DESIDOC Journal of Library & Information Technology, Vol. 38, No. 5, Sept 2018, pp. 342-348, DOI : 10.14429/djlit.38.5.13000

Performance Analysis and Ranking of Corporate Medical Institutions in India

Susama Nanda, Manoj Mishra*, and D.B. Ramesh

IMS & SUM Hospital, Siksha 'O' Anusandhan, Bhubaneswar-751 030, Odisha, India
**E-mail: manojmishra@soa.ac.in*

ABSTRACT

Health science research focuses to generate new knowledge through new technique, research design and organisational interventions to serve the whole community. The corporate Medical colleges are determined to establish themselves in both academic and research purpose. The performance index (P-index) is an interesting parameter to calculate the ranking performance of any institution. This study presents an analysis of the research growth, collaboration of researchers with ranking of the corporate medical institutes in India according to p-index.

Keywords: Corporate medical institutions; P-index; Bibliometrics; Scopus; h-index; India

1. INTRODUCTION

Until the early 1980s, higher education on health care was provided by the institutions funded by the government. During the last three decades several institutions managed by the trusts or societies or corporate sector have emerged which corporate medical education in India. These institutions were started after obtaining permission from the concerned state governments, government of India as well as Medical Council of India (MCI). It is found from the website of MCI (http://newmciindia.org/) that there are 226 corporate medical college in India. This study reveals that 116 medical colleges are in south region of India where 35 college are in Karnataka and it is highest in the whole country. There are 44 institution in the western region. Maharashtra is on the top having 27 college in that state. UP is on the top in northern part of India with 21 institution. There is more participation of corporate medical colleges in Indian health care sector. They are taking a larger participation in producing health manpower in India, though, there is no such difference between corporate medical colleges and government medical colleges in terms of infrastructure facility, national and international exposure, clinical facilities and performance. In this study, an attempt has been made to analyse the performance and ranking of these corporate medical institutions in India using P-Index.

2. LITERATURE REVIEW

In the past several bibliometric studies have been made. Subbiah Arunachalam (1999) in his macroscopic study used standard scientometrics techniques to map the published life sciences articles in India during 1992 – 1994 and presents the Indian research (life sciences) in different sub-fields with a strong approach towards the collaboration of authors in native and abroad. This study reveals that 64.5 per cent of research article are contributed by the academicians[1]. Subbiah Arunachalam (1997) identified the most preferred journals by the Indian health science researchers to publish their research experience within the major subjects of medical sciences to indicate the mortality and morbidity causes based on the data from "Medline" to show the contribution of different Indian institutions situated at different states and cities. He also collected data both from SCI and Medline database to identify the major sub-fields in Medical sciences in which the Indian health science researchers are interested to publish their manuscript[2]. Huffman et al. (2013) downloaded the research articles, number of citations etc. from the Thomson Reuter's web of knowledge for their study during 1999 - 2008. They compared all the data and found a significant result with p value <0.05[3]. Garg and Rag (1988) has made a study in the field of science. They analysed the documents published both in the SCI and non SCI journals during the period of 1965–1982[4]. Similarly, Koganuramath et al. (2002) analysed 663 research publications of Tata Institute of Social Sciences during 1990–2000. They observed that scientists were more conscious of publishing their research results in more reputed journals but their aim was to show a better result on the bibliometrics growth of research articles[5]. Kumbar et al. (2008) retrieved their data from Scopus database during 1996–2006 on research publication in the field of Science and Technology of the University of Mysore. They evaluate and analysed 1516 research article and observed that the average annual growth rate of that University is 23 per cent[6]. Grace & Jeyshankar (2015) retrieved 1764 records from SCOPUS to analyse through different scientometrics parameters like: source wise, collaboration pattern, growth rate of documents etc[7]. Velmurgan & Natrajan (2017) used collaborative index, citation index, source index etc. to analyse 2622 record retrieved from WoS[8]. Kolle & Shankarappa (2016) found 4780 suitable record from WoS to find the productive journals, collaborating countries and institutions with citation

Received : 14 May 2018, Revised : 19 July 2018
Accepted : 23 July 2018, Online published : 5 September 2018

counts for total papers[9].

These studies deal with scientometric assessment of Indian science and technology by many researchers. Besides these, some studies dealt with bibliometric assessment of medical and life sciences. Some studies are also related to different engineering institutions in India. However, no study has been reported in literature that dealt with corporate medical institutions in India. The present study is an attempt in that direction.

3. OBJECTIVES OF THE STUDY

The main objectives of the study are as follows.

- Identify and analyse the average growth rate of the top 10 corporate medical institutes based on their publications
- Analyse the performance and ranking of top 10 corporate medical institute
- Identify most preferred journals by the Indian health science researchers
- Analyse the global collaboration of the Indian health science researchers.

4. METHODOLOGY

There are many ways to calculate ranking performance of institutions. The simplest way is using the quantity of output (P) and the citations obtained (C), and impact (i = C/P) or someone can do this by a performance index combining quantity and quality, i.e. h-index. Some recent studies have revisited the problem of ranking performance of any institutions. The geometric mean of C and C/P can be used as the best single indicator to rank any institution, taking consideration of both quality and quantity of publications of the concerned institutions. It can be shown that this has the dimension of $h^{3/2}$. We can define the mock h-index as $h_m = (C^2/P)^{(1/3)}$ (Pratap & Gupta, 2011). It can be used as the substitute of the best indicator for performance with the correct dimension of h. This index is termed as p-index[10]. We have to discuss about the term $C^2/P=C\times C/P$. The impact i=C/P and the number of citation (C) is used again to calculate the energy of those institutions. This formula is ($E= iC = C^2/P$) and this interpretation is useful to display the research performance of various institutions on a two dimensional map.

Performance ranking of international institutions is based on both quality & quantity of scientific research which is a very complex exercise. P-index is introduced for ranking performance of different corporate medical colleges & hospitals which is introduced in last few years. According to the Medical Council of India, there are 226 corporate medical college & Hospital in India[11,12].

The data presented in this study has been accessed from SCOPUS (http://www.scopus.com) and the top 10 corporate medical college with more number of publications in comparison to others during the period of study i.e. 2007-2016 has been taken. The total numbers of 20743 bibliographic record were gathered from Scopus database because it comprises a huge number of publishers & multi-disciplinary subjects.

5. DATA ANALYSIS

5.1 Annual Growth of the Published Documents

Table 1 represents the year wise growth rate of the corporate Indian teaching hospitals depending upon the total output during the period of study.

It is found that the overall highest growth rate occurs in the year 2008. It is noticed that negative growth also occurs in the year 2015 which is lowest in this table. The second highest growth happens in the year 2014. But in the year 2014, these 10 corporate Indian medical institutions published the highest number of 2692 documents.

Table 1. Year wise growth of output

Year	Total output	Per cent of growth	Cumulative output
2007	1315		1315
2008	1486	13.00	2801
2009	1618	8.88	4419
2010	1826	12.86	6245
2011	2020	10.62	8265
2012	2248	11.29	10513
2013	2354	4.72	12867
2014	2692	14.36	15559
2015	2542	-5.57	18101
2016	2642	3.93	20743

Source: SCOPUS database

5.2 Comparative Growth of Top Ten Institutions

Table 2 shows the comparative growth rate of these 10 institutes.

It reveals that L.V. Prasad Eye Institute occupies top position in this table among all the institutes while comparing the same institutions 5-year growth on publication status. The highest publishing institute i.e. Christian Medical College, Vellore occupies 8th position in this table. Kasturba Medical College, Mangalore has a negative growth in this comparison and placed at the bottom of the table. Sri Rama Chandra University, Chennai is placed in the 2nd position of this table.

5.3 Performance of Top Ten Indian Corporate Medical Institute

There are about 20743 papers published by the top 10 corporate medical institute/college from India during the period 2007-2016. These medical institutes were identified and selected according to productive publication ranging from 1173 paper to 4080 paper. The citation received by publications of these Indian corporate medical colleges is taken to calculate the average number of citations per paper for each institute. The h-index of these corporate medical colleges are retrieved from Scopus and presented for study during these 10 year. Table 3 represents the overall status of 10 corporate medical college & hospital, i. e the number of publications (P), the citations received during the studied period (C), and the mean value of citation known as impact (i=C/P). (Table 3) also represents the h-index and appropriately introduced performance index (p) which is calculated using $(C^2/P)^{(1/3)}$. The performance ranking of institutions has been done in (Table 3) using the p -index. As we have already discussed about the energy, which is

Table 2. Comparative growth percentages of top ten institutions

Name of the Institution	Total output during 2007-11	Per cent	Total output during 2012-16	Per cent	Total Output	Per cent of Comparative growth rate
L. V. Prasad Eye Institute, Hyderabad	440	27.62	1153	72.38	1593	162.05
Sri Rama Chandra University, Chennai	351	29.92	822	70.08	1173	134.19
Pandit Bhagawat Dayal Sharma Postgraduate Institute, Rohtak	562	36.93	960	63.07	1522	70.82
Amrita Institute of Medical science, Kochi	585	38.09	951	61.91	1536	62.56
Kasturaba Medical College, Manipal	1240	38.28	1999	61.72	3239	61.21
Sir Ganga Ram Hospital, Delhi	483	39.33	745	60.67	1228	54.24
Tata Memorial Hospital, Mumbai	1196	39.72	1815	60.28	3011	51.76
Christian Medical College, Vellore	1728	42.35	2352	57.65	4080	36.11
Jamia Hamdard University, Delhi	718	47.36	798	52.64	1516	11.14
Kasturaba Medical college, Mangalore	962	52.14	883	47.86	1845	-8.21

Table 3. Performance of top ten corporate medical institute during 2007 – 2016

Name of the institute	Publication	citation	h-index	C/P	Performance
Christian Medical College, Vellore	4080	34342	66	8.42	66.12
Kasturaba Medical College , Manipal	3239	12281	35	3.79	35.98
Tata Memorial Hospital, Mumbai	3011	12111	35	4.02	36.52
Kasturaba Medical college ,Mangalore	1845	9122	34	4.94	35.6
L. V. Prasad Eye Institute, Hyderabad	1593	12126	42	7.61	45.19
Amrita Institute of Medical Science, Kochi	1536	21367	63	13.91	66.74
Pandit Bhagawat Dayal Sharma Postgraduate Institute, Rohtak	1522	4857	25	3.19	24.93
Jamia Hamdard University, New Delhi	1516	20421	60	13.47	65.04
Sir Ganga Ram Hospital, Delhi	1228	7134	35	5.81	34.61
Sri Rama Chandra University, Chennai	1173	15376	38	13.11	58.63
Total	20743	149137			

calculated with the multiplication of C and C/P is seem to be an energy like term ($E=iC=C^2/P$) and this interpretation allows us to present the research performance of different institution which is shown in a two dimensional map in the Fig. 1.

It is seen from Table 3 and Graph-1 that the highest performance of top 05 corporate medical institutions in India are- Amrita institute of medical sciences, Kochi; Christian medical college, Vellore; Jamia Hamdard University; Sri Ram Chandra University and L.V. Prasad Eye Institute having performance value (66.74), (66.12), (65.04), (58.63) and (45.19) respectively.

5.4. Publication of Top Ten Corporate Medical Colleges in the Area of Medicine

Table 4 represents the performance status of 10 corporate medical college in medicine subject. The name of top 05 institute is not same as the names are listed in (Table 3). Tata Memorial Hospital, Mumbai (68.5) is listed on top and followed by other top performed institutes in Medicine. The others are Christian medical college, Vellore (63.84), Sri Rama Chandra University, Chennai (63.19), Amrita Institute of Medical Science, Kochi (48.03) and L. V. Prasad Eye Institute, Hyderabad (47.03).

5.5 Documents Published in Different Sources

Table 5 reflects the list of most preferred journals by the Indian health science researchers with their publishing country and impact factor.

It is found that there are 1410 document are published in Journal of Clinical and Diagnostic Research and also it is noticed that Kasturba Medical College, Mangalore published highest number 152 documents in this journal. 3.81 per cent

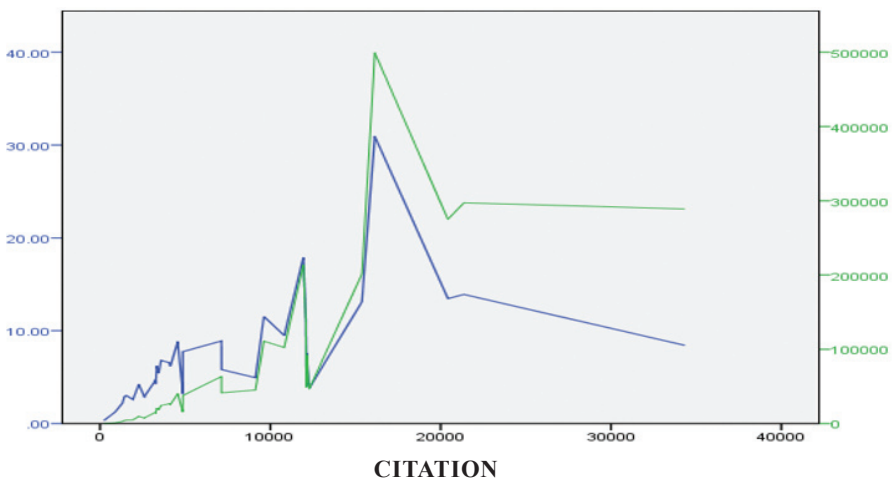

Figure 1. The impact-citation-energy (iCE) representation of performance in medical research of the top 10 corporate medical colleges in India during 2007–2016

of total documents are published through "BMJ Case Reports" which is placed in the 2nd position. Overall 25.68 per cent of total documents are published by these 10 journals. The other 75 per cent are published through more than 5000 journal. Neurology India, published from India has the highest impact factor with 1.758 and 05 journals have not mentioned their impact factor. Out of 10 journal, only BMJ Case Report is published from Britain where as others are published from India.

5.6 Collaboration of Indian Health Science Researchers

There are about 6689 document are published by the researchers of these institutions from India in collaboration with the top 10 country.

Table 4. Performance of top ten corporate Medical Colleges in the area of medicine during 2007–2016

Name of the Institute	Publication	Citation	h-index	C/P	Performance
Christian Medical College,Vellore	3782	31369	63	8.29	63.84
Kasturaba Medical College , Manipal	2798	10628	32	3.80	34.3
Tata Memorial Hospital, Mumbai	2728	29614	57	10.86	68.5
Kasturaba Medical College, Mangalore	1585	9333	35	5.89	38.02
L. V. prasad Eye Institute, Hyderabad	1495	12471	43	8.34	47.03
Amrita Institute of Medical science Kochi	1137	11223	41	9.87	48.03
Pandit Bhagawat Dayal Sharma Postgraduate Institute, Rohtak	1401	4496	25	3.21	24.34
Jamia Hamdard University, New Delhi	299	4994	32	16.70	43.69
Sir Ganga Ram Hospital, Delhi	1193	7086	35	5.94	34.78
Sri Rama Chandra University, Chennai	704	13327	35	18.93	63.19
Total	17122	134541			

Table 5. Top ten preferred sources

Name of the Source	Number of document	Per cent	Impact Factor	Country
Journal of Clinical and Diagnostic Research	1410	6.80	N A	India
BMJ Case Reports	791	3.81	N A	Britain
Journal of the Association of Physicians of India	595	2.87	N A	India
Indian Journal of Pathology and Microbiology	427	2.06	0.616	India
Indian Journal of Ophthalmology	386	1.86	0.835	India
Indian Journal of Pediatrics	372	1.79	N A	India
JMS Journal of Medical Society	359	1.73	N A	India
Indian Pediatrics	350	1.69	1.152	India
Neurology India	329	1.59	1.758	India
Journal of Cancer Research and Therapeutics	308	1.48	0.75	India
Total	5327	25.68		

Table 6. Top ten collaboration of Indian researchers

Name of the Country	Number of document	Percentage
United States	2389	11.52
United Kingdom	934	4.50
Canada	563	2.71
Australia	554	2.67
Saudi Arabia	423	2.04
Malaysia	394	1.90
France	389	1.88
Germany	364	1.75
Italy	340	1.64
Netherlands	339	1.63
Total	6689	32.25

Table 6 represents that more researchers from United States of America are associated with the Indian health science researchers. It is also found that 2389 document are from United States, United Kingdom with 934 document is placed in 2nd position and Netherland occupied the 10th position in the list with 339 collaboration.

5.7 Participation of Foreign Institutes in Indian Health Science Research

Table 7 shows all the clear data of these institutions for their collaboration and publication with other foreign countries.

5.8 Performance of Medical Colleges – Government vs. Corporate

On a random study, the top two Medical colleges, one from Government funded another from a corporate sector have been analysed and presented in Table 8.

It is found that in every parameter All India Institute

Table 7. Collaboration of top ten institutions with other foreign institutions

Name of the Institution	Collaboration with top five Foreign Institution				
Christian Medical College, Vellore	King's College, London (50)	National Institutes of Health, Bethesda (41)	Johns Hopkins University, Washington, DC (38)	University of Toronto (37)	Tufts Medical Center, Washington (35)
Kasturaba Medical College, Manipal	University of The West Indies Trinidad and Tobago (10)	Ngee Ann Polytechnic, Singapore (8)	National University of Singapore (8)	Yong Loo Lin School of medicine, Singapore (8)	University of Malaya (8)
Tata Memorial Hospital, Mumbai	University of Pennsylvania, Health System (64)	International Agency for Research on Cancer, Austria (42)	University of Pennsylvania (36)	University of Texas M. D. Anderson Cancer Center (33)	School of Medicine, Pennsylvania (24)
Kasturaba Medical College, Mangalore	John's Hopkins school of medicine, Maryland	International Medical University,(9),USA	University of Arkansas for Medical Sciences,USA (9)	Saba University School of Medicine,U.S.A (6)	University of Alabama at Birmingham, (6)
L. V. Prasad Eye Institute, Hyderabad	University of Melbourne (51)	Bascom Palmer Eye Institute,(45)	University of New South Wales UNSW Austra ia,(39)	Vision Cooperative Research Centre, Australia (37)	Singapore Eye Research Institute (35)
Amrita Institute of Medical Science, Kochi	Kansai University, Japan (25)	High Technology Research Centre, Japan(18)	National University of Singapore (12)	UCL, London (12)	King's College, London (9)
Pandit Bhagawat Dayal Sharma Postgraduate Institute, Rohtak	Ospadale Maggiore, Italy (14)	Hadassah University Medical Centre, Jerusalum (12)	Denver Health Med Center,USA (12)	Mansoura University, Egypt (12)	Helsinki University Central Hospital (11)
Jamia Hamdard University, New Delhi	King Saud University College of Pharmacy (43)	King Saud University, UAE (43)	King Abdulaziz University (35)	Oman Medical College, Oman (18)	Konkuk University, Korea (18)
Sir Ganga Ram Hospital, Delhi	Weill Cornell Medical Center, NY (35)	Saint Vincent Catholic Medical Centers, NY (27)	New York Presbyterian Hospital (20)	NYU Langone Medical Center (15)	Amtssygehusti Gentofte, Denmark (6)

Table 7. Collaboration of top ten institutions with other foreign institutions

Name of the Institution	Collaboration with top five Foreign Institutions				
Sri Rama Chandra University, Chennai	Emroy University, USA (20)	University of Liverpool, England (19)	Columbia University in the City of NY (19)	Albert Einstein College of Medicine of Yeshiva University, NY (17)	University of Washington, Seattle (17)

Table 8. Performance of medical colleges – Government vs. Corporate

Name of the institute	Publication	Citation	h-index	C/P	Performance
Christian Medical College, Vellore	4080	34042	66	8.42	66.12
All India Institute of Medical Sciences, New Delhi	13598	156438	118	11.5	121.64

of Medical Sciences is ahead of Christian Medical College, Vellore as shown in Table 8. However, it is suggested that more depth study is required to be done using all parameters such as manpower, funding, infrastructure, etc.

6. FINDINGS AND CONCLUSIONS

The major findings of the study are as follows.

- Overall highest growth rate occurs in the year 2008, negative growth in the year 2015
- L. V. Prasad Eye Institute occupies top position in this table among all the institutes while comparing the same institutions 5 year growth on publication status
- highest performance of top 05 corporate medical institutions in India are - Amrita institute of medical sciences, Kochi (66.74), Christian medical college, Vellore (66.12), Jamia Hamdard University (65.04), Sri Ram Chandra University (58.63), L.V. Prasad Eye Institute (45.19)
- In medicine subject,.Tata Memorial Hospital, Mumbai (68.5) is listed on top followed by Christian medical college, Vellore (63.84), Sri Rama Chandra University, Chennai (63.19), Amrita Institute of Medical Science, Kochi (48.03) and L. V. Prasad Eye Institute, Hyderabad (47.03)
- The top preferred journal titled "Journal of Clinical and Diagnostic Research" with 1410 papers and Kasturba Medical College, Mangalore published highest number (152) documents in this journal
- 3.81 per cent of total documents are published through "BMJ Case Reports" which is placed in the 2nd position.
- Neurology India, published from India has the highest impact factor with 1.758
- More researchers from United States of America are associated with the Indian health science researchers. It is also found that 2389 documents are from United States, United Kingdom with 934 documents is placed in 2nd position and Netherland occupied the 10th position in the list with 339 collaborations
- In every parameter All India Institute of Medical Sciences is ahead of Christian Medical College, Vellore

This study has attempted to rank the Indian corporate medical colleges using a rational process. The research output of these corporate medical colleges gives a clear knowledge that research is a measure part in the higher education area. The performance of 10 corporate medical institution with some limit in bibliometric parameter leads to demonstrate the better understanding about the broader aspect of research productivity of these institutions in India. The trend of medical research output of the other Government funded medical institutions in India is similar to the progressive output of these 10 corporate medical institution. This study may help the other researchers to carry forward the similar analysis to rank the other medical institutions in India.

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CONTRIBUTORS

Mrs Susama Nanda, is working as Assistant Librarian at Central Library, Institute of Medical Sciences & SUM Hospital, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar. Her areas of research include bibliometrics, scientometrics, and digital library services.
All authors contributed equally to the current study.

Dr Manoj Mishra received his PhD in Library and Information Science from Berhampur University, Odisha. Presently he is working as Assistant Librarian at the Central library, Institute of Medical Sciences & SUM Hospital, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar. He has published 20+ research paper in journals and conference. His areas of research include: Information seeking behaviour of researchers, information management, and scientometrics. All authors contributed equally to the current study.

Dr. D. B. Ramesh, is currently working as Chief Librarian at Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar, India. He holds a Ph.D degree in LIS from Utkal University (2001). He has taught Library and Information courses for BLISc, MLISc and PGDLAN at the IGNOU Regional centre, He has published around 40 papers in refereed journals and 65 paper in edited Seminar proceedings volumes. He has edited 6 books. His research interests include: Content Management, Information seeking Behavior, Scientometrics, Web-based Information Services and open access to information.
All authors contributed equally to the current study.