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10 Years Experience with Pioneering Open Access Publishing in Health Informatics: The Journal of Medical Internet Research (JMIR)

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Abstract

Peer-reviewed journals remain important vehicles for knowledge transfer and dissemination in health informatics, yet, their format, processes and business models are changing only slowly. Up to the end of last century, it was common for individual researchers and scientific organizations to leave the business of knowledge transfer to professional publishers, signing away their rights to the works in the process, which in turn impeded wider dissemination. Traditional medical informatics journals are poorly cited and the visibility and uptake of articles beyond the medical informatics community remain limited. In 1999, the Journal of Medical Internet Research (JMIR; http://www.jmir.org) was launched, featuring several innovations including 1) ownership and copyright retained by the authors, 2) electronic-only, "lean" non-for-profit publishing, 3) openly accessible articles with a reversed business model (author pays instead of reader pays), 4) technological innovations such as automatic XML tagging and reference checking, on-the-fly PDF generation from XML, etc., enabling wide distribution in various bibliographic and full-text databases. In the past 10 years, despite limited resources, the journal has emerged as a leading journal in health informatics, and is presently ranked the top journal in the medical informatics and health services research categories by impact factor. The paper summarizes some of the features of the Journal, and uses bibliometric and access data to compare the influence of the Journal on the discipline of medical informatics and other disciplines. While traditional medical informatics journals are primarily cited by other Medical Informatics journals (33%-46% of citations), JMIR papers are to a more often cited by "end-users" (policy, public health, clinical journals), which may be partly attributable to the "open access advantage".

Keywords:

Medical informatics, Publications, Knowledge translation, Medical informatics education, Bibliometrics

Introduction

Between 1987 and 2006, over 77,000 medical informatics articles were published, in 4,644 unique journals [1]. Being a highly interdisciplinary field, it is difficult to determine what constitutes a "medical informatics" journal. In the mid 90ies, several studies independently attempted to identify a core set of medical informatics journals [2-5], based on cocitation analysis and Medical Subject Headings (MeSH) co-occurrences. Another approach to identify "medical informatics" core journals is to consult the Thomson/Reuters Journal Citation Reports (JCR) database, which assigns subjects to journals. Currently, the JCR 2008 (the most recent version as of March 2010) lists 20 journals in the "medical informatics" discipline. Traditional medical informatics journals are poorly cited and the visibility and uptake beyond a relatively small medical informatics community remains limited [6].

At the end of the 90ies, all journals identified as "core medical informatics" journals using the methods above had the following in common: 1) they were published by professional publishers, with authors signing away their copyright as a condition for publication; 2) all had a "paper" counterpart, none of them were "electronic-only" journals; 3) all medical informatics journals were subscription-based journals, none was freely available.

In addition, it became clear that the Internet had a major impact on medicine and public health, as well as on the discipline of medical informatics itself, without any journal covering specifically this field. The *Journal of Medical Internet Research* (JMIR, www.jmir.org) was created to fill this gap [7]. Perhaps even more significant was the fact that the Internet itself as a disruptive technology allowed a change in the publishing model, bypassing traditional intermediaries (publishers), leaving ownership and control of published works in the hands of the scientific community. JMIR was created with these values in mind.

This report chronicles the first 10 years of this ongoing experiment, during which JMIR has risen to the top ranked journal in the Medical Informatics journal, by Thomson/Reuters Impact Factor (IF). While the author recognizes that the Journal Impact Factor is an inadequate and questionable metric of "quality" (in particular if used as proxy for article quality), it is one important metric to compare journals with each other. In this paper, we also go beyond comparing IFs, and look at the origin of the citing articles. One of the underlying hypotheses to be explored is the role of the open access policy for helping the *Journal of Medical Internet Research* to achieve a re-

spected place in the community, without the marketing budget of a large publisher.

Materials and Methods

Journal Details

History

The JMIR editorial board was assembled in 1998 and the first articles were published in August 1999. JMIR was conceived and founded by Gunther Eysenbach, MD, MPH who continues as Editor and Publisher of the journal. At the time JMIR was the first international scientific peer-reviewed journal covering all aspects of research, information and communication in healthcare using Internet and Intranet-related technologies. As a publisher of a journal about the Internet, the founding editor was also dedicated to using and experimenting with the Internet as a communication vehicle [7].

This included making all articles immediately electronically available on the Internet, free of charge for the reader, a model which is now known as "open access" publishing. It should be stressed that while "open access" publishing has now become more prevalent and accepted, at the time of creation, JMIR was an early pioneer of this model. Other open access journals (such as BiomedCentral journals, which launched in 2000, or the PLoS journals, which launched in 2003/2004) as well as other significant developments such as PubMed Central (which launched in 2000) were not existing at the time of the JMIR launch.

Table 1 – JMIR Milestones Timeline

1999: Launch
2001: NLM/Medline indexing
Dec 2002: named Official Journal of IHCC (Internet Health Care Coalition)
Aug 2003: named Official Journal of SIM (Society for Internet in Medicine), abandons *Medical Informatics and the Internet* (Taylor & Francis) as Official Journal
Nov 2003: Use of OJS 1.0
Nov 2004: Major site relaunch: PDFs available, all articles available as XML
2005: ISI begins monitoring JMIR
2006: JMIR in PubMed Central
2007: First Impact Factor (2006) published by ISI: 2.9 (#2/20 in Medical Informatics [MI], #6/56 in Health Care Sciences & Services [HCSS])
2007: Upgrade to OJS 2.0
2007: 30k SSHRC grant for open access journals
2008: Impact Factor (2007): 3.0 (almost the same as the #1 JAMIA: 3.1)
2008: 90k SSHRC grant for 3 years
2009: Founding member of the Open Access Scholarly Publishers Association (with BMC, PLoS, and others)
2009: Impact Factor (2008): 3.6 (now ranked #1 in MI and #2 in HCSS)

Scope

JMIR publishes manuscripts on all aspects of research, information and communication in the healthcare field using Internet and other eHealth technologies. This field overlaps with what is called "consumer health informatics", or – more recently – Medicine 2.0 or Health 2.0 [8] (which is highlighted by the fact that the journal now co-sponsors an annual Medicine 2.0 conference – http://www.medicine20congres.com). The journal also publishes original research on development, evaluation, and application of other (non-Internet) e-technologies in the health care setting (e.g. m-health applications). JMIR targets a broad readership consisting of health professionals, policy makers, consumers, health informaticians, developers, researchers, hospital and health care administrators, and e-health businesses.

As eHealth is a highly interdisciplinary field JMIR invites research papers from a range of disciples including the medical sciences, the computer, behavioral, social and communication sciences, psychology, library sciences, informatics, human-computer interaction studies, and related fields.

Business Model

Open access journals can, by definition, not create revenue through subscriptions. In order to cover the publishing costs, which include professional services such as hosting, copyediting, XML tagging/typesetting etc., novel ways of creating revenue had to be found.

JMIRs business model is unique as it creates its primary revenue streams from personal and institutional memberships, in addition to article processing fees, and sale of PDF reprints. Institutional memberships for departments or institutions such as research centers, universities, and corporations, provide reduced or waived author publication fees for employees, faculty, or students of the institution or department. Many academic medical informatics departments are an institutional member of JMIR. Institutional memberships start at $900 per year, which allows their faculty and students to publish free of charge in JMIR.

While HTML versions of all material in the journal are freely available, PDF versions of individual articles, entire issues and topical article collections ("e-collections") are available for a fee (or freely available for members). An additional revenue stream are a nominal submission fee (currently $90), as well as the optional fast-track fee. The journal also accepts advertisements including Google Adsense on the web site as a source of additional income.

As of September 2009, the journal has almost 400 paying members. As a result, the proportion of funding coming from member contributions is increasing steadily, with over half of the revenue coming from memberships and only 25% from article processing fees. Between 2004 and 2006, JMIR has doubled its total revenue, which now exceeds $100,000 per year.

Review Process

Manuscripts are first reviewed by the Editor who decides whether the manuscript meets the criteria specified in the in-

structions for authors and whether it fits within the scope of the journal. Manuscripts are then sent to an external expert for peer review. Authors are required to suggest at least two peer reviewers. The identity of JMIR reviewers is revealed if the manuscript is published (they are acknowledged in each manuscript), unless requested otherwise by the reviewer, but anonymous during the review process and in case of rejection. Approximately 30-40 percent of unsolicited articles are accepted for publication. The Journal is currently (2010) experimenting with open peer-review models, where submitted articles and their abstracts are listed on the website and any reader can sign up as peer-reviewer (submitting authors can opt-out of this model).

As frustration over traditional turnaround times was one of the original motivations for creating JMIR, editors seek to review and publish manuscripts very quickly. A unique feature is that if authors chose to pay for the journals "fast track" review option, a publication decision is *guaranteed* within 3 weeks and publication within four weeks. Otherwise, the journal attempts to complete the review and publication process as quickly as possible but does not guarantee a specific timeline.

Rights Management

JMIR papers are published under the Creative Commons Attribution License. The license grants others permission to use the content in whole or in part, and insures that the original authors and the journal are properly credited/cited when content is used.

Editorial Board/Governance

The journal has an elected editorial board that has responsibilities such as acting as section editors that oversee the review and editing process for specific sets of manuscripts. The journal also seeks guest editors interested in compiling special theme issues of the journal.

Indexing/archiving

JMIR is indexed or abstracted in a wide variety of bibliographic databases, reference sources, and alert services, including Medline and over 20 other databases. It also deposits full text articles in PubMed Central. A full listing of these can be found on the journal web site, (http://www.webcitation.org/5NwssREcf)

Structure, Content and Formatting

JMIR's article section is organized into yearly volumes and quarterly issues. Open access versions of articles are published in HTML. PDF versions are available for a fee and to individual and institutional members. A variety of manuscript formats are published including editorials, original articles, viewpoints, literature reviews, short papers and letters.

Technical Implementation & Innovations

Automatic XML Production with OrangeX

Since 2002, JMIR is using a LAMP-based (Apache/MySQL/PHP) online manuscript management and publication system, code-named OrangeX, which is a heavily customized and expanded version of the Open Journal System (OJS), an open source journal management system available from the Public Knowledge Project (PKP, 2007). OJS required extensive redevelopment, as it has multiple severe bugs and usability issues, and originally did not support an XML-based publishing workflow. The JMIR development group donated the code and workflows/plugin ideas developed for JMIR as open source to the OJS project. For example, the XML/PDF functionality of OJS and many other plugins have been developed by the JMIR group (MJ Suhonos and Juan Alperin).

The most significant development of the OrangeX modules is a fully OJS-integrated system to generate Pubmed Central-compatible XML documents, from OJS-based metadata and through a conversion of word-documents to XML. OrangeX also automatically checks and corrects cited references against bibliographic databases such as PubMed. Earlier versions of the XML conversion and reference checking software module – which was made available under a GNU license - has formed the basis for the Lemon8-XML software [9], which is a standalone, non-OJS integrated version. OrangeX is not currently released as open source software, but the JMIR group offers hosting of open access journals on the OrangeX platform.

Other Innovations

The journal has been innovative in a number of areas, including: 1) first journal to use screening software to check for plagiarism of material published on the web; 2) development of the WebCite system (www.webcitation.org), which supports permanent archiving of web material cited by authors [10], now adopted by hundreds of other journals; 3) open peer-review models.

Impact Analysis

Analysis of the impact of a journal can come from two sources: Quantitative citation analysis, and qualitative feedback from authors. While we have anecdotal and qualitative evidence from authors reporting on the wide uptake of their works, in this paper we focus on quantitative data based on citation analysis, with benchmarking against other medical informatics journal. We selected 5 benchmarking journals from the Journal Citation Reports database (journals from the medical informatics subject category): Journal of the American Medical Informatics Association (JAMIA), International Journal of Medical Informatics (IJMI), Journal of Biomedical Informatics (JBI), Telemedicine and ehealth Journal, and Methods of Information in Medicine ("Methods").

We used the Web of Science database (Sept 2009) to analyze citations to JMIR and benchmarking journals. In order to determine the subject areas of citing journals, we searched for all articles citing JMIR (or benchmarking journal) articles which were published in 2007-2008. We then tabulated all subject areas of the citing journals and reported those which constitute at least 10% of the citing articles in any of the benchmarking journals. The journal subject areas are assigned by JCR staff. Note that a journal in JCR can belong to multiple subject areas (for example, JMIR belongs to "Medical Informatics" and "Health Sciences and Health Services Research").

Impact factors (defined as the average number of citations to those papers that were published during the two preceding

years) were extracted from the Journal Citation Reports (JCR) database (Thomson/Reuters 2009), searched in October 2009.

Results

Reach and Readership

JMIR has grown to be a very widely read journal with approximately 60.000 pageviews per month (Sept 2009, Google Analytics), and 25-30.000 visits per month. The Alexa Traffic Rank was 440.860 in March 2010 (benchmarked against JAMIA, which is ranked 2,551,028 by traffic). Approximately 24,000 readers subscribe to e-mail notifications of publications (as of Sept 2009).

Impact

The Journal Impact Factor has steadily grown. In 2009, with publication of the 2008 impact factor, JMIR is now the top-ranked journal in the Medical Informatics category (Figure 1), as well as in the Health Sciences and Health Services Research Category (not shown; review journals excluded). While Thomson-Reuters only began publishing an "official" impact factor for JMIR in 2006, previous inofficial impact factors for 2004 and 2005 suggest impact factors of about 2.5 – 3.0.

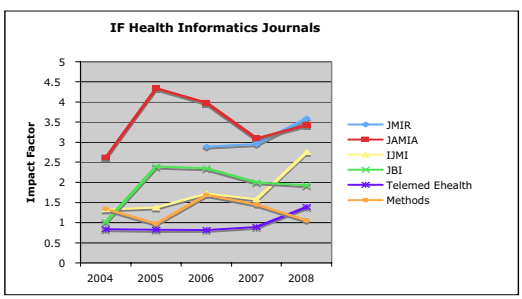

Figure 1- Ranking of Medical Informatics journals by Reuters/Thomson Impact Factor 2004-2008

Citing Journals

In order to explore differences in citation patterns between JMIR and the benchmarking journals we looked at the subject areas of the source journals citing articles from JMIR (or the benchmarking journals). Figure 2 illustrates the subject areas of journals citing articles in JMIR and other medical informatics journals (Note that JBI is also cited by journals from the disciplines "Biochemical Research Methods", "Biotechnology & Applied Microbiology", and "Mathematical & Computational Biology" which are not significant sources of citations for the other journals and which have been omitted from the figure).

As seen in Figure 2, 28% of articles published in 2007/2008 in JMIR were cited in Medical Informatics journals (first vertical bar), a figure which is higher in most other Medical Informatics journals, which tend to be cited primarily by other Medical Informatics journals. In contrast, JMIR is more often cited by "applied" and clinical journals, including those dealing with public health and health services research.

Discussion

Over the course of the last decade, the *Journal of Medical Internet Research (JMIR)* has emerged as an influential and sustainable dissemination tool for health informatics research, despite limited resources and manpower. It is difficult to decide whether the observed quantitative (Figure 1) and qualitative (Figure 2) differences in citation patterns are a result of the open access policy or a result of the editorial policies (or – most likely – a mix of both), but it can be argued that they are – at least partly – attributable to what has been called the "open access advantage" [11]. While the "hard" evidence of an open access citation advantage comes from a citation analysis of articles from a "mixed model" journal (PNAS) [12], these data are complemented by narratives of JMIR authors who often report that their work has been used and taken up by unexpected sources.

Thus, it has been argued that the open access advantage has three components [11]: (1) a citation count advantage (as a metric for knowledge uptake within the scientific community) [12], (2) an end user uptake advantage (end-users being patients, policy makers, clinicians), and (3) a cross-discipline fertilization advantage, meaning that knowledge is more easily discovered and absorbed by scientists from other disciplines. While cross-journal comparisons are always confounded by differences in editorial policies and differences in article selection criteria, data provided in Figure 1 and Figure 2 are consistent with these three hypotheses, showing not only more citations, but also citations coming from a wider area of applied disciplines, instead of just medical informatics, computer and information science journals.

Knowledge users who are not researchers (policy makers, consumers, journalists) do not necessarily read scientific publications. In our 10 years of experience with this journal (JMIR), we have received many anecdotal reports from authors and research users testifying that open access publication can help to bridge this gap. Policy makers and end-users are much more likely to "google" for evidence than to do a formal literature search [13], and even if they come across a subscription-based scientific paper through Google, they are unlikely to actually order it. Only if a publication is open access will end-users skim and eventually read it, or contact the author, after they discovered that it is relevant to the policy (or practical) question at hand. We know that JMIR is used as much by patients and other nonresearchers (eg, policy makers) as it is by eHealth researchers, and we know from our authors that they are often contacted by "atypical" readers (knowledge end-users) who bumped into their article by pure chance, which they would never have done had the article been published in a subscription-based scholarly journal.

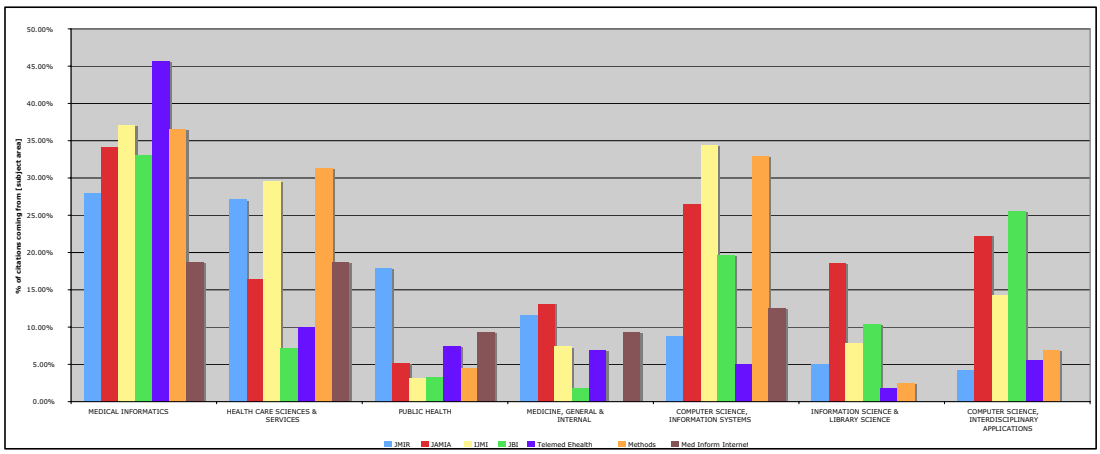

Figure 2 – Subject areas of citing journals

While these findings seem to support the Open Access Advantage, especially in regards to facilitating and broadening the knowledge transfer within and between disciplines, it should be noted that generating revenue with the Open Access model is difficult. As many societies rely on income from their journals, Open Access as a business model is not appealing to them. JMIR has been fortunate to enjoy an increasing circle of institutional support from leading academic medical informatics departments, providing an alternative knowledge dissemination model.

While JMIR has been one of the a pioneer of open access publishing in health informatics (and in medicine at large), other Open Access journals have recently been created in the field (none of which indexed in ISI/JCR yet), using a similar model, e.g. BMC Medical Informatics and Decision Making, Indian Journal of Medical Informatics, Open Medical Informatics Journal (a commercial journal published by Bentham, a publisher who has recently been criticized over quality issues [14]), the Journal of Health Informatics in Developing Countries, The Electronic Journal of Health Informatics (eJHI), an official publication of the Health Informatics Society Australia. JAMIA, also has (in 2010) started to offer an open access option for authors, where they can pay $2000 to make the article open access.

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