

UNSHACKLING BASIC KNOWLEDGE

Diane Lester describes the thorny situation in biomedicine where private journal publishers control taxpayer-funded research literature

Australian taxpayers spend billions of dollars yearly on basic biomedical research. By a grave anomaly, the main literature from this research is not made accessible to the public; instead, it is mostly given away to a motley bunch of journal publishers who mostly sell it at monopoly prices to readers. The arrangement arises from the ‘establishment’ of the international research community still supporting publishing practices dating from print times. So far, the United States is the only country to have corrected the anomaly by legislating public access to federally funded biomedical research literature. Australia has been laggard in following suit.

Biomedical research literature carries new basic knowledge intended for social and economic benefit—and is thus a public good. Clearly, society should not have to pay to read it or allow it to be controlled by journal publishers who do not fund the research. The arrangement encourages ignorance, smothers innovation, and is unethical.

Biomedical discovery and its publication in journals

In earlier times amateurs were able to extend the boundaries of knowledge about the world, but today most discovery comes from formal research programs affiliated with institutions. Researchers in biomedicine are highly qualified in science and/or medicine and work in teams. Academia makes up the heart of the research world, but research institutes, hospitals, government authorities, and industry also make vital contributions.

The subject matter of biomedicine is the natural world and obviously includes human beings. Observation, experimentation and

theory are the main methods used by researchers, except in clinical medicine where experiments on humans are often ethically inappropriate. Clinical methods are mainly observational and are often used in large-scale studies over extended time frames.

Biomedical research is highly international and collaborative, supporting alliances of all sorts. A single research team might have members from various institutions in various countries. Ties arise from a need for specialised expertise and facilities, and reflect the universal nature of the field.

Discovery is mostly supported by public funds, with nations directing a significant portion of their GDP towards it for economic and social benefit. Australia spends at least \$3 billion of taxpayer money on basic biomedical research annually, with an additional \$1 billion supplied by industry and non-profit organisations.

Research is inherently unpredictable, but the average team generates a handful of discoveries a year. What constitutes an advance in biomedicine can seem inconsequential to the lay person. Understanding progresses through an accumulation of tiny steps—with the occasional sudden shift.

Basic biomedical discoveries are detailed in reports submitted for publication to journals.

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Endnotes for this article can be found at www.policymagazine.com.

Each report is comprehensive and non-redundant, with all members of the research team listed as authors. New knowledge is not always 'cut and dried,' which means the reports contain argument and deduction, as well as data. A single report always cites previously published ones, and debate between reports is common.

Research reports undergo 'peer-review' before being accepted for publication, whereby the journal editor consults active researchers with appropriate expertise to give written independent assessments on submissions. If a report is to be accepted, the reviewers must confirm that it contains original knowledge and is scientifically sound. In deciding whether to accept a report, the editor is usually advised by an editorial board comprising active researchers.

Basic advances with commercial implications appear in journals after intellectual property issues have been dealt with through patent protection. Patent documents are public, so keeping such work secret is often pointless. Commercial environments publish less of their research than public ones because it is more applied than basic, but journal publication is highly prized within them. The reports are viewed as reliable and independent because of the review process they undergo, and firms use them to promote their products.

Biomedical journals and their organisation

More than 6,000 peer-reviewed journals operate in biomedicine today. Collectively, they announce and record authoritatively all basic advances made by the world's biomedical researchers. They make up the primary literature of biomedicine, from which virtually all the secondary literature is derived. This literature is rich and lively, replete with practical information, ideas and imagination. It is a reservoir of knowledge with universal significance and can directly save lives.

A single field of enquiry is serviced by many journals, with some more specialised than others. Titles include *Gut*, *Journal of Biochemistry*, *Proceedings of the National Academy of Sciences USA*, *Physiologia Plantarum*, *Chinese Journal of*

Digestive Diseases, *Annals of General Psychiatry*, *Biology and Fertility of Soils*, *PLoS ONE*, and *Medical Journal of Australia*.

Most of the journals began in the second half of the 1900s, but a few are older or more recent. Half the journals are distributed among not-for-profit entities in various countries, mainly scientific societies and university presses. The remaining journals are owned by a handful of large commercial publishers, mainly based in Europe.

The 6,000 journals of biomedicine form a hierarchy in which they are ranked by the number of times their contents are cited. The citation rate of a journal is broadly seen as an indicator of its influence. Researchers heed the hierarchy when submitting their work for publication. In theory, they have a wide choice of journals in a subject area to submit to, but in practice they choose one with a level of influence they deem appropriate for their work. If their pitch at the rankings is overambitious their report is usually rejected. Most journals do not want to accept reports that might make their citation rate fall. The journal rankings had a scientific benefit in print times because they made the literature physically navigable for readers. Today their true benefit is debatable, and the force behind them is mainly research administration.

The running costs of public research programs are covered by fixed-term grants awarded to research team leaders by agencies, and the agencies use the journal hierarchy in deciding who will win support. Unsurprisingly, hierarchy has become firmly etched in the collective psyche of the international research community. In popular view, the most significant discoveries appear in high rank journals and the forgettable ones in low rank journals. Anyone who has spent time at the research coalface knows this is not true.¹ All journals work together as an interdependent primary communication system, and knowledge at every level is important.

Journals at the top of the hierarchy are famous beyond biomedicine. *New England Journal of Medicine (NEJM)*, *Nature*, *Science*, *Lancet*, and *BMJ* (formerly *British Medical Journal*) were founded in the 1800s.² *PLoS Biology* and *PLoS*

Medicine appeared in the digital age.³ These journals primarily carry discovery reports but also have front sections that are prepared 'in house' with news, debate and editorial comment relevant to biomedicine.

Each research report is unique and therefore the sale of content involves no competition: core demand comes from academic institutions the world over.

PubMed, run by the National Library of Medicine in the United States is a public bibliographic database and index of biomedical journals. It carries summaries of discovery reports only. PubMed Central (PMC), run by the United States and a few other countries, is a public full text journal database, but many publishers are highly protective of their full text so PMC does not cover biomedicine well. Many other journal databases—bibliographic and full text—are available but most are privately owned and surrounded by pay-walls, which limits their utility. Detailed searching and data mining by subject area is hardly possible in biomedicine because of the way full text literature is organised.

Who reads the journals?

Basic biomedical knowledge is relevant to medicine, the allied health sciences, industry and education, agriculture, fisheries, environment, financial investment, government, local communities, law and other areas. The audience of the journals is global and diffuse, and becoming more so as technology advances, economies become more knowledge-based, and education levels rise.

Many refer to the journals for professional reasons, but not all. Patients actively involved in their treatment are an important group of readers.

Journals are businesses

Nearly all journals, whether not-for-profit or commercial, are run as businesses by their owners, generating revenue above what is needed for publishing operations. The ability

to make money is seen as essential for the sustainability of the periodicals. Two main business models are used.

The traditional subscription-based business model, called Toll Access, is still used by nearly all established journals. Under the model, the publisher gains ownership of journal content and then erects pay-walls around it, thus levying readers. Researchers who publish through Toll Access journals sign written agreements with publishers, which vary from being a licence to publish to a complete transfer of copyright.

A small minority of journals employ the Open Access business model. Most are recently founded, as are their publishers, who are both not-for-profit and commercial. The Open Access model is based on levies at authors, and in most cases, releases content under the Creative Commons Licence, thus making content a public resource. It exploits modern information communication technology fully in the dissemination and database organisation of content. Researchers, though, can perceive Open Access journals as unattractive publishing outlets because of their upfront costs and lack of established influence.

Cost of journals

The cost of Toll Access journals is difficult to quantify because various prices apply to their diverse audience. Moreover, institutional libraries are core buyers and their deals with publishers are large and commercial-in-confidence. Even the researchers within an institution who author journal literature are often unaware of the prices.

In a developed country, a yearly subscription to a journal typically costs \$1,000–\$6,000 for an institution and a few hundred dollars for individuals. These prices are lower in developing countries and waived for some institutions of poor countries under a scheme run by the World Health Organization.⁴ Most journals offer single report purchase for \$15–\$45.

Toll Access journals typically apply complimentary free access to some of their reports. Some not-for-profit Toll Access journals make back content freely available with a few even depositing it in PMC, thus relinquishing their control over the content.

Generally, Toll Access journals are free for authors, but there are exceptions. Top journals levy authors for reports that do not fit a basic format, with charges often amounting to thousands of dollars.

Journal costs under the Open Access model are limited to author charges of \$1,000–\$4,000 per research report levelled at the time of publication.⁵ Charges may be waived for authors with limited means.

The journal publishing industry

In biomedicine, the journal publishing industry is worth at least \$5 billion annually and exceptionally profitable. Its lucrative nature is attributable to the Toll Access model, under which the publisher gains precious primary literature virtually for free. Neither the authors nor the reviewers of journal reports are paid by the publisher; editorial board members receive nominal sums at best. Each research report is unique and therefore the sale of content involves no competition: core demand comes from academic institutions the world over.

Examining the finances of journals in detail is not possible because publishers are private interests who need not make their accounts public. The turnover of a top Toll Access journal is roughly \$100 million a year and \$1.5 million for relatively minor journals.⁶ The yearly accounts of large corporate journal publishers show steady profits at margins of more than 30%.⁷

Open Access publishing does not have the monopoly element conferred by content ownership, and although only recently established, is stimulating a degree of healthy competition in the journal industry. It is in harmony with the unpaid labour of authors and reviewers (whose salaries are mostly met by taxpayers) because it delivers content to the public, not the publisher.

Communication crisis

For many years, the Toll Access journal publishing business model has been dogged by controversy.⁸ Under it, basic reference literature representing massive public investment becomes privately owned and subject to costly and cumbersome access. Tolerable access only to this literature can be gained from within large academic

institutions of developed countries at a cost of millions of dollars yearly to each institution.⁹ Wider society cannot effectively utilise the literature in a crisis of primary communication.

Generating basic scientific and medical knowledge and then keeping it tightly fettered is counterproductive and costly to humankind. Science and medicine rest on transparency, debate, universality, logic, and evidence-based methodology. The Toll Access journal business model does not sit well with this. It raises ethical questions, which are acute in clinical medicine, and challenges the democratic principle that basic information should be free. It is a print age relic that is now releasing cutting edge knowledge.

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The communication crisis of biomedicine is an extreme ‘tail wagging the dog’ scenario. The international research community is beholden to established journal publishers because it uses a reward system, which depends on their ‘brands.’ If Toll Access publishing is to fold, the research community must turn away from prominent titles like *Lancet*, *NEJM*, *Science* and *Nature*, which is unlikely to happen.¹⁰

The researchers’ continued support for traditional-style journals is ironic because the mark of a good researcher is an ability to abandon long-held views. At least for now, only a minority are supporting the digital age Open Access journals. Notwithstanding the barriers to entry these new journals face, a few have become spectacularly successful and highly influential. Established publishers have begun to develop interests in the new model, but most retain Toll Access for their long-running titles.

Government inaction

With one exception, governments seem oblivious to the communication crisis of biomedicine, even though they fund journal content. The journals ‘fall through the cracks’ because governments have no history of involvement

with them, and they are highly international and subject to unwritten rules.

Toll Access journal publishers have extraordinary control over primary and secondary information channels of biomedicine, with the latter covering inadequately the crisis and its effects on society.¹¹

‘Self-archiving,’ which operates alongside journals, is a non-market approach to making research reports available to the public.

Self-archiving

Some funding agencies and institutions within the research community are addressing the communication crisis by promoting ‘self-archiving’ to their researchers, whereby discovery reports are lodged in institutional public repositories parallel with Toll Access journal publication.¹²

‘Self-archiving,’ which operates alongside journals, is a non-market approach to making research reports available to the public. Its reports are viewed as informal sources, often slightly different to official ones (final versions of reports often cannot be stored because of the copyright agreements of Toll Access journals) and not necessarily available immediately. It is not independent from journals because it relies on their peer-review step for quality control. ‘Self-archived’ reports are generally not present in PMC but can be located with the search engine Google Scholar.

In the long term, the journal industry would be transformed if everybody practised ‘self-archiving,’ but that day is far off in biomedicine. Even when ‘mandated,’ the practice is not always adopted by researchers because of a lack of enforcement.

Some in the international research community believe a boycott of Toll Access journals is

necessary to solve the communication crisis; however, this view represents a paradigm shift that funding agencies cannot accommodate.¹³

US Public Access Act

In 2007 through broad bipartisan vote, the United States government introduced legislation requiring public access for federally funded biomedical discovery reports.¹⁴ Under it, researchers must deposit their reports in PMC parallel with journal publication. This approach is similar to ‘self-archiving’ except it ensures final (author) versions of reports are stored by binding researchers not to give away their copyright. In addition, it puts the reports alongside official journal literature (PMC also holds Open Access journals and back content of some Toll Access journals).

The US *Public Access Act* concerns 65,000 discovery reports annually from a public annual investment of \$30 billion. Freeing up the knowledge of the reports is predicted to have profound benefits for the nation.¹⁵ All other countries will benefit as well.

Journal publisher lobbying has produced a regressive bill aiming to scuttle the *Public Access Act* but is unlikely to succeed as the Act has wide support from society, including industry and patient advocacy groups.

Australian biomedical research reports

Publicly funded biomedical research in Australia produces about 4,000 official reports a year, and most end up exclusively owned by Toll Access journal publishers. Many of the reports describe clinical studies in which Australian patients have participated. At the time of writing, the national agencies of the Australian Research Council and the National Health and Medical Research Council had no way of ensuring public access to their reports.¹⁶ A minority of the reports do become publicly accessible because individual research teams choose to publish through Open Access journals and/or they practise ‘self-archiving.’

Endnotes

- 1 The flaws of using the journal hierarchy to ‘measure’ discovery reports are widely acknowledged; some agencies are trying to drop the practice. Even if the hierarchy is not used overtly in agency methodology, it still works subtly because journal rank equates with prestige, which is highly valued by the research ‘establishment.’
- 2 Owned by the Massachusetts Medical Society, Macmillan Publishers, the American Association for the Advancement of Science, Reed Elsevier, and the British Medical Association, respectively.
- 3 Published by the Public Library of Science.
- 4 ‘HINARI Access to Research in Health Programme.’ South Africa, a country whose government was in denial about the HIV pandemic, is ineligible for this program, not being poor enough.
- 5 Author charges of Open Access journals represent 1% to 3% of the cost of the average research report. They are met by authors through discretionary research funds, or by the hosting institution or funding agency.
- 6 Richard Smith, *The Trouble with Medical Journals* (London: Hodder Arnold, 2011), 211.
- 7 Reed Elsevier, ‘Annual Reports and Financial Statements’ (2010), 9.
- 8 Richard Smith, *The Trouble with Medical Journals*, as above, 211–222; Richard Poynder, ‘Suber: Leader of a Leaderless Revolution,’ *Information Today* 28:7 (July/August 2011); George Monbiot, ‘Academic publishers make Murdoch look like a socialist,’ *The Guardian* (29 August 2011).
- 9 Academic institutions use taxpayer money to buy taxpayer-funded content that taxpayer-funded academics have given away. See Oliver Marc Hartwich, ‘Let internet replace journals,’ *The Australian* (25 November 2009). The arrangement lacks competition and journal prices rise inexorably, creating problems for institutional libraries of all countries in maintaining literature access. Chinese librarians recently reported sustained prices rises of 10% to 20% yearly. See National Science Library, Chinese Academy of Sciences, Joint Open Letter to International Publishers (1 September 2010).
- 10 As yet, few journals have migrated from Toll to Open Access, among them is the *BMJ*.
- 11 Toll Access journal publishers own prominent secondary communication channels, including the ‘front sections’ of long-running top journals and consumer magazines such as *Scientific American* (Macmillan Publishers) and *New Scientist* (Reed Elsevier). Top Toll Access journals carry advertisements for themselves and have a captive global audience.
- 12 Kylie Pappalardo, et al., ‘Understanding Open Access in the Academic Environment: A Guide for Authors’ (Queensland University of Technology, June 2008).
- 13 In 2001 the Open Access Public Library of Science, led by Nobel Laureate Harold Varmus, called on the international research community to withdraw its support for journals maintaining control over content beyond six months. Richard Smith, *The Trouble with Medical Journals*, as above, 219.
- 14 The US *Public Access Act* and related developments are described at ‘Alliance for Taxpayer Access.’
- 15 John Houghton, ‘Economic and Social Returns on Investment in Open Archiving Publicly Funded Research Outputs’ (Washington, DC: Scholarly Publishing and Academic Resources Coalition (SPARC), 2010).
- 16 Danny Kingsley, ‘How one small fix could open access to research,’ *The Conversation* (3 August 2011).