the misunderstanding about the criteria for authorship, the misunderstanding of the need for ethical review board approval of studies, the misunderstanding of the need for informed consent for research from patients and ethical review boards, the various sources of assistance to editors and authors in dealing with the many ethical issues arising in the publication process, the commercialization and manipulation of medical journals by industry, the prevalent and complex financial entanglements of authors with industry, and the imperfect impact factor, which has the potential to be abused. The perspective concludes with theorization of the role of medical journals in the future. Readers need to scrutinize data in the literature carefully and interpret the discussions and conclusions critically, as there are biases in what is published in medical journals.

Key words: medical journals, commercialism, bias, scientific merit.

Abbreviations: IF – impact factor, WoS – Web of Science, Equation – Eq.

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Medical journals hold an exalted position in the profession, but they are not without their faults, some being announced by the media and some only known by the editors. Richard Smith, former Editor of the BMJ (previously known as the British Medical Journal), in his book, "The Trouble with Medical Journals", provides impetus to consider many of these issues and herein are some that may trouble those who hold the journals in such high esteem. Commercialism, bias, and inexperience are the sources of many of these problems, which may accelerate for the reasons presented here. Editors, reviewers, authors, and readers (the public) need to be aware of these shortcomings and remain skeptical in interpreting reports that emanate from these pulpits. The problems affect all medical journals, and perhaps more the high impact journals in which competition for publication and the enhanced glory of publication are enhanced.

THE MISSION OF MEDICAL JOURNALS UNCERTAIN IN THE DIGITAL AGE

The mission of medical journals is a debatable issue. There are many aims of medical journals and not all can always be met simultaneously. These include good and exciting science, physicians' education, improvements in patient care, public information, and public health, entertainment (or at least interesting), and enough value for subscribers to maintain the economic model. Some journals take on the role of both a scientific and a clinical journal if they determine that the research has potential short-term implications (i.e. is translational) for patients. Each journal and journal editor will have their own notions of the direction for the journal. Some journals are scanned carefully by readers when they arrive and others are just placed on a pile for possible

*The editors dedicate this article to the memory of Prof. Ludwik Hirszfeld, founder of the Institute of Immunology and Experimental Therapy, Polish Academy of Sciences (Wrocław, Poland) and its two journals (Postępy Higieny i Medycyny Doświadczalnej in 1949, Archivum Immunologiae et Therapiae Experimentalis in 1953), who died fifty-five years ago.

future reading. Even many academics approach the literature only on the internet as the need arises, since the internet is fairly current and, for some journals, ahead of the print version. Google and other search engines bring you information quickly, even from journals (Liesegang 2007c).

Editors must answer to many groups, including authors, the editorial board, reviewers, clinicians, the public, the publisher, the media, and perhaps others. Trust is crucial to journals and can only be maintained by editorial independence. Journal editors and editorial boards should make decisions about the scientific content of the journal independent of interference, providing they are consistently prudent in their decisions. Many journals belong to societies or organizations and some are clearly beholden to those organizations, as witnessed by some firings at JAMA and the Canadian Medical Association Journal as well as other suspicious replacements.

Some journals seem especially interested in how the media will perceive a study and accept sensational studies of little scientific merit. Some feel journals should be entertaining so that they will be read. Most academic editors feel there are separate roles for tabloids and for journals. Tabloids are more frequently read because they present a synopsis written in clinical jargon (rather than research jargon) by a clinician, perhaps industry funded, to distill the complicated science presented at a meeting (and later in a journal). The Ingelfinger--Relman rule (Relman 1981) restricts study publication by the media (including medical tabloids) prior to publication, but it is under strain because authors are ethically required to present the clinical findings of publically funded research at meetings, while journalists have a duty to cover meetings and the material can appear in print or digital format closely after a meeting. We accept this current media presence, but we have published a suggested solution to this issue which requires that authors not provide journalists with additional information other than what they can obtain from the podium presentation; in that way the complete methods, results, and discussion are delayed until the journal can complete a peer-review process and subsequently publish the article (Bressler et al. 2004). Most manuscripts undergo significant changes during the peer-review process, some changing the results and even conclusions, so medical journals still have a significant primary role here.

It is the obligation of major journals to publish research that is important and well conducted. Therefore some authors might question why high impact journals are able to reject good work. Editors have a responsibility to both the public and the authors and must choose (with an unavoidable human personal bias) what they consider most important for the readership or public.

VOLUNTARY EDITORIAL BOARDS

Until recently there was no job description or training manual for editors or editorial board members and virtually none had planned this activity early in their careers or had proper preparation. This is especially true within the smaller medical journals, whose number far exceeds the larger high-impact visible journals which may have professional editors and staff that meet regularly to thrash out issues and manuscripts. Most journals process manuscripts through a static peer-review process with little interaction about the manuscript and with an isolated decision made by the editor-in-chief, who must garner whatever opinions have been provided, realizing that some of the best in our profession may have been invited to provide a peer review but have declined to participate. A lively interaction within the editorial board or with other reviewers is occasionally needed to decide the fate of a manuscript, but these interactions are not common. The editor-in-chief has the major accountability for each decision made by the journal, with the only oversight provided by the perceptions of the editorial board or publisher might be able to perceive. It is best if the editor-in-chief brings no financial or any other bias to the table, but we all, admittedly, have human biases.

Fortunately, for the newly ordained editor there are now organizations such as the Council of Scientific Editors (Scott-Lichter et al. 2006), the World Asso-ciation of Medical Editors (WAME) (Utiger 2001), and other publications that can provide some assistance and occasional meetings, such as the peer-review proceedings sponsored by JAMA. The editors of the American Journal of Ophthalmology, Archives of Ophthalmology, and Ophthalmology have combined to produce a series of articles in our specialty as part of our own education in editorship as well as the education of future editors (Editorship Series in Ophthalmology).

PEER-REVIEW IS SUBJECTIVE

Peer review, the backbone of the journal editorial process for a century, is only now being studied in a systematic way (Rennie 1986). Whereas trust is the factor in acceptance of the process, early systematic investigations confirm the opinion of many authors that the peer--review process is costly, takes up significant academic time, and is highly subjective, slow, inefficient, ineffective, capricious, and prone to bias and abuse. Despite these shortcomings, almost all editors cling to the present system until a better system is devised, although these shortcomings affect what gets published and adds to the complexity of the authors' own biases.

Peer-review processes may differ among journals and are inconsistent even within the same journal; the author approaches each journal with some uncertainty. Most manuscripts rejected by one journal end up published in another journal, which is understandable, but

many authors ignore the recommendations of the initial reviewers, which is not acceptable (Liesegang et al. 2007; Lock 1991).

Mistakes are made in decisions about specific manuscripts, sometimes in the acceptance and sometimes in the rejection, but hopefully not out of undue bias. Editors are looking for original, relevant, interesting, methodologically correct studies and we rarely find all features in any one manuscript, so we are compromising in accepting most manuscripts in the first place. Over 50% of the articles printed in the major US general ophthalmology journals are from international authors, so the competition is now more intense for the limited print-page allotment. Many efforts have been made to improve peer review, but it is difficult for any journal, especially of smaller professional specialties, to improve the process except with a fulltime experienced professional editorial board. Open review (in which the reviewers are revealed) has a spotty history of success and has not really been adopted by most journals. Training reviewers might help somewhat, although studies have shown only modest improvement (Schroter et al. 2004).

What have we learned about peer review? The best reviewers are under age 40 and have spent a few hours reviewing the manuscript (Godlee and Jefferson 2003). I can attest that some reviews are outstanding, some are useless, and the majority are adequate to get the message across to the authors, whose opinion about the quality of the peer-review process correlates directly with the decision of acceptance or rejection. Most journals do not pay reviewers, so the process is voluntary and some of the best researchers decline to review for most journals. Thus, admittedly, journals do not always obtain the best review possible.

THE QUALITY OF ARTICLES PUBLISHED VARIES

There are rarely blockbuster reports in our journals as most articles contribute only incrementally to improving practice patterns. There is insufficient good evidence in the literature to support most of what we do in medicine. Journals publish what is submitted to them and do not follow a curriculum, although editors make an attempt to solicit articles which cover the most important current topics as articles, reviews, or editorials. Even the important studies reported in the literature are admittedly complex and most readers do not have the skills to interpret them. Many authors overstate or over-generalize their data, report results in unacceptable formats, or provide a discussion far beyond the meager data (Ioannidis 2005; Jabs 2005). Many studies are rejected because they were not set up correctly; these methodological problems should have been detected by the Institutional Review Boards (see below). Even studies that are scientifically valid are frequently not relevant to doctors or their patients. Half of all articles published are never even cited once by anyone. In the USA, clinicians frequently depend on (sometimes) financially conflicted key opinion leaders in a tabloid or from the podium to reveal what they should do with the complex or confusing literature information.

Journal articles, if in fact accurate and important, take years to be accepted into clinical practice; this substantial gap between publication and practice has been labeled an unacceptable "chasm" by the Institute of Medicine (Institute of Medicine 2001). Clinical practice should be driven by evidence-based medicine and at present we have difficulty getting a handle on where all this available information is located in cyberspace, and therefore cannot assimilate it for presentation and adoption. At a time when more information is being produced, most clinicians are more confused about how to treat certain diseases. Journals are not currently providing information in an easily useable format to be clinically useful in a "just-in-time" practice environment.

The quality of the writing varies, with many authors waxing eloquently about minimal points and in other instances writing unclear study designs. With smaller journals there is no "writing committee" to challenge or rework these manuscripts after the initial peer review and the copyeditors are usually only performing minimal grammatical changes (they are not scientists or clinicians). References are not confirmed by many journals. In short, the authors are required to provide a publication-ready manuscript, but frequently fall short in both the science and the communication.

Clinicians tend to prefer review articles (to original research) wherein someone else tells them how to interpret the literature, sometimes with an evidence-based approach, but more frequently just with an opinion. In the USA the commercial tabloids are more completely digested than the more learned journals. In some specialties, new and original information is presented at meetings and captured in a newspaper or professional trade magazine, while the journal only publishes the definitive (referable) article perhaps months later. In this day of meetings reported in tabloids and publication in blogs or internet journals, it becomes difficult for a journal to command truly original material. Should journals simply be a place to deposit well-known facts for posterity or do journals have an active role in original education? The mission of medical journals is evolving.

Much of what is published is later refuted: not as in fraud, but as in newer and better science. Peer review should extend for the life of the article, and not just be an event prior to publication. It is disappointing that there is a lack of challenge to most published articles. Publication should be the beginning of the debate and not the end of peer review.

However, exactly what to accept in correspondence is an issue, since some clinicians just want to rant without any factual information to convey. I am hesitant to provide a forum and a reference for ill-formed thought processes.

THE PUBLISHED LITERATURE IS BIASED

The published literature presents a rosy picture of most forms of therapy since inconclusive or negative studies (which report therapies as ineffective) seem to be published less frequently than positive studies. The blame for this is not, however, with the journals' rejection of negative studies (Olson et al. 2001), but rather with sponsors or authors who fail to submit such studies in the first place (Dickersin 1990; Dickersin and Min 1993). If the question is important, a negative study is just as valuable as a positive one. IRB-approved studies frequently do not lead to publication because of failure of action of the sponsor or principle investigator. Pharmaceutical company studies are much likelier to have positive results than studies not sponsored by pharmaceutical companies, so they have an inordinate influence on what gets published because they, in many instances, control what is submitted (Liesegang et al. 2008b; Lexchin et al. 2003; Kjaergard and Nielsen 2002).

Allegations of selective publication and biased reporting of clinical trials have led to the demand for full disclosure and transparency in clinical research (Levin et al. 2005). Clinical trial registration, as recommended by the International Committee of Medical Journal Editors (ICMJE) (The International Committee of Medical Journal Editors 2008) and required by many journals, has the potential of making all study results available, positive or negative, but it requires web publication of data in a format that cannot be interpreted by the public and by most clinicians (De Angelis et al. 2004).

AUTHORSHIP CRITERIA FREQUENTLY NOT FULFILLED

In fictional writing the author is clearly identified and it is usually a single person. In science, especially in this era of complex multicenter drug company-funded studies and with multidisciplinary translational research, the correct role, listing, or even the order of authors can become a muddled event. Authorship is related to the two features of 1) taking credit, which everyone wants, but at the same time 2) being accountable, which some authors shy away from when issues arise after publication.

The ICMJE has published criteria for authorship which are quite strict. Their criteria require that, to be an author, one should meet these three criteria: 1) contribute to the design, data acquisition, data analysis, or interpretation of the data, 2) be involved in drafting, revising, and critiquing the intellectual content, and 3) approve the final version of the manuscript (ICJME 2008). It is not surprising that authors, and even editors, do not know or do not agree with these tenets and certainly do not adhere to them (Bhopal et al. 1997; Shapiro et al. 1994). In fact, it would be difficult to assume that in a multi-authored article, each of the authors agrees with the interpretation of results and the conclusion of the study; uniform agreement is not humanly possible with complex data and human biases (Horton 2002).

To circumvent some of these confusions in authorship, Rennie and colleagues (Rennie et al. 1997) have advanced the concept of listing "contributors" rather than "authors". Although this has not supplanted authorship, many journals (including the American Journal of Ophthalmology) have adopted elements of this, with the specific "contributions" of the authors listed in the published acknowledgement section.

Ghost authors and guest authors are separate entities that deserve further clarification in this age of transparency (Flanagin et al. 1998). The ghost author, usually a medical writer who may work for a pharmaceutical company but is not listed anywhere in the published manuscript, is a form of journalism that should be abandoned. Although some editors feel these writers should be banned, they may serve to improve understanding of the science and clarity of the manuscript. They should not be the ones, however, to put the "spin" or bias on the study or discussion. Such medical writers may reach the level of authorship, but they should at least be acknowledged as well as held accountable. A guest author (also called variously Honorary or Gift Authorship) is someone who has not really participated in the study but is listed to add prestige to the work; this individual may be the chair of the department, the laboratory supervisor, or the leading academic in the field. All these types of guest authors do not meet the currently accepted guidelines for authorship and the practice of guest authors should be abandoned (Liesegang et al. 2008a).

ETHICAL REVIEW BOARDS, INFORMED CONSENT, AND JOURNALS

Ethical review boards, called Institutional Review Boards (IRBs) in the USA, are a relatively new entity that arose following the revelations of the Nuremburg trials and the publication of the Declaration of Helsinki. Prior to this, doctors alone decided what was ethical and they were, in retrospect, frequently misguided. Now frequently overworked, under-resourced, and/or insufficiently trained IRBs take on many and increasing roles to review the technical, ethical, legal, and scientific aspects of protocols on patients (Liesegang 2007a). An analysis by the Institute of Medicine found IRBs wanting and suggests that there be three committees: one to evaluate the scientific methodology, one for the ethics, and one for the conflicts of interest (Institute of Medicine 2002). It has been suggested that the board consist of full-time professional members rather than the present volunteer members. Even recently, IRB approval has been poorly documented and reported by journals. There are issues wherein private practitioners in some countries do not have access to an IRB, or in some developing countries there are no IRBs, or cultur-

al differences make it difficult to conform to western journal standards of informed consent for research.

IRBs have been harassed because of recent ethical research violations and many IRBs are focused primarily on ethical concerns and view the research protocol as the end of a process, rather than on coordination with journals for publication of the best science possible. Failure to publish completed studies is actually research misconduct, and approving/permitting research that is really not able to answer the hypothesis is likewise unethical since the participants are put at risk (Pich et al. 2003). However, these are not the issues that IRBs are confronting.

Patient informed consent with regard to research continues to be misunderstood and there is no clear definition of when the clinical care of patients (i.e. practice) converts to research and, in fact, it is usually only exposed in retrospect that the participants, ethicists, and the researchers have differing opinions, especially when bad results occur. I have explored the concept of "informed consent for research" in an editorial, but admit there are many alternate opinions (Liesegang 2007b). Most clinicians, and even journal editors, do not agree on what constitutes research (which must be approved by an IRB) and what constitutes sufficient informed consent "for research".

Informed consent for research requires that the participants know it is research (as distinct from routine clinical practice) and they should receive a description of the risks and benefits, alternative treatments, extent of confidentiality, statement of compensation for possible problems, contact information for further information, and a statement about the voluntary nature of their participation. At the present time there is a disconnect between IRBs and journals which is a misfortune, especially for the participants of research. IRB review, journal peer review, publication, and post-publication dialog through correspondence should be a continuum of discussion and debate rather than isolated disjointed events.

Let us also acknowledge the opposite situation of excess bureaucracy from IRBs and from the Health Insurance Portability and Accountability Act (HIPAA) in the USA as well as the ethical hurdles that studies must overcome, which is actually stifling research (Institute of Medicine 2009). These processes, though well intended, have increased the complexity and cost of research such that only large pharmaceutical companies or governmental organizations can afford clinical trials, shutting out smaller biotech firms, which are the lifeblood of research in medicine. We must search from more streamlined processes and education about the true benefits of each of these processes.

ETHICAL MISCONDUCT IN JOURNALS

Ethical issues are complex and arise ever more commonly in journals. Many cases of fraud and episodes of research misconduct has been discovered and then exploited by news tabloids. The incidence is low, but all journals must strive together to improve the editorial and publication process so that these can be limited, recognized, and corrected. Concerted efforts have been made to improve the science and integrity of the literature through various publications and the formation of the Committee on Publication Ethics (COPE), founded in 1997, to educate and assist editors in the principles and many guidelines that have been proffered for dealing with misconduct (Committee on Publication Ethics 2004). The WAME (World Association of Medical Editors 2009), the ICJME (The International Committee of Journal Medical Editors 2008), and the Committee of Science Editors (Scott-Lichter et al. 2006) have also been helpful in drafting consensus guidelines on approaching ethical issues. Trust is assumed in the scientific world and journals do not employ police forces. Although editors cannot undertake most investigations, they have a duty to ensure that the appropriate authorities (IRB, institutions, and sponsors) are alerted to suspected misconduct and to request a return report. If there is not full cooperation and the facts revealed by publication, journal editors still have the responsibility to publish notices of concern. In some instances, material must be appropriately retracted or corrected. Researchers should be willing, and are required by some journals as a condition of peer review, to provide further information or raw data to the journal in the process of peer review either before or after publication. Editor misconduct can also be addressed by several mechanisms (Godlee 2004).

COMMERCIALIZATION AND THE MANIPULATION OF MEDICAL JOURNALS

Commercial companies now independently conduct all aspects of scientific research on their products, often designing the studies, performing the analysis, writing the papers, and deciding whether, when, and in what form to publish the results. In some multicenter trials the authors may not even have access to all their own data (Angell 2008). Industry has a responsibility to its shareholders to market products as well as it can by whatever legal means; ethical concerns are less of a burden. Doctors have a responsibility to their patients, so they are at evident odds with industry in some regards, but at the same time have become financially dependent on industry for much of what is done in medical research and education (Lichter 2008; Jampol et al. under preparation).

As pharmaceutical companies run out of diseases or the number of significantly new products decreases, as in recent years, they have shifted more of their considerable resources from research to promotional marketing, which includes "education" by Key Opinion Leaders and other CME or non-CME events, but also using journals

in clever ways to extend their marketing theme (Smith 2006). Clinical trials published in a large-circulation journal are far more valuable than advertising in journals since it provides some sort of validation. So what can be the damage if we end up with good clinical trials? Richard Smith (Smith 2006) outlines only some of the intentional scientific weaknesses in industry-conducted clinical trials compared with non-industry-reported studies that result in this marketing bonanza. Frequently the studies are "seeding trials" in which doctors are paid to use drugs without a hypothesis or controls. Doctors may also be paid to participate in "switching" patients to a newer drug. A "post-marketing surveillance" study pays doctors to monitor patients for adverse effects; these do have clinical relevance, but at a large cost and no comparison group. Pharmaceutical companies are usually required to test a drug against a placebo, although this is not ethical if there is an evidence-based effective therapy. The "head-to-head" trial against an effective treatment is a concern for pharmaceutical companies since one drug company usually loses. Thus companies prefer the placebo-compared trials, which usually can only show that the drug is at least as good (the so-called "equivalence" or "non-inferiority" trial) and are hard to interpret and frequently meaningless if the data are explored fully; these are easy for drug companies to tout and are therefore popular. "Economic evaluations" are also troublesome since they are complex and difficult to interpret or to get properly peer reviewed. The commercialization of medical journals has other ill effects on professionalism (Liesegang 2008).

Most large randomized controlled trials in the major journals are funded by a pharmaceutical company (Egger et al. 2001) and are not conducted at academic medical centers (because the processes are too slow) but rather by contract firms. These firms are paid for their services and the participants are enrolled by local clinicians who may not even know the hypothesis, will not see the data or results, and are usually not sophisticated enough to interpret the data (Liesegang et al. 2005a). The company can chose to publish those clinical trials that it wishes since they control the data, unlike the responsibility of the principle investigator at an academic institution (Freeman 2005). Not surprising, almost all studies funded by industry have favorable results towards industry, admittedly at the same time having seemingly high quality, which makes it difficult for journals to reject the studies (Lexchin et al. 2003) that industry chooses to submit for publication. When academics are involved it gets much more complex and there have been many instances of academics differing with the pharmaceutical company on the decision to publish and what to publish, some of which have reached the news media (Rennie 1997). The Committee of Journal Medical Editors has taken a strong stance that journals should accept manuscripts for publication only if the authors control the decision for publication (Davidoff et al. 2001).

The free medical newspapers or tabloids that clinicians receive regularly are funded by pharmaceutical companies and are highly effective in influencing physicians' behavior. The majority of clinicians read this content, in preference to reading journals, since it is synthesized and short, easy to read, attractively laid out with pictures and diagrams, and clinically relevant. The same content may appear in a peer-reviewed journal either before or after the tabloid. These tabloids are a good impetus for medical journals to improve their value to clinicians. The tabloids are not always accurate and, just as in the rest of advertising, the information is frequently misleading by overstating effectiveness or minimizing risks (Gottlieb 2002; Villaneuva et al. 2003; Wilkes et al.1992). Most editorial boards are attuned to these issues and pharmaceutical companies are held to higher standards in the peer-review process since we all realize their marketing aim, although the peer reviewers must be clever to detect the faults and biases in these pharmaceutical studies. Some editors suggest refusing publication of all industry-sponsored studies, but this seems unreasonable.

PREVALENT CONFLICTS OF INTEREST

Authors and peer reviewers are all humans and have biases, including religious, personal, political, and competitive, all of which should be declared and may require personal recusal during a peer-review process. Financial bias is the one bias that can be quantified and will be addressed here because of its current topical interest and since it has the potential to distort the publication message.

The WAME, the ICMJE, and COPE all have guidelines that recommend financial disclosure policies for authors, staff, peer reviewers, and editors (Committee on Publication Ethics 2004; Scott-Lichter et al. 2006; The International Council of Medical Journal Editors 2008; World Association of Medical Editors 2009). Financial conflicts may include salary, consulting fees, research grants from a company with an interest in the results or a competitor, honoraria, stock or equity interests, intellectual property rights (patents, royalties, and copyrights), and expert witness testimony. I prefer that the authors disclose every financial involvement and not decide that some involvement does not influence this specific manuscript or presentation: that is for the reader or participant to judge. Journals try to ensure that readers are aware of the authors' financial relationships and potential conflicts of interest, but this "reader beware" warning fosters an unfounded assumption that disclosure in and of itself cleanses the issue (Liesegang 2008).

Academics and institutions are increasingly intertwined with industry as support for medical research from pharmaceutical companies has skyrocketed and also as marketing has become a primary focus of industry (Smith 2005). Pharmaceutical companies fund trials, studies, education events, and entertainment for doctors

because these activities do influence physicians' behavior. Most physicians who have financial contracts are convinced that have no conflict or change in behavior, whereas their peers as well as studies in human nature confirm that they are in fact conflicted due to the strong human principle of "reciprocity" (Association of American Medical Colleges 2007). Even the Declaration of Helsinki was recently revised by the World Medical Association to require researchers to declare their conflicts of interest to the study participants (World Medical Association 2008).

Financial involvements are still not consistently being reported despite journal requirements and direct questioning of authors (DeAngelis 2006; Fontanarosa et al. 2005) The financial statements of authors must be declared prominently in the manuscript. Some journals have tried to eliminate authors who have financial conflicts, especially in editorials and reviews, but it is difficult since so many physicians are now entangled with commercial companies. It is not appropriate to restrict pharmaceutical studies, but all persons involved in the peer-review process should be alert to the potential for bias in the conduct, process, and interpretation of a study by either the sponsor or the investigators. Clinical Trials Registration can now assist in helping to assure that authors are not "cherry picking" what portions of the data to support.

IMPACT FACTOR IMPERFECT

The journal impact factor is not a direct measure of quality and must be used with considerable care, especially since funding decisions are sometimes based on this consideration (Seglen 1997). Despite the recognition that the impact factor is an imperfect measure and has many detractors in the literature, there is no obvious alternative.

Thomson Scientific's Journal Citation Reports is intended to be a comprehensive aggregation of citations at the journal level in the appropriate literature field. There are over 6500 journals indexed and monitored, but this represents about 5% of the journals published in print or online. Journals not listed in the Science Citation Index database are often crudely referred to as having no impact factor (zero). This suggests, incorrectly, that 95% of journals are never formally cited, which is false. The impact factor of a journal is calculated by dividing the number of current-year citations to the source items published in that journal during the previous two years by calculating the ratio between the number of citations received (the numerator) and the number of *citable* articles published (the denominator). This two-year period is arbitrary, as is the whole objective measurement of impact factor. These source items (the denominator) include original articles and reviews of the literature, although the inclusion criteria for the index are somewhat unclear if you try to assess these and errors can arise in ensuring that the right types of articles are counted. The denominator does not include editorials, corrections, letters to the editor, and other editorial materials, reviews of books, software, hardware, and databases. However, if one of these latter items is cited, it counts in the numerator. The fact is that in most journals, 20% of the articles account for 80% of the citations and a large proportion of the articles are never cited at all (Seglen 1994). Some of those heavily cited articles are examples of fraud or misinterpretation.

There are several interpretive nuances regarding this objective impact number. The value of the impact factor is affected by the subject area, type and size of a journal, and the time frame of the impact measurement. There is actually little correlation between the citations of an individual article and the impact factor of the related journal (Seglen 1994; Seglen 1997) and all articles in a journal are obviously not of similar quality. Journal impact factors will vary with time in both absolute numbers and rankings, but the rankings of journals are a better indication of quality than absolute number, i.e. they are useful in establishing the influence journals have within the literature of a discipline. Scientific journals rank higher than clinical journals since the very life of a scientist is research and publication, whereas we hope doctors spend more time treating patients. Also, scientific articles tend to cite only scientific articles, whereas clinical articles cite both scientific and clinical articles, thus increasing the impact factor of scientific journals compared with clinical journals. English-language journals score higher than those in other languages and American journals tend to have higher impact factors. The algorithm favors journals having a larger proportion of non-citable items that do get cited. Review journals tend to score higher than those containing original articles and review articles tend to score higher than the original articles. Internet access of journals, especially open access, increases the impact factor of a journal. Online-only journals can have a high impact factor.

Impact factors may be manipulated by both authors and editors. References can be requested by the editor or reviewers that favor the journal. A high rate of self-citing can affect the impact factor, but it is neutralized by the fact that it is a frequent occurrence in most journal articles (as in this article where I have previously published on several editorship issues). Review articles can attract citations rapidly and in large numbers and research letters or letters to the editor and meeting abstracts can act as numerators. A paper that is retracted later may continue to be cited (and not necessarily with the retraction), thus adding little to the scientific validity of the journal.

THE ROLE OF JOURNALS IN THE FUTURE

Journals are relatively staid products that have overall been slow to change in this new electronic and social-networking atmosphere. Sometimes journals are the last to report important findings, but on the other hand they

are the only source that has undergone the filter of peer review; readers can be more comfortable with the information. Journals remain a prominent force in patient care and in public health, but there are many positive and negative issues that are accelerating and will change the present landscape. Journals are overly dominated by industry's influence on the type of clinical trials that are published and conflicted authors with unavoidable bias. At the same time, because of IRB protections, the HIPAA, and other costly processes, significant large research can only be afforded by the government or large pharmaceutical companies. Authorship is much more complicated as the studies are more complex and multidisciplinary; it has become more difficult for authors to sign the declaration that each has read and agrees with the manuscript submitted. The present system of publisher-oriented journal revenue has robbed the academic community of intellectual content without fair compensation, and open access is a strong movement with logical intent and impassioned drive [open access is not dealt with here because of space constraints, but summary information is available (Liesegang et al. 2005b)]. The traditional journal will remain the choice for academics until promotion boards better recognize online-only contributions.

Ultimately, all research protocols, results, and manuscripts will be on the web, but the interpretation of these studies still needs to be peer reviewed, clarified, and debated, either on the web or in the traditional journal format. Journals must change and adapt to new technologies and processes. Journals must embrace the web as people have learned new ways to communicate, assimilate knowledge on demand, and apply it to projects that interest them. Web 2.0 and 3.0 are already here and journals cannot remain static in this environment (Liesegang 2007c).

Patients are becoming more actively involved, are reading more medical content, and have more information (and perhaps even knowledge) in this age of open access, so the future practitioner will be pressed to match their knowledge. The new patient will not be the recipient of care, but in many ways will co-direct his or her care.

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