

## Reading Factor: A Bibliometric Tool to Manage a Virtual Library

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### Abstract

Among the many bibliometric criteria used to evaluate biomedical journals, the impact factor is the most commonly used. Despite its limitations, it quantifies the influence of a journal on secondary publications. It does not however evaluate the practical usefulness of primary documents. Usefulness is field-related and varies greatly among specialities. We introduce a new bibliographic criterion, the "reading factor", and define it as the ratio between the number of electronic consultations of a particular journal (i.e., number of clicks on a hyper-link) and the mean number of electronic consultations of all the journals studied (itself calculated by dividing the total number of electronic accesses by the number of journals in the database). We describe its observed distribution, relative to that of the impact factor, based on electronic consultation records from our University Hospital medical digital library, where full-text electronic versions of 45 major biomedical journals have been available since December 1997. From this analysis we found no correlation between the 1999 reading factor and the 1998 impact factor of these 45 journals, and we observed a dramatic change in the hierarchy of journals upon using the reading factor as the yardstick rather than the impact factor. Moreover, we describe how using the reading factor has helped in managing the collection of our University Hospital's virtual library. The selection of journals to be discarded from the virtual library for the year 2001 was based on journals' RF values and this process will be repeated over the coming years. The reading factor also permits a cost-analysis of a virtual library. Conclusion: The measurement of the reading factor is highly automated, practical and efficient. It appears as a new tool for electronic collection management by librarians, well fitting with economical data.

### Keywords:

Bibliometrics; Hospitals, teaching; Journals; Medical library / organization & administration; Publishing.

### Introduction

The rapid increase in journal prices, both electronic and printed, has made the optimization of collection management essential [1]. There is therefore an urgent need to improve the management of the library collection. But there is no real standard tool to do this. During the 1970's, crude attempts to count xeroxes or issues left on library tables were undertaken [2]. Such methods were time consuming and have been discontinued, especially since electronically computed indicators have been introduced.

Although having been widely criticized, the impact factor (IF) published in the Science Citation Index Journal Citation Reports by the Institute for Scientific Information is the most commonly used bibliometric criterion. It quantifies the influence of a periodical on secondary publications [3], and is commonly used not only to rank and evaluate journals, but also for academic promotion or for the selection of research grant applications. However, the users of bibliometrics claim that IF is marred by numerous limitations. Indeed, the scale of IF varies widely between scientific fields and medical specialties and a given IF is not, per se, a good indicator of scientific value. There is no significant correlation between the citation frequency of a given paper and the impact factor of the journal in which it has been published. Citations themselves should be carefully analyzed, and citation bias has been discussed recently [4-6]. IF does not appear to be a relevant tool for collection management.

In order to be accepted a relevant indicator must fulfil precise specifications. It must be automatically computed and available in real time. Furthermore, it should reflect as directly as possible the utility of the document. In the medical field, the utility can be taken as the ability to transform the practices. Quantifying such a phenomenon appears complex. Lacking easy access to individual document's utility, at least it is possible to measure its use. However, when a document is read, even in its paper version, it is difficult to assess whether it has been collectively discussed, read the pen in hand, partly read,

skimmed through, or discarded at first glance. On a practical level, one can only count electronic consultations.

Electronic access to full text journals has only been available in university and hospital settings for a few years. Specific software can be used to measure the numbers and types of articles consulted. Based on the use of such software, we propose to develop a new means of evaluation of the usage of journals by end-users, and of their impact on medical practice and research processes. Because such an analysis directly relies upon the consultation of articles, we suggest to define a new index called "reading factor" (RF).

In this paper, we introduce a way of measuring the consultation rate, which we dubbed the reading factor (RF) with reference to the impact factor. The results of its observed distribution for the year 1999 are presented and compared with that of IF in 1998 at the Rouen University Hospital (RUH) where a medical digital library was created in 1997 [7]. This library allows all 306 RUH senior physicians to access Medline and 45 electronic full text journals from their office at no charge.

## Methods

Ovid® is commercial company which has been providing full text electronic journals via the RUH Intranet in addition to Medline since 1997. These journals are provided as packages known as Biomedical Collections volumes I, II, and III, each of which contains 15 journals. They have been available at RUH since June, September and December 1997, respectively. The journals in each package are selected by Ovid based on the coverage of major biomedical specialties, journal impact factors, and agreements with publishers. All 45 journals are listed in table 1.

In order to obtain a standardized measure of the consultation rate, we defined RF in the following equation (1):

$$RF_j = \frac{C_j}{\frac{\sum C_j}{N}} \quad (1)$$

where  $C_j$  is the number of electronic consultations of journal  $j$  and  $N$  is the total number of journals available in the database. Thus a value of 1 represents an average consultation rate, while a value greater (respectively lower) than 1 represents a higher (respectively lower) than average consultation rate.

We assessed the distribution of RF for the year 1999, the second calendar year with full electronic availability of the 45 journals listed in table 1. RF was automatically extracted from log files using Ovid software. The number of electronic consultations is incremented each time an end-user clicks on a hyper-link in order to open an individual publication.

We obtained the most recent data on IF from Journal Citation Reports, 1998 CD-ROM edition. The existence of

a correlation between IF and electronic journal use as measured by RF was assessed by using the Pearson and Spearman rank correlation coefficients. Analyses were performed using BMDP New System for Windows, Version 1.1 (BMDP Statistical Software Inc) and StatXact software version 3.0.2 (Cytel Software Corporation).

## Results

### RF vs. IF

A total of 8,280 publications were accessed during the year 1999. Table 1 displays the number of electronic consultations as well as the value of RF in 1999 (in decreasing order) and the value of IF in 1998 for each journal. The mean IF in 1998 of these journals was  $5.9 \pm 6.4$  (mean  $\pm$  SD) and the median value was 3.5 (range 1.4-28.8). The mean number of articles electronically consulted per journal was  $184.0 \pm 177.8$  and the median was 125.0 (range 9-901). While the mean was 1 by construction, the observed RF median was 0.69 (range 0.05 – 4.90).

Pearson's correlation coefficient between IF and RF was positive ( $r=0.29$ ) and borderline significant ( $p=0.052$ ). However, as the distributions of IF and RF were clearly not normal, additional analyses were conducted. Firstly, the New England Journal of Medicine was the most influential journal in this analysis and strongly induced a positive correlation between IF and RF because of its very high IF (28.7) and RF values (4.1). Indeed, the correlation coefficient calculated for 44 journals (excluding this journal) was no longer significant ( $r=0.046$ ,  $p=0.77$ ). Secondly, no significant correlation could be found either using log transformed variables ( $r=0.048$ ,  $p=0.75$ ) or the Spearman rank correlation coefficient ( $r=0.083$ ,  $p=0.59$ ) on all 45 journals.

We found highly significant correlation among the RF of the years 1998, 1999 and 2000, as pairwise Spearman's rank correlation coefficients were 0.9682 (years 1999 and 2000) ( $p<0.0001$ ), 0.8738 (years 1998 and 2000) ( $p<0.0001$ ) and 0.8930 (years 1998 and 1999) ( $p<0.0001$ ).

### RF as a tool to manage a virtual library

In September 2000, the RUH medical librarian decided to modify the access to our Virtual Library (VL) from Intranet to Internet to take advantage of the better updating providing by the Internet as compared to the Intranet (>3 months difference). Moreover, a smaller work load in the Computing Department was expected as the result of this change. Finally, a change of editorial policy by Ovid took place, giving an opportunity to access the data not only by packages of 15 journals, but also individually. This last option and the Internet access is more expensive (30% over) than the Intranet and package solution. It was therefore necessary to reduce the number of journals available. The RUH medical librarian decided to select the RF as the final criterion to manage the virtual library collection, instead of a human consensus among physicians,

Table 1- RF and IF of the RUH Virtual Library journals

	RF 1999	IF 1998
Lancet	4.90	11.793
New England Journal of Medicine	4.01	28.66
JAMA	1.74	9.522
Journal of Urology	1.80	2.685
Circulation	1.67	9.173
Chest	2.23	2.246
British Medical Journal	2.69	5.325
British Journal of Surgery	1.49	2.381
Annals of Internal Medicine	1.50	10.900
British Journal of Surgery	1.49	2.381
Pediatrics	1.41	3.466
Journal of Neurology, Neurosurgery & Psychiatry	1.31	2.938
American Journal of Obstetrics & Gynecology	1.27	2.634
Journal of Pediatrics	1.23	3.014
Gut	1.05	5.111
Archives of Neurology	0.92	3.375
Anesthesiology	0.92	4.280
Journal of Clinical Pathology (with Clinical Molecular Pathology)	0.86	1.459
American Journal of Medicine	0.85	4.409
Archives of Internal Medicine	0.85	5.385
American Journal of Cardiology	0.78	2.137
Thorax	0.77	2.861
American Journal of Surgery	0.68	1.874
British Journal of Haematology	0.67	3.209
Canadian Medical Association Journal	0.64	1.429
Journal of Clinical Investigation	0.64	9.315
Mayo Clinic Proceedings	0.63	1.984
Archives of Dermatology	0.59	2.456
Archives of Ophthalmology	0.49	2.426
Archives of Surgery	0.49	2.526
Fertility and Sterility	0.48	3.344
Journal of Bone and Joint Surgery	0.43	2.073
Medicine	0.36	3.694
Science	0.35	24.346
American Journal of Psychiatry	0.34	5.939
Heart	0.33	2.060
Nature	0.32	28.833
QJM: Monthly Journal of the Association of Physicians	0.29	2.244
Obstetrical & Gynecological Survey	0.27	2.252
American Journal of Public Health	0.26	3.576
Hypertension	0.23	4.253
Archives of General Psychiatry	0.21	9.398
Arteriosclerosis, Thrombosis and Vascular Biology	0.15	3.917
Circulation Research	0.13	7.988
Diabetes	0.05	8.459

which is, from experience, difficult to find. All the journals with  $RF < 0.5$  (see Table 1) were excluded from the RUH VL with two exceptions: Nature and Science because of their very high IF ( $>10$ ). The threshold  $RF < 0.5$  was empirically chosen because it means that these journals read half as often as the average journal of the RUH VL.

The empirical rule is therefore: if  $RF < 0.5$  and  $IF < 10$  then the journal is excluded from the RUH VL. It is likely that this rule will change greatly over time.

On the other hand, because some other journals (e.g. British Medical Journal) were available freely on the Internet or with a password in a package with the paper version, the RUH VL had the opportunity to add some new journals spending the same amount of money (22,000 euros).

In order to choose these new journals which would be included into our virtual library in September 2000, we used the following indicators:

– Brandon/Hill List of Journals (URL: [http://www.nlm.nih.gov/psr/outreach/bran\\_sitespecific.html](http://www.nlm.nih.gov/psr/outreach/bran_sitespecific.html))

– Abridged Index Medicus (AIM) Journal Titles (URL: <http://www.nlm.nih.gov/bsd/aim.html>)

– Journal Citation Reports (URL: <http://www.isinet.com/isi/products/citation/jcr.html>).

The new journals to be included in the RUH VL must be present in the Brandon/Hill List, the Abridged Index Medicus, and the Journal Citation Reports and must be available in the Ovid list of electronic journals.

The last criterion was the previous extensive coverage of RUH VL according to medical specialties. The following journals will be added in 2001: Archives of Otolaryngology-Head and Neck Surgery, Arthritis & Rheumatism, Clinical Orthopaedics and Related Research, Clinical Pharmacology and Therapeutics, Critical Care Medicine. Next year, RF will be applied to these new journals as the entire virtual library.

The total number of electronic consultations of articles can also permit a cost-analysis of the RUH VL. In 1998, this number was 5,007, 8,280 in 1999, and 6,903 during the first nine months of 2000 (9,181 during 2000 by extrapolation). An article in interlibrary loan costs an average of 4 euros in France. This cost depends mostly on the speed of the answer (fax, Email or snail mail), the number of pages in the article, and the type of library. Knowing that the RUH VL costs annually 22,000 euros, the cost of an electronic article was 4.13 euros in 1998, 2.66 euros in 1999 and 2.40 euros in 2000.

## Discussion

Electronic full text journals have several advantages over printed journals, one of which is the availability in every care unit 24 hours a day, 365 days a year, which greatly reduces consultation time. Furthermore, electronic access allows a reliable and automatic appreciation of the

consultation rate of such documents. It appears to be a more practical version than the manual count of documents or printed copies borrowed from the library [2]. As for its printed counterpart however, there is no real way of determining whether this corresponds to a partial or a complete reading, an effect of curiosity, or even an accidental click. To avoid the latter, a revised version of the RF will count a click if the visitor spent an appropriate amount of time looking at the document (e.g. 30 seconds).

Despite this limitation, our proposed electronic RF criterion will provide an estimation of the real interest generated by a journal. One of the major advantages of this approach is the availability of results with minimal delay. By contrast, the use of references, as in IF, is often biased due to the fact that several years are taken into account, although this length of time varies depending on the field being studied.

To our knowledge this is the first study to compare electronic journal use and citation frequency. A few published studies have evaluated the relationship between printed journal use and citation frequency, but with inconsistent results. Tsay recently investigated the relationship between journal use in Taipei medical library and journal citation in the biomedical field [2]. The results of his study showed a significant positive correlation between the frequency of use and IF for all titles, although the estimated Pearson and Spearman correlation coefficients were rather low (0.34 and 0.35 respectively). Tsay also found a significant positive correlation between the frequency of use and IF when journals that publish clinical medicine and journals that publish life science articles were considered separately. By contrast, no correlation or only partial correlation was found between journal use and citation patterns in biomedical sciences for studies published in the late seventies [8-11].

These results suggest that RF provides different bibliometric information than IF. The frequency of use of a journal could therefore be a significant parameter of its interest to readers and could be used as a more relevant marker of a given journal's influence. However, an artificial increase of RF could be generated by end-users purposefully clicking through an article.

The rapid increase in journal prices, both electronic and printed, has made the optimization of collection management essential [1]. Our results suggest that collection managers would not be able to predict electronic journal use on the basis of journal impact factors alone. Complementing the quality criteria, we propose RF as the economic criterion to optimize electronic journal management in academic institutions, as the cost of a click can easily be compared to the cost of a photocopy obtained from other institutions.

Furthermore, the ranking of RF values of the journals available at the RUH VL seems to be stable over time, as exhibited from the high correlation for the years 1998 to 2000. Finally, it is possible to conclude that our virtual library is cost-effective.

### Future trends

The absence of correlation reported between IF and electronic consultation of journals warrants further studies, and should stimulate research on new ways to evaluate the scientific and medical interest in certain specific publications. These observations also suggest that the use of the impact factor as a universal means of evaluating papers, researchers and research units is overrated.

As our approach to the assessment of the use of electronic journals use is simple and automated, aggregation in real time of all available individual results from institutions or from commercial providers is a foreseeable possibility. The emergence of a wide scale centralizing center, on the model of ISI for IF, would be required to accomplish this task.

A typology of readerships and journals could be achieved by a correlative examination of RF and IF. Biomedical publications could be classified in those of scientific interest ( $IF > RF$ ), those of major scientific interest ( $IF \gg RF$ ), those of clinical interest ( $RF > IF$ ) or major clinical interest ( $RF \gg IF$ ) and mixed interest ( $RF \approx IF$ ).

### Conclusion

The measurement of RF is highly automated and practical. RF is an objective and immediately available criterion of local journal use, or interest in a particular journal. It is a promising economical criterion for the local collection management of an electronic library. It should, however, not be used in isolation, but should be considered with other indicators of quality or of scientific relevance, IF being one of them.

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