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Medicine Research in India: A Scientometric Assessment of Publications during 2009 – 2018

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Abstract

The purpose of this paper is to qualitative analyse of medicine research output using select scientometric indicators with the aim of identifying top preparing countries, subject subthemes, organisations, authors and journals in the area. The present study has examined 29153 publications in medicine research, *the present study deals with the Assessment of Indian medicine research output as reflected in Web of Science (WOS) database for the period 2009 to 2018 for identifying the research output in the field of medicine literature. It also provides a comparative evaluation and performance of different types of scientometric indicators, such as number of publications, number of citations, relative growth, doubling time, activity index and collaboration from India. The Indian medicine research has increased exponentially over the last decade.*

Keywords: Medicine research, Indian publications, Scientometrics, Biblometrics.

1. Introduction

Medical research is not singularly poor in our country. We have less than impressive performance in other spheres of research, innovation and technological development. The poor performance of medical research, however, has more serious repercussions since it directly affects health of people and therefore, of the nation. Obviously, we need to ensure quality medical research on a much larger scale. More than rules and regulations, what we really need to achieve these goals include: i) commitment and passion, rather than compulsion, for research and innovation combined with necessary mentoring, ii) bi-directional interactive and integrative environment that promotes and sustains collaboration between clinical and basic scientists on one hand and the technologists on the other, who can convert innovative findings into usable technology for affordable healthcare, iii) good training of medical students in clinical research especially for those who are inquisitive and research-oriented and iv) adequate independence of doing research to take their discovery to masses. Scientometrics indicators can be classified to the number of scientometrics sets they represent and the application of reference standards Scientometrics indicators referring to the measure of a single Scientometrics aspect of Scientometrics system represented by a single Scientometrics set with a single hierarchical level are termed gross indicators. Those indicators which consist of several gross or complex indicators, preferably with weighting

factors and each representing a special aspect of a Scientometrics system are composite or compound indexes (Chaman, Dharani & Biradar, 2017).

2. Methods and Materials

The data for the present study were retrieved from Web of Science database, by using suitable search syntax, the data has been downloaded for the period 2009-2018.Dr. Eugene Garfield revolutionary concept of citation indexing, the Web of Science has launched in 1997 and now it is maintained by Clarivate Analytics formerly maintained by Thomson Returns. Web of Science provides access to an unrivalled breadth of world class research literature linked to rigorously selected core of journals, ensuring a unique combination of discovery through meticulously captured metadata and citation connections, coupled with guaranteed quality, impact and neutrality The collected data were analyzed using MS-Excel Spreadsheet and MS-Word. The string used to retrieve the data on medicine research in India during 2009-2018 as follows: SU= (Medicine) AND CU= (India) AND PY= (2009-2018).

3. Review of the Study

Few quantitative studies have been carried in the past analyzing Indian overall medical or biomedical research. This study describes and explores the factual picture of research interests within medicine literature by analyzing the literature. Bibliometrics has established itself as a viable and distinctive research technique for studying the science of science based on bibliographical and citation data (Gupta & Gupta,2004). There has been an increasing interest in using scientometric information for assessing or monitoring research activities for the past few decades. The discipline devoted to the quantitative study and evaluation of the scientific literature is called scientometrics or bibliometrics. Bibliometrics has been applied to the evaluation of scientific disciplines, national scientific production, and bibliographic databases, and it provides valuable tools to describe scientific activity in the past and to orient future research (Schoepflin & Glanzel 2001). The aim of scientometrics is to provide quantitative characterizations of scientific activity. Because of the particular importance of publications in scientific communities, it largely overlaps with bibliometrics, which is quantitative analysis of media in any written form (Chaman, Dharani & Biradar, 2017). Bibliometric studies on engineering are rather scantly found. Kim (2002) compared the citation patterns of researchers from physics and mechanical engineering domains in Korea and, found m that m the type of publication source and type of authorship were found to influence the choice of sources cited by them. Noteworthy is that articles in physics journals from Japan are more frequently cited in

papers written with purely Korean authorship than those with international co-authorship. In addition, articles in Korean journals are more highly cited in nationally authored papers than in internationally co-authored papers, in both fields. Ravichandra Rao and Suma (1999) analysed the Indian engineering literature and found that the engineers in India publish in a few selected journals and only a few of the institutions are concentrated in engineering research. They observed that research output in applied physics, light and optics, bioengineering, and information science are increasing both at the world and India level. Sangam, Keshava, and Agadi (2010), Gupta, Kshitij, and Verma (2011), Bhattacharya, Shilpa, and Bhati (2012), Elango and Rajendran (2015), Hadagali and Anandhalli (2015), Singh, Banshal, Singhal, and Uddin (2015), Liu, Lin, Wang, Peng, and Hong (2016), Zou and Laubichler (2017), and Nobre and Tavares (2017) are studies assessing scientific research output in the last ten years, to mention a few Bagalkoti, V. T., & Hosamani, S. C. (2014). There has been an increasing trend towards collaboration between countries and institutions in almost all fields of science and technology. However, the extent of collaboration and their rate of growth varies from one subject to another, one branch to another branch of the same subject, and from one country to another country. The present study aims at finding the growth of research publications of the mechanical engineering domain from India, Japan, and South Korea. Reddy et al. (1991) analyzed the extent of research activities in major Indian medical colleges and concluded that only a few medical colleges (10 out of 128) are active in research. Arora et al. (1996) examined the extent of research undertaken in Indian medical colleges and concluded that majority of the 88 Indian medical colleges receiving research grants from ICMR did not produce any research paper in 1991. Only 10% of the projects funded to Indian medical colleges ended up in publications in indexed journals. Deo (2008) examined the current status of undergraduate Indian medical education and research and discussed the steps that need to be taken to promote research at grassroot level. Satyanarayana (2001) examined Indian contribution in biomedical research (3605 papers in 1990 and 3241 papers in 1994) as indexed in three databases, such as Index Medicus, Excerpta Medica and Tropical Disease Bulletin. Srivastava and Diwakar (2008) provided a comparative analysis of Indian biomedical papers (4732 in 1999 and 6088 in 2007), using SCI database. Kundra (2009) analyzed the research collaboration (as reflected in co-authored papers) in Indian medical research from 1900 to 1945, by focusing on the pattern of collaboration in basic and applied research, multiplicity of authors and types of collaboration. Dutt et al.(2009) analyzed 2183 papers by Chinese researchers and 1034 papers by Indian researchers in the field of plant-based medicine during 1990-2004 as indexed by PubMed. Arunachalam (1995) examined the relevance of Indian

medical research during 1981-1985 using Science Citation Index database and concluded that Indian global share of research in medical sciences is very small compared to our contribution in other SandT fields. Arunachalam (1997) re-examined the relevance of Indian medical research by repeating the above study by using MEDLINE database from 1987 to 2004. He examined 19,916 Indian medical papers in 1440 journals, of which 14,822 were published in journals with impact factor less than 1.0 in contrast to only 58 papers in journals with impact factor more than 8.0. Dandona et al.(2004) assessed the health research output and concluded that both the magnitude and distribution of research output are not commensurate with the disease profile and burden. In the later much broader study, Dandona et al.(2009) examined Indian medical publications in PubMed database and unpublished research reports available in the public domain from 2001 to 2008. According to this study, public health research in India has grown in the past decade, but continues to be inadequate in scope and quality, considering the country's daunting disease burden. Based on a survey undertaken, Sahni et al.(1992) examined various aspects of 75 (out of 113) major published Indian medical journals, of which 22 are included in Index Medicus. Of these journals, only eight were judged by Indian and foreign referees to be of international standard. Jain (2018) examined the visibility and extent of coverage of Indian biomedical and life sciences journals in global alerting services. Pandya (1990)) examined the Indian medical research output and discussed the factors for low output of Indian authors and institutions and also indicates that although the number of Indian medical journals is rising rapidly over the years, their contents, regularity and quality leave much to be desired.

4. Hypothesis of the Study

The following hypotheses are formulated for this study based on objectives.

4.1. There are more literatures published in Indian medicine.

4.2. Growth of publications in medicine is comparatively higher in developed countries

4.3. The research productivity in medicine literature is dominated by English language.

4.4. Journals are major source of publications for Medicine.

4.5. There exists no steady growth in publication production in medicine research.

5. Objectives of the study

5.1. To examine the Indian medicine during the period 2009 – 2018

5.2. To identify Indias share of internationally collobrative papers

5.3. To identify the document type of the publications in Indian medicine.

5.4. To examise the Language wise distribution of records in the Indian medicine.

5.5. To identify the organisations conducting the research in Indian medicine.

5.6. To identify the top source titles those, carry the research productions in medicine

5.7. To identify the top prolific authors in the Indian medicine Research.

6. Results and Discussion

6.1. Year wise growth rate of publications.

This section provides the results after application of scientometric tools to analyze the outcome.

Table - 1 indicates the year-wise productivity of medicine research in India. The global research output in medicine research has increased from 2292 in 2009 to 2612 in 2016. In the same manner, the Indian research output in medicine H -Index too has decreased expect 2018 from 18 in 2009 to 52 by 2018.

Table 1 – Year wise growth rate of publications.

YEAR	TP	ICP	ACP	H - INDEX
2009	2292	42238	18.43	72
2010	2446	39474	16.14	71
2011	2945	49856	16.93	78
2012	2976	48397	16.26	60
2013	3121	36990	11.85	63
2014	3112	31403	10.09	60
2015	3073	23295	7.58	46
2016	3178	19747	6.21	48
2017	3397	11036	3.21	36
2018	2612	1366	0.52	12

TP= Total Publication, TC = Total Citations, ACP = Average Citations per paper

It could be clearly observed from the table 1 the research output of India and average citations per papers of India. India has produced 29153 papers, and received 15.07% during the

period 2009-2018, average citations per Paper is not available in the database. In the year of 2009 were produced with 2292 articles (42238 citations) with 18.43 of average citations per paper and h-index is 72 followed by year of 2010 produced 2446 papers and received 39474 citations with an average of 16.14 and his h-index is 71 in the year of 2018 published 2612 publication, 1366 citations with h – Index is 12. The table show that India has contributed total number of publications onmedicine as per Web of Science database 2009 – 2018. Highest publications (3397) were published in 2017 and lowest publications (2612) were published in the year of 2018.

6.2. International Collaboration

Table - 2 showes that India's share of internationally collobrative papers (ICP) in Medicine research was 0.21% from 2009 – 2018, which increased 2.02% in the year of 2009.

Table 2 – Publication Share of Leading Foreign Countries Collaborative papers (ICP) research output in Medicine Research during 2009 – 2018

Collaborative Country	Number of International Collaborative papers			Share of International collaborative papers		
	2009 - 2018	2009	2018	2009 - 2018	2009	2018
USA	471342	41519	49099	35.52%	36.70%	32.18%
China	134685	4836	21904	10.15%	4.27%	14.35%
England	10766	9121	10212	0.811%	8.06%	6.69%
Germany	91857	8678	8945	0.069%	7.67%	5.86%
Canada	61186	5654	6460	0.046%	4.99%	4.23%
Japan	59380	2344	5895	0.044%	2.07%	3.86%
Italy	54738	4695	5603	0.041%	4.15%	3.67%
Australia	53134	3948	5656	0.400%	3.48%	3.70%
France	51702	4547	5122	0.038%	4.01%	3.35%
South Korea	42513	2787	4857	0.032%	2.46%	3.18%
Netherlands	39994	3569	4098	0.030%	3.15%	2.68%
Brazil	39683	3401	4022	0.029%	3.00%	2.63%
Spain	39215	3374	3896	0.029%	2.98%	2.55%
Switzerland	37135	3183	3904	0.027%	2.81%	2.55%
Turkey	31192	2711	2587	0.023%	2.39%	1.69%
India	29152	2292	2612	0.021%	2.02%	1.71%
Taiwan	21615	1773	1969	0.016%	1.03%	1.29%
Belgium	21233	1816	2042	0.016%	1.06%	1.33%
Sweden	19063	1603	1996	0.014%	1.41%	1.30%
Iran	17059	1274	1676	0.012%	1.12%	0.01%
Total	**1326644**	**113125**	**152555**	**47.368%**	**98.83%**	**98.81%**

Amoung the leading countries contributing to internationally collobrative papers of India, USA topped the list with 35.52% shre, followed by China 10.15%, England 0.81%, Germany 0.069%, Canada 0.46%, Japan 0.044%, Italy 0.41%, Australia 0.400%, France 0.038%, South Koria 0.32%, Netharlands 0.300%, Brazil 0.029%, Switzerland 0.027%, Turky 0.023% , India 0.21%, Taiwan 0.016%, Belgium 0.016%, Sweden 0.014%, and Iran 0.012% publications form 2009 – 2018. Top most international publications share placed USa and folled by China and last position placed Iran in this 20 top most countries list.

6.3. Document types

The publications in Indian medicine publications were contributed in different bibliographical forms such as Research article, Reviews, Conference Proceedings papers Editorials Materials, Book Review, Book Chapter, News Item, Letter etc and the same is showen in Table 2.

Table 2- Source based Distribution

Document Types	**Records**	**% of 29153**
Article	18477	63.375
Meeting abstract	3382	11.6
Letter	2617	8.976
Editorial material	2357	8.084
Review	2127	7.295
Proceedings paper	161	0.552
Correction	95	0.326
Book chapter	70	0.24
Biographical item	56	0.192
News item	21	0.072
Reprint	12	0.041
Retracted publication	11	0.038
Retraction	7	0.024
Book review	3	0.01
Early access	3	0.01
Hardware review	1	0.003
Total	**29153**	**100%**

The publications were divided in to 16 document typs, were article was the dominating type accounting for 63.37% and it show that maximum number of articles 18477 are published in journals. This followed by Meeting abstract papers 3382 (11.6%) are published, Lettar2617 (8.976%) are published, Editorials 2357 (8.084%) are published, Procedings papers 161 (0.552%) Correction 95 (0.326%) are published, Book Chapter 70 (0.24%) are published, Biographical item 56 (0.192%) are published, News item 21 (0.072%) are published, Reprints 12 (0.041%) are published, Retracted publication 11 (0.038%) are published.

6.4. Publishing Languages

Language is significant medium to disseminate the scientific productivity in any subject area. Therefore, researcher tried to know the language in which author preferred to publish. Study

Table 3 – Language based publications

Languages	Records	Percentage
English	71455	99.959
Croatian	13	0.018
German	5	0.007
Japanese	4	0.006
Spanish	3	0.004
Korean	2	0.003
Estonian	1	0.001
Polish	1	0.001
Portuguese	1	0.001
Total	**71484**	**100%**

As shown in table 3, most articles were published in English 71455 (99,959%0, followed by Croatia 13 (0.018%). Articles published in other langiages (eg. German, Japanese, Spanish, Korea, Estnian, Polish and Postuguese) made up only from 5 to one records of the total articles. Given that the most commen publishing journals for medicine research were English – language journals. It was expected that English was the most common publication language.

6.5. Research output of major Research Institutions and Universities in India

Organizations-Enhanced	Records	% Of 29155
All India Institute Of Medical Sciences	2209	7.577
PGIMER Chandigarh	1479	5.073
Institute Of Post Graduate Medical Education Research Ipgmer	1456	4.994
Manipal University	1058	3.629
Council Of Scientific Industrial Research CSIR India	964	3.306
Tata Memorial Hospital	786	2.696
Christian Medical College Hospital Cmch Vellore	781	2.679
Indian Institute Of Technology System IIT, System	631	2.164
Bhabha Atomic Research Centre (BARC)	612	2.099
University Of London	612	2.099
Indian Council Of Medical Research	579	1.986
Banaras Hindu University	487	1.67
Sanjay Gandhi Postgraduate Institute Of Medical Sciences	427	1.465
Defence Research Development Organisation DRDO	385	1.321
Harvard University	385	1.321
King George S Medical University	381	1.307
World Health Organization	369	1.266
National Institutes Of Health NIH USA	357	1.224
Public Health Foundation Of India	357	1.224
London School Of Hygiene Tropical Medicine	355	1.218
University Of California System	324	1.111
University Of Delhi	294	1.008
Panjab University	284	0.974
Department Of Science Technology India	281	0.964
Department Of Biotechnology DBT	277	0.95
Johns Hopkins University	272	0.933
Government Medical College	256	0.878
Jawaharlal Institute Of Postgraduate Medical Education Research	254	0.871
Moulana Azad Medical College	247	0.847

Table - 4 reveals the ranking list of top 30 highly productive Research Institutions in India based on their highest publications, citations, average citations per publication and h-index. According to the web of science database All India Institute Of Medical Sciences, Delhi contributed the highest publications to the field of Medicine i.e. 2209 publications, followed

by PGIMER Chandigarh published i.e. 1479 (5.073%), Institute Of Post Graduate Medical Education Research Ipgmer Published 1456 (4.994%), Manipal University published 1058 (3.629%) Council Of Scientific Industrial Research CSIR India published 964 (3.306%), Tata Memorial Hospital published 786 articles and recived (2.696%), Christian Medical College Hospital Cmch Vellore produced 781(2.679%), I Indian Institute Of Technology System IIT, System produced 631 (2.164%), Bhabha Atomic Research Centre published 612 (1.391%), University Of London published 612 (2.164%), Indian Council Of Medical Research published 579 (1986%) , Banaras Hindu University 487 (1.67%), , Sanjay Gandhi Postgraduate Institute Of Medical Sciences, Defence Research Development Organisation DRDO 385 (1.321%), etc. during 2009 – 2018.

6.5. Sources wise distribution of Indian Medicine Research in India during 2009 – 2018

The data collected for the sudy indicate that from the 71484 publications of the source from various most preferred journals in the field of Indian medicine Research over the 10 years period.

Table 5 – Source wise distribution of the Indian Medicine Research out put

Name	TP	TC	ACPP	H - INDEX
Indian Journal of Medical Research	2158	14237	6..6	41
National Medical Journal of India	824	1654	2.01	16
Journal of Post Graduate Medicine	716	2833	3.96	22
Biomedicine Pharmacotherapy	584	2761	4.73	22
Journal of Ethno pharmacology	578	8994	15.56	41
Biomed Research International	558	4409	7.9	28
LANCET	513	70037	136.52	113
Biomedical Research India	473	648	1.37	9
Asian Pacific Journal of Tropical Medicine	457	3451	7.55	23
VACEINE	424	4473	10.55	29
American Journal of Respiratory and Critical Care Medicine	404	1334	3.3	16
American Journal of Tropical Medicine and Hygiene	381	2425	6.36	24
Topical Doctor	372	964	2.59	12
Journal of Nuclear Medicine	369	438	1.19	11
Oral Oncology	369	1544	4.18	23

Table 5 showes that the total Indian publications ourput in medicine research 93.36 % appeared in Journals. The top 15 most productive journals accounted for the ten years. Based on the publications the *Indian Journal of Medical Research* published the highest publications i.e. 2,158 articles and 14237 citations, followed by *National Medical Journal of India* published 824 publications and 1654 citations published, *Biomedicine Pharmacotherapy* published 584 papers ans 2761 citations, articles *Journal of Ethno pharmacology* published 578 articles and 8994 citations are recived *Biomed Research International* published 558 articles and 4409 citations, *LANCET* published 513 papers and 70037 citations are published, *Biomedical Research India* published 473 papers and 648 citations are published, *Asian Pacific Journal of Tropical Medicine* published 457 papers and 3451 citations are published *VACEINE* published 424 papers and 4473 citations are published etc. during 2009 – 2018.

6.6. Most prolific authors in Indian Medicine research

Table - 6: Most prolific authors in Indian Medicine research

Authors		Records	% of 29155	Citations
Kumar S	Post Graducate Institute of Medical Education and Research	713	2.446	5430
Kumar A	University College	555	1.904	5223
Kumar S	All India Institute of Medical Science	492	1.688	3702
Sharma S	Jamia Hamdard University	341	1.17	2061
Sharma A	Gurunanak Dev University	327	1.122	2504
Singh S	Post Graduate Institute of Medical Education	326	1.118	2130
Sharma P	Sri Arbindo Institute Medical Science	315	1.08	1797
Gupta S	Indian Institute of Technology	297	1.019	2754
Kumar P	Jaslok Hospital Research centre	290	0.995	2180
Gupta A	Government Medical College	251	0.861	1785
Kumar V	All India Institute of Medicial Science	242	0.83	1785
Basu S	Tata Medical Hospital Annex Branch	234	0.803	15564
Singh A	Government Dental College	233	0.799	6394

According to study highest publications are by Kumar, S, occupies first rank with 713 articles (2.446% with 5430 citations) followed by Kumar, A. published 555 with 5223

citations, Kumar S 492 papers with 3702 citations, Shrma S 341 papers with 2061 citations, Sharma A published 37 papers with and Das S. published 541 papers (0.757%), Kumar P 504 papers (0.705%), Singh, B. produced 479 papers (0.67%), Singh S. published 477 articles (0.667%), Kumar V published 421 (0.589%) papers, Ghosh S published 407 (0.569) papers, Singh AK published 397 (0.555) papers, Singh R published 384 (0.537%) papers, Chakraborthy S published (.0537%) papers, Kumar M published 336 (0.47%) papers, Sharma A published 322 (0.45%) papers, Roy S published 301 (0.421%) papers Singh A published 298 (0.417%) papers, Kumar N published 286 (0.4%) papers, Singh SK published 264 (0.369%) papers, Gupta A published 257 (0.36%) papers, Sanker S published 244 (0.341%) papers, Das SK published 241 (0.337%) papers, Banerjee S & Singh K published 239 (0.334%) papers and Ghosh A published 238 (0.333%) papers. (table – 6).

7. Conclusion

It could be clearly observed from the research output of India and average citations per papers of India. India has produced 29153 papers, and received 15.07% during the period 2009-2018, average citations per Paper is not available in the database. In the year of 2009 were produced with 2292 articles (42238 citations) with 18.43 of average citations per paper and h-index is 72 followed by year of 2010 produced 2446 papers and received 39474 citations with an average of 16.14 and his h-index is 71 in the year of 2018 published 2612 publication, 1366 citations with h – Index is 12. Highest publications (3397) were published in 2017 and lowest publications (2612) were published in the year of 2018.

The study analyses India's performance in the field of medicine using publications data and different quantitative and qualitative measures. Its focuses on India's global publication share, growth rate, citation quality, international collaborative publications, its publication share and distribution in sub-fields using 10 years data from the Web of Science database. The study suggests the need to increase the pace of Indian medicine research and also improve its quality. Scientometric analysis is also extremely essential to plan appropriate measures to be taken to upgrade the research activities. A detail scientometric analysis of medicine research of India and its comparison with other countries is very important to obtain a clear picture and

to take necessary measures to upgrade the research performance. It is important to evaluate the research performance of major medicine research institutes of the country and to compare their performance among themselves and similar institutes of other countries. The growth in literature has become a major concern for the scientists, scholars, and library professional as they try to keep themselves abreast with new advances in their subject, and information professionals try to organize this knowledge.

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