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Ranking of Indian medical colleges for their research performance during 1999-2008

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The study aims to to analyze the performance of education and research institutes in India in medical and allied sciences during 1999-2008, based on their research output, using robust quantitative and qualitative indicators which give a more rational procedure for ranking their research performance. Data is collected from the SCOPUS database and a new composite performance indicator, the *p*-index, is used to measure performance. The overall ranking of top 30 colleges give an indicative, if not nearly comprehensive, assessment of how the medical higher education is performing as generators of new knowledge. Ranking on a specialisation basis is also provided.

Introduction

It is well recognized that assuring a minimal level of health care to the population is a critical constituent of the development process. The expansion of medical education in the country has been rapid since independence, but it continues to remain inadequate by the standards of developed countries. This is reflected in the shortage of health professionals and health services by international benchmarks, and wide disparities remain between rural and urban areas and also between the various states. The need to expand India's medical education and research system is therefore urgent, and the pressing challenge is to achieve this while maintaining world-class quality[1].

The authorities that control medical education in the country include Ministry of Health, Medical Council of India (MCI), Dental Council of India, Pharmacy Council of India, Dental Council of India, University Grant Commission (UGC), State Medical Education Departments and Councils, Medical Colleges/ Institutes, NAMS and NBE (National Board of Examinations). The MCI was established in 1933 under the Indian Medical Council Act 1933, with the main function of establishing uniform standards of higher education in medicine. The Indian Medical Council Act 1933 was deemed inadequate and a new act was enacted in 1956, which was further modified in 1964, 1993 and 2001. The MCI is entrusted with the duty in inspecting and monitoring the institutions that offer medical education in India periodically, by keeping a check on their infrastructure, standards of faculty, instructional aids, institutional support and clinical practices of medical colleges in the country[2].

Although medical education in India encompasses allopathic medicine and other indigenous systems of medicine, it is the former that is by far the most favoured of all systems. This article deals with only education relating to the allopathic system of medicine. In the various medical colleges recognized by the Medical Council of India, students can opt for para-medical and medical courses leading to undergraduate and postgraduate degrees. The graduate courses offered by the medical colleges leads to Bachelor of Medicine or Bachelor of Surgery (MBBS) of five and half years of duration. A MBBS degree with registration by the Medical Council of India is the basic requirement of all postgraduate courses in the field of medicine and surgery. A substantial number of medical colleges also offer post-graduate degrees (of three years duration) or diploma (of two years duration) leading to Doctor of Medicine (MD), Master of Surgery (MS) or Diploma of National Board (DNB). The universities affiliated to the Medical Council of India offer the MD/MS degrees and the DNB degree is awarded by the National Board of Examination, an independent autonomous body under the Ministry of Health[3].

The post-graduate courses are available in different areas of medical sciences, such as general medicine, general surgery, orthopaedics, radio diagnosis, radiotherapy, ENT, ophthalmology, anaesthesia, paediatrics, community medicine, pathology, microbiology, forensic medicine, pharmacology, anatomy, etc. Following post-graduation courses, students can opt for further sub-specialization in their areas of interest by opting for courses called DM or DNB (Doctorate of Medicine), or MCh or DNB (Master of Chirurgery/ Surgery) again of 3 years duration[3].

In addition, a number of paramedical courses are offered in India in nursing, medical laboratory technology, pharmacy, physiotherapy, speech & hearing, ophthalmic techniques, human biology and medical technology in radiography. In India, admission to medical colleges is organized by the central government as well as the state governments through rigorous entrance examination, as mandated by the Supreme Court of India. The top medical colleges of India offer research, teaching and patient care facilities. Indian medical education system is at present one of the largest in the world and produces many physicians, which not only serving their own country, but emigrate to USA, U.K, Canada, Australia and several other countries. The quality of physicians produced by these medical colleges, therefore, has a broad global impact.

Western medicine and related health care system in India is a legacy of the British rule in India. The English East India Company in the early 18th century started in the Indian Medical Service to look after Europeans in India. A few centres for training midwives, dressers and hospital attendants were initiated. A century elapsed before the first medical college was launched in 1835 in Calcutta[4]. Since then the number of medical colleges have increased from 30 at the time of independence to 1900 by 2009[5].

The annual intake of medical students in the 271 medical colleges till March 2008 has crossed more than 40,000, of which more than 30, 000 are in MBBS graduate course and more than 11,000 in postgraduate courses in different disciplines in medicine. A large number of medical colleges are concentrated in Maharashtra (40), followed by Karnataka (36), Andhra Pradesh (32), Tamil Nadu (25), Kerala (18), Uttar Pradesh (16), Gujarat (13) and so on[6]. Approximately, 30,000 MBBS doctors graduate in India each year, of which nearly 10,000 acquire medical license. Thousands of Indian doctors either go for higher education abroad or jobs abroad each year.

The Indian Health Ministry has recently approved a plan to boost medical education in the country, where new courses has been introduced, besides increasing the post-graduate seats by 30 percent for different specializations. The amendment includes increase in the postgraduate students to professor ratio to 2:1 from the present 1:1, which automatically added 4000 seats to post-graduate courses annually[7]. In order to improve medical education and make it internationally competitive, there is urgent need to develop research-oriented educational programs at undergraduate and post-graduate level[8].

It has generally been observed that medical colleges funded by central government are better than colleges funded by state governments. Similarly, government medical colleges are better than private medical colleges in terms of performance. Most other government medical colleges have comparable degree of faculty, good student quality and very good clinical exposure. Some of these medical colleges, however, lack the latest diagnostic equipment, which are essential for proper diagnosis. In comparison, private medical colleges generally suffer from weak infrastructure and facilities and lower clinical opportunities and exposure.

So far, no ranking of medical colleges and institutes for their research performance has been undertaken. Although there is no official ranking system of medical colleges in India, a few surveys by media have been conducted in the past by DoctorNDTV, India Today, Times of India, etc. which takes into account factors like facilities, patient volume, past placements, faculty, etc. This paper attempts to rank the medical colleges based on research performance.

Objective of the study

- To analyze the research performance of medical colleges and allied sciences based on their research output during 1999-2008.

Methodology

The international bibliographical database SCOPUS (http://www.scopus.com) has been used to gather the

necessary data for the study. Based on the data on medical research in India obtained from Scopus, the top 30 medical colleges with comparatively higher output of publications during a ten-year period from 1999-2008 were identified. Most of the international ranking schemes are complex exercises and assess both quantity and quality of scientific research, but use such elitist levels of achievement (number of Nobel Laureates; papers in *Nature* and *Science*, etc.) that they cannot be meaningfully applied here[9-11]. Therefore for ranking purposes in this study, the recently introduced *p*-index has been employed.

The *p*-index

There are several ways of ranking performance, e.g. the simplest and crudest being by quantity of output (P or C), or by quality (mean citation rate = C/P; also known as impact i), or by a performance index combining quantity and quality, e.g. the h-index. The insight emerging from some recent studies[12-14] which have re-visited the problem of ranking research performance of any entity (from individuals to countries) considers the best single indicator to be used for ranking using quality and quantity together, to be a geometric mean of C and C/P. However, by dimensional analysis, one can show that this has the dimensions of $h^{3/2}$. Indeed, a substitute or mock h-index defined as $h_m = (C^2/P)^{(1/3)}$ is the best indicator for performance, having the correct dimensionality, that of h. The index is referred to as p-index. Some discussion about the term $C^2/P = C \cdot C/P$ is called for. This hyperbolic product of quality ($i = C/P$) and quantity (C) is seen to be an energy like term ($E = iC = C^2/P$) and such an interpretation allows us to display the research performance of various entities on a two-dimensional map.

Analysis

The 30 institutes during the period 1999-2008 have published 32393 papers during this period, according to publication data downloaded from Scopus. Put together, these papers constitute 9.68 percent of the total cumulative research output from India during 1999-2008. These colleges were identified and selected on the basis of publication productivity ranging from 250 to 8021 papers.

The citations received by papers of these Indian medical colleges are considered for first three-years (three year citation window) from the date of their publications (C). This allows the average number of citations per paper (C/P) to be computed for each of these institutes for the three-year citation window. h-indices for these colleges for the same period (i.e. 1999-2008) were also determined from the SCOPUS database.

Table 1 shows a summary of the data for the 30 Indian medical colleges, i.e., the number of papers published (P), the citations obtained during the citation window (C), the average number of citations per paper, also known as impact ($i = C/P$). Also shown in Table 1 is the Hirsch h-index and the newly proposed composite performance index (p). The ranking of the institutions in Table 1 has been done using the p-index.

As explained earlier, the hyperbolic product of quality hyperbolic product of quality ($i = C/P$) and quantity (C) is seen to be an energy like term ($E = iC = C^2/P$) and such an interpretation allows us to display the research performance of various entities on a two-dimensional map as shown in Figure 1.

From Table 1 and Figure 1 it is seen that the top eight colleges in the area of medical research are: All India Institute of Medical Sciences (AIIMS), New Delhi, Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh, Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow, National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, Christian Medical College Hospital (CMCH), Vellore, Banaras Hindu University, Institute of Medical Science (BHU-IMS), Varanasi, King George Medical College (KGMC), Lucknow and Institute of Post Graduate Medical Education & Research (IPGMER), Kolkata. The performance of each of the remaining 23 medical institutes is an order of magnitude lower than that of the leader, All India Institute of Medical Sciences (AIIMS), New Delhi. It can also be noticed that a few states dominate the list of top 30 medical colleges. Karnataka accounts for 6 of the top 30 medical colleges, and Delhi and Maharashtra for another 4 each. Several prominent states and regions are unrepresented in this list: Bihar, Orissa, Madhya Pradesh, Chattisgarh, Gujarat, Jharkhand and the entire North-East.

Table 2 shows the data for the same list of medical colleges in the area of medicine. The list of top eight

Table 1—Performance of the top 30 medical colleges in India during 1999-2008

Sl. no.	Institution	*P*	*C*	*C/P*	*h*	*p*
1	All India Institute of Medical Sciences (AIIMS), New Delhi	8021	20338	2.54	52	37.22
2	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	4791	9463	1.97	38	26.54
3	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	2204	6113	2.77	34	25.69
4	National Institute of Mental Health & Neurosciences (NIMHANS), Bangalore	1048	3838	3.66	30	24.13
5	Christian Medical College Hospital (CMCH), Vellore	2259	5132	2.27	34	22.68
6	Banaras Hindu Univ. Institute of Medical Science (BHU-IMS), Varanasi	1119	2461	2.2	29	17.56
7	King George Medical College (KGMC), Lucknow	670	1673	2.5	26	16.11
8	Institute of Post Graduate Medical Education & Research (IPGMER), Kolkata	331	1044	3.15	22	14.88
9	Sree Chitra Tirunal Institute of Medical Science & Technology (SCTIMST), Thiruvanathpuram	998	1745	1.75	22	14.50
10	Maulana Azad Medical College (MAMC), Delhi	1149	1861	1.62	20	14.45
11	Kasturba Medical College (KMC), Manipal	1131	1770	1.56	21	14.04
12	University College of Medical Sciences (UCMS), Delhi	937	1377	1.47	20	12.65
13	Nizam's Institute of Medical Sciences (NIMS), Hyderabad	400	814	2.04	16	11.83
14	Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER), Pondicherry	991	1278	1.29	15	11.81
15	St. John's Medical College (SJMC), Bangalore	323	690	2.14	16	11.38
16	Medical College & Hospital (MCH), Kolkata	485	839	1.73	19	11.32
17	Govt. Medical College (GMC), Nagpur	306	608	1.99	17	10.65
18	Govt. Medical College & Hospital (GMCH), Chandigarh	782	933	1.19	15	10.36
19	Lady Harding Medical College (LHMC), New Delhi	607	810	1.33	15	10.26
20	Sri Ramchandra Medical College & Research Institute Deemed Univ. (SRMCRI), Chennai	279	419	1.5	13	8.57
21	Amrita Institute of Medical Sciences (AIMS), Kochi	416	487	1.17	12	8.29
22	Pandit Bhagwat Dayal Sharma Postgraduate Institute of Medical Sciences (PBDSPGIMS), Rohtak	696	614	0.88	15	8.15
23	Indira Gandhi Medical College (IGMC), Shimla	277	376	1.36	11	7.99
24	Kasturba Medical College (KMC), Mangalore	656	546	0.83	13	7.69
25	Grant Medical College (GRMC), Mumbai	249	307	1.23	12	7.23
26	BYL Nair Charitable Hospital & T.N. Medical College (TNMC), Mumbai	449	380	0.85	12	6.85
27	M.S.Ramaiah Medical College (MSRMC), Bangalore	250	268	1.07	10	6.60
28	Govt. Medical College (GMC), Mysore	252	264	1.05	11	6.52
29	SMS Medical College (SMSMC), Jaipur	298	276	0.93	11	6.35
30	Armed Forces Medical College (AFMC), Pune	627	390	0.62	12	6.24
	Total	33001	63392	1.96	19.4*	49.57
	Country Output during 1999-2008	334476				
	Share of 30 Medical Colleges in Country Output	9.87				

Table 2—Performance of the top 30 Medical Colleges in the area of Medicine in India during 1999-2008

Sl. no.	Institution	*P*	*C*	*C/P*	*h*	*p*
1	All India Institute of Medical Sciences (AIIMS), New Delhi	6742	15752	2.34	48	33.26
2	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	1902	5241	2.76	31	24.35
3	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	4036	7586	1.88	35	24.25
4	Christian Medical College Hospital (CMCH), Vellore	1976	4143	2.1	31	20.56
5	National Institute of Mental Health & Neurosciences (NIMHANS), Bangalore	812	2543	3.13	21	19.97
6	King George Medical College (KGMC), Lucknow	543	1352	2.49	22	14.99
7	Maulana Azad Medical College (MAMC), Delhi	1020	1660	1.63	19	13.93
8	Banaras Hindu Univ. Institute of Medical Science (BHU-IMS), Varanasi	734	1360	1.85	21	13.61
9	Institute of Post Graduate Medical Education & Research (IPGMER), Kolkata	260	672	2.58	18	12.02
10	St. John's Medical College (SJMC), Bangalore	485	908	1.87	17	11.93
11	Nizam's Institute of Medical Sciences (NIMS), Hyderabad	400	814	2.04	16	11.83
12	Medical College & Hospital (MCH), Kolkata	485	839	1.73	19	11.32
13	University College of Medical Sciences (UCMS), Delhi	793	1032	1.3	17	11.03
14	Sree Chitra Tirunal Institute of Medical Science & Technology (SCTIMST), Thiruvanathpuram	711	960	1.35	19	10.90
15	Jawaharlal Institute of Post Graduate Medical Education & Research (JIPMER), Pondicherry	799	986	1.23	14	10.68
16	Kasturba Medical College (KMC), Manipal	836	948	1.13	15	10.24
17	Lady Harding Medical College (LHMC), New Delhi	571	742	1.3	15	9.88
18	Govt. Medical College & Hospital (GMCH), Chandigarh	690	800	1.16	15	9.75
19	Govt. Medical College (GMC), Nagpur	245	450	1.84	15	9.38
20	Sri Ramchandra Medical College & Research Institute Deemed Univ. (SRMCRI), Chennai	220	325	1.48	10	7.83
21	Pandit Bhagwat Dayal Sharma Postgraduate Institute of Medical Sciences (PBDSPGIMS), Rohtak	635	532	0.84	13	7.64
22	Amrita Institute of Medical Sciences (AIMS), Kochi	354	377	1.06	11	7.38
23	Indira Gandhi Medical College (IGMC), Shimla	244	292	1.2	10	7.04
24	BYL Nair Charitable Hospital & T.N. Medical College (TNMC), Mumbai	411	328	0.8	12	6.40
25	SMS Medical College (SMSMC), Jaipur	298	276	0.93	11	6.35
26	Kasturba Medical College (KMC), Mangalore	534	350	0.66	9	6.12
27	Govt. Medical College (GMC), Mysore	215	218	1.01	11	6.05
28	Grant Medical College (GRMC), Mumbai	236	223	0.94	9	5.95
29	M.S.Ramaiah Medical College (MSRMC), Bangalore	155	155	1	8	5.37
30	Armed Forces Medical College (AFMC), Pune	595	284	0.48	9	5.14
	Total	27937	49721	1.8	16.87	44.56
	Country Output in Medicine	65436				
	Share of 30 Medical Colleges in Country Output in Medicine	42.69%				

performers remains largely the same except for the appearance of Maulana Azad Medical College (MAMC), Delhi at the seventh position.

Table 3 summarises the top 5 performers in other areas like Biochemistry, Genetics & Molecular Biology; Pharmacology, Toxicology & Pharmaceutics; Immunology & Microbiology; Neurology; and Public Health (Supplementary data is available with the authors).

The top 30 medical research institutions account for

Table 3—Performance of the top 5 Medical Colleges in various areas of medical specialisations in India during 1999-2008

Subject	Institution	*P*	*C*	*C/P*	*h*	*p*
Biochemistry, Genetics & Molecular Biology	All India Institute of Medical Sciences (AIIMS), New Delhi	1218	4604	3.78	32	25.91
	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	301	1051	3.49	19	15.42
	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	562	1420	2.53	19	15.31
	National Institute of Mental Health & Neurosciences (NIMHANS), Bangalore	163	697	4.28	21	14.40
	Kasturba Medical College (KMC), Manipal	194	620	3.2	19	12.56
Pharmacology, Toxicology & Pharmaceutics	All India Institute of Medical Sciences (AIIMS), New Delhi	510	1523	2.99	25	16.57
	Kasturba Medical College (KMC), Manipal	160	573	3.58	14	12.71
	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	281	701	2.49	18	12.05
	Banaras Hindu Univ. Institute of Medical Science (BHU-IMS), Varanasi	130	329	2.53	17	9.41
	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	49	190	3.88	10	9.03
Immunology & Microbiology	Christian Medical College Hospital (CMCH), Vellore	192	1001	5.21	20	17.35
	Banaras Hindu Univ. Institute of Medical Science (BHU-IMS), Varanasi	106	664	6.26	16	16.08
	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	319	1127	3.53	21	15.85
	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	168	766	4.56	17	15.17
	All India Institute of Medical Sciences (AIIMS), New Delhi	468	1256	2.68	25	14.99
Neurology	National Institute of Mental Health & Neurosciences (NIMHANS), Bangalore	400	1526	3.82	24	18.00
	All India Institute of Medical Sciences (AIIMS), New Delhi	500	1252	2.5	21	14.64
	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	191	575	3.01	17	12.01
	Sree Chitra Tirunal Institute of Medical Science & Technology (SCTIMST), Thirvananthapuram	157	417	2.66	14	10.35
	Christian Medical College Hospital (CMCH), Vellore	172	397	2.31	13	9.71
Public Health	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	88	341	3.88	12	10.97
	King George Medical College (KGMC), Lucknow	28	164	5.86	11	9.87
	All India Institute of Medical Sciences (AIIMS), New Delhi	198	358	1.81	14	8.65
	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	85	186	2.19	10	7.41
	Kasturba Medical College (KMC), Manipal	37	105	2.84	8	6.68

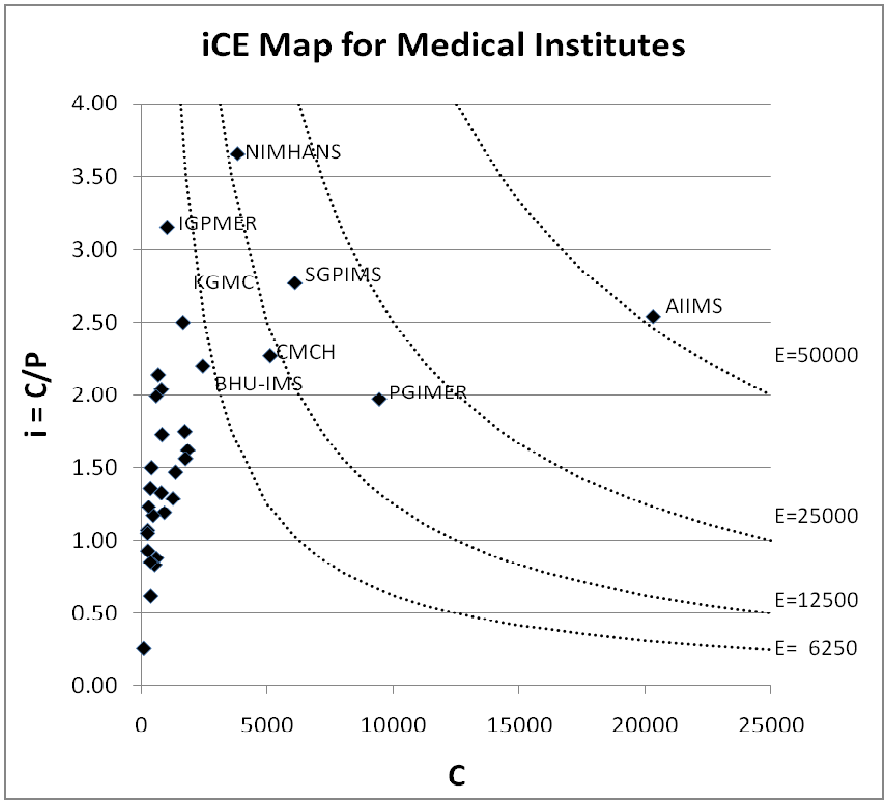

Fig. 1—The impact-Citations-Energy (iCE) representation of performance in medical research of the top 30 medical colleges in the country during 1999-2008

nearly 10 percent of the total cumulative research output from India during 1999-2008. The analysis above, as reflected in the Tables and Figure give a glimpse of the relative performance overall and also specialization-wise. A few leading institutions like the All India Institute of Medical Sciences (AIIMS), New Delhi, the Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh, the Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow, the National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, and the Christian Medical College Hospital (CMCH), Vellore, play dominating roles. A few states account for a significant portion of the top 30, namely, Karnataka, Delhi and Maharashtra.

Conclusion

In this paper, a more rational procedure has been used for ranking the research performance of Indian medical colleges in the country. The research output data is collected from the SCOPUS database and a new composite performance indicator, the *p*-index, is used to measure performance. The approach also permits the presentation of results on a two-dimensional quality-quantity map. The overall ranking of top 30 colleges give an indicative, if not nearly comprehensive, assessment of how the medical higher education is performing as generators of new knowledge. The top 30 performers in the area of Medicine and the top 5 performers in other important areas of medical specialisations are also identified.

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