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Growth of Research Literature on Bacterial Meningitis, 2003 to 2014: A Scientometric Study

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Abstract

Scientometric Studyis beneficial for librarians and managers of information centers in identifying the use of periodical literature.The paper analyse the articles as reflected through PubMed database for the year 2003 to 2014 to investigate the trend in the growth of literature on Bacterial Meningitis. The results of the study reveals that , the value of an average RGR of articles R_t(P) increased gradually from 0.72to 2.26 (2003 to 2013) and there is drameticallyincreased in the year 2014(2.56). The mean relative growth R_t(P) for the first 6 years (2003- 2008) indicates a growth rate of 2.08 years and in the next6 years (2009 - 2014) it was increased 4.39 years. The R^2 value for the linear trend (0.2951) is more than that of exponential trend (0.3023), which indicates that the exponential trend is more suitably fit to as compared to linear trend.

Keywords: Meningitis; Bacterial Meningitis; Scientometric Study; Growth of Literature; RGR (Relative Growth Rate); Doubling Time(D_t).

Introduction

Scientometrics is branch of 'Science of Science'. It is one of the most significant measures for assessment of scientific productivity. Is alsointerrelated to and has overlapping benefits with bibliometrics and informetrics.

In 1969, Nalimov and Mulchenko coined the Russian equivalent of the term "Scientometrics" *(Nalimov, and Mulchenko, 1969).*The term 'Scientometric' is a field which consists of the quantitative methods applied to the study of the science as an information process. This techniquecontains statistical and thesaurus methods, and indicators as to the number of citations, terms so on and it is a scientific discipline, which performs reproducible measurements of scientific activity, and exposes its objective quantitative regularities.

'Scientrometrics is an application of *quantitative techniques (*i. e. system analysis, mathematical and statistical techniques etc) *to scientific communication* (science output, science policy, science administration etc.) with the objectives of:

(a) Developing science indicators; (b) Measuring the impact of science on society; and (c) Comparing the output as well as the impact of science at national and international levels*(Keshava, 2014)*

Meningitis is caused by a bacterial infection that began elsewhere in the body, such as in the sinuses and ears. It is the major reason of mortality in about 1,000 publics around the world every day; many of them young adults and children. Meningitis is a shocking and very poisonous disease that kills patients within hours.(Rehana Basri, 2015).

Bacterial meningitis is severe infections and should be treated as emergency. Many of the people with meningitis recover, it can cause serious difficulties, such as brain damage, hearing loss, or learning disabilities. *(cdc.gov, 2015).* Bacterial meningitis sufferings all ages and was mostly a paediatric disease until the success of the Haemophilus influenza type b vaccine (HIB). (Russell Bartt, 2012).

Growth of Literature

The variations in the mass of literature over a specific period termed as growth literature. Gilbert (1978) has studied the existing literature on the indicators of growth of knowledge in scientific specialties, and has listed many ways of measuring

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it, noting their strength and limitations and commenting, at same time, on their use. Gupta, B.M (1977) suggests two approaches that have normally been considered in understanding knowledge growth: (i) Qualitative and (ii) Quantitative. Qualitative methods recommended the structural or descriptive models of knowledge growth, while descriptive model use social phenomenon to explain diffusion and formation of knowledge. Quantitative approach is trusted on summarization of statistics to elaborate the observed behavior, whereas others apply growth and technology diffusion models and bibliometric / Scientometric techniques.

More number of studies has been made on the growth of literature in the field of Medicine literature but a lesser amount of studies has been reported on growth of research literature on ***Bacterial Meningitis***. Therefore an attempt has been made to study the growth and dynamics of Bacterial Meningitis research literature.

Objectives

- To define the growth of 'Bacterial Meningitis' literature by calculating relative growth rate and doubling time for publications;
- To fit both modified exponential curve and linear curve for the original publications data studying actual growth pattern.

Scope and Methodology

The Scientometric study is a statistical method of counting to evaluate and quantify the growth of a subject. The research trend during the said time span would be clearly understood from this study and a predictive projection may be made for an anticipatable future. There are several areas in science, social science and arts for which scientometric studies have been carried out.

The present study is confined to only 'Bacterial Meningitis' literature as reflected in the PubMed database which were published during the year from 2003 to 2014.

The data for this study was downloaded from the *PubMed database*, it is a free resource developed and maintained by the National Center for Biotechnology Information (NCBI) at the National Library of Medicine (NLM). Here we used Pubmed for downloading the data; the search term applied was "Bacterial Meningitis". This may considered as central keyword of the topic discussed. A total of 3973 records spanning over the years 2003 to 2014 were downloaded from Pubmed on 15.03.2015. The downloaded data was analysed for source items to find the research trend. The articles were categorized chronologically and transported to spread sheet application (MS Excel) and evaluated the data as per objectives of the study.

Data Analysis

The articles were downloaded and classified chronologically. To investigate the nature and growth of articles, exponential, linear and logistic were tested. The exponential growth is define as:

$F(t) = a\, e^{bt}$

Where ,

a = the initial size of literature i.e. at time t=o and b, the continuous growth rate is related to the percentage by which the size increases each year.

The logistic has a lower limit and an upper limit or a celling beyond which the size cannot grow and can be represented mathematically as $U_t = \frac{K}{1+\mu}$

Where,

U = expected size of literature

K and μ = constants and t= time.

Similarly, the linear growth is represented as $U_e = a + b_t$

Relative Growth Rate (Rgr)

Relative Growth Rate (RGR) and Doubling Time (Dt) had been applied. RGR means the increase in the number of articles per unit of time. The mean RGR of articles over the exact period of interval is represented as:

Rt = Relative Growth Rate of articles over the specific period of time.

$\log_e p(0)$ = Logarithm of initial number of articles

$\log_e p(t)$ = Logarithm of final number of articles

Similarly, RGR of subject's articles has increased in number of articles per unit of time. The mean RGR of subject articles Rt(SA) over the period the specific period of time is determined as:

$$Rt(SA) = \frac{1}{t}\left[\log_e p(t) - \log_e p(0)\right]$$

Rt (SA) = Relative Growth Rate of articles over the specific period of time.

$\log_e p(0)$ = Logarithm of initial number of articles

$\log_e p(t)$ = Logarithm of final number of articles

Doubling Time (D_t)

Dt (Doubling Time) has been calculated using the following formula:

Doubling Time or Dt = 0.693/R

Dt (Doubling Time) is directly related to RGR and is defined as the time required for the articles to become double of the existing amount. In case the number of articles in subject doubles during a given period, then the difference between logarithms of number at the beginning and at the end of this period must be the logarithm of the number 2. We used Napier logarithm and the taken value of is 0.693. Therefore, as per this (0.693) and an average growth rate we calculated by what time interval does the Napier logarithm of numbers increase by 0.693. So the Doubling time is calculated as:

$$\text{Dt (SA)} = \frac{\log_e 2}{R_t(SA)} = \frac{0.693}{R_t(SA)}$$

Here, Dt (SA) = average doubling time of the articles(Keshava, 2014).

Table 1: Relative Growth-rate (RGR) and doubling time (D_t) of articles in Bacterial Meningitis from2013 to 2014.

Year	No. of Articles	Cumulative	$\text{Log}_e 1^p$	$\text{Log}_e 2^p$	R_t (P)	Mean R_t (P)	D_t(P)	Mean D_t(P)
2003	297	297	5.69	5.69	0.00		0.00	
2004	280	577	5.63	6.36	0.72		1.45	
2005	295	872	5.69	6.77	1.08		2.17	
2006	334	1206	5.81	7.10	1.28		2.57	
2007	339	1545	5.83	7.34	1.52		3.03	
2008	370	1915	5.91	7.56	1.64	1.04	3.29	2.08
2009	355	2270	5.87	7.73	1.86		3.71	
2010	338	2608	5.82	7.87	2.04		4.09	
2011	323	2931	5.78	7.98	2.21		4.41	
2012	354	3285	5.87	8.10	2.23		4.46	
2013	381	3666	5.94	8.21	2.26		4.53	
2014	307	3973	5.73	8.29	2.56	2.19	5.12	4.39

R^2 (Linear trend for no. of articles)= **0.2951**
R^2 (Exponential trend for no. of articles) =**0.3023**
R^2 (Exponential trend for cumulative no. of articles) = **0.9052**

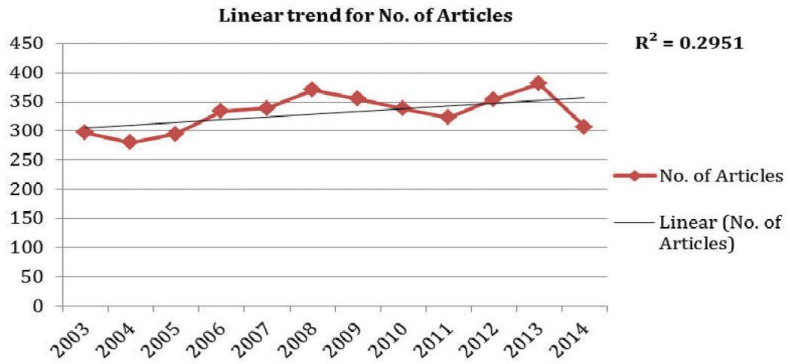

Fig. 1: Linear trend for no. of articles from 2003 - 14

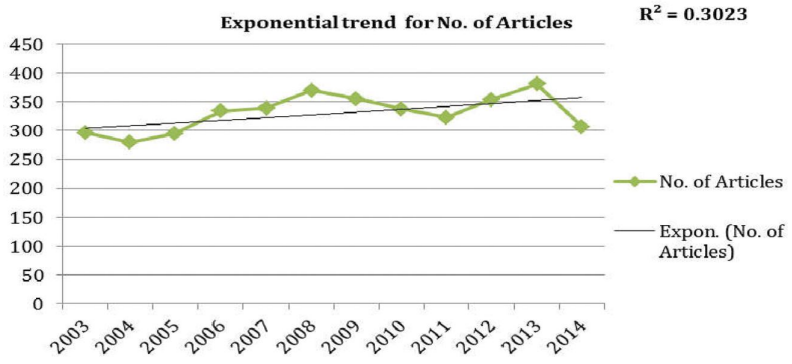

Fig. 2: Exponential trend for no. of articles from 2003 – 14

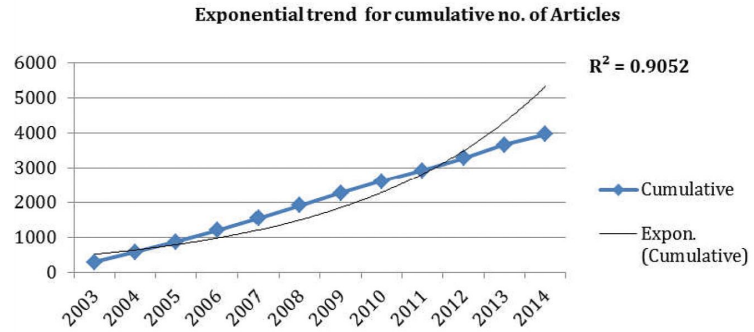

Fig. 3: Exponential trend for cumulative no. of articles from 2003 - 14

Here Doubling time can give more intuitive sense of the long term impact of growth than simply viewing the percentage growth rate.

$$T_d = \frac{\log 2}{\log(1+\frac{r}{100})}$$

Where:

T_d= Doubling Time

r= Constant Growth rate.

Relative Growth Rate (Rgr)

As the table1 clearly indicates, the value of an average RGR of articles $R_t(P)$ increased gradually from 0.72 to 2.56 (2003 to 2014). and there is little increased in the year 2014 (2.56). Therefore during year 2003 to 2013 there were much research has been done to eradicate this deadly disease. Majority of the countries of the world has given much importance to research to control and combat the disease , hence the RGR has been increased. It is due to most of the countries successfully eradicated the disease of Bacterial Meningitis. Therefore, not much studies have not been reported. For the first six years i.e. 2003 to 2008 the RGR was 1.04 and in the next six years i.e. from 2009 to 2014, it was increased to 2.19 interestingly. Cumulative values of Doubling time of the publication of articles $D_t(P)$ increased gradually from 2004 (1.45 years) to 2014 (5.12).

The mean relative growth $R_t(P)$ for the first 6 years (2003- 2008) indicates a growth rate of 2.08 years, whereas for the next six years (2009- 2014) it was increased 4.39 years. It shows that the mean relative growth of Bacterial Meningitis literature has shown an increasing trend. It may be due to interdisciplinary and multidisciplinary nature of research and the communication patterns of medical researchers. Therefore, it is inferred that majority of the countries have shown keen interest in research to eradicate Bacterial Meninigitis. The linear growth trend is fit to number of articles and exponential growth trend fit to number of articles and number of cumulative articles for the years 2003 to 2014. The table 1 and Fig. 1, 2& 3 reveal that the R^2 value for the linear trend (0.2951) is more than that of exponential trend (0.3023), which indicates that the exponential trend is more suitably fit to as compared to linear trend. Further, the exponential trend is fit to the cumulative number of articles from 2003 to 2014. The R^2 value for this trend is 0.9052, shows 90.52 % variation observed from the cumulative number of articles.

Results

The year-wise analysis of the growth of literature output shows that the growth was asymmetrical from the year 2003 to 2014, and it was high during 2013 to

2014.Between the years 2003 to 2014 there was a exponential growth of research literature on Bacterial Meningitis worldwide. The high productivity during these years may be due to their significance of the studies on Bacterial Meningitis, which may have got prominence in Research and subsequent literature as well. Therefore, it is evident from the study that there was an asymmetrical growth of literature on 'Bacterial Meningitis'during a span of 12 year (2003 to 2014).

Conclusion

The result of the present study would be very useful for librarians and information managers to organise the most frequently and frequently used materials and necessary. It also helps in discording the less frequently used materials from the library collections. Many of the disciplines around the world, would be aimed at informed decision making, critical assessments of the amount of new knowledge contributed by the research output and so on. Therefore valid measures of knowledge growth may be obtained. It helps to provide exact, useful descriptions and estimatedgrowth of knowledge in the field of 'Bacterial Meningitis'.

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