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Specificities of Electronic Publication in Medicine

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Abstract

Background: Electronic Media are considered to be a useful tool to distribute scientific information in medicine. Starting in this century all main publishers use electronic information transfer and distribution, either solely by electronic media or in combination with conventional paper printing.

Theory: Information distribution and communication require a sender (author), a transport medium (visual or acoustic signals, telephone, radio, TV, printed journals), and a receiver (hearer, reader). Information distribution in science and medicine should permit an objective and non-biased understanding of the transferred information by the receiver (doctor). These actions should be repeatable in time and space. This aim is in contrast to emotional, business-oriented, or political information transfer that commonly wants to direct the receiver in a certain surge or emotion.

Implementation: Scientific, peer reviewed open access journals have been established since the beginning of this century. After a period of hesitation and resistance which lasted for about 10 years, now-a-days nearly all big publishing companies offer open access journals in their product line. Most of them still hold on paper printed journals in addition, others offer hybrid journals, i.e., paper printed information display contemporary with electronic distribution. The electronic structures differ from classic structures (different, subject oriented domains) to articles of different focus that are fully integrated in only one individual domain. The advantages and disadvantages of the different structures are discussed in detail.

Conclusions and perspectives: Information distribution and communication is one important issue of life. The progress of technology does not stop at the doors of research and practice in medicine. To the contrary, it promotes both, understanding, interpretation and innovation of research, and the practical application. These facilitations of promotion are accompanied by ease of falsification and faked data. Business models of open access publication open doors of temptations to undercut science by anticipated profit. Previously serious publishers are already spoiled, and the scientific community should be aware that global investors are already misusing modern communication in science and research for their profit interest

Keywords: Open access publication; citation index; faked data; publication manufactories; globalization diagnostic pathology

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Introduction

Communication is as essential for human life as water, nutrition, or movement [1]. Historical medical communications have been detected in ancient Egypt periods, Chinese dynasties, Greek and Roman empires [2, 3]. They usually include visual information that was documented in "case reports", crude descriptions of symptoms and derived "diseases" as well as suggested treatment [4]. The knowledge of body organs or organ functions was poor and often wrong [5]. Certain documents (for example, the Andronikos scripts of Aristoteles) were considered as "absolute truth" that could not be corrected by experiments or own contradictory observations [6]. This period lasted for several centuries, and could only be surmounted when scientists, medical doctors, and researchers were brave and forced by detected natural laws to adjust the documented information to reality [7].

Social and medical communication was significantly promoted by the development of paper printing and the reproduction press by Johannes Gutenberg in 1442, its mechanical version by Friedrich Koenig in 1810, and the rotation printing machine by Richard March Hoe in 1845 [8, 9]. All these tools including their electronic equivalents such as TV distribute "passive, or fixed information", i.e. they only permit information acquisition, and no immediate reply of the reader to the information sender or source.

It lasted to 1665 when the first scientific medical journal "Journal des Scavans" and "Philosophical Transactions of the Royal Society (London) were printed [10]. After the construction of the rotating printing machine more sophisticated medical journals followed, for example the *New England Journal of Medicine, Surgery and Collateral Branches of Science* by John Collins Warren at the Massachusetts General Hospital, or the Münchener Medizinische Wochenschrift (Weekly Munich Medical Journal 1853 in Munich) [11]. A survey of historic medical information distribution and application and its influence in modern publication is given by Cerny [3].

Certainly, the development of the printing technology also influenced the distribution and display of scientific journals; however, the most significant changes occurred contemporary with the "digitalization technology" and its worldwide application [12, 13].

The digital world was born in the 1940s when Zuse developed his first digital calculator in 1941 [14]. Twenty years later electronic digital machines were first applied in Physics, especially nuclear Physics. It took another 40 years to implement "electronic visual signaling" in terms of information transfer and receive in medicine. The first solely electronically published peer reviewed medical journal, the "electronic journal of pathology and histology" was implemented in January 1995 [15]. Its last edition was published in 2001. It took additional six years to restart

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an electronically published journal in pathology, called

diagnosticpathology.org. This journal is working on an open access basis, and possesses a citation index of 2.41 today.

In our days open access journals multiply like mice, as their performance can be handled with open access software, communication transfer lines do exist without or nearly without any costs, access to the displayed information is easy, and the publication procedure is very fast, if handled correctly [16].

Can the present stage of open access publication be considered to be the peak of development? Are there additional issues that might be included into the medical publication process? If yes, what will they be, and what is their perspective?

Herein, we will try to answer these questions. We will start to clarify and define publication procedures, conditions, and influencing factors in medical science before we will discuss the perspectives of electronic publication in medicine.

Definitions in publication of medical sciences

Publication is a target oriented, usually a one way directed transfer of information. It can be acoustically transferred, often in steering processes; however, in science most of the information is transferred visually. The source translates the message into a letter, an image, and the receiver “reads” the letter, image, etc. The important factor of any publication is the “aim”. The aim is composed by two major influences. These are the expectations a) of the scientist (who wants a fast and far spread distribution of his message), and b) of the publisher (who considers publication as business, and consecutively wants to earn money). Both interests can collaborate in creating a journal with ordered structures (standards to read it), attractive illustrations, distribution of the journal to colleagues, or assistance in translation by the publisher.

The interest of the publisher is dependent upon the business plan of the publishing company. Three major payment methods have been established:

a) The reader pays. This is the conventional method, and can be implemented independent from the publication technique. In electronic publication the reader is provided with a password or a restricted access which he has to pay for.

b) Advertisement is included and reimbursed by companies, medical societies, government, grants, or other users, who are interested to distribute their services in addition to the scientific content.

c) The author pays. This business model is usually implemented in so called open-access journals. A free and world-

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wide accessible reading of the journal prohibits model a), because nobody can control the readers in an open access. Thus, open access journals are journals that permit a free and world-wide reading of their articles, and, in compensation for the free access, charge the authors for manuscript publication.

The boundaries of the involved interests differ between conventional publication structures and open access publications: They are clearly separated in paper printed conventional articles, and the authors are not involved in payment or reimbursement. To the contrary, open access publications are paid by the authors or their financial resources such as grants or commercial contributions. The situation seems to be strange and reminds of Tom Sawyer who hired his friends to paint a fence and got, in addition, paid by them.

The situation becomes even stranger as the authors who are financing the publisher do not have any influence about the amount they have to pay for publication. How to explain?

Globalization and publication

Open access publication is a financially successful result of globalization. World wide and completely free access to scientific publications allows any reader to have access to the latest and innovative articles. The number of potential readers by far exceeds that of paper printed articles, and amounts to thousands of "clicks" in well known journals. For example, the open access peer reviewed journal diagnosticpathology.org reports 50,000 clicks per month on its home page, those journals covering broader aspects of sciences report more than 200,000 clicks per month. Globalization which is by definition an international network of different global "actions" such as trade, politics, education, science, or medicine, requires mandatorily two prepositions, namely a) fast, reliable, and accessible "connection lines", i.e. the internet and related communication systems, and b) standards of communication, for example technical, ethical, financial, and linguistic standards [17].

The advantages of open access scientific publication touch several aspects which depend upon the aim of the involved actors.

Publishers can expect a worldwide business source, which is nearly unlimited due to tax related resources. A good running journal will carry approximately 500,000 US$ / year, which cannot be reached by any paper printed equivalent. Authors can expect an audience that can afford to read the distributed information. The only prerequisites include a computer (PC, Lab-top, e-phone, i-phone, etc.) with internet or comparable communication connection. Thus, researchers, doctors, scientists working in developing countries have immediately access to all kinds of information available. The privilege of colleagues working in developing countries which have been informed in a

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more advanced manner does no longer exist.

Publishing companies experience an additional advantage which is related to an inbuilt misconstruction of globalization, the unlimited and non-regulated pecuniary power which tends to expand and invade the boundaries of neighboring issues. To give an example: At present, the global market of scientific and open access publication is dominated by four main players, namely Pearson (5,6 Billion Euro), Reed Elsevier (4,4 Billion Euro) und Wolters Kluwer (3,6 Billion Euro), and Holtzbrinck Publishing / Springer Group (appr. 3,2 billion Euro) [18]. These four main players can easily control the market and regulate the fees, which authors (or the tax payer) have to pay for publication. In other words, similar to other fields of globalization, the participating communities are not informed about, not interested in, or not able how to regulate a network that is, in principle, adjusted to solely capitalistic ideas and performance [19].

What are the disadvantages for authors who want to publish their research and medical results? The greatest disadvantage of any author is primarily related to her/his working conditions which are equivalent to the working environment. It includes expensive equipment, well trained personnel, sufficient support of consumables, and satisfactory payment. These conditions are commonly not existent in developing countries. It has to be mentioned, that the publication fee is often waived and significantly reduced for colleagues working in developing countries. However, there is no general regulation. It depends upon the publisher, how the waivers are given, and to which conditions [20-24].

More frightening is the fact that some publishers such as Biomed Central try to censor scientific publications. They are eager to take over the scientific responsibility and to dominate science by solely pecuniary interest. This behavior assures short term profit, and diminishes the scientific reputation and quality as well as promotes the publication of falsified manuscripts. Thus, an additional general disadvantage or danger of open access publication is related to the network or information distribution system itself.

Falsified manuscripts

Manuscripts that contain falsified data are a great problem in open access publication, and hard to detect [25-28]. It seems that they are increasing in number and by technological tricks. The falsification includes to forge laboratory protocols, to incorrectly select patients for clinical trials, to use in-adequate statistical procedures, to copy images and figures from the internet, or to wrongly interpret own data [29-31]. Certainly, invited reviewers try to detect the misbehavior and to stop any publication; however, conditions exist, that limit the reviewer's action. Reviewers are usually working at a voluntary basis, and often do not have time to intensively judge a submitted

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manuscript. More important, however, is the fact that an increasing number of manuscripts focuses on scientific specificities which cannot be judged from colleagues who are not directly involved in the issue under consideration. Several investigations how to detect falsified data focus on reviewers who are proposed from the authors in comparison to reviewers who are invited by the editor [27]. Only negligible differences between these two strategies have been found [32, 33]. These investigations assume that reviewers who are proposed by authors automatically are prone to present courtesy reports. In our opinion these investigations do not trace the real important problem which is related to the specification in science. The more specific the research the less scientists are involved, and the more difficult it is to recruit experts. To give an example, in 1985 the European Union could not find independent reviewers to judge research in high energy physics because all potential reviewers have been involved in at least one of the applied proposals [34]. In addition, one should assume that colleagues who know each other also treat each other in an honest manner. This is, in fact true, as several investigations reported similar acceptance / rejection rates between reviewers who have been proposed by the authors and those proposed by editors [33].

Potential solutions include the publication of digitized images acquired from whole glass slides (virtual slides (VS)) in order to avoid copies taken from the internet or other sources, access to interactive calculations of crude data by the reader in order to check the accuracy of statistics, or interactive measurements of published immunohistochemistry images. These solutions are or will in the near future be implemented in the new journal diagnosticpath.com. None of the main publishing companies seem to be interested in these issues or to protect science against financial interest.

The electronic environment of open access publication has opened new publication methods that are known as publication manufactories, which touch the boundary of scientific data evaluation and publication [35].

Publication manufactories

Medical science, practice and research undergo significant changes in our days [22]. These are as all research closely associated with the technological development and changes in education of our children and students [36, 37]. The use of information databanks and global access such as Wikipedia, smart phones, and apps automatically changes the conventional communication tools and the knowledge how to apply them.

Children are no longer able to write in conventional scripts but use a keyboard, students are no longer trained to write a scientific expertise but check the internet and copy / paste the eligible paragraph.

Borkenfeld et al., diagnostic pathology 2015, 1:3
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What happens to researchers? Researchers investigate in and perform a specific experiment. When the first investigation is finished, they might just change the objects, and use the same experiment again. A characteristic performance are meta-analyses that analyze published data of the relationship between modified macromolecules and a selected disease, such as polymorphism of receptor A and disease I (for example polymorphism of estrogen receptor-ß and endometriosis, see *Diagnostic Pathology* 2014, **9**:184, published on September, 26, 2014). Once such an article has been made, it is easy to replace receptor A by another receptor B, C, etc., and /or the disease I, II, etc., and to feed in the new data into the text of the first article.

The next step of such manuscript generating procedure would be to compare scientific data of similar nature and to automatically write the wanted manuscripts by using a standard text with filled-in specific data. Commercial institutes have started to provide research teams with such programs. They are called publication manufactories. Several big publishing companies offer this service in addition to specialized companies. The scientists are no longer forced to learn "how to write an article". They just submit their data to a publication manufactory, pay, and finally receive the honour of a published, world-wide accessible article which displays their names as authors. The advantages and disadvantages of publication manufactories include again financial and scientific issues, and have been discussed in detail by Seife [38].

Is this behaviour to be blamed? It seems to be the unavoidable consecutive of open access publication, and is obviously related to the common use of ghost writers. In addition, even well known researchers buy commercially available tools which they do need for their experiments, for example antibodies, knock-out mice, labelled macromolecules, information taken from gene banks, etc.

We can conclude that the ethics of publication are changing. One might consider this behavior as scientific misuse which is not in agreement of generally accepted ethic regulations of science, especially medicine. Serious authors should be appropriately trained and be able to write and publish their research / medical data by themselves. This should belong to the minimum standard of education and performance of science and medicine. Contradictory opinions can argue that the scientist should not waste her/his time in order to write an article which can be better and faster done by professionals. In addition, the aims of the manuscript can be more effectively reached when specialists are involved.

Ethics cannot be proven to be right or wrong, at least not at this level. We therefore propose that articles written by publication manufactories should be clearly marked, and related articles should be mentioned in all of these publications.

Borkenfeld et al., diagnostic pathology 2015, 1:3
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Publication networks

Open access or mixed conventional / open access journals seem to display with the latest development in electronic communication [39]. All of them are "stand alone" communication tools. The publishing companies seem to consider journals that address the same or similar scientific fields as competitive rivals. They are afraid to loose authors and consecutively money.

Innovative electronic communication will not stop and limit itself in stand alone systems. New innovative issues have left their childhood and are in preparation to enter and probably dominate the scenario [40]. Their basis is the well developed communication standards such as the internet, or wireless telephony. To start with:

Similar to the development of Grid technology systems have been implemented that permit histo-morphology diagnostics on digitally acquired whole slide images, so – called virtual slides (VS) [37]. In addition, measurement systems are included into this communication system, as well as access to the latest articles listed in open access libraries (for example the NIH library, Pubmed), automated translation tools such as Google translation, and the creation of diagnostic assistants.

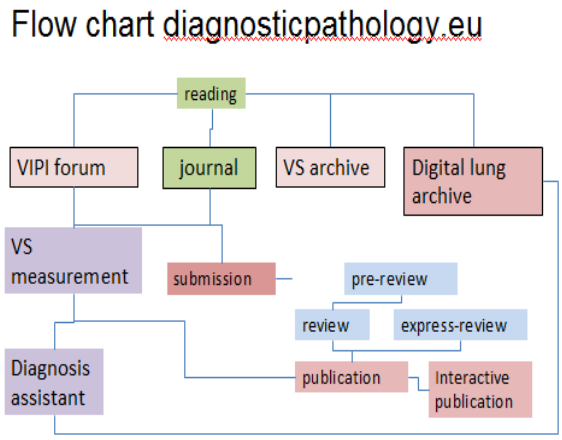

Figure 1: Flowchart of the electronic communication network, which is under preparation. The open access journal "The journal of diagnostic pathology" forms the center, connected with the Virtual International Pathology Institute (VIPI), the digital lung archive, the virtual slide (VS) containing case report collection, the automated VS measurement system (EAMUSTM), and derived diagnosis assistants to be applied for routine diagnostics (beside the microscope).

Specific publication modus include "How to diagnose?" and "Interactive publication" (not shown).

An additional tool will be an open access peer reviewed scientific journal, for example diagnosticpath.com, [41]. The general scheme of such a network is displayed in <figure 1>. As demonstrated, this open access journal is only one compartment (or vertex) of a complex electronic information acquiring and communication network. At present, such a system is in the stage of implementation. It is far more advanced as all comparable open access journals. Its implementation is not at all expensive as

Borkenfeld et al., diagnostic pathology 2015, 1:3
ISSN 2364-4893
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nearly all servers are operating in tailored versions of open access programs [41].

Will such a system be successful?

Citation index

The interest of authors in a specific scientific journal focuses mainly on its citation index (CI) [42]. The CI is a reference data bank which was founded 1961, i.e. far before the implementation of the first solely electronical published scientific journal on pathology [43]. The Institute for Scientific Information implemented this score that should measure the impact of a published article on its scientific environment. It is maintained by the Canadian American company Thomson Reuters Corporation. It is now-a-days expanded to the Science Citation Index Expanded (SCIE) which is an online data bank and includes more than 8,600 journals of approximately 150 scientific fields [44].

In open access journals the significance of CI or SCIE is closely related to financial issues. The importance of the CI relies on common facts, such as:

1. Several grants require publication of research results in journals that possess a CI above a certain level; (commonly >1.8)
2. The bonus that numerous universities grant to the authors or their department is strictly related to the CI of their published articles;
3. Grants are usually easier to get if authors can demonstrate publications in journals with high CI [45].

However, most of the innovative and "fresh" scientific issues are not published in journals with high or even outstanding CI (SCIE) levels. The editor's policy does not address to innovative research which is usually done by only a few scientists. An editor is mainly interested in many readers and articles that promise frequent citation, such as review articles. Histological reviews of so - called classic articles demonstrate that "clinically highly important articles are not always frequently, some of them not even once cited several years after their publication" [2]. This observation can probably be explained by the fact that innovative and outstanding research and medical science require time until they will be acknowledged in their discipline. In addition, some authors investigated in the bias of CI. They report, that articles published in high-impact journals are more likely to be cited than others [46]. In other words, a high CI journal automatically promotes the reputation of its published articles.

These and other principle disadvantages of CI (SCIE) are well known [2, 47, 48]. However, it always has been claimed that the CI procedure is well established and should expanded but not be replaced by other procedures [49].

Borkenfeld et al., diagnostic pathology 2015, 1:3
ISSN 2364-4893
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Indeed it is quite difficult to reproducibly measure the scientific quality of a journal or an article.

To our opinion one should clearly distinguish and define whether the scientific (medical) "value" of an article or that of a journal is in focus. Certainly, both issues are related to each other; however, it is clear that the CI (SCIE) measures in principle the "journal's and not the article's quality".

This difference is important when open access journals are in focus due to the high impact of the applied business model. The number of researchers who cite a certain article is closely related to the CI of the journal, and, therefore, the CI acts as the journal's main marketing factor. Unfortunately, the CI is only a crude measure of the article's scientific quality, and, in addition, its significance is declining as new publication techniques seem to neglect its reputation [50]. We, therefore, propose a different procedure that should meet the following conditions, and which should

1. be independent or nearly independent from financial issues;
2. address to the individual published article or message;
3. be applicable to modern publication techniques such as forum, archives, dynamic databanks, etc;
4. permit a comparison between different scientific fields such as molecular biology, pathology, immunology, clinical trials, or even between nuclear physics, radiology, biochemistry, etc. (In other words, they should measure within the same scales).

How to implement?

As mentioned, authors prefer to publish their research results in journals that are equipped with a high CI. The CI is known to the authors prior to the publication of their article. They also do know that in this case their data will be cited more often and that their research results posses a higher reputation in the scientific community. These expectations are one door to open financial pollution of science, because they induce automatically a financial dependence of publications. Journals with high CI are at least tempted to charge more than those with a low or even not existing CI. For example, Biomed Central adjusts its publication fee annually to the CI of their open access journals.

These facts suggest that

1. articles should be considered as information release and acquisition, or communication with strict regulations, independently how and where they have been created;
2. submitted articles should be peer reviewed as usual, and the CI of all peer reviewed journals should be set to zero, i.e. deleted;
3. all published articles should be scaled by an international article scoring board of specialists (IASB) who score each article within a predefined range;
4. this score will be given to the published article, and might be used by the publisher

Borkenfeld et al., diagnostic pathology 2015, 1:3
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to create its own (for example by article averaging) journal score;

5. IASB should be formed by members of international scientific / medical societies, for example European Society of Pathology (ESP), or International Academy of Pathology (IAP), etc. They could be selected on a voluntary basis with strict time limitation (for example 3 years), and about 30% of its members should be replaced every year;
6. the communication platform should be responsible to submit its published articles to the IASB; and the IASB to provide the article score within a certain period of time (for example 6 months).
7. IASB should be financed by the authors, i.e. each participating journal should provide a certain percentage of its publication fee to the IASB.
8. IASBs should organize themselves in an IASB forum, in order to regulate financial issues, interdisciplinary issues, regulate the provided scores, etc.

What are the advantages and disadvantages of such communication quality assurance?

The first disadvantage will be the replacement of a long lasting and continuous maintained journal attribute, the CI. It will be replaced, and disappear after some years. Therefore, historic analyses will become difficult or even unfeasible. A huge administrative organization dependent upon external financial sources and scientific societies (organizations) might be an additional disadvantage. Herein, modern IT can probably solve the apparent constraints in terms of a specialized forum, etc. To become familiar with such an article scoring system will require some time, which might be an additional constraint.

The advantages are a concept of science scores that is nearly independent from financial issues. It will focus on the "quality" of an individual article, and will give all publication media the same chance to receive articles of major scientific or medical level. A similar approach has been implemented in neurosciences by creating a peer review consortium which reviews again rejected articles [35]. The historic PARIS project (pathology reviewer international scoring) has focused on similar ideas; however not been implemented {Kayser, 1998 #428.

Conclusions

Open access journals do exist since approximately ten years. They have been matured and posses several advantages such as fast and cheap distribution of medical and scientific data, world wide access and financially independent accession to latest research.

They are, however, also endangered by commercial invasion and subject to unlimited speculation. The conglomerate of only four main players is the first symptom that scientific communication is on the way to loose its freedom.

Borkenfeld et al., diagnostic pathology 2015, 1:3
ISSN 2364-4893
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On the other hand open access journals are only the first step in implementation of new communication modules. The implementation of a communication network that includes an open access journal in its center is in its childhood, and will include this journal.

The center will be connected with a specialized diagnostic and therapeutic medical forum that is organized in an institutional manner. It is called Virtual International Pathology Institute (VIPI, www.diagnomx.eu/vipi) and is organized similar to a pathology institute with duty plans, organizing specific laboratory examinations, education, and training of young colleagues.

For quality assurance, the digitalization of glass slides in virtual slides is mandatory for all suitable published articles in this journal. The VS are subject to automated measurements by the reader, i.e., each colleague who is reading an article can check whether the included data are correct and the images are representative for the described results.

An express reviewer team that is also working in a duty plan assures a fast and non biased proof of the submitted manuscripts.

All published articles can be expanded to an interactive publication network if the original authors agree. This is a unique opportunity for authors to aggregate their results independent from the date and place of investigations. A first test of such a publication was performed with the former electronic journal of pathology and histology and described as successful [51, 52].

The finishes of this network will be the construction and implementation of diagnosis assistants. These are based upon the published original articles extended by data sets of the laboratories and institutes which are using the assistants. They will work similar as those assistants implemented in text or image programs (Word, Power Point, etc.).

In aggregate, this journal and its open access publication are only the first step to climb up new mountains of medical and scientific communication. They will allow medical doctors, scientists and involved colleagues as well as the patients to get new ideas and views of the dark valleys of disease.

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Borkenfeld et al., diagnostic pathology 2015, 1:3
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