

Changing Face of Indian Medical Research: A collaboration analysis of papers from SCI (1999 & 2007)

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Abstract:

We have seen an explosive growth in information being generated and our capabilities to both collect and store data, and generate even more data by further computer processing. But our inability to interpret and digest these data has created a need for a new generation of tools and techniques for intelligent database analysis. The new data and text mining techniques, combined with analytical skills, can assist in the creation of new knowledge and promote “informed” decision making and policy formulation in all areas of activities in the scientific and technical, organizations. In bibliometric research methodology such as collaboration between authors of a paper, be at local level or different geographical areas are opening up new possibilities for tracking down analytical information from large collections of bibliographic data. Address (s) of co-authors can be explored to study collaboration patterns on - intradepartmental, interdepartmental, interinstitutional, intercity or international or to study concentration of researchers working in a particular subject area. Collaboration studies can help to study

concentration of researcher in different geographical locations. Through this : Growth in subject area , or trends studies; Strength in the subject area or Lacunae in a particular subject area can also be studied. The sophisticated value of online information provision is not to use the databases only for finding facts and accessing documents, but to tap the unique items of useful information, the nuggets of knowledge and (by synthesis and/or analysis) extract the “searched pattern” in the raw data.

In the present study through collaboration analysis efforts have been made to identify comparative upcoming subject areas as well as scientific hubs in India, in the field of Biomedical Sciences for two time periods- 1999 and 2007. The basic data for the study has been culled out from SCI, related to the scope of the study only for Papers from India as one of the authors. The findings have clearly indicated change of productive institutions, subject areas being covered by authors and the collaboration pattern between Cities and the countries.

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Introduction:

Co-authorship counts and collaboration is the participation of the significant number of the scientists and is evidence of a critical mass of researcher working on the related topics. The existence of the such group has been considered as an indicators of the maturity of research community. Through this growth in subject area , trend studies, strength in the subject area or lacunae in a particular subject area can be studied. Due to the researchers' primary scientific orientation in their own discipline, their interests often are strongly related to their specialty. Researchers and information professionals in co-operation with domain specialists are often involved here in the studies of research frontiers; trends, gaps and similarities in research efforts at institutional, national, and international levels. Apart from this, these studies can be useful for science policy also. This is the smallest but financially the most potent group. Their studies are at the meso- and macro-level where the national, regional and institutional structures of science and their comparative presentation are in the foreground.

Lancaster made use of the bibliometric techniques, and in this study he explored several dimensions of literature growth and spread of influence. One of the central problems in the application of this method is the definition of "key issue": when can an issue be considered 'key'? One obvious way of recognizing a key issue is from the rate of growth of the literature on this issue at a particular point in time. Using bibliometric techniques in large databases it is possible to analyze when an issue reaches some pre-established increment of growth, e.g., in the form of considerable

increase in the number of publications on this topic from one year to the next, or by measuring the relative and absolute frequencies of collaboration between institutions, cities or at international level. Rapid increase in the number of databases including literature on a given topic clearly indicates spread of interest. "Spread" can be added to "growth rate" as a potential indicator of when an issue can be considered "hot".

Collaboration is now actively promoted with a view to breaking down the barriers between research institutions, industry, commerce, government and the public services. Specific driving factors include: the growth of the knowledge economy and attempts to strengthen the economic and social contribution of research; a shift towards more applied research in collaboration with other knowledge creators and users; greater concentration of research activity and partnership in the use of plant, equipment and expertise; the growth of the directed mode of funding based on priority areas and problem oriented project funding . Collaboration occurs at various levels including individuals, groups, departments, institutions, sectors and countries. Some collaboration is formal, much more is informal. Collaboration occurs between individuals, groups, departments, institutions, sectors and countries. The latter may emerge from political memoranda of understanding between nations, although definitions of higher levels of collaboration are no easier to arrive at than for inter-individual collaboration. Nevertheless, it is important to make this distinction between the different levels because an inter-institutional or international collaboration may not necessarily entail an inter-

individual collaboration. What constitutes a collaboration varies across institutions, fields, sectors and countries, and changes with time.

For decades the multiple-author publication, frequently referred to as a co-authored publication, has been used as a basic counting unit to measure collaborative activity. Smith was one of the first researchers to observe an increase in the incidence of multiple-author papers and to suggest that such papers could be used as a proxy measure for collaboration among groups of researchers. In the present study explicit networks of such connections have been constructed by using data drawn from Science Citation Index, for only the Indian Biomedical Papers during the period of 1999 and 2007 . The results include distribution of numbers of collaborators of authors, demonstrate the presence of clustering in the networks, and highlight a number of apparent differences in the patterns of collaboration between the fields studied along with the two time periods *ie.* 1999 and 2007. Differences among researchers have been investigated with regard to productivity, number and rate of national/international collaborations. I refer to collaboration in terms of inter-departmental and inter-institutional intra – city & intercity collaboration as well as international collaboration. The degree of (national, international) collaboration is

the percentage of (national, international) collaborative articles out of the total number of articles. All Indian institutional addresses on the papers were unified to a set of standard institutional names and each standard name was assigned to an institutional sector.

There were total 12797 (1999) and 27,000 (2007) records in all the fields of science & technology from India .For only Biomedical Papers for present study, 4732 (1999) & 6088 (2007) records were extracted. All these papers appeared in 412 (1999) and 1475 (2007) unique Journals. The choice of publication outlet is important because much of the future visibility, recognition and acceptance of the work and its authors are dependant on the dissemination and status of the outlet in which it was published. The top most contributing institutes for these publications were from about 79 Cities for 1999 and 85 during 2007 ,across the country. Out of these institutes 11 institutions contributed 30.3% of the papers during 1999 and, during 2007 total 20 institutes has the same percentage contribution. The top most institutes were:

Top most institutes in terms of share of papers

During1999 :

Institute	Total	%
All-India-Inst-Med-Sci	345	7.29
Indian-Inst-Sci	237	5.01
Bhabha-Atom-Res-Ctr	150	3.17
Banaras-Hindu-Univ	138	2.92
Christian-Med-Coll-&-Hosp	105	2.22
Cent-Drug-Res-Inst	101	2.13

Indian-Inst-Chem-Technol	92	1.94
Indian-Inst-Chem-Biol	70	1.48
Ctr-Cellular-&-Mol-Biol	68	1.44
Madurai-Kamaraj-Univ	64	1.35
Postgrad-Inst-Med-Educ-&-Res	64	1.35

During 2007

Institute	Total	%
All India Inst Med Sci	448	7.43
Postgrad Inst Med Educ & Res	229	3.80
Christian Med Coll & Hosp	134	2.22
Sanjay Gandhi Postgrad Inst Med Sci	128	2.12

All the papers were distributed in a total of 81 (1999) and 97 (2007) subject areas. These subject areas were assigned on the basis of journal field of the bibliography. Main subject areas covered by Indian scientists were Chemistry, Chemical Biology, and Biochemistry etc. Percentage of papers published in top 11

Indian Inst Technol	100	1.66
Banaras Hindu Univ	91	1.51
Univ Delhi	82	1.36
Tata Mem Hosp	80	1.33
Panjab Univ	71	1.18
Univ Madras	71	1.18
Indian Inst Sci	70	1.16

categories was 28.04 during 1999, which changed to Drug Development, Oncology, Biochemistry & Molecular Biology, Medicinal Chemistry, Surgery, Clinical Neurology *etc* during 2007. The top 15 Subject areas were covered by more than 50% of papers. This indicates a clear shift towards more applied and frontline areas.

1999			2007		
Chemistry	344	7.27	Pediatrics	389	6.39
Chem-Biology	173	3.66	Pharmacol-Pharm	378	6.21
Biochemistry	132	2.79	Oncology	357	5.86
Pharmacology	129	2.73	Biochem Mol Biol	310	5.09
Radiology	99	2.09	Chem-Medicinal	194	3.19
Biomedicine	96	2.03	Surgery	179	2.94
Biotechnology	94	1.99	Clin Neurol	177	2.91
Bioscience	91	1.92	Immunology	147	2.41
Oncology	88	1.86	Neuroscience	126	2.07
Ophthalmology	81	1.71	Ophthalmol	126	2.07

For collaboration analysis authorship pattern as well as the address fields of co-authors Along with Subject-wise multi-authorship pattern have been computed. Medicine, and particularly HIV/AIDS, Drug Development, Immunological Studies including Vaccine Development, Studies related to Carcinoma and Tuberculosis were the areas where multicentric studies were carried out resulting in number of papers during 2007. These papers appeared with collaboration of many countries including USA (768), South Africa (240), UK (168), Australia (180) among developed countries and Thailand (144), China (210) and Korea (10) from south east Asia. Medical informatics & Diagnostics, Drug Development, were the scientific disciplines where teamwork and collaboration was priority during 1999. This characteristic can be considered as an indicator of maturity of research teams In India, Medicine is a scientific discipline with a great tradition that counts with numerous well-established, internationally recognized teams International collaboration of these groups has been favored by the great diversity and complexity of Indian territory that has arouse the interest of many foreign scientists, mainly Americans, French, German and British

The main findings from the analysis indicate:

- Collaboration is the rule not the exception, during both the periods of study more than 88% of all the papers involved two or more authors and more than 50% involved two or more institutions.
- Total 674 Papers were having co-authors from other institutions which increased to 3034 during 2007, indicating

trend towards team work and intense collaborative activities. Indian Institute of Chemical Biology collaborated with other domestic institutions on 38.57% of their papers, Indian Institute of Sciences, Indian Institute of Chemical Technology and Central Drug Research Institute collaborated in 25.73%, 17.39% and 14.85 % papers respectively during 1999 ,where as during 2007, Central Drug Research Institute had maximum (66.13%) paper as co authors followed by National Institute of Mental Health and Neurosciences (60%), Indian Institute of Science (50%), Christian Medical College & Hospital (45%), Sanjay Gandhi Post Graduate Institute of Medical Sciences (46%) and All India Institute of Medical Sciences (43 %).

- The chemistry papers exhibited the highest percentage of multiple author papers followed by biochemistry , biological sciences , life sciences and clinical medicine (1999) the other medical disciplines like pharmacy, gynecology & obstetrics , pediatrics surgery and pharmacology were having lower percentage share of multiple authors where as during 2007 the trend changed towards Pediatrics, Drug Development, Oncology, Biochemistry and Molecular Biology, Immunology and Vaccine Development along with Medical Biochemistry.

- There is a distinct relationship between institutional publishing size and the amount of institutional collaboration. On average, institutional collaboration showed a strong invisible relationship with the publishing size of the institutions.

- A greater proportion of publications from smaller institutions than from larger institutions involved domestic, intra-city, inter-city collaboration. On the

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other hand a greater proportion of the papers from larger institutions were having international collaboration than from smaller institutions.

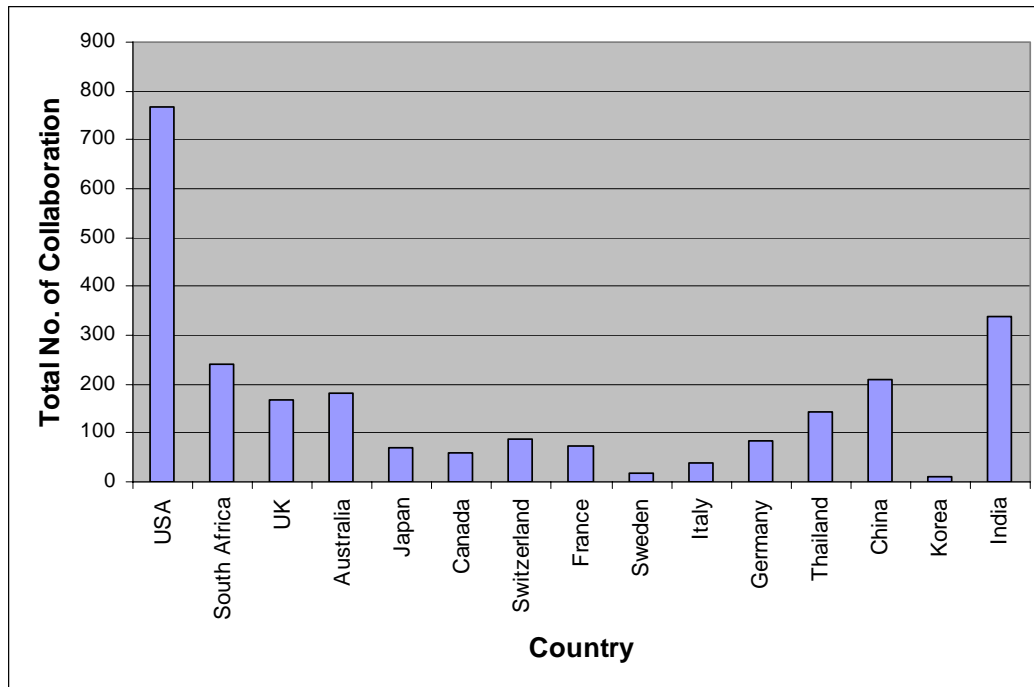
- In terms of collaboration of papers from different cities it was observed that although Delhi and New Delhi combined produced maximum number of papers (714) but Chennai was having maximum number of papers (45%) in national and international collaboration. While analyzing percentage share of cities as co-authors again Chennai occupied the place

with 34% followed by New Delhi with 20% papers during 1999 but the trend changed during 2007. The maximum contribution of papers came from New Delhi (15.10%) followed by Bombay (6.36%), Chennai (6.18%), Chandigarh (6%) and Lucknow (5.37%). As a Collaborating author Bangalore occupied the top position by having authorship in more than 100% papers followed by Pune (94%), Calcutta (85.26%), New Delhi (80%), Hyderabad and Bombay (78%).

Contribution of Cities in terms of No of Papers						
	1999	% Contrb.	2007	% Contrb.	as co-auth.	% as co-auth.
Bangalore	385	8.14	289	4.75	315	109.00
Pune			134	2.20	126	94.03
Kolkata	262	5.54	312	5.12	266	85.26
N Delhi	714	15.09	919	15.10	731	79.54
Hyderabad	311	6.57	265	4.35	208	78.49
Mumbai	318	6.72	387	6.36	302	78.04
Lucknow			327	5.37	250	76.45
Vellore	107	2.26	127	2.09	97	76.38
Varanasi	140	2.96	97	1.59	74	76.29
Chennai	100	2.11	376	6.18	276	73.40
Chandigarh	116	2.45	360	5.91	212	58.89
Trivandrum			113	1.86	56	49.56
Mysore			97	1.59	46	47.42
Pondicherry			72	1.18	30	41.67

- As International collaboration USA was the most favored (26.07%) country followed by Germany (12.06%), Malaysia (11.67%) and UK (9.72%) during the year of 1999. In the year of

2007, many International Trials were going on. This resulted into a large number of collaborating studies with coauthors from many countries. The top most countries were USA, South Africa, Australia, UK, Switzerland and Germany.



The bibliometric evidence indicates that the majority of scientific research is collaborative. The size and geographical location of an institution influences its collaboration profile. An institution and its researchers do not work in isolation; they work within broad and extensive research networks. The implications of the findings suggest that evaluation activities may need to make adjustments for the non-linear effect of institutional size when making comparisons. They also suggest we need a better understanding of how much collaboration policy actually influences a science system where the emerging nature and culture of scientific research appears to encourage collaborative activity.

Evidence from the study provides the following headline findings:

- Collaboration is an essential feature of the biomedical research base. Collaboration in research is pervasive

throughout. In all the papers the basic building block is inter-personal collaboration. They are based on individual researchers, who work collaboratively in a climate of shared intellectual interest and trust.

- Although, the inter-institutional or international collaboration may not necessarily entail inter-personal collaboration, evidence from the case studies suggests that a strong collaborative research base is an important success factor in the operationalisation of higher levels of aggregation

- In India, the study revealed that Southern States were working more in collaboration with each other as compared to Northern States but later on during 2007 the shift has taken place towards Northern Region.

- On the basis of collaboration analysis and total number of papers for both the periods, the city emerging as “scientific hub” are Bangalore, Pune,

Hyderabad , New Delhi, Chennai and Kolkata in the same order.

- The upcoming subject areas of activity of researchers are Immunological Studies, HIV/AIDS, Oxidative Stress & Protein Chemistry, Pediatrics, Controlled Clinical Trials, Coronary Heart Diseases, Drug Development, Biochemistry & Molecular Biology, Oncology , Clinical Medicine , Infectious Diseases.

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