

# Scientific Production by Cardiologists and Scientific Societies of Cardiology: Differences and Similarities Between Argentina and Regional and Central Countries

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## SUMMARY

The present study analyzes the scientific production by cardiologists in general and by Societies of Cardiology in particular in Argentina and other regions of the world, including Latin America, USA, Europe, Asia, Oceania and South Africa. We used the h-index created by Professor Jorge E. Hirsch, an Argentinean physicist who is currently working in the University of California, USA. Despite its limitations, the h-index is nowadays used in most of the universities of the developed countries to measure the scientific quality of an investigator, a group of investigators or a scientific society. This index considers all the publications performed by the author and the amount of citation the work has received. The limitations of this index are discussed in this paper. We have tried to quantify the scientific production in cardiology measured by the h-index in different countries. The h-index of the presidents of the scientific societies of cardiology in the last 20 years is also analyzed. The possible explanations for these findings are discussed. Despite its shortcomings, the h-index is used in most of the universities in the USA and Europe for the award of tenure, promotion and advancement in the career of an investigator, which I consider of undoubted value at the moment of measuring scientific and academic production.

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## BACKGROUND

Medical associations, as those of other disciplines, are gathered by different primary and secondary objectives. Although these targets were established when the associations were founded, they may change over the time. For example, the American Heart Association (AHA), the leading society of cardiology in the United States, was conceived and remains as a scientific and academic association, prioritizing these interests over those which are currently more common in other societies of cardiology or of interventional cardiology. This was not the case of the other leading society of cardiology in the United States: the American College of Cardiology with a mission aimed primary at education. Other associations were founded as labor welfare unions, adding the scientific and academic mission over the time. One of the closest examples is the Argentine College of Interventional Cardiology. I was one of the founding members of this association.

Its initial mission was to give relevance to the practice of the specialty, with interest in union activities. After several years of intensive union activities, the association added academic and educational interests which have currently the same relevance as the founding union mission.

This is not the case of the Argentine Society of Cardiology (SAC) which has a fundamental academic and educational mission. The objectives of the SAC in our country are similar to those of the AHA and ACC in the USA and/or other associations in Europe.

We may ask ourselves about our status as Society of Cardiology compared to other leading societies of cardiology in core countries and regional Latin American countries. We should consider the fact that the specialists -cardiologists, radiologists and cardiovascular surgeons- in our country have contributed to the advances in the cardiology field, and some of their contributions were of such magnitude

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that they have changed the treatment strategies of coronary artery disease and peripheral vascular disease. (1-4)

### INDICES OF ACADEMIC PRODUCTION

How can we measure the academic production of a scientific society or of a medical community? Can this matter be quantified?

Journal evaluation is measured by citation in PubMed and by the “impact factor”. (5-7) The inclusion of a journal in PubMed is practically a prerequisite to evaluate the scientific quality of an original paper published in a peer review journal, while the impact factor would be a quantitative estimation of the importance of the journals where the articles are published. The impact factor of a journal is the average number of citations received per paper published in that journal during the two preceding years. As an example, a journal with an impact factor of 6 in 2010 means that, on average, the articles published during 2008 and 2009 have been cited six times. The impact factor is calculated each year for all the journals included in the “Thomson-Reuters Journal Citation Report” (6) and a journal obtains this impact factor after being included in this database for three consecutive years. Editorials, letters to the editor and errata are not considered for the analysis of the impact factor. The impact factor of half of the journals included in the Thomson-Reuters Journal Citation Report is less than 1. PubMed index and the impact factor have been criticized at the moment of analyzing the quality of a journal, as the introduction of information technology and the publication of articles prepared by the pharmaceutical industry may distort this analysis. (7-9) Undoubtedly, it is easier for industry-sponsored studies to be published in high impact journals of internal medicine or cardiology. (10, 11) This matter might have several readings and controversies which are beyond this analysis. However, we have not been indifferent to this issue (12, 13). Despite these limitations, both indices, particularly the inclusion in PubMed, are still most accepted by the scientific and academic community to measure the quality of a journal in our specialty.

So, how do we measure the academic quality of a medical community, of a scientific association and/or the scientific activity of a physician?

The h-index (also called Hirsch-index) is used to measure the scientific quality of an investigator, a group of investigators or a scientific society. (14) This index is currently used by many university hospitals and academic institutions in Europe and the United States for the award of tenure, promotion and advancement in the career of an investigator. For example, in Europe, a value of about 18 could mean a full professorship, and recently many academic European centers have suggested a value of 20 for becoming full professor in cardiology. In the Netherlands an h-index of 40 is required. (15)

The h-index was created in 2005 by the Argentinean Professor Jorge E. Hirsch, who is working at the Department of Physics of the University of California, San Diego. It aims to measure the professional quality of physicists and other scientists output by looking at the amount of citation his/her scientific work has received. A scientist has an index h if h of his/her papers have at least h citations each. The h-index is based on a list of publications ranked by the number of citations these publications received. (14) The h-index can be calculated automatically from within the Scopus, Web of Science and Google Scholar databases which may have few differences. The h-index is based on publications in journals that may not be indexed in PubMed and considers papers published by hospitals and universities, as well as editorials, letters to the editor and/or review articles.

In my opinion, the main limitations of the index are that it includes journals that are not indexed in PubMed and discards the information contained in author placement in the authors' list, thus all collaborators will have the same value h, introducing a potential error. In the same way, scientists with a short career are at an inherent disadvantage as their index will be low. As an example of these potential limitations, Albert Einstein would have a h-index of 51, significantly lower than that of Eugene Braunwald - 124 - or Patrick W. Serruys - 108. Despite the immeasurable and invaluable contribution of the latter investigators in Clinical and Interventional Cardiology, they cannot be compared with the impact of Einstein's investigations for progress in science and even in our everyday life.

However, and despite these shortcomings, the h-index is used in most of the academic centers in the USA and Europe for the award of tenure, promotion and advancement in the career of an investigator; (15) we think that this method has undoubted value at the moment of measuring the academic production of an investigator or a group of investigators, and of associations with a scientific and academic mission.

### SCIENTIFIC PRODUCTION BY CARDIOLOGISTS AND SOCIETIES OF CARDIOLOGY

Figure 1 shows the country rankings ordered by the h-index corresponding to the cardiology field; all the cardiologists of each country are represented on the graph. For space reasons, only the first 50 countries are described; yet there are 168 countries measured with an h-index of 1 or greater that are not mentioned. (16)

Argentina is placed in the 28th position with an h-index of 56, above Russia, Hungary, Turkey, Czech Republic, Slovenia, Croatia, Portugal and India, among others. In our region, only Brazil is above Argentina, while Mexico, Chile, Venezuela and the other Latin American countries are placed below our country. According to this graph, the cardiology field in our country presents a more than acceptable

index of scientific quality measured by the value of the Hirsch index. In addition, the Argentine population is lower compared to that of core countries with higher h-index, as the United States, Germany, Great Britain, France, Italy and Japan, which, together with the Netherlands and Canada, have an h-index above 150 (Figure 1).

Now, do these indices really measure the scientific quality of the scientific associations of their respective countries? Which would be the value of correlating these variables?

We analyzed the h-index obtained from the Scopus database of the presidents of the Societies of Cardiology from 21 countries over the last 20 years. These countries belong to different regions of the world: the United States, Europe, Asia, Oceania, Africa and Latin America. They were selected after obtaining the full name and membership details of each of the presidents of these societies over the past 20 years. These societies differ in the way they renew their leaders: once a year as the AHA, the ACC and the Societies of Cardiology of Argentina, Chile and Paraguay or every two years as most of the European Societies. China has had only three presidents over the last 20 years. The United States were represented by the indices of the AHA and ACC.

According to Figure 2, the AHA is at the first rank, followed by the Societies of Cardiology from Japan, Germany, the ACC, the Netherlands and Great Britain. The Mexican Society of Cardiology ranks first

in our region, followed by Argentina and Chile; yet, these ranks are quite below those of the core countries. Interestingly, Figure 2 demonstrates that the h-index of the ACC is ranked below that of the AHA. This finding is consistent with the fact that the AHA was founded as a scientific and academic association, while the ACC was based on education.

Figures 3 and 4 show the number of manuscripts published by each president and the number of citations per manuscript. Germany ranks first in the number of manuscripts, followed by the Netherlands, Japan, Italy, Greece, the AHA, Great Britain and the ACC. In this analysis, Argentina has a low rank. The analysis of Figure 3 indicates that the number of publications is a prerequisite to become president of the German Society of Cardiology and is also very important for the associations from the Netherlands, Greece, Italy, Japan or the AHA. At the other end, the number of publications is less important to become president of the Brazilian Society of Cardiology, with an h-index of 3 over the past 20 years. Yet, the h-index in the cardiology field of all the cardiologists in Brazil is 71, at the first rank in Latin America as shown in Figure 1, suggesting that the cardiologists with the highest scientific production who are members of this association do not have leading positions. The situation of our country is similar to that of Brazil. Despite the SAC has an average h-index of 5.1, ranking second in Latin America (Figure 2), only 15% of the clinical cardiologists, interventional cardiologists and/or

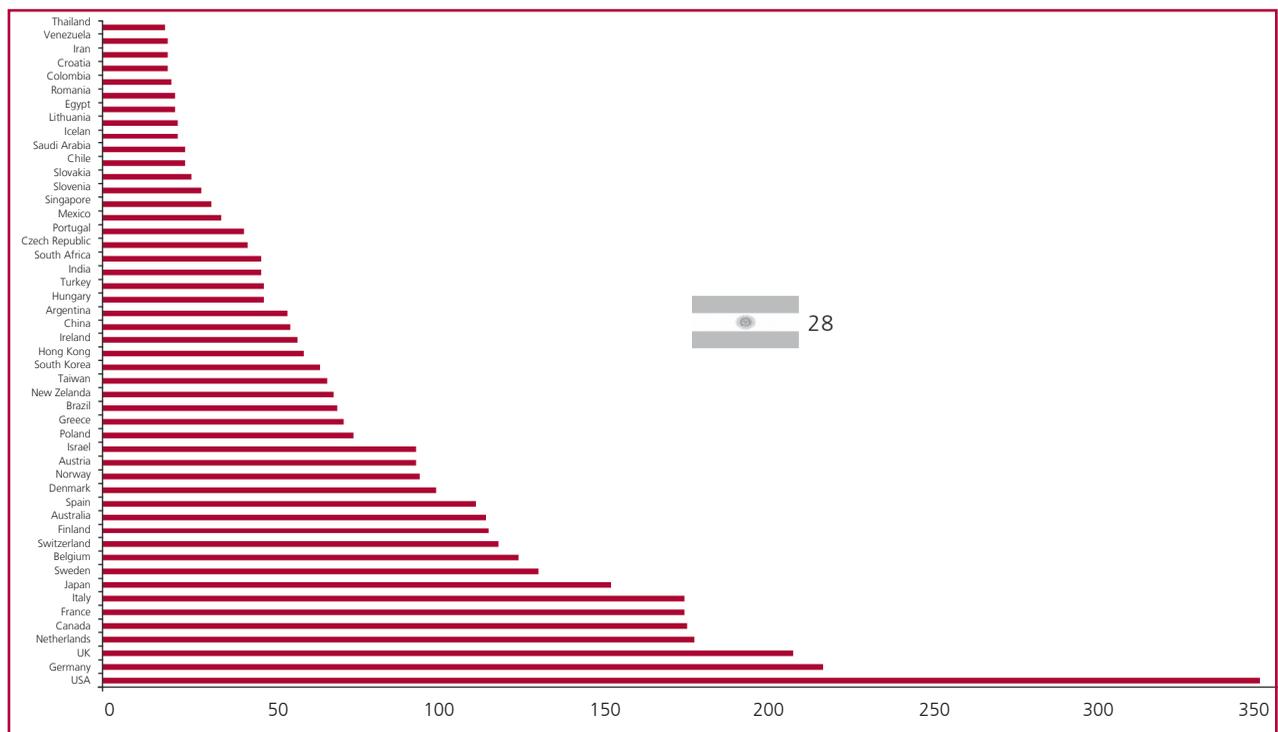


Fig. 1. Country rankings of the first 50 countries ordered by the h-index of all the cardiologists from each country. Source: SCImago Journal & Country rank (based on Scopus) in Cardiology and Cardiovascular Medicine. Data to August 2011.

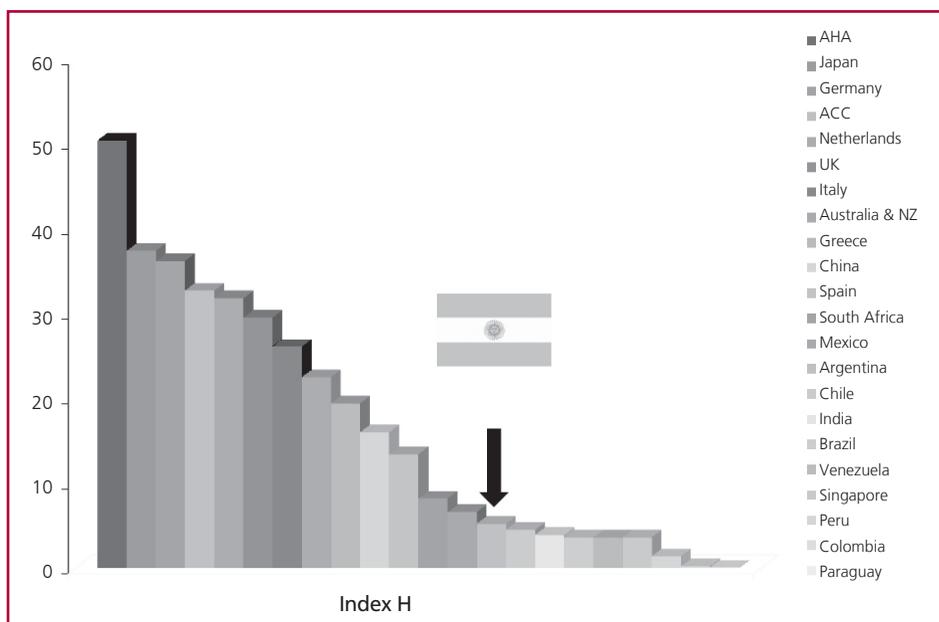
cardiovascular surgeons with the 20 highest h-indices has been president of the SAC, while the remaining 85% has little or no probability at all of becoming president. Of interest, Figure 4 shows the number of citations per manuscript of the different associations, demonstrating that the SAC ranks in an intermediate position. This finding indicates that at least few of these articles are frequently cited, yet the h-index is low due to the small number of publications.

Clearly, this suggests that despite the SAC is an association with scientific and academic basis, the scientific activity, as measured by the number of manuscripts published by a cardiologist throughout his/her career, does not seem to be a criterion for the selection of candidates for leading positions.

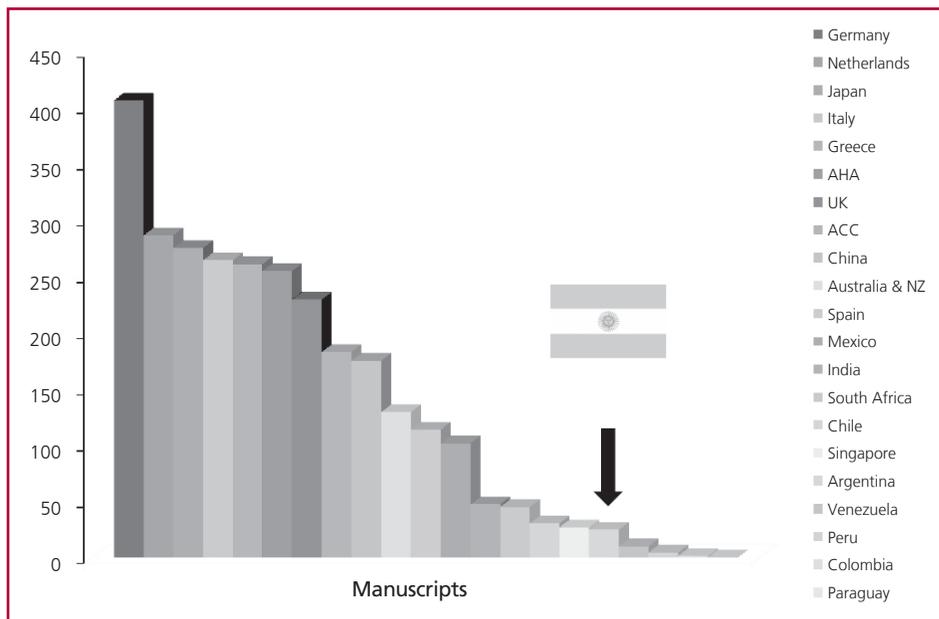
This difference is also present in most countries. Comparing Figure 1 and 2, in general, the h-index of

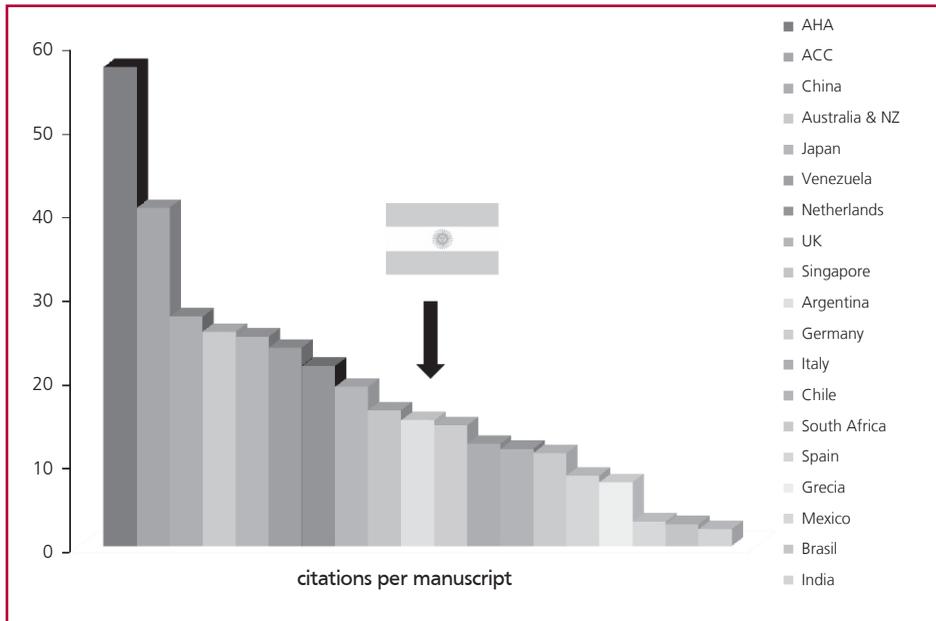
a country is greater than that of the corresponding association. For example, the h-indices of the United States and of the AHA are 350 and 56, respectively, reflecting differences which originate in mean values so dissimilar that the indices of the associations differ in a similar proportion. The impact of the economic differences on medical education might be one of the most attractive explanations to this finding, yet not the only one. Thus, the gross domestic product (GDP) per capita in industrialized countries does not correlate with the academic production. This finding is more evident in those countries with a new leadership role, specifically Brazil, Russia, India and China, with GDP growth rates which are higher than those in developed countries. (17) However, the scientific output of these four countries is far behind that of most European countries, the United States

**Fig 2.** h-index of the Societies of Cardiology.

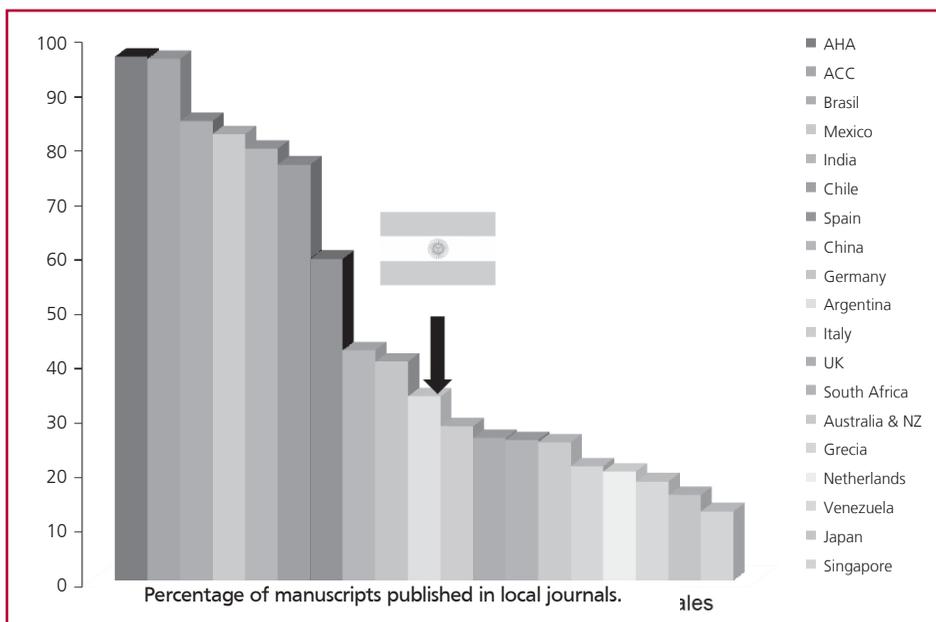


**Fig 3.** Average of manuscripts published by the presidents of the Societies of Cardiology.





**Fig. 4.** Average of citations per manuscript published by the presidents of the Societies of Cardiology.



**Fig. 5.** Percentage of manuscripts published in local journals.

and even our country (Figure 1). Probably, many years of sustained economic growth are needed to achieve an impact on medical education.

Another issue is to analyze in which journals the papers from the scientific societies of the different countries are published. Figure 5 shows that the AHA and the ACC publish in journals of the United States, probably due to the quality and number of journals in that country. This might explain why American journals have greater impact factor compared to European journals. (15) However, it is worth noting the scientific quality of countries like the Netherlands, Germany and Japan with the highest h-index and with a population significantly lower than that of the United States. Despite these countries have several

journals indexed in PubMed, most of their articles are published outside the countries, suggesting the high scientific interest of their members for this type of activity. In Argentina, more than 60% of the manuscripts were published in foreign journals, demonstrating the interest of cardiologists at the moment of publishing an original article. Yet, the fact that our journal is not indexed in Medline also contributes to explain this finding.

**FINAL CONSIDERATIONS**

1. The academic and scientific activity of our specialty can nowadays be individually and collectively quantified. All the indices have limitations. However, the fact that the main

Medical Schools and University Hospitals in the United States and Europe use the Hirsch-index to evaluate the skills of a physician applying as head of a department gives this index an unquestionable value.

2. The analysis of this index by country identifies that Argentine cardiology has an expectant role in the global context and occupies a leading position in the region; yet, it is still far from the position of core countries due to regional and own issues. The Argentine Society of Cardiology seems to follow the scientific development of Argentine cardiology in a lower degree. One of the explanations to this finding may be the little value given to scientific publications in assembling the structure of Cardiology in our country. The improvement of this deficiency should be a beneficial target for the future generations.
3. Finally, the fact that our journal is not indexed in PubMed is a major limiting factor for the scientific growth of cardiologists in our country. This should be one of the primary targets of the current and future leaders of the SAC.

## RESUMEN

### Productividad científica de la Cardiología y de las Sociedades de Cardiología: diferencias y similitudes de la Argentina con la región y los países centrales

En el presente trabajo se analizan la productividad científica de la Cardiología en general y de las Sociedades de Cardiología en particular de nuestro país y de otras regiones del mundo, incluyendo América Latina, Estados Unidos, Europa, Asia, Oceanía y República de Sudáfrica. Con este propósito, el método de análisis empleado es el índice h, creado en el año 2005 por el Profesor Jorge E. Hirsch, físico argentino radicado actualmente en la Universidad de California, Estados Unidos. El índice h, a pesar de sus limitaciones, es utilizado hoy en día en la mayoría de los centros universitarios de los países más desarrollados para medir la calidad científica de un investigador, de un grupo de investigadores o de una sociedad científico-educativa. Este índice toma en cuenta para su elaboración todas las publicaciones realizadas y además cuántas veces éstas fueron citadas. Como todo índice tiene sus limitaciones, que se discuten en este trabajo. Se trata de cuantificar la productividad científica de la Cardiología medida por el índice h de diferentes países y además de las Sociedades de Cardiología en cabeza de sus presidentes de los últimos 20 años, con una discusión de

las posibles explicaciones a los hallazgos. A pesar de las limitaciones, al ser este índice la medida en la mayoría de los centros universitarios de los Estados Unidos y Europa para el ascenso de "clase" de un determinado investigador, tiene a mi criterio un valor indiscutible a la hora de cuantificar una productividad científico-académica.

**Palabras clave** > Cardiología - Bibliometría - Argentina

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