

Title of the Project: **Global Database of Research Papers on Malaria during last 50 years and its Analysis**

Principal Investigator: **Dr. (Mrs.) Divya Srivastava**

Implementing agency: **Indian Council of Medical Research (HQ), New Delhi**

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Executive Summary

1. Malaria is a public health problem today in more than 90 countries worldwide. Mortality due to malaria is estimated to be over 1 million deaths each year.
2. With the recent breakthrough in Genomics and Proteomics and availability of quantum of information on Human, the research has entered in to a new arena with more prospects on vaccine development, drug delivery system, diagnostics, alternative methods of control and evaluation of newer insecticides and drugs.
3. Given the significant growth in the malaria research and malaria research investments in the country, India needs to monitor and measure its performance in malaria research on regular basis. This requires building suitable indicators of malaria research performance, designed to understand the dynamics of research at all levels depicting how Indian research is performing vis-à-vis a select other similarly placed countries and against countries from the developed world.
4. The database (on a CD, through specially developed software have been developed on the basis of records captured from different global secondary services and Indian Science Abstracts, and hopefully, will facilitate a quick access to all the malaria related work carried out during last 50 years (1955-2005) published in a journal. and is first of its kind to provide a consolidated and comprehensive Bibliographical Database (MALPUB) on Malaria Research Papers, in the field of malaria around the Globe.
5. The software has two versions: User Version is having facilities for simple and advance search, summarization, saving in desire format & printing. The other is Admin Version, with additional facilities.

Analysis of MALPUB

1. The report presents a the research efforts being made from the resultant database MALPUB.
2. A 25 years of publications data from 1981 to 2005 on India and to p 20 productive countries have been used for developing indicators for Malaria research, at country level
3. The total numbers of papers published during 1955-2005 is 122055. During 1996-2005 the number of papers in the field of Malaria was at it's maximum with 47.21%. The cumulative publication share in world research output indicated an exponential growth of papers from 3.34 (1955-65) to 47.21 (1996-2005).
4. The total number of countries involved in malaria research have increased from 130 (1981-85) to 135 (2001-05). India has maintained it's position among the top 4 countries through out the period of study (1981-2005) in the bracket of USA, UK, and France. In this way India has established itself as one of the giants in the field of malaria research, and ranks 4th among the top 20 countries, with its global publications share of 6.57%.The other countries that contributed publication in the range of more than 2% were Switzerland (2.78%), Japan (2.55%) & Brazil (2.41%).

5. The overall global publication share of top 20 countries in Malaria research ranged from 0.82% to 26.89%. The United States tops the list United Kingdom ranks second, followed by France, India, Australia and, Germany.
6. USA, UK, India, France, Netherlands, Switzerland, Germany, Thailand, China, Australia, South Africa, Italy, Brazil, Japan, Nigeria, Sweden are the strong contributing countries.
7. The average growth rate of developing countries in top 20 is from (-)14.39 to (+)29.35 during successive years. India and Brazil are the top most growing countries.
8. In spite of top rank of USA, it has not shown any considerable increase of annual growth, only its percentage share was more to keep it at the top position. Similarly UK get top position due to its share but annual growth have decreased from 9.41 to 8.67. France and Australia have got an increase in their annual growth rate.
9. India has nearly 442 high productive institutions in the field of Malaria Research, during 1986-2005 publishing a total of 5669 papers. The top 10 institute contributed approximately 55% papers with an average of 285.8 paper per Institute. The rest of the papers were published by the rest 432 research institution and University Departments with an average of 5.53 paper per institute.
10. National Institute of Malaria Research (Earlier Malaria Research Center) Delhi, contributed maximum papers (18.64%) during the period of study followed by Central Drug Research Institute, Lucknow (10.06%), Vector Control Research Center, Pondicherry (5.66%) and International Center for Genetic Engineering & Biotechnology, New Delhi with 4.44%.
11. 18 subject areas within malaria research were identified. They comprised around 52% of all malaria papers. Analysis indicates, an increase in the relative effort devoted to modern research in the field of control measures and understanding of vectors e.g. Artemisinin (ACT), Genome or Gene Studies, Malaria Vaccine, *P. falciparum* and Mosquito or Vector Control. Vaccines research have shown an increase during 1986-95, and has remained at about 22% of the total world average.
12. Among the pharmaceutical approaches, it is striking that research on Chloroquine has also increased over a period of 1981-2005. Work related to Artemesinins has increased from almost none in the early 1980s to around 70% world average, in the 21st century.
13. It is remarkable to note that in the field of parasite biology most of the efforts are concentrated on *P. falciparum* with world average of 33.06 (1981-85), 35.77 (1986-95) and 71.18 during 1996-05 whereas the papers on *P. vivax* have shown only a marginal increase from 8.91 (1981-85) to 17.43 during 1996-05.
14. Recent report of *P. knowlesi*, the monkey malaria infecting human being in some areas of South-east Asia made new developments from no paper during 1981-85 to the global output of '4' during 1996-05.
15. New technologies such as use of Rapid diagnostic kits were adopted for research areas in later years and the data indicated that its growth increased from Nil during 1981-85 to 1.58 of world average during 1996-05.
16. Among the productivity of developing countries as compared to world average India have shown its strong commitment towards Artemisinin and ACT, Drug Resistance, Malaria in Pregnancy and Malaria in Children, Mosquito or Vector Control, DDT or DDT Resistance, Fish or Biological Control and Bed nets showing an steady increase from 1981 through 1996-05.
17. China has shown strong commitment in Artemisinin based combination therapy of malaria control whereas Thailand has also depicted the same trend as of India with main focus on drug resistance, ACTs, malaria in children etc.
18. There were total 6064 journals publishing a total of 122055 papers during the whole study period (1955-2005). The first 50% papers (around 61115) appeared in a total of 47 journals with an average of approximately 1300 papers per journal. The rest of the

papers were distributed among a total of 6017 with an average of 11 papers per journal.

19. Both the number of journals and the number of articles grew exponentially. The number of articles has increased from 4026 to 57619 from 55-65 to 96-05. Also the number of journals has increased from 502 to 3072 (1955-65 to 1996-05).
20. The most important observation is that the number of least productive journal has increased from 463 to 2951. This is perhaps due to: Interdisciplinary nature of research in Malaria and related topics, and High growth rates (exponential in nature!) of journals and articles
21. The top most journal contributing more than world average (21 papers per journal) were *Trans R Soc Trop Med Hyg* with an average of 112 papers followed by *Am J Trop Med Hyg*, *Mol Biochem Parasitol*, *Lancet*, *Ann Trop Med Parasitol*, *Exp Parasitol*, *J Am Mosq Control Assoc*, *Infect Immun*, *Trop Med Int Health*, *Parasitol Today*, *J Med Entomol*, and *Parasitol*.
22. In the next group, contributing papers between the range of 11-20, *Indian J Malariol* stood at the top position (13 papers per journal) much closure to world average.
23. *J Med Entomol* and *J Infect Dis* are new entrants in the publishing journals for malaria research occupying position among the top 10 world ranking journals during 1995-2005.

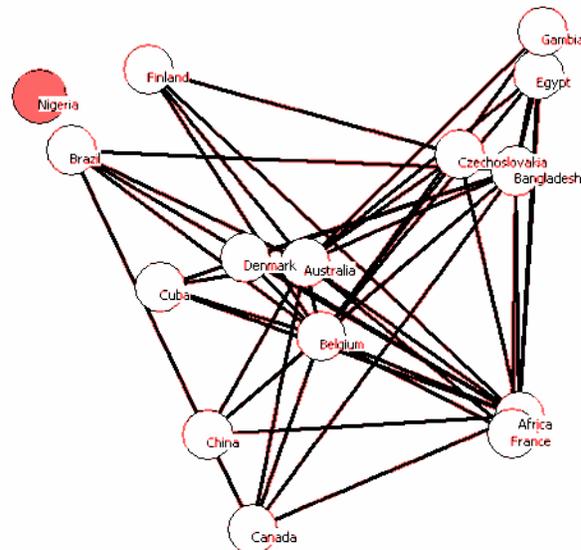
The data mining has also been done to which clustering techniques are applied. Clustering identified some groups that contained relatively homogeneous types of jobs. Training a classification model to learn the cluster groups allowed those jobs to be identified in unseen data. With some manual analysis to code a target variable for a subset of the data, classification models were trained to predict the target variable based on text features. This was achieved with a moderate level of accuracy. BibTechMon was used for the analysis, a software developed by a group of scientist at Vienna, Austria.

Result of Data Mining:

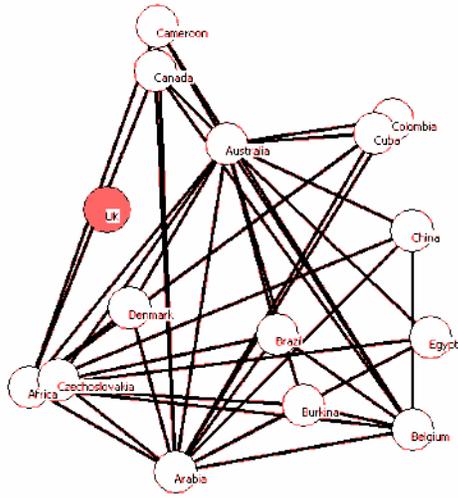
Here the line between the nodes shows the common title of the research papers published by the countries involved. The circle size of the node indicates the frequency and the orange color circle is having the highest frequency.

Figure:

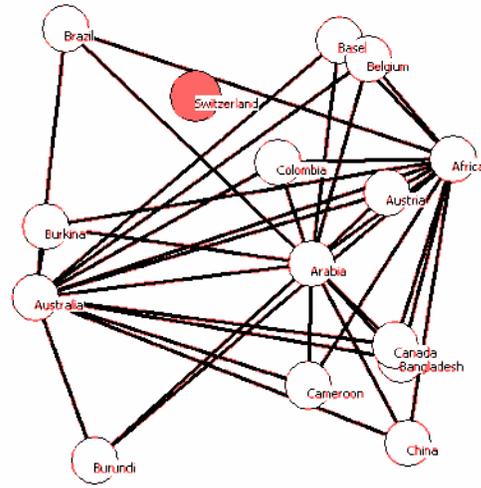
Most Frequent Countries Publishing Articles Between Year 1981 - 85



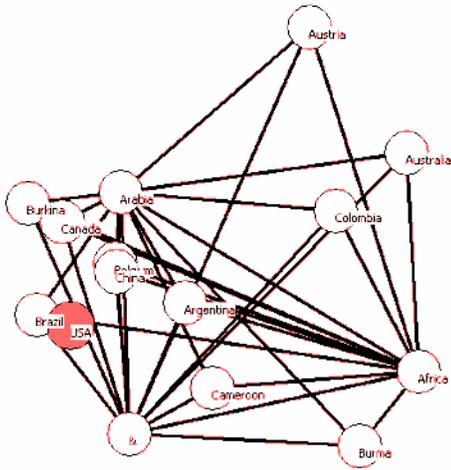
Most Frequent Countries Publishing Articles Between Year 1986 - 90



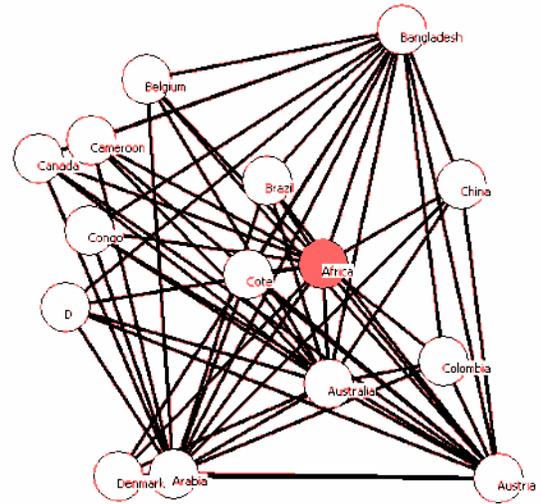
Most Frequent Countries Publishing Articles Between Year 1991 - 95



Most Frequent Countries Publishing Articles Between Year 1996 - 2000

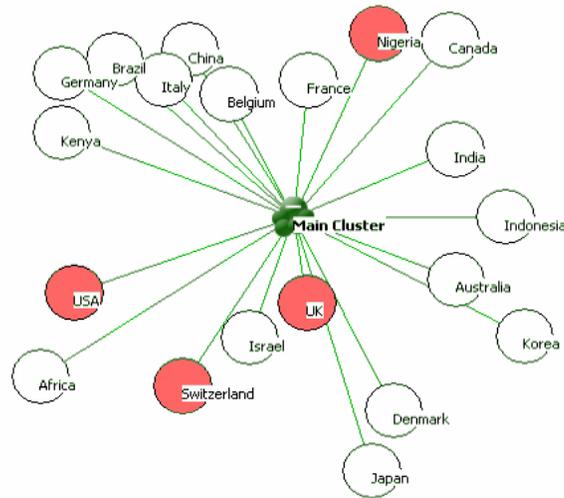


Most Frequent Countries Publishing Articles Between Year 2001 - 05

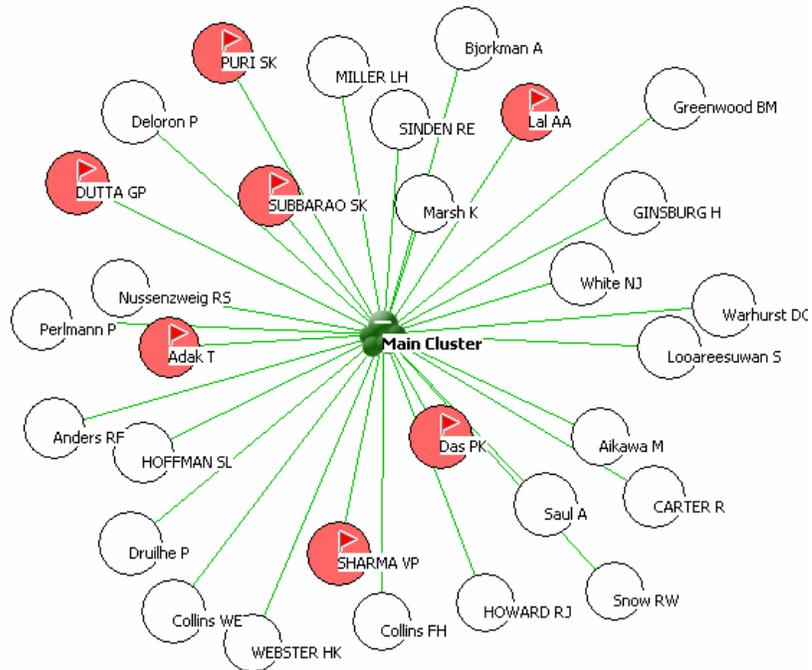


Following Figure is the result of the analysis which shows the most prominent countries (in terms of frequencies) in publishing papers and articles.

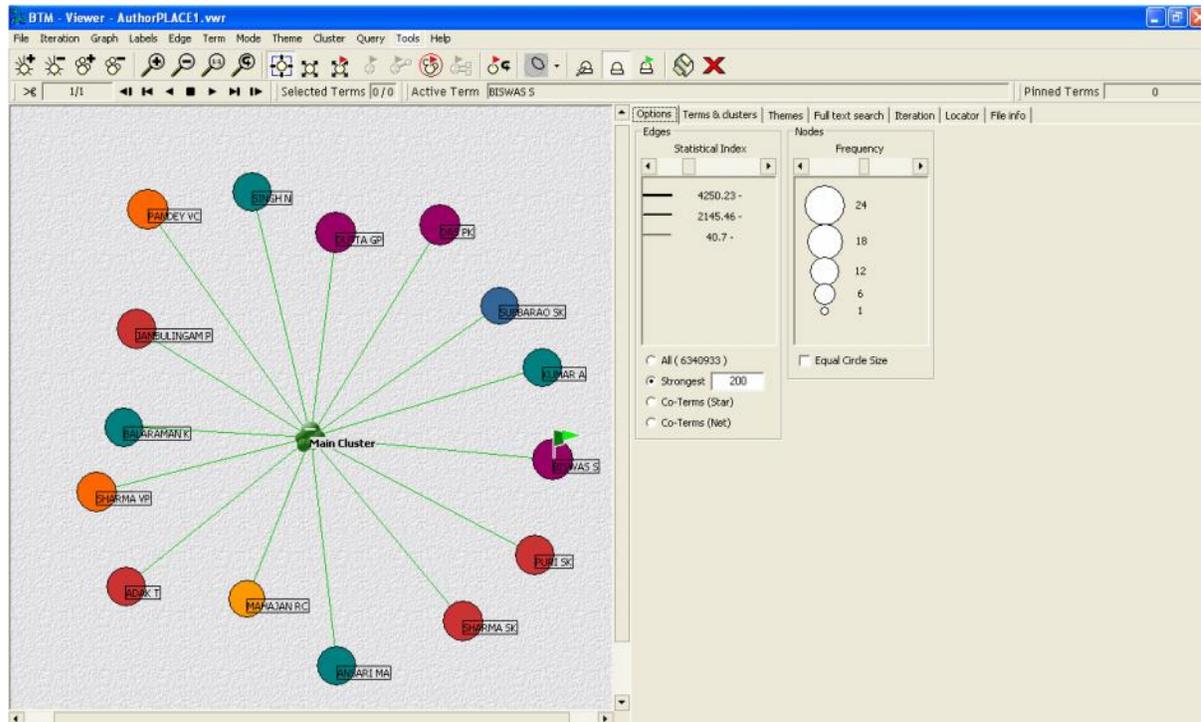
Most Frequent Countries Publishing Articles Between Year 1981 - 2005



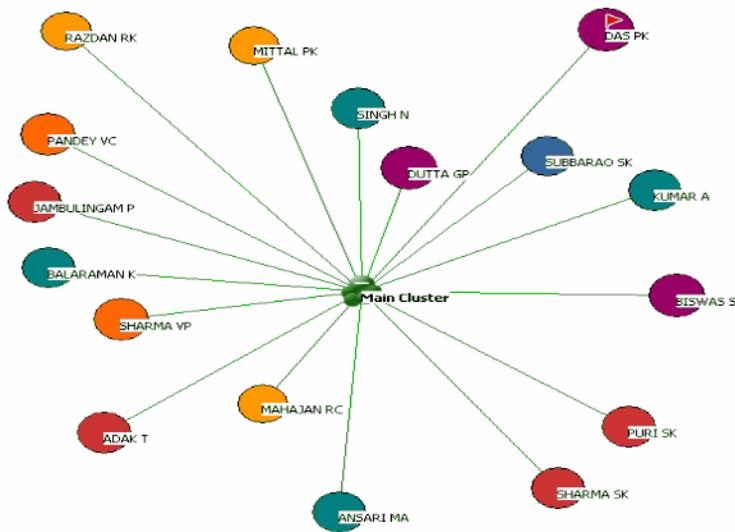
Most Prominent Authors from 1981 - 2005 (Indian Authors are in Orange Color)



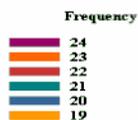
When we focus on the Indian authors and their addresses we get the following output :



Some more clear view is as follows



Top 17 Indian authors with their frequencies



The captured data have been analyzed to compute time trend analyses, subject-wise analyses and the type of the study – whether basic or applied, individually for the data from different global database e.g. SCI, MEDLINE, TDB and ISA also. An analysis has also been carried out to find out comparative coverage and trend of papers between two different databases also.

Analysis of the Data Captured from SCI

1. The analysis has been done for the records from SCI, over the quarter -century from 1980 to 2004, and national outputs of malaria papers with their production of biomedical papers overall were compared, so as to show their relative commitment to malaria research also in terms of the approaches being researched for malaria control. These include the study of mosquitoes and their habitats; spray ing with DDT and other insecticides; the use of Bed nets; Vaccine development; and Genetic approaches. We have also looked at five sets of drug -based methods of attack: Quinine; Chloroquine; Mefloquine; Pyrimethamine; and the new Artemesinins.
2. Malaria research is a small sub-field and currently represents about 0.4% of biomedical research output in the SCI, though it was only about 0.3% in the early 1980s.
3. The distribution of the research levels of the malaria papers, with, for comparison, papers in three other biomedical sub-fields – AIDS, cancer and respiratory medicine were also evaluated. The malaria papers are the most basic of the four, with a median value of RL of 2.66 compared with 2.10 for AIDS, 1.98 for cancer and 1.77 for respiratory medicine. This suggests that much still has to be learned about the fundamentals of the disease, whereas for the other research sub -fields, the emphasis of research is very much on the development of new and better drugs.
4. The countries most committed to malaria research in relation to their biomedical research output are all ones affected by the disease, but Kenya, Thailand and Nigeria are in a different group from India, South Africa and Brazil. Among the industrial countries, Australia, Switzerland and the UK ar e relatively the most active, followed by France and the Netherlands.
5. There has been a steady relative decline in the amount of attention given to mosquitoes and their habitat, but, an increase in the relative effort devoted to genetics. Vaccines research increased in the 1980s, and has remained at about 9% of the total.
6. Among the non-pharmacy approaches, mosquito control research is undertaken most by the USA and Canada. South Africa concentrates heavily on the insecticidal approach and Kenya and the UK on the Bed net approach. Malaria vaccines have been most favored by Switzerland, although Colombia has a RC of 5.5 to this subject area.
7. Among the pharmaceutical approaches, the new Artemesinins have principally engaged the attention of the Chinese, followed by the Thais. Chloroquine research has been the main interest of Nigeria, and Mefloquine research in Thailand, Switzerland, Nigeria and Sweden. Nigeria has also been active in work on Pyrimethamine (as has Kenya), and Thailand in work on the trad itional remedy for malaria, quinine, which is now making something of a comeback as resistance develops to some of the newer drugs

Comparative Study of SCI & MEDLINE Data

1. The papers from two very important International databases namely SCI & MEDLINE for the two-time period 1986-90 & 2001-05 with a gap of 10 years have indicated the total coverage of malaria papers during 1986 -90, - MEDLINE 5888 and SCI covered 3967 papers.
2. During 2001-05 the coverage of MEDLINE leaped many folds (12,491). In SCI also, number of papers covered was more (10123). This indicates that MEDLINE is the world's most comprehensive source of life sciences and biomedical bibliographic information.
3. The trend of journals enlisted in both the database shows that the topmost journals covering malaria papers were almost same in both MEDLINE and SCI. American Journal of Tropical Medicine and Hygiene has grabbed 1st position (2001-05)

replacing Transactions of the Royal Society of Tropical Medicine and Hygiene (1st during 1986-90).

4. The contribution of total no. of articles in MEDLINE is more as compared to SCI during 2001-05 as well as during 1986-90. But while looking at the percentage contribution of both the databases there is no significant change as the total no. of articles on malaria covered in SCI is less.
5. The journals covered in SCI are more from the developed countries with USA standing at the top followed by UK, Germany, Netherlands, France *etc* (In recent years UK is at the top position followed by USA (2001 -2005). While in MEDLINE, journals from the developing countries like India, China, Brazil, Thailand are having better percentage share