

New initiatives in biomedical scholarly communication: removing barriers, enhancing progress

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R E S U M O

Objectivo: Rever a forma como a comunicação e a publicação científica se desenvolveram na área da investigação biomédica, identificar as mudanças e os modelos novos que estão a ser explorados e implementados, e explorar os actuais desafios e oportunidades.

Resultados: É revista a comunicação e a publicação científica tradicional, assim como os factores que conduzem à exploração de modelos novos: custo excessivo na publicação, na distribuição; novas tecnologias que oferecem soluções para problemas existentes e novas oportunidades para a comunicação dos resultados da pesquisa; a atenção ao copyright e às regras da propriedade intelectual; reivindicações pelos vários intervenientes de um acesso mais fácil e menos oneroso aos resultados de pesquisa; e a globalização que cria exigências no que diz respeito ao acesso à informação nos países em desenvolvimento permitindo oportunidades de colaboração recíproca.

Conclusões: Nenhum modelo novo emergiu ainda, que seja a solução para toda esta problemática. Os investigadores e os bibliotecários têm oportunidades e obrigações novas para dar forma e controlar o acesso às novas descobertas e ao conhecimento biomédico.

A B S T R A C T

Objective: To review scholarly communication and publication as they have developed in the biomedical academic and research communities, identify changes and new models being explored and implemented, and explore current challenges and new opportunities.

Results: We review traditional scholarly communication and publication, as well as factors driving exploration of new models: unsustainable publication and distribution costs; new technologies which offer solutions to existing problems as well as new opportunities for communication of research results; attention to copyright and intellectual property regulations; demands by legislators, patients and researchers for easier, less costly access to research results; and globalization, which creates both new demands for access to information from developing countries and expands collaborative opportunities between developing and developed.

Conclusions: No single new model has yet emerged, nor is a single one likely to be the resolution to all issues confronting us today. Researchers and librarians have new opportunities and obligations to shape and control access to biomedical knowledge and new research findings.

"An old tradition and a new technology have converged to make possible an unprecedented public good"

BUDAPEST 2005

INTRODUCTION

Controversy, uncertainty and excitement mark current discussion of the present status and future possibilities for biomedical publishing and scholarly communication. Clinicians, researchers, research sponsors, legislators, publishers, librarians, patients and the general public have valid and varied interests and concerns that merge and diverge in sometimes-unexpected ways. This paper describes biomedical publishing, as it has been, recent changes and future directions, and the issues and opportunities for positive changes in scholarly communications. The perspective is that of two american authors, one a biomedical librarian, the other a physician and journal editor.

THE TRADITION OF BIOMEDICAL PUBLICATION

Creation and dissemination of biomedical knowledge has been a process in which all participants knew and understood their place: **researchers and clinicians**, with funding provided by **financial supporters** such as an academic or research institution, commercial concern such as a pharmaceutical company, a funding agency or even clinical or personal income, generated **data** and incorporated it into a coherent presentation and interpretation. The resulting **manuscript** was submitted, until recently in paper form, to a scholarly **journal**; the **editor** and staff, in conjunction with **reviewers**, typically other researchers with expertise in the subject of the paper, reviewed the manuscript for quality, currency, appropriateness to the journal and the journal's publishing priorities. Upon acceptance, the author released the legal rights related to the manuscript to the legal authority of the journal's **publisher**, who assumed both the **costs and risks** of final editorial preparation of the manuscript, publication, and distribution, and the related privileges of **copyright**. **Subscribers**, both individual and institutional, typically **libraries**, purchased the journal issues; libraries made the contents available to their own scholars and students as well as those of other institutions via interlibrary loan protocols. Libraries and publishers shared **archiving** responsibilities; **indexing and abstracting services** contributed to broader dissemination by providing bibliographic control of the subject matter of journals. Journals paid their bills through a combination of subscription fees, advertising revenue, reprint rights

and, in some cases, subsidies from the membership dues of sponsoring scientific societies. In yet a further confounding cycle, university libraries have been funded in part by "overhead" charges collected by universities from granting agencies, and thus these agencies paid for the research to be done and paid in part for making the results available to the researchers who had done the research.

In this model, **costs** are borne by and redistributed among the various players; **intellectual content** is provided by the author-researchers and by the editorial process; **access to the content** is controlled by the economics of publication; and **ownership** is split, with physical ownership of the journal resting with the individual or library purchasing the issue, but that of the intellectual content resting with the journal copyright holder, in nearly all cases the publisher.

The purpose of all of this activity is the creation and dissemination of new knowledge; this in turn is the foundation and impetus for further knowledge. It is accepted and acknowledged that knowledge must be communicated and shared for it to be evaluated, appreciated, transmitted and built upon. In many countries, principles of free and equal access to information are part of an underlying political theory and common understanding of the citizenry.

SHORTCOMINGS OF THE TRADITIONAL SYSTEM

The last several years have seen this traditional system fail at an accelerating rate. Three major factors contributed to this failure: a dramatic escalation in the number of journals and articles published; increasing costs for their acquisition, which far outstrip increases in library budgets to support their purchase; and the delay inherent in the traditional peer-review and publication process, adding months or even years to the time between first submission of a manuscript and its use by the primary readers.

The increase in journals published can be seen in average number of journal titles held by Association of Research Libraries member libraries: in 1986 the average was 15,919; it increased to 17,673 in 2002 and 18,142 in 2003. The average budget for these subscriptions grew from \$1.5 million to \$5.3 million (KYRILLIDOU 2004; ARL STATISTICS 2004).

Despite the growth in absolute terms for the largest academic libraries in the United States, the numbers actually represent a realignment of journal purchasing, in many cases reflecting a shift of increasing percentages of libraries' budgets into the

scientific and technical areas at the expense of humanities and social sciences (as well as a dramatic drop in the number of monographs purchased, with a concomitant crisis for university and scholarly presses.) The average price of a medical title rose from \$125.57 in 1984 to \$962.83 in 2005, a 7.6-fold increase; in literature and language the increase was from \$23.02 to only \$80.39, a 3.5-fold increase (BELANGER 2005). For many years librarians have warned that their budgets are only able to support a smaller and smaller percentage of the expanding journal literature. Between 1986 and 2002 serial expenditures in research libraries increased by 227% but the number of serials purchased with these resources only increased by 9%. In 2003, the Association of Research Libraries reported that unit costs for serials increased 215% over a 17-year period, and that overall journal prices of ARL member libraries increased 712% between 1994 and 2002 (KYRILLIDOU 2004). These rises in expenditures compare to a rise in the consumer price index of 64% during these years. Monograph expenditures during this same period increased 62%, while the number of monographs purchased fell 5%. (KYRILLIDOU 2002). It is ironic that libraries had to purchase the knowledge created by their own faculty, who were not directly compensated for this work by the legal owner of copyright (BERGSTROM 2001).

Electronic submission and editing of manuscripts and increasingly electronic distribution of the content of journals all seem to have the potential to reduce costs incurred by publishers; researchers, learning from their librarians that journal costs were nevertheless increasing, began to suspect that price increases and profits were further indications of a breakdown in the traditional communication process, with a seeming shift in emphasis on corporate profitability at the expense of knowledge dissemination. That was confirmed in the minds of many when one of the major publishers reported a profit of well over 30%, an 85% increase, for the year in which its name became synonymous with inflexible negotiations at rates beyond what any academic library was able to support without dramatic cancellations of serial subscriptions (CROUCH 2004; WYSOCKI 2005).

INCREASED DEMAND FOR BIOMEDICAL INFORMATION

The demand for free access to the biomedical literature was first driven by its primary audience: clinicians, researchers, and health care administrators and policy makers. Clinicians have smaller allotments of time to search for and retrieve literature; nevertheless, decreasing access to their primary and secondary journals makes appropriate patient-care decisions difficult; the push for evidence-

-based medical care requires even wider access to the literature. For scientists and administrators, the demand for rapid access to the latest information is at least as crucial, as research fronts move rapidly and health care delivery in the United States has been transformed into a business.

There is also a strong secondary audience, broadly defined as public or lay readers. Their demands for quick, free access to the biomedical information, modeled after the general access to recreational reading and information offered by a responsive public library system, has been driven by several factors: increased access to the technology by which to identify and access electronic information; a shift in the population with the heaviest users of medical care, the elderly, making up an expanding share of the population, and having time and interest to pursue understanding their medical options; increasing literacy rates and confidence in ability to comprehend highly technical literature; well-established and vocal consumerism; pressures on physicians and other health care providers to spend less time with individual patients, shifting the task of informing patients to the patients themselves; and distrust or suspicion on the part of many patients leading to a commitment to verify information and options (SIEVING 1999) or even to demand involvement in the research process (TERRY 2000). The introduction of free searching of Medline on the PubMed platform made identification of sources and the extent of the biomedical literature obvious to the public. Access to the necessary technology, even for those unable to afford computers and high-speed Internet connections in their homes, is nearly universal: A recent study by Florida State University found that 98.9% of American public libraries offer free public Internet access, up from 95% in 2002 and 21% in 1994 (MCCLURE 2005)

The two populations' increased expectations and demands, at the time that the actual information was becoming tantalizingly easy if just out of reach on subscription-only Web sites, led quickly to hearings by the U. S. Congress on difficulties and costs of taxpayers' access to the research their tax dollars had funded, and a recommendation of free access to research financed by the National Institutes of Health (LIESEGANG 2005).

NEW MODELS FOR PUBLISHING BIOMEDICAL RESEARCH

Technological changes, accelerating over the past 30 years, have provided new options for storage and transmission of data, with increasing capacity, decreasing

cost, and increasing speed of transmission motivating both academic and commercial explorations. These changes have made possible not only changes in publishing formats and ease of electronic access, but thoughtful discussion of new modes of scholarly communication. Charles BAILEY's maintenance of the comprehensive Open Access Bibliography assures that those with an interest in this topic can consult a single source for a comprehensive listing of documents on these new models (BAILEY 2005)

Successful models of scholarly communication

The most successful new model of communication may be arXiv, which is described on its website as an «e-print service in the fields of physics, mathematics, non-linear science, computer science, and quantitative biology». Begun in 1991, it is now managed by the Cornell University Library with support by Sun Microsystems and the U. S. Department of Energy's Office of Scientific and Technical Information. It is a fully automated archive and distribution system. Current submissions to the program hover around 4000 per month. In 1996 there were 70,000 transactions per day; for a single day in July 2005, the figure was just under 300,000, approaching 90,000,000 for a month (arXiv 2005), comparable with 68,080,000 searches of PubMed in March 2005 (National Center for Biotechnology Information 2005). Functioning only as an archiving and distribution system, arXiv's costs are approximately \$10/article (GINSPARG 2000). It co-exists with the traditional peer-review process.

Several universities are involved with institutional repository development. DSpace, developed at Massachusetts Institute of Technology and available for use by anyone, is an open source content management system which accommodates all of the traditional formats for academic intellectual property: books, theses, datasets, computer programs, multimedia publications and 'learning objects'. The DSpace Website notes the program can be run on any machine starting with a laptop, though larger products require greater power, and suggests startup costs of \$40,000 to \$1.8 million. The project held an international conference in Bangalore, India in early 2005; among the outgrowths is a DSpace Wiki at wiki.dspace.org, which lists DSpace-based projects around the globe, from Australia to Kansas, Denmark to China (DSpace 2005).

Other options include the Creative Commons, a nonprofit organization supporting flexible copyright in 11 areas (attribution, commercial and noncommercial use,

derivative works, etc); the Science Commons similarly encourages scientists to share data under similar conditions (CREATIVE 2005). The Soros Foundation's Open Society Institute makes available a guide for open access publishing by scholarly societies (OPEN SOCIETY INSTITUTE 2005). Finally, SPARC, the Scholarly Publishing and Academic Resources Coalition, promotes and enables several new publishing ventures which «are committed to fair pricing, the ethical use of scholarly resources, and intellectual property management policies that emphasize broad and easy distribution and reuse of material» (SPARC 2005).

Open access publishing models in biomedical research

Currently **access** to the traditional peer-reviewed literature published in print journals with electronic counterparts (or in only-electronic journals which otherwise function as print) falls into several categories, actually themes with variations: access by subscription only; free full text; and a middle ground, in which the content available freely on the Web changes over time, and the actual content of a journal available to nonpaying readers may vary from that available to subscribers and scientific society members.

PUBLICATION DATE	# PUBMED RECORDS	PUBMED CENTRAL RECORDS	FREE FULL-TEXT RECORDS
JULY 05	25,075	246(0.98%)	977(03.9%)
2004	616,804	18,247(2.95%)	81,844(13.27%)
2003	579,870	6,396(2.83%)	103,353(17.82%)

TABLE 1 – PUBMED RECORDS, PUBMED CENTRAL RECORDS, AND TOTAL PUBMED RECORDS AVAILABLE AS FREE FULL-TEXT WITHIN TWO YEARS OF PUBLICATION

Free full text for the entire content of journals is available for relatively few biomedical journals. Approximately 5% of the titles indexed in Medline are immediately available free within PubMed Central. However, access to back issues, after a period in which content is available only to subscribers, is increasingly available. Currently approximately 4% of articles indexed by PubMed records are immediately available free online, but within two years nearly 18% can be read freely regardless of subscription status (table I). A search of PubMed on July 22, 2005, retrieved 25,075 articles with July 2005 publication dates; of those, 246 articles (0.98%) are available as PubMed Central titles, and 977 (3.9%) are available as free full

text. For the 2003 publication year, for which 579,870 articles were added to the PubMed file, 16,396 (2.83%) are available in PubMed Central, and 103,353 (17.82%) are available free; for 2004, 616,804 total articles were added to PubMed, of which 18,247 (2.95%) available in PMC and 81,844 (13.27%) as free full text.

"Open access" is a term indicating free access to online journal articles, although various groups define or present the concept in different ways. The Bethesda Statement on Open Access Publishing (BETHESDA 2003) is a wide interpretation noting that open access is a property of individual works, rather than of journals or publishers, and relies on community standards to enforce responsible use of the intellectual property of authors who make their work available in this way. The Bethesda Statement requires two conditions be met. The first is that the author(s) and copyright holder(s) grant(s) to all users a free, irrevocable, worldwide, perpetual right of access to, and a license to copy, use, distribute, transmit and display the work publicly and to make and distribute derivative works, in any digital medium for any responsible purpose, subject to proper attribution of authorship, as well as the right to make small numbers of printed copies for their personal use. The second requirement is that a complete version of the work and all supplemental materials, including a copy of the permission as stated above, in a suitable standard electronic format, is deposited immediately upon initial publication in at least one online repository that is supported by an academic institution, scholarly society, government agency, or other well-established organization that seeks to enable open access, unrestricted distribution, interoperability, and long-term archiving; for the biomedical sciences, PubMed Central is such a repository.

WILLINSKY (2003) identifies nine "flavours" of open access publishing, distinguished by the different economic models which address the issue of who pays for the editing, production, maintenance, distribution and archiving of the research record. A survey of societies publishing on the Highwire platform and of journals included in the DIRECTORY OF OPEN ACCESS JOURNALS (DOAJ) (2005) by the Association of Learned and Professional Society Publishers in 2004 specified 12 different business models, all variations on the theme of open access, plus "other". (VARIATIONS 2004). Open access has been described as «a vision, not a business model» by the university librarian of Columbia University (James Neal, personal communication). Nevertheless, the ALPSP survey provides some useful data: for Highwire journals with archives open to all,

author fees accounted for only 9% of total revenues, and those primarily for reprint and color charges; the source of those funds came primarily (65%) from grant support, but 25% from authors' personal funds, and authors' libraries provided only 3% of the charges. Titles included in the Directory of Open Access Journals relied on author fees for 47% of total reviews, with similar support from granting agencies (57%), less from personal funds (7%), but 41% from library budgets; this figure may derive from institutional subscriptions to such programs as BioMed Central. 75% of Highwire titles reported a net surplus; 61% noted that their financial outlook was trending upward and only 11% downward; 64% responded that revenue met or exceeded expectations.

Other models which allow access by all, transferring the costs to payments, for individual manuscript page charges or for institutional memberships, by researchers and their institutions, include Public Library of Science, with journals covering medicine, biology, computational biology, genetics and pathogens, and BioMed Central, with more than 150 individual titles. Building on their successes, recent initiatives from various sources have made statements to encourage more access to publications without regard to the ability of the individual or his/her institution to pay for that access. These initiatives include encouragement to publish in journals which make their content available freely, either immediately or soon; encouragement to publish in journals in which the cost of access is borne by authors and/or their institutions; the development of institutional repositories; and mandates from research institutions that the research be available to all, immediately or soon after publication. An additional factor of concern, the relative ranking of journals in which a researcher publishes, as a measure of quality, is being addressed both by the inclusion of open access journals in the impact factor calculations of the Institute for Scientific Information, and consideration by researchers themselves of the meaning of these rankings (BIOMED CENTRAL 2005; BEREUTER 2004). Finally, there is considerable discussion about the effect on citation patterns of a journal's online availability, particularly as free fulltext (DE GROOTE 2005).

The mandate for open access with the most significant possible impact is that known as the National Institutes of Health Public Access Policy. NIH, which funds approximately \$24 billion in research annually, is by far the largest research-granting agency; the policy is discussed below.

New technology is being utilized in innovative ways to move the scholarly communication process forward. For instance, the online British Medical

Journal, *bmj.com*, offers added value: links to cited articles which are available via a click-through from the original article; links to articles citing the original; the ability to comment online and read comments by others already posted; automated alerts if corrections, comments, or cites to the article are posted. Other publishers are experimenting with similar value-added enhancements to the publication process, inserting themselves in new ways into the scholarly communication process. Whether these will prove ultimately useful and knowledge enhancing, or instead contribute to less use of the published literature due to information overload remains to be tracked and evaluated. An additional concern is whether these links, currently limited to other titles produced by the same publisher or having collaborative agreements for mutual access, will influence reading patterns, journal use and citation rankings.

COPYRIGHT ISSUES IN THE ELECTRONIC ENVIRONMENT

Copyright issues are of paramount concern in the discussion of new scholarly communication models, in the requirements to deposit and make available research reports in more open repositories, and in the movement along the open access continuum. Authors and artists have observed the benefit of transferring copyright to publishers in return for having it become part of the peer-reviewed publication stream, for enjoying the prestige of the journal's title, as well as the marketing by the publisher, ease of access by colleagues, and permanent archiving; royalties might be available, although not guaranteed in many cases. It is ironic, however, that the dataset authors work hard to collect and organize in their accepted manuscript could be an important addition to a classroom lecture, but that permission frequently must be sought from the publisher/copyright holder to use this information.

Most academic institutions in the United States specifically allow faculty members to retain copyright on works they create in the course of their teaching, research or artistic activities. Major exceptions are Federal and sometimes state employees, whose work is specifically not subject to copyright. ROWLANDS and his colleagues have studied the scientific communication process from the scientists' point of view (2004). The phrase coined on the Medinfo Weblog in spring, 2005, offers the most concise statement: «Science wants to be cited» (MEDINFO 2005).

Project RoMEO (Rights Metadata for Open Archiving) analyzed over 500 survey responses about copyright from academic researchers across the entire spectrum of disciplines. One-third of researchers admitted to not really knowing who held

copyright to their intellectual property. The survey noted specific concerns by the researchers regarding use of their property by others: they do not want the work to be plagiarized or used by others for commercial gain, they want their work protected from compromise, and they want attribution and the contents correctly cited (Project RoMEO nd). Similarly, a Publishers Association survey in 2003 elicited little real knowledge by most authors of the terms and conditions of the copyrights they assign to their publishers (VARIATIONS 2004).

In the ALPSP survey, 30% of Highwire Press journals stated they make copyright transfer a condition of publication; this compares to 16% of the DOAJ titles. Within this broad statement, however, lies very broad variation in auxiliary permissions granted. 89% of Highwire journals require written permission to use content, while 10% of DOAJ titles have that policy. 11% of the Highwire titles and 18% of the DOAJ titles allow any academic use, but commercial use only with specific permission. The majority of Highwire titles allow the posting of pre- and post-prints to the author's personal website, but only 8% of DOAJ titles have the same policy. Finally, 86% of Highwire journals allow the author's use of copyright material in the author's own presentations and publications, but only 13% of DOAJ journals allow this use (VARIATIONS 2004). Where one publishes makes a dramatic difference, even in this early stage of change.

THE NATIONAL INSTITUTES OF HEALTH MANDATE

The first mandated change on the part of a major funder of biomedical research is the United States National Institutes of Health Public Access Policy. The stated purposes of the policy are to create a stable archive of peer-reviewed research publications resulting from NIH-funded research to ensure their permanent preservation; to assist in the management of the NIH research portfolio and help set and reach research priorities; and to make the published results of NIH-funded research more readily accessible to the public, health providers, educators and scientists. Under this policy, researchers whose work is funded by NIH are requested, but not required, to deposit a copy of their final peer-reviewed, accepted manuscripts resulting from that research in an archive maintained as part of PubMed Central at the National Library of Medicine. The author sets the date on which access to the article is open, from the date of publication of the article to 12 months from that date. Publishers can choose to move the date forward, and to substitute a copy of the published paper for the manuscript. This archive opened for submissions on May 2, 2005; the first submitted manuscripts

became available for use in mid-July, 2005. Based on metadata derived from Medline for 2003 and 2004, it is estimated that approximately 10% of articles indexed by Medline might be made available as manuscripts through this mechanism. Questions remain as to how many researchers will cooperate, what the actual cost to maintain the archive will be, and what effect it will have on publishers' economic viability, on relationships between authors and publishers, and what use will be made of the manuscripts and by whom.

Two initiatives based in the United Kingdom were announced shortly after the NIH policy. The Wellcome Trust, with an endowment of £10 billion (WELLCOME 2005a, 2005b) announced in June, 2005, that it will introduce conditions on its grants beginning in the fall of 2005 which will require deposition of electronic copies of research papers resulting from Trust funding accepted in a peer-reviewed journal be deposited into PubMed Central or a UK equivalent, once that is established. The policy goes on to make several statements in support of freely-accessible information and new ways of thinking about and evaluating the scholarly enterprise including encouraging the establishment of free-access, high-quality scientific journals available via the Internet; providing additional funding to grant holders to pay fees for open-access publication; encouraging researchers to retain copyright as recommended by SPARC and other organizations; and, importantly, affirming the principle that it is the intrinsic merit of the work, not the title of journal in which it is published, which should be considered in funding decisions.

The second British initiative is from the Research Councils of the United Kingdom (RCUK), which has announced a position statement on access to research outputs from public funds. The "four fundamental principles" on which their new policy is founded are: (1) Ideas and knowledge derived from publicly funded research must be made available and accessible for public use, interrogation, and scrutiny, as widely, rapidly and effectively as practicable; (2) effective mechanisms should ensure that published research output is subject to rigorous quality assurance, through peer review; (3) the models and mechanisms for publication and access to research results must be both efficient and cost-effective in the use of public funds; and (4) the outputs from current and future research must be preserved and remain accessible not only for the next few years but for future generations (RESEARCH COUNCILS 2005).

The RCUK proposes that, subject to copyright and licensing agreements, all grants awarded starting October, 2005 carry a requirement to deposit resultant journal

articles or conference proceedings in an appropriate e-print repository, either institutional or subject based, at the earliest opportunity, wherever possible at or around the time of publication; publications from grants made before that time are encouraged to be deposited as well. RCUK commits to cover resulting costs to grantees. These and similar initiatives must be thoughtfully implemented, because a substantial percentage of biomedical research is done by teams collaborating across national boundaries; harmonization of requirements for public access to the results will present unique challenges.

INSTITUTIONAL AND PUBLISHER INITIATIVES

In addition to the activities noted above using DSpace materials, several universities have active programs to track and discuss copyright, publication, tenure decisions, and related issues. The University of California system maintains an active program under the auspices of the university library to continue discussions of relationships with publishers, open access journals, digital repositories, and new technologies for monographs and other primary source material for scholarship and teaching (UNIVERSITY OF CALIFORNIA 2005). Similarly, the library of Cornell University maintains a Website with discussion of copyright of faculty publications, prices of scholarly publication, alternative publishing models, and open access (CORNELL 2005). The Cornell Faculty Senate passed a resolution in May, 2005, noting the faculty's commitment to free and open information, detailing the current crisis, calling on faculty to be informed on pricing policies of journals in their individual specialties, requesting faculty to take pricing into account when submitting papers to or performing editorial work for journals, calling on the library to 'negotiate vigorously with publishers who engage in exorbitant pricing,' urging tenured faculty to take a leadership role in choosing to publish in journals with open access and reasonably priced subscriptions, encouraging that authors retain all or most of their copyright rights, and encouraging the use of the Cornell or subject-specific open access repositories to store pre- and postprints of their articles (CORNELL 2005).

There are also models of institutional support for experiments in sustainable open access economics. The Stanford Encyclopedia of Philosophy (STANFORD 2005) is building an endowment from subscriptions, grants, and private contributions to enable this reference work to continue to be freely accessible to everyone. Nearly 100 libraries and library consortia have made commitments to support the endowment with outright gifts or subscriptions, varying with constraints

on fund commitments at their own institutions. Other universities have contributed in-kind support of space, computing resources, and faculty time to enable journals to open their virtual pages without charge; one successful model of this is Molecular Vision, published at Emory University with additional support from pharmaceutical companies, philanthropic organizations and a scientific society. The journal, peer-reviewed and indexed by Medline, has been online only and freely available since the beginning; it ranks near the top in impact factor.

Finally, the German Academic Publishers Project (GERMAN 2005) is a nonprofit platform for electronic publication; the condition for use of their platform is that all content will be accessible on the Internet and directly printable, free of charge.

There are many variations on the future of biomedical publishing. The Internet has made possible innovative tools to expand and publish medical information. Unlike other commodities, almost everyone is interested in their medical health as well as research in their areas of interest or need. It would be foolish to underutilize the technology both available and desired by some many. In many instances the government has already paid for the research and its citizens and researchers should have easy access to the results. Another issue revolves around the multiple voices that lay claim to ownership and control of the intellectual property of research including scientists, universities, taxpayers, grant-funding agencies, and the publishers who provide value-added services. Access to this information is also crucial to the health and economic progress of people in developing countries; their well-being has implications for the entire world. Active dialog, early mandates, initial experimentation, and competition are now taking place. Although the model for the dissemination of biomedical information will undoubtedly change, it is important that prudent decisions are made, especially in view of limited resources, so that we ensure that any medical information published in print or on the Internet remains archivable and retrievable in the future.

REFERENCES

Note: all URL were verified on July 23, 2005.

ARL STATISTICS 2004. [http://www.arl.org/stats/arlstat/.arXiv Web Server Usage](http://www.arl.org/stats/arlstat/.arXiv%20Web%20Server%20Usage). 2005. http://arxiv.org/todays_stats.

BAILEY, Charles W., Jr. – *Open Access Bibliography: Liberating Scholarly Literature with E-Prints and Open Access Journals*. Washington, DC: Association of Research Libraries, 2005. www.escholarlypub.com/oab/oab.htm

BELANGER, J. B. – "Prices of U.S. and Foreign Published Materials". *The Bowker Annual Library and Book Trade Almanac*, 50th ed. Medford: Information Today, 2005; pp. 501-548.

BEREUTER, W.; BEREUTER, T. L. – "Impact Faktoren von Open Access Journalen". *medizin – bibliothek – information*. 2004; 4(2): 18-19

BERGSTROM, T. C. – "Free Labor for Costly Journals?" *J Econ Perspect* 2001; 15: 183-98.

- BETHESDA STATEMENT ON OPEN ACCESS PUBLISHING. 2003. <http://www.earlham.edu/~peters/fos/bethesda.htm#definition>
- BIOMED CENTRAL. Do Journals Published by BioMed Central Have Impact Factors and Are Their Citations Tracked?. 2005 www.biomedcentral.com/info/about/faq?name=impactfactor.
- BUDAPEST OPEN ACCESS INITIATIVE. 2005. www.soros.org/openaccess.
- CORNELL UNIVERSITY LIBRARY. Transforming Scholarly Communication and Libraries. <http://www.library.cornell.edu/scholarlycomm/>.
- CREATIVE COMMONS. 2005. www.creativecommons.org and www.sciencecommons.org.
- CROUCH, G. – "Publisher's Profit Rises. World Business Briefing". *New York Times* February 20, 2004. Late edition final, section W, column 3 page 1.
- DE GROOTE, S. L.; SHULTZ, M.; Doranski, M. – "Online Journals' Impact on the Citation Patterns of Medical Faculty". *J Med Lib Assoc* 2005; 93:223-8. Available in PubMed Central.
- DIRECTORY OF OPEN ACCESS JOURNALS. 2005. www.doaj.org
- DSPACE DURABLE DIGITAL DEPOSITORY. <http://libraries.mit.edu/dspace-mit/index.html>.
- GERMAN ACADEMIC PUBLISHERS PROJECT, 2005. http://www.ubka.uni-karlsruhe.de/gap-c/index_en.html.
- GINSPARG, P. Can peer review be better focused? 2002. <http://arxiv.org/blurb/pg02pr.html>.
- KYRILLIDOU, M.; YOUNG, M. ARL Statistics 2001-02: Research Library Trends. 2002. www.arl.org/stats/arlstat/02pub/intro02.html.
- KYRILLIDOU, M. – "Serial Trends Reflect in the ARL Statistics 2002-03". *ARL Bimonthly Report* 234, June 2004. www.arl.org/newsltr/234/serials.html.
- LIESEGANG, T. J.; SCHACHAT, A. P.; ALBERT, D. M. – "Perspective: The Open Access Initiative in Scientific and Biomedical Publishing". *Am J Ophthalmol* 2005; 139:156-67.
- MCCLURE, C. R.; BERTOT, J. C., project directors. *Public Libraries and the Internet 2004: Survey Results and Findings*. Florida State University, Information Use Management and Policy Institute, 2005. Reported in: RUEHLING, G.: "Almost all libraries in U.S. Offer Free Access to Internet." *New York Times* June 24, 2005. Accessed online at www.nytimes.com
- MEDINFO WEBLOG. April 24, 2005. "Science wants to be cited." <http://medinfo.netbib.de/archives/2005/04/20/454>.
- NATIONAL CENTER FOR BIOTECHNOLOGY INFORMATION. NCBI Databases and Tools, PubMed Searches. 2005. http://www.ncbi.nih.gov/About/tools/restable_stat_pubmeddata.htm
- OPEN SOCIETY INSTITUTE. Open Access Publishing and Scholarly Societies: a Guide. 2005. http://www.soros.org/openaccess/pdf/open_access_publishing_and_scholarly_societies.pdf. Accessed July 23, 2005.
- PROJECT RoMEO. ND. <http://www.lboro.ac.uk/departments/dis/disresearch/romeo>.
- RESEARCH COUNCILS OF THE UNITED KINGDOM. RCUK Position Statement on Access to Research Outputs. 2005. <http://www.rcuk.ac.uk/access/statement.pdf>.
- ROWLANDS, I.; NICHOLS, D.; HUNTINGTON, P. – "Scholarly communication in the digital environment: what do authors want?" *Learned Publishing* 2004; 17:261-73.
- SIEVING, P. C. – "Factors Driving the Increase in Medical Information on the Web: One American Perspective". *J Med Internet Res* 1999; 1(1): e3. www.jmir.org/1999/1/e3.
- SPARC. 2005. <http://www.arl.org/sparc/>.
- STANFORD ENCYCLOPEDIA OF PHILOSOPHY. 2005. <http://plato.stanford.edu/>.
- TERRY, S. F.; DAVIDSON, M. E. – "Empowering the Public to be Informed Consumers of Genetic Technologies and Services". *Community Genet* 2000; 3:148-50.
- UNIVERSITY OF CALIFORNIA BERKELEY LIBRARY. Scholarly Publishing – New Models. http://www.lib.berkeley.edu/Collections/publishing_models.html.
- Variations on Open Access: a Study of the Financial and Non-financial Effects of Alternative Business Models for Scholarly Journals. Kaufman-Wills, Group. Nov. 8, 2004. <http://www.alpsp.org/events/previous/kau081104.ppt>
- WELLCOME TRUST. Clinical Infrastructure Initiative. 2005a. <http://www.wellcome.ac.uk/>.
- WELLCOME TRUST. Position Statement in Support of Open and Unrestricted Access to Published Research. 2005b. http://www.wellcome.ac.uk/doc_WTD002766.html.
- WILLINSKY, J. – "The Nine Flavours of Open Access Scholarly Publishing". *J Postgrad Med* 2003; 49:263-7. <http://www.jpgmonline.com/article.asp?issn=00223859;volume=49;issue=3;page=263;epage=267;aualst=Willinsky;year=2003>
- WYSOCKI, B., Jr. – "Scholarly Journals' Premier Status is Diluted by Web". *Wall Street Journal* May 25, 2005, page A1.