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# Ranking of Indian Corporate Medical Institutions and Their Performance

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## Abstract

The performance index (P-index) is an interesting parameter to calculate the individual strength among the teaching hospitals. There is the determination of the Indian corporate Medical Institutions to establish themselves in both academic, patient care and research field. Healthcare, teaching and research are basic components of research activities in healthcare sector. This study highlights the research growth, comparative growth, collaboration of researchers and ranking of the teaching hospitals according to P-index.

**Key Words:** P-index, MCI, Corporate Medical Institutions, Scopus, h-index, Bibliometrics

## 1. INTRODUCTION

The outcome of one research satisfies the need of one segment whilst the other one satisfies different segments as per need. But researches in the field of Healthcare satisfy the need of every individual of the society as health management is must for all. India is potentially largest and fastest growing economy in the world and undergoing huge urbanization. The development of the society is spontaneous only because of continuous strive of human beings to tackle the existing challenges by means of exploring into various types of solutions. The venture to analyze the cause and effect of the problem and finding out an acceptable solution is the research, which drives advancement of the society by fulfilling the need of the concerned. So many discoveries/inventions are the outcome of these researches in various fields. The general practitioners are determined to improve the quality of life which is directly related to the new research in their concerned field. Health science research focuses to generate new knowledge through new technique, research design and organizational interventions to serve the whole community.

The importance of Healthcare management can be envisaged as it emerged from the primitive time and gradually upgraded through continuous research works and combination of technologies in form of poison and therapeutics. The growth factor of the economy and fastest urbanization leads to health hazards associated with it. Medical research can be influenced by the efficacy and adverse effects to control the variables. There are many methods to control allergy, several diseases and also to develop the immunity. General practitioners follow methods like: vaccines, medical devices and also use drugs to control over these problems. Food and

Drug Administration (FDA) generally approves to use a particular drug after a clinical trial over a few patients. Identifying clinical experience with the medicine is important to track the relatively rare unpleasant effects and to determine the usefulness in various communities or in variable situations. 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. It is observed that there is no such difference between corporate medical colleges and government medical colleges in terms of infrastructure facility, national & international exposure, clinical facilities and mostly performance. India Today, Times of India and Doctor NDTV etc. have ranked the Indian medical colleges from their faculty position, number of patients, placement system and the health care facilities provided by the concerned organization in the past. There is no such ranking system of corporate medical colleges for their research performance. Here is an attempt to rank the corporate medical colleges based on research performance<sup>1-5</sup>.

## **2. DEVELOPMENT OF CORPORATE MEDICAL INSTITUTIONS**

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 private sector have emerged which provide 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). Most of the readers will agree that the institutes in corporate sector are most evolved in southern region of India whereas charitable/trust institutes have flourished in the western part of the country. The northern and eastern regions are also not behind. They are also showing the growing trend in private hospital expansion<sup>6, 7</sup>. It is found from the website of MCI that there are 226 corporate medical institutes in India. This study reveals that 116 medical colleges are in south region of India where 35 colleges are in Karnataka and it is highest in the whole country. There are 44 institutions in the western region. Maharashtra is on the top having 27 colleges in that state. UP is on the top in northern part of India with 21 institutions<sup>8</sup>.

## **3. REVIEW OF LITERATURE**

There are several studies on Indian science and technology, medical, life sciences and different engineering institutions on different scientometrics and bibliometrics assessments. 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.

Subbiah Arunachalam (1999) in his macroscopic study used standard scientometrics techniques to map the published life sciences articles in India during 1992 – 1994. In this study, he compares and distributes the Indian

research (life sciences) in different sub-fields with a strong approach towards the collaboration of authors in native and abroad. His study reveals that 64.5 % of research articles are contributed by the academicians. He also considers the impact factor (IF) of journals to map the published articles<sup>9</sup>.

Subbiah Arunachalam (1997) identifies 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. He retrieved 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<sup>10</sup>.

Huffman et al. studied on the research articles, number of citations etc. from the Thomson Reuter’s web of knowledge. They compared all the data and found a significant result with p value  $<0.05$ <sup>11</sup>. Garg and Rag made a study in the field of science. They analyzed the documents published both in the SCI and non SCI journals. They studied across the period of 1965 – 1982 for their satisfaction<sup>12</sup>. Similarly Koganuramath et al. analyzed 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 reputed journals but their aim was to show a better result on the bibliometrics growth of research articles<sup>13</sup>. Kumbar et al. 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 evaluated and analyzed 1516 research articles and observed that the average annual growth rate of that University is 23%<sup>14</sup>.

#### **4. OBJECTIVES OF THE STUDY**

The objectives of the study are to:

- (a) Analyze the average growth and comparative growth rate of top 35 corporate medical institutions on publications.
- (b) Identify the top institute of performance.
- (c) Examine the performance of top 35 corporate medical institutions in the area of Medicine.
- (d) Identify most preferred journals by the Indian health science researchers.
- (e) Analyze the global collaboration of the Indian health science researchers.

#### **5. METHODOLOGY**

SCOPUS (<http://www.scopus.com>) database is used to find top 35 corporate medical institutions with more number of publications in comparison to others during the period of study i.e. 2007-2016. The bibliographic records were gathered from Scopus database because it comprises a huge number of publishers & multi

disciplinary subjects. According to MCI, there are 226 corporate medical colleges & Hospitals in India<sup>1, 10</sup>. Based on the Indian research, the top 35 corporate medical institutions with comparatively higher output of publications during a 10 year period from 2007-2016 were identified. 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 institutions which is introduced in last few years. 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 and shown as the dimension of  $h^{3/2}$ . We can define the mock h-index as  $h_m = (C^2/P)^{(1/3)}$ . 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**<sup>15</sup>. 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.

## 6. ANALYSIS OF PAPERS

### 6.1. Annual growth of the published documents

Table 1 represents the year wise growth rate of the corporate Indian Medical institutions depending upon total output during the studied period. It is found that the overall highest growth rate occurs in the year 2011 and a negative growth also occurs in the year 2015. The second highest growth happens in the year 2010. There is the highest number of publications (5180) in the year 2016 by these 35 corporate Indian Medical institutions.

**Table 1: Year wise growth rate of published articles:**

Year	Total output	Rate of growth	Cumulative output
2007	2202		2202
2008	2424	10.08	4626
2009	2703	11.51	7329
2010	3149	16.5	10478
2011	3722	18.2	14200
2012	4121	10.72	18321
2013	4399	6.75	22720
2014	4983	13.28	27703
2015	4939	-0.88	32642
2016	5180	4.88	37822

## 6.2. Comparative growth of the top 35 Institutions

Table 2 shows the comparative growth rate of these 35 institutes. It reveals that Siksha O Anusandhan Deemed to be University situated at Bhubaneswar, Odisha occupies top position 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 27<sup>th</sup> position in this table. Kasturba Medical College, Mangalore has a negative growth in this comparison and placed at the bottom of the table. Mahatma Gandhi Medical College & Research Institute is placed in the 2<sup>nd</sup> position.

**Table -2 Comparative Growth Percentages of top 35 Institutions**

Sl No	Name of the Institution	Total output during 2007 - 2011	Percent	Total output during 2012 - 2016	Percent	Total Output	Comparative growth rate
1	Sikshya O Anusandhan University	42	8.27	466	91.73	508	1009.52
2	Mahatma Gandhi medical college & research institute	83	13.97	511	86.03	594	515.66
3	SRM University	108	15.58	585	84.42	693	441.67
4	Jagatguru University	116	18.30	518	81.70	634	346.55
5	L. V. prasad Eye Institute, India	440	27.62	1153	72.38	1593	162.05
6	Sri Rama chandra University	351	29.92	822	70.08	1173	134.19
7	Christian medical college, Ludhiana	250	29.98	584	70.02	834	133.6
8	M.S. Ramiah Medical College	218	31.96	464	68.04	682	112.84
9	North Bengal Medical college	165	33.54	327	66.46	492	98.18
10	Indira Gandhi Medical college	314	33.55	622	66.45	936	98.09
11	Fortis Healthcare	225	33.73	442	66.27	667	96.44
12	BYL naire charitable hospital & TN medical college	300	34.05	581	65.95	881	93.67
13	Fr. Muller Medical College & Hospital	190	35.19	350	64.81	540	84.21
14	Nizam's Institute of medical sciences	404	35.38	738	64.62	1142	82.67
15	Dayananda Medical College & Hospital	225	35.83	403	64.17	628	79.11

16	Himalayan Institute of Medical Sciences	170	36.02	302	63.98	472	77.65
17	Indraprastha Appollo Hospitals	242	36.17	427	63.83	669	76.45
18	Pandit Bhagawat dayal sharma postgraduate I	562	36.93	960	63.07	1522	70.82
19	Manipal college of dental science	288	37.40	482	62.60	770	67.36
20	Amrita Institute of Medical science ,India	585	38.09	951	61.91	1536	62.56
21	Kasturaba Medical College , Manipal	1240	38.28	1999	61.72	3239	61.21
22	St. John's medical college	202	38.40	319	60.65	526	57.92
23	Sir Ganga Ram Hospital	483	39.33	745	60.67	1228	54.24
24	Tata Memorial Hospital	1196	39.72	1815	60.28	3011	51.76
25	PD Hinduja nNational Hospital & Medical research centre	323	40.32	478	59.68	801	47.99
26	Anamalai University	444	40.55	651	59.45	1095	46.62
27	Christian Medical College	1728	42.35	2352	57.65	4080	36.11
28	K.S. Hegede Medical Academy	230	42.91	306	57.09	536	33.04
29	Jawaharlal Medical college, Belgaum	305	44.14	386	55.86	691	26.56
30	Mahatma Gandhi institute of Medical Science	287	46.37	332	53.63	619	15.68
31	Jamia Hamdard Faculty of pharmacy	718	47.36	798	52.64	1516	11.14
32	Jaslok Hospital & Research Center	214	47.77	234	52.23	448	9.35
33	Regional institute of medical science	342	48.10	369	51.90	711	7.89
34	Arabind Eye hospital	248	48.16	267	51.84	515	7.66
35	Kasturaba Medical college, Mangalore	962	52.14	883	47.86	1845	-8.21

### 6.3. Performance of the top 35 corporate medical institutions in India

There are 37822 papers published by corporate medical institutions during 2007-2016 and collected from Scopus database. These institutes were identified and selected according to productive publication ranging from 448 to 4080 papers. The citation received by publications of these Indian corporate medical institutions is taken to calculate the average number of citations per paper for each institute. The h-index of these private medical colleges are retrieved from Scopus and presented for study during these 10 years of study. Table 3 represents

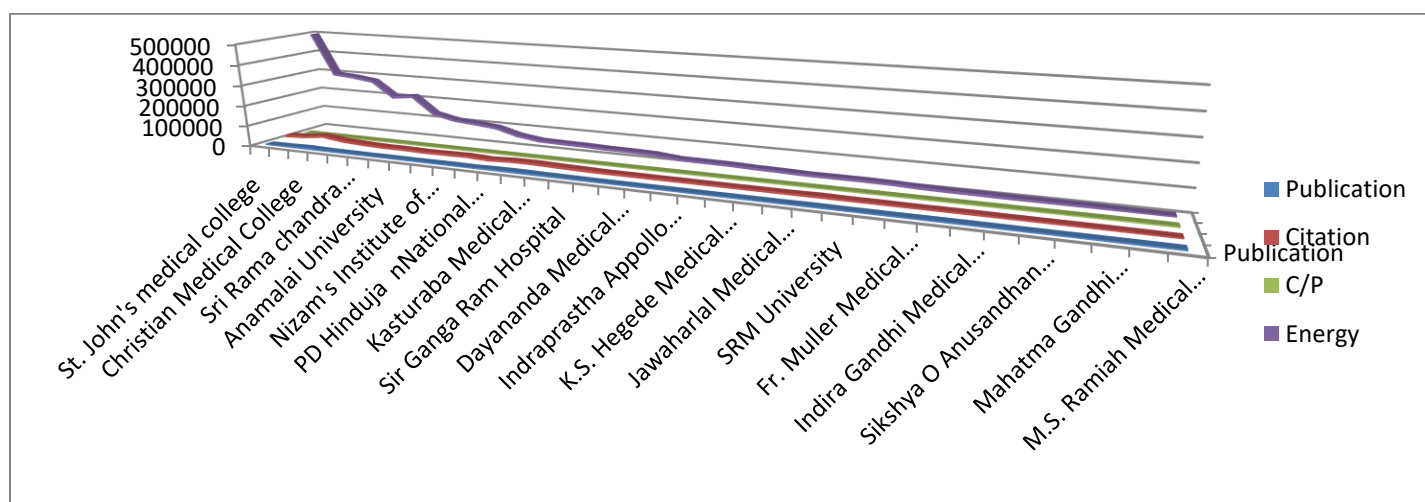
the overall status of 35 corporate medical institutions, i. e the number of publications (P), the citations received during the studied period (C), and the mean value of citation known as impact ( $i=C/P$ ) with h-index and appropriately introduced performance index (p) which is calculated using  $(C^2/P)^{(1/3)}$ . 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 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 institutions which is shown in a two dimensional map in the graph 1.

**Table 3: Performance of top 35 private medical colleges & Hospitals of India during 2007 - 2016**

SL NO	Name of the institute	Publication	citation	h-index	C/P	Performance
1	<b>Christian Medical College,Vellore</b>	<b>4080</b>	<b>34342</b>	<b>66</b>	<b>8.42</b>	<b>66.12</b>
2	Kasturaba Medical College , Manipal	3239	12281	35	3.79	35.98
3	Tata Memorial Hospital,Mumbai	3011	12111	35	4.02	36.52
4	Kasturaba Medical college ,Mangalore	1845	9122	34	4.94	35.6
5	<b>L. V. prasad Eye Institute, Hyderabad India</b>	<b>1593</b>	<b>12126</b>	<b>42</b>	<b>7.61</b>	<b>45.19</b>
6	<b>Amrita Institute of Medical science Kochi,India</b>	<b>1536</b>	<b>21367</b>	<b>63</b>	<b>13.91</b>	<b>66.74</b>
7	Pandit Bhagawat dayal sharma postgraduate Rohtak, Harayana	1522	4857	25	3.19	24.93
8	<b>Jamia Hamdard Faculty of pharmacy, New Delhi</b>	<b>1516</b>	<b>20421</b>	<b>60</b>	<b>13.47</b>	<b>65.04</b>
9	Sir Ganga Ram Hospital, Delhi	1228	7134	35	5.81	34.61
10	<b>Sri Rama chandra University, Chennai, India</b>	<b>1173</b>	<b>15376</b>	<b>38</b>	<b>13.11</b>	<b>58.63</b>
11	<b>Nizam's Institute of medical sciences, Hyderabad</b>	<b>1142</b>	<b>10815</b>	<b>39</b>	<b>9.47</b>	<b>46.79</b>
12	<b>Anamalai University, Tamilnadu</b>	<b>1095</b>	<b>12085</b>	<b>46</b>	<b>11.04</b>	<b>51.09</b>
13	Indira Gandhi Medical college, Shimla, Himachal Pradesh	936	2620	19	2.80	19.43
14	BYL naire charitable hospital & TN medical college, Mumbai	881	2625	22	2.98	19.85
15	<b>Christian medical college, Ludhiana</b>	<b>834</b>	<b>9620</b>	<b>28</b>	<b>11.53</b>	<b>48.05</b>
16	PD Hinduja nNational Hospital & Medical research centre, Mumbai	801	7130	36	8.90	39.89
17	Manipal college of dental science, Manipal , Karnatak	770	3276	22	4.25	24.07
18	<b>Fortis Healthcare, Delhi</b>	<b>667</b>	<b>11938</b>	<b>40</b>	<b>17.90</b>	<b>59.78</b>
19	Regional institute of medical science, Manipur	711	870	12	1.22	10.21
20	SRM University, Tamilnadu	693	3273	26	4.72	24.91
21	Jawaharlal Medical college, Belgaum, Karnatak	691	3281	25	4.75	24.98
22	M.S. Ramiah Medical College, Bangalore, Karnatak	682	219	21	0.32	4.13
23	Indraprastha Appollo Hospitals, Delhi	669	4127	28	6.17	29.42
24	Jagatguru University, Mysore,karnatak	634	3444	22	5.43	26.55
25	Dayananda Medical College & Hospital, Ludhiyana,Punjab	628	4865	27	7.75	33.53

26	Mahatma Gandhi institute of Medical Science, Sebagram, Maharastra	619	4059	27	6.56	29.86
27	Mahatma Gandhi medical college & research institute,Puducherry	594	1314	15	2.21	14.27
28	Fr. Muller Medical College & HospitalMangalore	540	2277	24	4.22	21.25
29	K.S. Hegede Medical Academy,Mangalore	536	3330	35	6.21	27.45
<b>30</b>	<b>St. John's medical college , Bangalore, India</b>	<b>521</b>	<b>16131</b>	<b>41</b>	<b>30.96</b>	<b>79.34</b>
31	Arabind Eye hospital, Puducherry	515	4557	32	8.85	34.29
32	Sikshya O Anusandhan University,BBSR, Odisha	508	1536	17	3.02	16.68
33	North Bengal Medical college, Westbengal	492	1423	15	2.89	16.03
34	Himalayan Institute of medical sciences, Deradun,Uttarakhand	472	3123	16	6.62	27.44
35	Jaslok Hospital & research centre, Mumbai, Maharastra	448	6562	38	14.65	45.81
	<b>Total</b>	<b>37822</b>	<b>273637</b>			

It is seen from table 3 and graph 1 that the top 10 corporate medical institutions in India are: St. john medical college, Bangalore (79.34), Amrita institute of medical sciences, Kochi(66.74), Christian medical college, Vellore(66.12), Jamia Hamdard Faculty of pharmacy(65.04), Fortis Healthcare(59.78), Sri Ram Chandra University(58.63), Annamalai university(51.09), Christian medical college, Ludhina(48.05), Nizam's Institute of Medical science(46.79), L.V. Prasad Eye Institute(45.19). The performance of each of the remaining 25 institutes is an order of magnitude lower than the top ranked institute, St. John medical college. This study reveals that all these top 35 corporatr Medical institutions are from few Indian states. Karnataka leads in the list with 10 institutions followed by Tamilnadu with 5. New Delhi and Maharashtra are placed in 3<sup>rd</sup> and 4<sup>th</sup> position with 4 and 3 institutions respectively. Punjab and Telangana equals West Bengal with 2. Odisha, Manipur, Pondicherry, Kerala, Himachal Pradesh, Gujurat and Haryana are the other states with 1 institution each.



**Graph 1- The impact-citation-energy (iCE) representation of performance in medical research of the top 35 corporate medical institutions in India during 2007– 2016**

#### 6.4. Publication of top 35 corporate medical institutions in the area of Medicine

Table 4 represents the performance status of 35 corporate medical institutions in medicine. The name of top 10 institutes is not same as the names are listed in table 3. St. John's medical college, Bangalore (82.11) is listed on top and followed by other top performed institutes in Medicine. The others are Tata memorial Hospital, Mumbai (68.5), Christian medical college, Vellore (63.84), Sri Rama chandra University, Chennai (63.19), Fortis Healthcare, Delhi (61.17), Anamalai University, Tamilnadu (53.13), Christian Medical College, Ludhiana (50.58), Amrita Institute of Medical Science, Kochi (48.03), L. V. Prasad Eye Institute, Hyderabad (47.03) and Jaslok Hospital & research centre, Mumbai, Maharashtra (45.73). It is found that St. John's Medical College, Bangalore remains on the top both in the overall performance and performance on the Medicine subject. But the other institutes cannot keep their ranking same in both tables.

**Table 4 – Performance of the top 35 private Medical Colleges in the area of Medicine in India during 2007 – 2016**

SL. NO	Name of the Institute	publication	citation	h-index	C/P	performance
1	<b>Christian Medical College,Vellore</b>	<b>3782</b>	<b>31369</b>	<b>63</b>	<b>8.29</b>	<b>63.84</b>
2	Kasturaba Medical College , Manipal	2798	10628	32	3.80	34.3
3	<b>Tata Memorial Hospital,Mumbai</b>	<b>2728</b>	<b>29614</b>	<b>57</b>	<b>10.86</b>	<b>68.5</b>
4	Kasturaba Medical college ,Mangalore	1585	9333	35	5.89	38.02
5	<b>L. V. prasad Eye Institute, Hyderabad India</b>	<b>1495</b>	<b>12471</b>	<b>43</b>	<b>8.34</b>	<b>47.03</b>
6	<b>Amrita Institute of Medical science Kochi,India</b>	<b>1137</b>	<b>11223</b>	<b>41</b>	<b>9.87</b>	<b>48.03</b>
7	Pandit Bhagawat dayal sharma postgraduate Rohtak, Harayana	1401	4496	25	3.21	24.34
8	Jamia Hamdard Faculty of pharmacy, New Delhi	299	4994	32	16.70	43.69
9	Sir Ganga Ram Hospital, Delhi	1193	7086	35	5.94	34.78
10	<b>Sri Rama chandra University, Chennai, India</b>	<b>704</b>	<b>13327</b>	<b>35</b>	<b>18.93</b>	<b>63.19</b>
11	Nizam's Institute of medical sciences, Hyderabad	991	9566	36	9.65	45.2
12	<b>Anamalai University, Tamilnadu</b>	<b>1059</b>	<b>12604</b>	<b>47</b>	<b>11.90</b>	<b>53.13</b>
13	Indira Gandhi Medical college, Shimla, Himachal Pradesh	773	2201	18	2.85	18.44
14	BYL naire charitable hospital & TN medical college, Mumbai	836	2521	22	3.02	19.66
15	<b>Christian medical college, Ludhiana</b>	<b>736</b>	<b>9758</b>	<b>27</b>	<b>13.26</b>	<b>50.58</b>
16	PD Hinduja nNational Hospital & Medical research centre, Mumbai	775	6832	35	8.82	39.2
17	Manipal college of dental science, Manipal , Karnatak	430	3423	25	7.96	30.09
18	<b>Fortis Healthcare, Delhi</b>	<b>645</b>	<b>12149</b>	<b>39</b>	<b>18.84</b>	<b>61.17</b>
19	Regional institute of medical science, Manipur	634	784	12	1.24	9.9
20	SRM University, Tamilnadu	672	3370	26	5.01	25.66
21	Jawaharlal Medical college, Belgaum, Karnatak	561	2775	24	4.95	23.94
22	M.S. Ramiah Medical College, Bangalore, Karnatak	645	1936	19	3.00	17.98

23	Indraprastha Appollo Hospitals, Delhi	684	3944	26	5.77	28.33
24	Jagatguru University, Mysore,karnatak	459	2298	21	5.01	22.58
25	Dayananda Medical College & Hospital, Ludhiyana,Punjab	599	4191	26	7.00	30.84
26	Mahatma Gandhi institute of Medical Science, Sebagram, Maharastra	561	3757	27	6.70	29.3
27	Mahatma Gandhi medical college & research institute,Puducherry	501	1105	14	2.21	13.46
28	Fr. Muller Medical College & HospitalMangalore	494	1889	20	3.82	19.33
29	K.S. Hegede Medical Academy,Mangalore	416	1601	17	3.85	18.33
30	<b>St. John's medical college , Bangalore, India</b>	<b>465</b>	<b>16044</b>	<b>42</b>	<b>34.50</b>	<b>82.11</b>
31	Arabind Eye hospital, Puducherry	487	4289	31	8.81	33.55
32	Sikshya O Anusandhan University,BBSR, Odisha	499	1554	17	3.11	16.91
33	Himalayan Institute of medical sciences, Deradun,Uttarakhand	472	2915	15	6.18	26.21
34	North Bengal Medical college, Westbengal	469	1368	14	2.92	15.86
35	<b>Jaslok Hospital &amp; research centre, Mumbai, Maharastra</b>	<b>452</b>	<b>6574</b>	<b>38</b>	<b>14.54</b>	<b>45.73</b>
	Total	32437	253989			

### 6.5. 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. There are 1410 documents are published in “Journal of Clinical and Diagnostic Research” and also reveals that Kasturba Medical College, Mangalore published highest number (152) documents in this journal. 2.07% of total documents are published through “BMJ Case Reports” which is placed in the 2<sup>nd</sup> position. “Indian Journal of Medical & Pediatric oncology” and “International journal of pharmaceutical and Clinical research” are placed in the 34<sup>th</sup> and 35<sup>th</sup> position of the list with 147 numbers of publications each. Overall 32% of total documents are published by these 35 journals. The other 68% are published through more than 5000 journals. International Journal of Pharma and Bio Sciences, published from India have the highest impact factor with 6.268 and 13 journals have not mentioned their impact factor.

**Table 5– Top 35 preferred sources**

Sl. No	Name of the Source	Number of document	Percentage	Impact Factor	Country
1	Journal Of Clinical And Diagnostic Research	1410	3.69	N A	India
2	BMJ Case Reports	791	2.07	N A	Britain
3	Journal Of Association Of Physicians Of India	595	1.56	N A	India
4	Indian Journal Of Pathology And Microbiology	427	1.12	0.616	India
5	Indian Journal Of Ophthalmology	386	1.01	0.835	India

6	Indian Journal Of Pediatrics	372	0.97	N A	India
7	JMS Journal Of Medical Society	359	0.94	N A	India
8	Indian Pediatrics	350	0.92	1.152	India
9	Neurology India	329	0.86	1.758	India
10	Journal Of Cancer Research And Therapeutics	308	0.81	0.75	India
11	Indian Journal Of Cancer	302	0.79	0.497	India
12	Research Journal Of Pharmaceutical Biological And Chemical Sciences	292	0.76	0.35	India
13	Journal Of The Indian Medical Association	285	0.75	N A	India
14	Indian Journal Of Medical Research	284	0.74	1.532	India
15	Journal Of Anaesthesiology Clinical Pharmacology	284	0.74	N A	India
16	Indian Journal Of Anaesthesia	274	0.72	0.4	India
17	Indian Journal Of Dermatology	262	0.69	1.069	India
18	Indian Journal Of Dermatology Venereology And Leprology	262	0.69	1.948	India
19	Plos One	262	0.69	2.806	USA
20	Indian Journal Of Medical Microbiology	250	0.65	N A	India
21	Asian Journal Of Pharmaceutical And Clinical Research	246	0.64	0.4	India
22	Indian Journal Of Gastroenterology	217	0.57	0.69	India
23	Indian Journal Of Surgery	215	0.56	0.256	India
24	National Medical Journal Of India	202	0.53	1.412	India
25	Indian Heart Journal	195	0.51	N A	India
26	Indian Journal Of Critical Care Medicine	194	0.51	N A	India
27	Lung India	192	0.50	N A	India
28	Indian Journal Of Urology	185	0.48	N A	India
29	International Journal Of Pharma And Bio Sciences	177	0.46	6.268	India
30	Indian Journal Of Psychiatry	175	0.46	0.81	India
31	Indian Journal Of Pharmacology	174	0.46	0.638	India
32	Annals Of Indian Academy Of Neurology	156	0.41	0.95	India
33	Journal Of Postgraduate Medicine	154	0.40	1.874	India
34	Indian Journal Of Medical And Paediatric Oncology	147	0.39	N A	India
35	International Journal Of Pharmaceutical And Clinical Research	147	0.39	4.51	India
Total		10860	28.45		

## 6.6. Collaboration of Indian health science researchers

There are 11595 documents are published in collaboration with the top 35 countries. Table 6 represents that more researchers from United States of America are associated with the Indian health science researchers. It is found from that 2389 documents are from United States while retrieved from Scopus database (preliminary data

is present with the author). United Kingdom with 934 documents is placed in 2<sup>nd</sup> position and undefined documents are not taken into consideration. Poland occupies the 35<sup>th</sup> position in the list with 127 collaborations. The top 35 Indian corporate medical institutions account for 37822 research outputs during this decade. The above analysis helps us to reflect overall performance and specialized performance of these institutes which is clearly pictured in tables and graph. A few institutes like the St. John medical college, Amrita Institute of medical sciences, the Christian Medical College, Vellore, the Jamia Hamdard faculty of Pharmacy, New Delhi and Sri Rama Chandra University, Chennai are placed in top 5 positions as per their performance. It is found that 29% of the total publication is published by these 5 institutes. There are 17 top corporate medical institutions are from south India and other 18 institutes are from the other region.

**Table 6 – Top 35 Collaboration of Indian researchers**

<b>Sl. No</b>	<b>Name of the Country</b>	<b>Number of document</b>	<b>Percentage</b>
1	United States	2389	6.26
2	United Kingdom	934	2.45
3	Canada	563	1.47
4	Australia	554	1.45
5	Saudi Arabia	423	1.11
6	Malaysia	394	1.03
7	France	389	1.02
8	Germany	364	0.95
9	Italy	340	0.89
10	Netherlands	339	0.89
11	Japan	338	0.89
12	China	315	0.83
13	Brazil	275	0.72
14	Singapore	251	0.66
15	South Korea	245	0.64
16	Switzerland	231	0.61
17	South Africa	230	0.60
18	Pakistan	217	0.57
19	Sweden	217	0.57
20	Spain	215	0.56
21	Argentina	212	0.56
22	Nepal	212	0.56
23	Belgium	196	0.51
24	Taiwan	168	0.44
25	Turkey	168	0.44
26	Denmark	161	0.42
27	Mexico	158	0.41

28	United Arab Emirates	145	0.38
29	Thailand	144	0.38
30	Austria	143	0.37
31	Oman	137	0.36
32	Philippines	137	0.36
33	Israel	133	0.35
34	Egypt	131	0.34
35	Poland	127	0.33
Total		11595	30.37

### 6.7. Participation of foreign institutes in Indian health science research

It is found from this study that the Indian researchers published their papers with other researchers from outside India. It is decided to tabulate the top 5 other institutes for the collaboration of top 35 corporate medical institutions in India. Table 7 shows all the clear data of these institutions for their collaboration and publication with other foreign countries.

**Table 7 - Collaboration of Top 35 Institutions with other Foreign Institutions:**

Sl. No	Name of the Institution	Collaboration with top 5 Foreign Institutions				
1	Christian Medical College,Vellore	King's College London (50)	National Institutes of Health, Bethesda,(41)	Johns Hopkins University(38), Washington, DC	University of Toronto,(37)	Tufts Medical Center,(35) Washington
2	Kasturaba Medical College , Manipal	University of The West Indies Trinidad and Tobago,(10)	Ngee Ann Polytechnic,(8), Singapore	National University of Singapore(8)	Yong Loo Lin School of medicine,(8) Singapore	University of Malaya,(8)
3	Tata Memorial Hospital,Mumbai	University of Pennsylvania, Health System,(64)	International Agency for Research on Cancer,42, Austria	University of Pennsylvania, (36)	University of Texas M. D. Anderson Cancer Center,(33)	School of Medicine, Pennsylvania (24)
4	Kasturaba Medical college ,Mangalore	John's Hopkins school of medicine,Maryl and	International Medical University,(9), USA	University of Arkansas for Medical Sciences,(9), USA	Saba University School of Medicine,(6), U.S	University of Alabama at Birmingham,(6), U.S

5	L. V. prasad Eye Institute, Hyderabad India	University of Melbourne,(51)	Bascom Palmer Eye Institute,(45)	University of New South Wales UNSW Australia,(39)	Vision Cooperative Research Centre, Australia,(37)	Singapore Eye Research Institute,(35)
6	Amrita Institute of Medical science Kochi,India	Kansai University,Japan(25)	High Technology Research Centre,japan(18)	National University of Singapore,(12)	UCL, London,(12)	King's college,London(9)
7	Pandit Bhagawat dayal sharma postgraduate Rohtak, Harayana	OspedaleMaggiore,Italy(14)	Hadassah University Medical Centre,Jerusalem,(12)	Denver Health Med Center,USA,(12)	Mansoura University,Egypt,(12)	Helsinki University Central Hospital,(11)
8	Jamia Hamdard Faculty of pharmacy, New Delhi	King Saud University College of Pharmacy,(43)	King Saud University,(43),UAE	King Abdulaziz University,(35)	Oman Medical College,Oman(18)	Konkuk University, Korea(18)
9	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)	Amtssygehuset i Gentofte,Denmark(6)
10	Sri Rama chandra University, Chennai, India	Emory University,USA (20)	University of LiverpoolEngland,(19)	Columbia University in the City of NY,(19)	Albert Einstein College of Medicine of Yeshiva University,N.Y(17)	University of Washington, Seattle(17)
11	Nizam's Institute of medical sciences, Hyderabad	King Saud University,(19)	University of Washington, Seattle(12)	University of Chicago,(10)	University of Toronto,Kanada(9)	Bristol Royal Hospital for Children,England,(70)
12	Anamalai University, Tamilnadu	Sultan Qaboos University,Oman (24)	Universita di Pisa,Europe(16)	King Saud University,saudi Arabia(14)	Johns Hopkins Bloomberg School of Public Health,(11)	King Saud University College of Applied Medical Sciences,(9)

13	Indira Gandhi Medical college, Shimla, Himachal Pradesh	University of Oklahoma Health Sciences Center,USA(9)	Faculte de Medecine de Marseille Universite de la Mediterranee, France,(3)	South-East Asia Office,(2)	Universite de la Mediterranee Aix-Marseille II,(2)	West Virginia University, USA(2)
14	BYL naire charitable hospital & TN medical college, Mumbai	Prince Aly Khan Hospital,PAK(4)	Korea University,(3)	Icahn School of Medicine at Mount Sinai,NY(2)	VA Medical Center,Verginia(2)	Inje University, Korea(2)
15	Christian medical college, Ludhiana	The University of Sydney,Aus(21)	University of Oxford,ENG(15)	University College of Medical Sciences,Chai na(15)	Universidade de Sao Paulo – USP(14)	Monash University, Aus(14)
16	PD Hinduja nNational Hospital & Medical research centre, Mumbai	University of California, San Diego,(22)	California Department of Health Services,(9)	University of Arkansas - Fayetteville,(8)	San Diego State University,(8)	University of Cape Town,(8)
17	Manipal college of dental science, Manipal , Karnatak	International Medical University, Florida(7)	Case Western Reserve University,Ohio (5)	University of Dammam, Soud Arabia(4)	MAHSA University,Malesia(3)	University of Adelaide(3)
18	Fortis Healthcare, Delhi	University of California, San Francisco(15)	The Aga Khan University,Pak(15)	Population Health Research Institute, Ontario(14)	Wayne State University,USA(13)	McMaster University, Canada(12)
19	Regional institute of medical science, Manipur	University of Melbourne,Aus(2)	Oxford University Clinical Research Unit (1)	University of Melbourne,(2)	HIMS,Korea (1)	FMMC,Japan(1)
20	SRM University, Tamilnadu	University of Texas at Austin(5)	Asian Institute of Medicine, Science & Technology(5)	Stanford University School of Medicine(4)	Konkuk University, Korea(3)	University of Pittsburgh,USA (3)
21	Jawaharlal Medical college, Belgaum, Karnatak	RTI International, USA(51)	University of Alabama at Birmingham,(43)	The Aga Khan University,PAK(41)	Columbia University in the City of NY(32)	Massachusetts General Hospital,USA(30)

22	M.S. Ramiah Medical College, Bangalore, Karnatak	University of Alberta, Canada(8)	Universiti Sains Malaysia(5)	Wayne State University School of Medicine,USA (5)	Texas A and M University,US A(2)	Wayne State University, USA(2)
23	Indraprastha Appollo Hospitals, Delhi	Academic Medical Centre, University of Amsterdam,(50)	VU University Medical Center, Netherlands(5)	Harvard Medical School ,USA(5)	University of Witwatersrand, South Africa(5)	Pavol Jozef Safarik University in Kosice, Slovakia(5)
24	Jagatguru University, Mysore,karnatak	Imperial College London(11)	University of Hail, Soud Arabia(11)	King's College London(9)	King Saud University(9)	Monash University, AUS(9)
25	Dayananda Medical College & Hospital, Ludhiyana,Punjab	University of Groningen,Netherlands(10)	UCL Institute of Neurology,London(80)	University of Oklahoma Health Sciences Center,(7)	Harvard Medical SchoolUSA,(6)	UCL,London,(6)
26	Mahatma Gandhi institute of Medical Science, Sebragam, Maharastra	Ohio State University,USA (20)	Nanyang Technological University,Singapore(2)	Hallym University, College of Medicine(2)	King Saud University(2)	Hallym University Singapore(2)
27	Mahatma Gandhi medical college & research institute,Puducherry	University of South Carolina USA(18)	Life Sciences and International Cooperation,South Africa(8)	University of Arkansas for Medical Sciences,USA (5)	University of New South Wales UNSW Australia(3)	University of Dammam, Soud Arabia(3)
28	Fr. Muller Medical College & HospitalMangalore	University of South Carolina,(18)_	Life Sciences and International Cooperation,South Africa(8)	University of Arkansas for Medical Science(5)	University of New South Wales UNSW Australia(3)	University of Dammam, Soud Arab(3)
29	K.S. Hegede Medical Academy,Mangalore	Strides Research and Specialty Chemicals Ltd,USA(7).	University of Wollongong, Dubai(50)	University of Oxford(3)	University of Cambridge(3)	Tohoku University, Japan(2)
30	St. John's medical college , Bangalore, India	Population Health Research Institute, Ontario(48)	McMaster University,Cana da(44)	Hamilton Health Sciences,Cana da(19)	University of Cape Town,South Africa(17)	Duke Clinical Research Institute(18),USA
31	Arabind Eye hospital, Puducherry	University of California, San Francisco,(22)	Szegedi Tudományegyetem,Hungary (17)	Johns Hopkins University,US A(15)	The Wilmer Eye Institute at Johns HopkinsUSA (14)	Stanford University School of Medicine,C alifornia(12)

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32	Sikshya O Anusandhan University,BBSR, Odisha	Universite Catholique de Louvain,Belgium(2)	Universita degli Studi di Milano, Italy(2)	University of Alberta,Canada(2)	IRCCS Istituto Ortopedico Galeazzi,(9)	PIMS,USA (1)
33	North Bengal Medical college, Westbengal	The Johns Hopkins School of Medicine,USA((2)	Russian Academy of Sciences(2)	Engelhardt Institute of Molecular Biology, Russian Academy of Sciences(2)	Columbia Asia Hospital(1)	WHO-NPSP (1)
34	Himalayan Institute of medical sciences, Deradun,Uttarakhand	Somnogen Canada Inc.(3)	King Saud University Medical College,(30)	LAUTECH Teaching Hospital,(2)	Hospital General Universitario Carlos Manuel de Céspedes(2)	Hospital Castro Rendón,(2)
35	Jaslok Hospital & research centre, Mumbai, Maharastra	Karolinska Institutet, Sweden(14)	Universitat Ulm, Germany(11)	Chinese University of Hong Kong(10)	St George's University of London(10)	Wellington School of Medicine and Health Sciences,U SA(9)

## 7. CONCLUSIONS

There is an attempt to rank the Indian corporate medical college using a rational process and p-index is used to indicate the top performer. Quality – quantity figure is prepared with the help of energy factor in two-dimensional map. This study also identifies the most preferred journal and also finds the collaboration of Indian researchers with the other researchers in abroad. The research output of these corporate medical institutions gives a clear knowledge on Indian health science research.

The top 35 performers in the area of Medicine and top 5 performers in other areas of health care field is identified. It is understood that the research publication of corporate medical institutions does not grow positively when compared to the corresponding year. There is a negative growth in the year 2015 and the highest positive growth occurred in the year 2011.

We hope the trend of medical research output of the other medical institutions in India is similar to the progressive output of these 35 corporate medical institutions. This study analyzed the performance of 35 corporate medical institutions with some limit in bibliometrics parameter which leads to demonstrate the better understanding about the broader aspect of research productivity. It is suggested to carry forward the similar analysis to rank the other medical institutions in India.

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