# Measurement of data obsolescence in public health journals of Mexico

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## Abstract

**Introduction:** *In the process of scientific communication, obsolescence is defined as the decrease of information validity or usefulness over time.* **Objective:** *To determine the degree of obsolescence of information published in three public health journals in Mexico and quantify their annual utility loss in a given period.* **Method:** *Multisynchronous bibliometric study of indexed, peer-reviewed and active journals, with more than 30 years of existence. Analyzed variables: source articles' year of publication, references' year, age of the latter. From the references of original articles published between 2008 and 2013, variables and indicators were obtained according to Brooks' mathematical model and the half-life method.* **Results:** *Obsolescence measurements and variables' mean values were obtained for each journal. The values obtained indicate a half-life of 7.5 years; actuality average, 39.76%; aging factor, 91.15%; loss of usefulness, 8.85% per year, which represents obsolescence of literature on this subject and country.* **Conclusions:** *This study delineates an obsolescence profile for each journal: the aging factor and annual loss of usefulness are consistent with those shown by the leading public health journals in Latin America and Spain.*

***KEY WORDS:*** *Scientific and technical publications. Information Sciences. Public health, Periodical publications. Mexico.*

## Introduction

Obsolescence is defined as the decrease of information validity or usefulness over time,[1] although some authors consider that the term denotes certain pejorative accent and prefer using the term aging.[2] In the process of scientific communication and information transfer, obsolescence constitutes one type of noise.

Obsolescence, a constant in scientific literature can be studied from different perspectives, namely: within the publication system of a library and associated consultations, and can be determined based on specific documents or sources (books, articles and journals); it can also be studied in flows of documental information that are delimited by subjects, fields, groups of authors, time intervals and other parameters, and additionally, as part of the scientific communication system of a specific field of knowledge.[3]

Several sources[3-5] agree that obsolescence studies can be classified as diachronic, synchronic, multisynchronic or diasynchronic. The diachronic approach calculates the value resulting between the documents year of publication and median citations they receive. The median is the year for which 50 % of received citations is accumulated. Its direction in time is prospective. The synchronic method determines citations mean age in a subset of documents published in a particular year. This is the most common obsolescence measurement, and its direction in time is retrospective. The multisynchronic approach is a specific type of synchronic obsolescence that measures aging of a group of documents published in a certain range of years. Finally, the diasynchronic method is a measurement of synchronic obsolescence that explains a group of documents aging, while taking into account the publication growth within the studied field.[3-5]

The first work where the concept of obsolescence appeared is the one by Gross and Gross of 1927.[6] In

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the following decades, studies on scientific literature,[7-12] sciences of health[13-16] and public helath[17-19] obsolescence can be identified. However, we do not entirely know this bibliometric characteristic in journals on public health, particularly in Mexico. The purpose of this work is to measure the multisynchronic obsolescence of literature published in the following journals: *Boletín Médico del Hospital Infantil de México, Gaceta Médica de México* and *Salud Pública de México*, with the purpose to document their annual loss of usefulness in a given time interval.

## Method

Multisynchronic bibliometric cross-sectional study on public health literature obsolescence in Mexico within a 6-year period, from 2008 to 2013.

The criterion for the selection of journals for this study focused its attention on three fundamental characteristics: they are scientific journals, they are published with the same periodicity (bimonthly), which enables similar level of participation in the study sample, they are journals with a long trajectory in academic life related to public health in Mexico, with more than 50 years of existence, and are included in national and international databases and indices. The 6 volumes of each journal were directly retrieved from the publishers and journals websites.

*Boletín Médico del Hospital Infantil de México* is regarded as a clinical and public health journal. It has accompanied the Hospital Infantil de México on its quest for solving children and adolescents' health problems, by means of specialized care, high-level research, generating knowledge and defining standards of care; the task it has accomplished has been national and international dissemination of knowledge, and since it started being published in 1944, it was considered by many to be the pediatric dissemination instrument of the highest prestige in the country and in Central and South America.

*Gaceta Médica de México* is the oldest journal; it has been continuously published since 1864 and is the National Academy of Medicine of Mexico official communication publication; *Gaceta* publishes, among others, original and unpublished works submitted by scientists for admission to that institution.

*Salud Pública de México* is an interdisciplinary, international, peer-reviewed journal published by the National Institute of Public Health; it is the Mexican forum par excellence where the results of research on this field of knowledge are published and the population health necessities and organized societal answer to tackle such conditions are debated.

The observation unit were original articles of these 3 scientific journals published between 2008 and 2013; a database was whereby designed and the articles were processed together with their references in an Excel datasheet, by means of which the indicators and models used for the research were obtained.

The chi-square test was employed to estimate the homogeneity of proportions between references averages per article in the source journals.[20] To measure obsolescence behavior, differences between the variables source articles and references year of publication and age of the latter were calculated, as the differential resulting between both these years. With these variables, the following indicators were calculated:

- *Half-life:* an indicator proposed by Burton and Kebler in 1960,[21,22] who, building upon the concept of half-life or atomic nucleus disintegration semi-period in nuclear physics, defined the concept of scientific literature half-life as the time during which half the active circulating literature on a particular subject was published. In other words, it is the median distribution of references per year of origin.[23,24]

In the preliminary methodological pages of Journal Citation Reports (JCR), published by the Institute for Scientific Information (ISI), the methodology used by that system for half-life calculation is accurately presented.

- *Price index:* proposed by Price in 1970,[25,26] it is the proportion resulting from the ratio of the number of operative references to total references (operative and file references), where operative references whose date of publication is < 5 years with regard to the publication date of the document or series of documents to be assessed are considered, as well as file references whose date of publication is > 5 years with regard to the date of publication of the document to be assessed.

The results of the calculated rate are expressed in percentage values, and Price index numerical value assumes limits between 22 % (normal growth in the field of study) and 39 % (rapid growth) for file literature, and between 75 and 80 % for operative-effect literature. Average for all sciences is established at 50 %, for physics and biochemistry between 60 and 70 %, for radiology between 55 and 60 %, for social sciences between 40 and 45 %, for botany 20 % and for philology and history < 10 %.

**Table 1. Distribution of articles, references and average value per journal**

| Journal | Articles (n) | % | References (n) | % | Reference average per article |
|---|---|---|---|---|---|
| BMHIM | 161 | 26.97 | 4 340 | 25.09 | 27.0 |
| GMM | 156 | 26.13 | 4 192 | 24.23 | 26.9 |
| SPM | 280 | 46.90 | 8 766 | 50.68 | 31.3 |
| Total | 597 | 100.00 | 17 298 | 100.00 | 29.0 |

*BMHIM=Boletín Médico del Hospital Infantil de México, GMM=Gaceta Médica de México, SPM=Salud Pública de México.*

- *Aging factor and utility loss:* these indicators first appeared in the already classical work of Brookes[27] for the study of obsolescence and the detailed explanation of which was published in Spanish by Ruiz Baños and Bailón Moreno in 1997.[3]
- *Annual aging factor:* it constitutes the rate at which residual utility is reduced for each passing year expressed on a per-unit basis.
- *Initial or total utility:* it represents the total number of citations a series of documents is assumed may receive after an infinite number of years (in diachronic studies), or total number of references offered by that series of documents regardless of their age (in synchronic studies).
- *Residual utility:* residual utility of a journal volume decreases according to a decreasing exponential function, from an initial maximum value, named initial or total utility, to a null utility in an infinite time. The mathematical formula of this model is represented as:

$U(t) = U(o)a^t \quad 0 \leq to \leq 1$

Where:

U (t) = residual utility

U(o) = initial utility

a = aging factor

t = references age

Annual aging factor "a" adopts values between 0 and 1, and the model is therefore always decreasing, in such a way that if a = 1, there is no aging, and if a = 0, aging is immediate. An aging factor of 0.8 indicates that, each year, utility is reduced to 80 % with regard to previous year, which implies it has an annual loss of 20 %.[3]

For the calculation of these obsolescence parameters, we used an Excel worksheet designed at the Laboratory of Information Metric Studies of Universidad Carlos III of Madrid, which is used in teaching practices of the Bibliometrics courses of that University and in courses imparted in the Thematic Framework for Information Metric Studies.[28] The structure of the worksheet was used for each source-year of the 3 studied journals. The method for the aging factor calculation was that of half-life.

## Results

A total of 597 original articles and 17 298 references were analyzed (Table 1). The data structure indicated that 46.9 % of articles corresponded to the *Salud Pública de México* journal; as for average references per article, there were no statistically significant differences in these proportions.

Overall values for public health literature aging were: Price index for operative references, 39.76 %, and file references, 60.24 %; half-life, 7.5; aging factor, 91.15 % and utility loss, 8.85 %. Detailed information on obsolescence behavior per journal, according to the year each of the source articles used was published, is described in Table 2.

The Price index showed a regular or similar behavior per years and journals, with an average operational capacity of the 3 journals between 35 and 41 % for currentness; however, currentness distributions per year, according to each journal (Fig. 1), indicated a marked decrease for *Boletín Médico del Hospital Infantil de México*, from 47 % to 36 % during the studied period, as opposed to what was observed for *Gaceta Médica de México* and *Salud Pública de México* since, although their curves showed peaks of growth and decrease, there was a trend towards an increase in the levels of currentness. In addition, the combination of the Price index on the journals' level of currentness and the half-life in a single double axis graph showed the inverse proportional relationship that occurs between both: high values of currentness were corresponded by low half-life values.

The aging factor and utility loss of the information published in the journals exhibited the same behavior shown by their half-life and currentness; i.e., they behaved in an inversely proportional form: to the extent the aging factor increased, annual utility loss did decrease (Fig. 2).

**Table 2. Distribution of references per source journal, according to publication year and obsolescence indicators**

| Journal/source year | Total references | Operative references | % | File references | % | Half-life | Aging rate | Aging factor % | Utility loss % |
|---|---|---|---|---|---|---|---|---|---|
| *Boletín Médico del Hospital Infantil de México* | | | | | | | | | |
| 2008 | 1075 | 511 | 47.53 | 564 | 52.47 | 6.4 | 0.89686714 | 89.69 | 10.31 |
| 2009 | 679 | 299 | 44.04 | 380 | 55.96 | 6.6 | 0.90091467 | 90.09 | 9.91 |
| 2010 | 629 | 245 | 38.95 | 384 | 61.05 | 7.3 | 0.90995957 | 91.00 | 9.00 |
| 2011 | 516 | 190 | 36.82 | 326 | 63.18 | 8.2 | 0.91934386 | 91.93 | 8.07 |
| 2012 | 834 | 316 | 37.89 | 518 | 62.11 | 7.8 | 0.91444464 | 91.44 | 8.56 |
| 2013 | 607 | 221 | 36.41 | 386 | 63.59 | 7.6 | 0.91315926 | 91.32 | 8.68 |
| Subtotal | 4340 | 1782 | 41.06 | 2558 | 58.94 | 7.3 | 0.90911486 | 90.91 | 9.09 |
| *Gaceta Médica de México* | | | | | | | | | |
| 2008 | 1027 | 324 | 31.55 | 703 | 68.45 | 9.0 | 0.92650597 | 92.65 | 7.35 |
| 2009 | 739 | 244 | 33.02 | 495 | 66.98 | 8.0 | 0.91746131 | 91.75 | 8.25 |
| 2010 | 485 | 177 | 36.49 | 308 | 63.51 | 8.2 | 0.91891011 | 91.89 | 8.11 |
| 2011 | 425 | 150 | 35.29 | 275 | 64.71 | 7.5 | 0.91202509 | 91.20 | 8.80 |
| 2012 | 570 | 249 | 43.68 | 321 | 56.32 | 6.8 | 0.90285368 | 90.29 | 9.71 |
| 2013 | 946 | 350 | 37.00 | 596 | 63.00 | 8.0 | 0.91700404 | 91.70 | 8.30 |
| Subtotal | 4192 | 1494 | 35.64 | 2698 | 64.36 | 7.9 | 0.91579337 | 91.58 | 8.42 |
| *Salud Pública de México* | | | | | | | | | |
| 2008 | 1750 | 712 | 40.69 | 1038 | 59.31 | 7.8 | 0.91446758 | 91.45 | 8.55 |
| 2009 | 1597 | 593 | 37.13 | 1004 | 62.87 | 7.8 | 0.91486138 | 91.49 | 8.51 |
| 2010 | 1431 | 651 | 45.49 | 780 | 54.51 | 6.6 | 0.90042593 | 90.04 | 9.96 |
| 2011 | 1120 | 487 | 43.48 | 633 | 56.52 | 7.1 | 0.90648242 | 90.65 | 9.35 |
| 2012 | 1500 | 619 | 41.27 | 881 | 58.73 | 7.3 | 0.90891047 | 90.89 | 9.11 |
| 2013 | 1368 | 539 | 39.40 | 829 | 60.60 | 7.6 | 0.91307166 | 91.31 | 8.69 |
| Subtotal | 8766 | 3601 | 41.08 | 5165 | 58.92 | 7.3 | 0.90970324 | 90.97 | 9.03 |
| Total | 17298 | 6877 | 39.76 | 10421 | 60.24 | 7.5 | 0.91153715 | 91.15 | 8.85 |

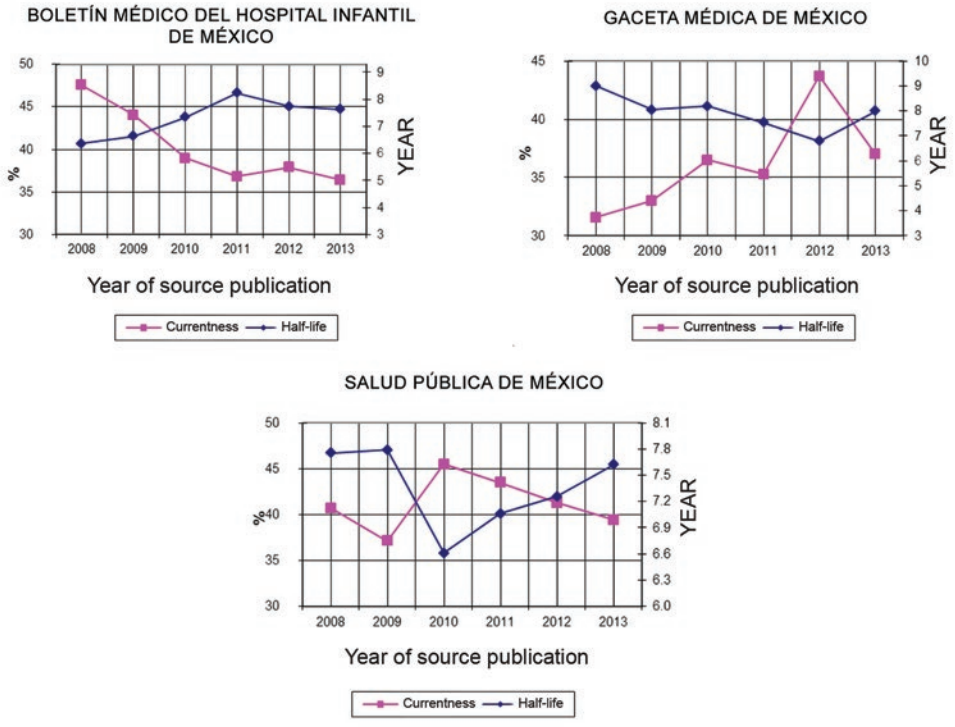


**Figure 1.** *Currentness and half-life per source journal, according to publication year.*

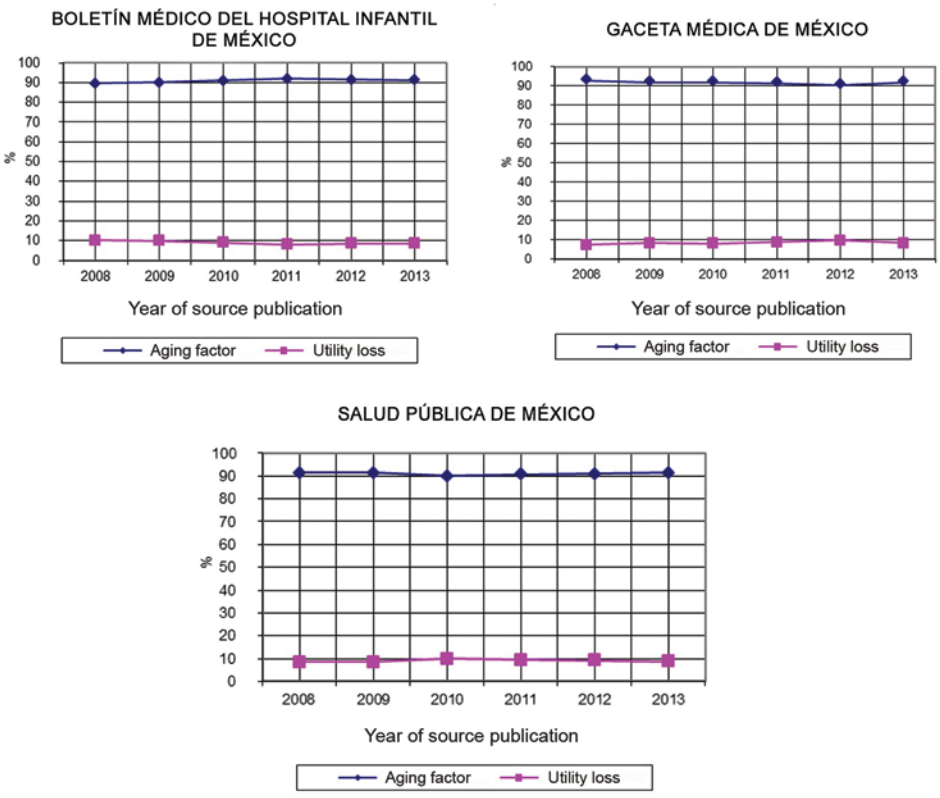


**Figure 2.** *Aging factor and annual utility loss by source journal, according to publication year.*

Aging factor for the 3 journals ranged from 90.91 to 91.58 %; this rather narrow variation indicates that each journal lost an average of 8.42-9.09 % of utility per year.

The results for each one of the indicators calculated for the 3 journals demonstrated that aging factor average value was 91.15 %, indicating that active literature present in Mexico on public health lost an average of 8.85 % of annual utility.

## Discussion

The results provide characteristics on literature annual utility loss in the sample of selected journals, delineating an obsolescence profile for each one of them. They also help to characterize the scientific information system on public health in Mexico as part of its scientific-technical potential.[29]

The obsolescence phenomenon and the studies on the subject have not been broadly examined in bibliometric bibliography,[30] which is in contrast with the vast universe of articles that examine other models and regularities, too numerous to be complied in a single article, such as studies on analysis of citations, productivity (Lotka) and concentration-dispersion approaches (Bradford), among others.[31-33]

From the distribution of data in this study, a certain disadvantage might be inferred for *Boletín Médico del Hospital Infantil de México* and *Gaceta Médica de México* with regard to *Salud Pública de México*, owing to the volume of samples they participate in the study with; however, there was no statistically significant difference in the percentage value of the reference average per article in the journals.

As for obsolescence behavior, the Price index establishes a set of values proposed for study topics, and although health sciences does not specifically appear among them, radiology and social sciences do, the latter on its broadest sense, the values of which[25] can be considered to be compared with those obtained for the 3 analyzed journals. In the thematic profile of these journals, the use of a considerable number of references classified by this indicator as file references was observed, which might indicate that this type of articles is of a historical nature and that the subject has a rapid growth.[25] Furthermore, these values, which are close to those found by Price for social sciences, could be experiencing an influence by the presence of works on the Mexican population epidemiological profile, the orientation of which

is more inclined towards the social than the clinical phenomenon.

The explanation of currentness and half-life behaviors per source journal could be indicating that the scientific literature obsolescence phenomenon is not only related to its growth in each one of the disciplines, or to the thematic profile of the content of its documents, but that articles' nature (historical, methodological, theoretical or practical) might be influencing as well.

Larivière et al.[16] have documented that, since the middle of the decade of 1960, cited material age has been constantly increasing due to modern science steady-state dynamics that followed its exponential growth after the two world wars. They refer that in 10 and 20-year citation windows, and in the fields of medicine and engineering, less than half the references were to material published within the 5 previous years, as observed in this study's data, and as shown by *Revista Española de Salud Pública*,[17] *Nutrición Hospitalaria*,[14] Spanish journals on occupational health[18] and *Revista Panamericana de Salud Pública*;[19] Larivière et al. call it "mature literature", i.e., articles that are between 6 and 10 years old and between 11 and 20 years old.[16]

Price index and half-life combination in a double-input graph shows at first sight that one curve appears as a mirror or inverse image of the other; in other words, when currentness of a journal increases, its half-life decreases,[25] a phenomenon that occurred in the journals analyzed in the present work.

Operating capability mean values observed in the studied sample are close to those found by Price for social sciences.[25] These values might be influenced by the epidemiological nature of the works published in these journals.

On the other hand, the half-life obtained for the journals analyzed in this work is consistent with that obtained by Spanish journals on occupational health,[18] by *Revista Panamericana de Salud Pública*[19] and *Nutrición Hospitalaria*,[15] publications that lose utility at a 7.3 % annual rate.

As one limitation, it should be mentioned that this study only reveals current obsolescence profile of 3 public health Mexican journals, although it is part of a broader research effort contained in the Doctor's degree thesis investigation carried out on 9 Mexican journals specialized on health subjects, over a 30-year period.

## Conclusions

The results associated with the bibliometric constant obtained in this study enable delineating an obsolescence profile for each journal that was subject to study, and are consistent with those obtained by Price foe the field of social sciences. Given the importance of these journals in the field of public health in Mexico, this study contributes with average values that typify the obsolescence behavior in this type of journals and in Mexico, which are consistent with those obtained for the main public health journals of Latin America and Spain.[17-19] The results may be used as a tool in decision making by government organizations and those that grant funding; in particular, they provide elements for journals themselves to review their editorial policies, always seeking to meet their goals and to maintain their quality for the development of the scientific communication system on public health in Mexico.

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