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Electronic Publishing in Medicine: Where are We ?

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"The next five years will see greater change". This is what the Editor of the *British Medical Journal* (BMJ), the first journal to be published electronically, wrote in March of this year [1].

Almost all scientists now use the Internet and most journals have produced an electronic version. This opens up the possibility for all scientists to have access to all research from their desktops. The price of access to scientific research has been increasing for years. Since the 1970s, libraries have cancelled subscriptions to journals and publishers have responded by raising prices well above inflation levels. The Association of Research Libraries in the USA reported a 207% increase in the price of journal subscriptions between 1986 and 1999, during which time the number of journals increased by 55%. The result is a 6% reduction in the number of journals to which American research libraries (the richest in the world) subscribe and an even greater reduction in the proportion of journals that libraries provide for their users. In short: 'libraries are paying more for less'. In 1997, the average net profit margin of the top four commercial publishers was nearly 19% which is very high. This exploitation has caused resentment in the academic community, particularly in the United States. But one of the fixed costs that should be taken into account is refereeing, a system still considered very important for assuring the quality of research findings. This service is donated free to publishers from the academic world and this is one of the scientists' complaints when they consider the high price they have to pay for reading scientific papers. But there is a real cost in this service that should be taken into account; this includes archiving submitted papers in a website, tracking submissions through rounds of reviewer and author revisions, making editorial judgements and other daily tasks. The American Institute of Physics has estimated this cost to be $500 per accepted article but others still consider this figure too high. At any rate, the number of subscribers is decreasing and various publishers are thinking about changing their business model, no longer billing readers but authors. They claim that this charge could easily be included in research costs and included in research budgets. But developing countries have been hardest hit by these price increases and the library shelves of many developing countries are now bare. In this case, publishers would make exceptions in order to ensure that no one is excluded for economic reasons. At the beginning of July 2001, it was officially announced at a press conference in London by Richard Smith, editor of the BMJ, Gro Harlem Brundtland, general director of the WHO, and Jon Conibear of Blackwell, that six of the world's leading medical publishers (Blackwell Science, Elsevier Science, Harcourt International, John Wiley, Springer Verlag, and Wolters Kluwer) have decided to enable more than 100 of the poorest countries in the world to access scientific information free of charge through the Internet giving access to over 1,000 of the top 1,240 international biomedical journals [2].

Fiona Godlee (editorial director for medicine at BioMed Central) and her colleagues wrote: "Access to information is essential for describing and understanding the deficiencies of the present, building visions of a better future, developing practical ways to achieve those visions, and educating and inspiring those who must make the future. Information empowers, and those who work with

information must realise that its flow, like good communication, must be two way. The information gap between rich and poor is currently widening, both between and within countries The digital divide is more dramatic than any other inequity in health or income. This lack of information persists - medical libraries in sub-Saharan Africa have had no current journals for years. Meanwhile, the electronic revolution is providing scientists and health workers in the developed world with unprecedented access to information. Whereas doctors in rural Africa may not have access to any information apart from outdated textbooks, doctors in the United States or Britain are able to access hundreds of journals and other databases from their homes and hospitals" [3]. How can this problem be resolved?

Various discussions among scientists, publishers, librarians and scientific societies have made this to be a 'hot problem' and possible solutions now have names such as 'PubMed Central', 'BioMed Central' and 'Public Library of Science'.

PubMed Central (PMC)
(http://www.pubmedcentral.nih.gov/)

In 1999, the US National Institute of Health suggested that a freely accessible public archive for scientific research would benefit the scientific community and its former Director, Harold Varmus, announced that, within two years, there would be an electronic archive of scientific and medical articles freely available to everyone. This is what has happened. The archive is managed by the US National Center for Biotechnology Information (NCBI) at the National Library of Medicine and has taken the lead in preserving and maintaining open access to electronic literature, the same work that the National Library of Medicine started in 1966, and is still doing, when it decided to create Medline, better known now as PubMed. PubMed and PubMed Central, belonging to the same group, will work together and scientists will be able to search the database and immediately have the full text online free of charge. Publishers may participate on a voluntary basis but their journals must meet certain editorial standards. A participating journal is expected to include all its peer reviewed primary research articles in PMC. A journal may deposit its material in PMC and make it available for public release as soon as it is published or it may delay release in PMC for a specified period after initial publication. On March 21st, 2001, the Advisory Committee decided that a participating journal may deposit material in the PMC archive and restrict the display of the full text of its articles to the journal's own site. Participating journals are still invited to make the full text of some or all of their articles available for viewing in PMC but it is no longer essential that they do so. PMC will provide full-text searching of all material in the archive. When a search finds articles from a journal that has chosen the new option, PMC will provide a link to the journal site instead of displaying the full text of the article in PMC. Additional features planned for the PMC archive, such as integration of literature with GenBank and other NCBI resources, will be implemented in a similar manner. Any article for which PMC provides a link to the journal site for the full text must be available free of charge and without access restrictions (at the journal site) within no more than one year of publication, and preferably within six months after publication. Almost 50 titles are already present in the project and many others are on the waiting list.

BioMedCentral (BMC)
(http://biomedcentral.com)

Current Science Group (London), publisher of several dozen biomedical journals, is gearing up to make the entire enterprise of scientific publishing "web-able". Together with BioMed Central this group will publish online, and only online, peer-reviewed scientific articles in 18 biological and 40 biomedical disciplines. Submission, revision and publication of the articles will all be done via the web. Not to be confused with PubMed Central, BMC has been designed to

complement PubMed Central. All published research articles are peer reviewed and made immediately and freely available through PubMed Central, where they will be archived, and PubMed, as well as through the BioMed Central website. At some stage, however, it will probably need to charge authors a moderate amount for publication to help support the cost of allowing free access to primary papers. If so, the charge would be waived where authors could not afford them.
BioMed Central believes that there may be a role for rapid access to unrefereed material as part of the future of biological and medical publishing, although they are extremely sensitive to the concerns of many scientists that unrefereed research should not be intermingled or confused with research that has been peer-reviewed.
With this in mind, some of its affiliated journals (e.g. *Breast Cancer Research* and *Genome Biology*) are already operating a pre-print service and this will be extended to other parts of BioMed Central if the demand exists. They will participate fully in open archive initiatives designed to allow pre-print servers to co-operate.
BMC welcomes articles and data that traditional journals may reject on the grounds of space or relevance to their readers such as negative studies and studies with findings of regional or sub-specialist interest.

Public Library of Science
(http://publiclibraryofscience.org/)

"Publish free or perish. Life scientists are urging publishers to grant free access to archive research articles". This is the title of an article which recently appeared in *Scientific American* [4]. E-mail, Internet discussion groups, databases and pre-print servers are now the means used by scientists to share and exchange information. Now they are demanding that their articles to be included in a free central electronic archive. It all started last autumn when a group of 12 scientists founded the Public Library of Science and distributed an electronic open letter (25,303 scientists from 169 countries had already signed the letter, among them several Nobel laureates) urging scientific publishers to hand over all research articles from their journals to public online archives for free within six months of publication, and not one year as some publishers suggested. The authors threatened a boycott starting in September 2001, pledging to "publish in, edit or review for, and personally subscribe to, only those scholarly and scientific journals" that agreed. The beneficiary will be PubMed Central. If one can wait six months for an article, then all he has to do is to go to this site and have the information at no cost.
Will the scientists who signed the letter really go through with a boycott? If journals depend on their authors, researchers need to publish in "brand name" journals, especially if they are young and at the beginning of their careers. With the open letter, a alid discussion has begun, and something will come of it soon or later.

Publishers

As already mentioned, publishers are reacting in different ways to allowing electronic free access to their journals, particularly in consideration of the open letter of the Public Library of Science.
Let's start with the *Proceedings of the National Academy of Sciences* (PNAS). The journal became a member of PubMed Central more than a year ago. Its content is posted at PMC only four weeks after the release of the print version. Nicholas Cozzarelli, Editor-in-Chief, wrote: "This free availability has not caused us any perceptible economic harm. If anything, it has been beneficial. It may seem paradoxical that giving our content away has helped PNAS. No doubt the brick red button next to PubMed citations to our journal that says 'Free in PMC' has provided an incentive for readers to explore PNAS" [5]. PNAS has been available free online since November 1996.
The *Journal of Cell Biology* announced that the journal will be available free on PMC six month after its publication. In this case, the material will remain on their server, but

access will be without password or entrance control.
The position of *Science* is different. They have decided, at least for the moment, to make their articles freely available after 12 months but at their own web site. This should be available late this year. They may also decide to give access through PMC [6]. The Editors, in their paper, mention another "multiple-journal-site", HighWire Press (http://highwire.stanford.edu/lists/freeart.dtl) at Stanford University. They develop and maintain the web versions of 285 journals in biomedicine and other disciplines, and give access to more than 290,000 free full-text articles.
But what is the difference between a multi-journal-site and PubMed Central? The difference is simply that PubMed is the most famous biomedical database. As Cozzarelli said, being there means being popular, and being popular means being read and cited. Will the six-month request be accepted by publishers? Vicky Reich of HighWire Press gives a good idea of the life of an article: "If you assume that when an article is published use is at 100%, what you see - and this is pretty constant across all titles - is that after three months of publication, use is down to 13% of the original, and after 6 months it falls to just 7% of the original. As far as we can tell it stays around 7% for a long time. This means that if you assume an average article has 500 users per article per month, after it is half a year old there are still 35 people a month wanting to read it" [7].

Concluding Remarks

Now that September has begun, will the scientists who signed the "open letter" really go through with a boycott? Will PubMed Central and BioMed Central be the future? Will scholarly publishers adapt to the wishes of the scientists? Many actors are on the stage and they need a very good and intelligent director.
Libraries will need to continue carrying out their current key tasks in the area of provision of scholarly information but developments in information and communication technology have changed the organisation of the library. Attention has to be focused on the new tasks associated with digital library systems and the digitalisation of scholarly information, and this has to be done without neglecting the traditional tasks of libraries. The librarian must be well-informed about all aspects of the information chain and he/she must be able to interact with information technicians such as programmers and web designers in the development of information systems.
The free flow of research information is fundamental to science. Sir Roger Elliott, Chairman of the ICSU, the International Council for Science, when opening the Second ICSU-UNESCO Expert Conference on Electronic Publishing in Science this year, said: "The scientific information chain has been in crisis for several years now. It is clear that the system must be modified and that electronic publishing provides a potential answer. But the community needs to ensure as far as possible that the new paradigm will meet the requirements of all scientists world-wide. Electronic publishing has its own problems. It needs quality assurance through the equivalent of peer review; authentication, to make clear which is the definitive uncorrupted version; availability so that there is easy access for browsing; and finally archiving so that it is not lost to posterity. All of these things have to be done properly and well if the full value of electronic publishing is to be realised. While it is often argued that a simpler electronic product could be made available much more cheaply than the print version, there seems to be no doubt that the scientific community will want all the added value which the medium allows. This involves the inclusion of a lot of extra material, such as the original data, moving pictures and sound. So it seems likely that the cost of a good electronic product will not differ greatly from those of print on paper although they will be spread differently" [8].
The health problems of world are concentrated in developing countries. Kofi Anan, the General Secretary of the UN, in his millennial statement talks about digital

bridges and, in particular, on the impact of electronic distribution of information in health and science. He urges the policy-making world to understand how the economy of information differs from the economy of scarce physical goods and to use it to advance policy goals such as a new health inter-network for developing countries with the establishment of 10,000 on-line sites and the transmission of health and medical information tailored to specific countries. If this means 'globalisation' let's hope for a better future for science and health.

Key words MEDLINE; Periodicals; Publishing

Abbreviations BMC: BioMed Central; BMJ: British Medical Journal; ICSU: International Council for Science; NCBI: US National Center for Biotechnology Information; PMC: PubMed Central; PNAS: Proceedings of the National Academy of Sciences

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