INDIAN SOCIETY FOR MEDICAL STATISTICS

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To,

Dr Harsh Vardhan
Hon'ble Minister of Health & Family Welfare
(Government of India),
Room no. 348, A - Wing, Nirman Bhawan, New Delhi -110 001

Dated: 26 October 2019

Subject: Recommendations of the Society's 'High Level Committee for Advancement of the Biostatistics Speciality' for enhancing research output and its quality in AIIMS like Institutes of the country – Request for your kind consideration.

Sir

As you know, Government of India, in past recent years, have established 10 AIIMS like Institutes in the country and around 12 such Institutes are in various phases of establishment. These Institutes are expected to serve as nucleus for nurturing excellence in health care, such as - teaching, research & clinical care. A medical specialist's training would be incomplete today without a reasonable acquaintance of biostatistics & research methods to enable him to plan his research studies with scientifically valid designs to arrive at meaningful conclusions. This important aspect of biostatistics' training did not get its due place in medical education of the country. This can be realized by the fact that, other than the AIIMS, New Delhi, and PGIMER, Chandigarh, none of the new AIIMSs – some of them even after several years of establishment and mostly with PG courses, have competent biostatistics faculty to teach research methods and guide PG students in their theses work. By the result, their research output & its quality is not up to the mark.

To look into reasons for poor research output and unsatisfactory research-quality in different AIIMS like Institutes, the ***Indian Society for Medical Statistics (ISMS)*** – the only professional Society of its kind in biostatistics in whole of SEA, had constituted last year, a high level 9 - Member Committee, consisting of top biostatistics' faculty of the country, with Dr B L Verma – its Founder & Former President, as its Chairperson. This 9 – Member Committee, after having frequent & prolonged conversations on the subject for about a year, have now come-out with some Specific Recommendations (attached herewith) to improve-upon the current scenario of medical search in AIIMS like Institutes of the country. On behalf of ***ISMS***, I request you to kindly consider our Society's Recommendations & take necessary action in the matter as regards their implementation
Thanking you and with kind regards

Encl.: Committee Recommendations

Yours Faithfully

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Indian Society for Medical Statistics

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Recommendations of the
High Level Committee for Advancement of the Biostatistics Speciality for Enhancing Research Output and Its Quality in AIIMS like Institutes of the Country

1. Background

Medical education and training in India, for past several years, has been in great debate – mostly for quality of training and medical manpower deficit. Medical Council of India (MCI), the regulatory authority for medical education & training, could not reach to the expectations of the country. As a result, this body was dissolved and National Medical Commission (NMC) has recently been established with a great hope and expectations. In a very short span of time, some visible reforms have been made by the NMC to streamline the medical education in the country. It is generally believed that biostatistics improves medical research; research improves medical teaching and teaching improves patient care, which is the ultimate goal of the medical education. Generally, resource input is prioritised for i) patient care and ii) teaching but, infrastructure for research & biostatistics are neglected and often run on extramural resources.

In fact, most of medical schools of the country – both in public as well as private sector, have no research environment and as a consequence, the globally known medical journal - Lancet[1] and the Supreme Court of India[1] , during May 2016, have adversely remarked on poor research output from Indian Medical Schools. In 2016, a Delhi Team of Doctors[2], based on 10 years analysis of publications from the country, brought-forth alarming results. They illustrated that the research output of Indian medical Institutes has been poor, with 57% of them, not having even a single publication included in the Scopus database between 2005 and 2014, and only 25 (4.3%) Institutes (out of 579 that are affiliated to the MCI and NBE) producing around only 100 papers a year.

There is a great deficit of medical and paramedical manpower in the country. To overcome this deficit, AIIMS like Institutes and other medical schools are being created by the Government of India, State Government and the private organizations. The annual intake of undergraduate medical students has now gone up to around 35,000. This has generated more demand for PG and super- speciality seats in the country. Availability of trained faculty to cater such a large base of students and to impart a quality education seems to be a big challenge to NMC and medical academia.

2. Biostatistics Resources and Training Needs of Medical Students

I) At the Undergraduate Level:

The Undergraduate Medical Education - leading to MBBS degree broadly requires training in *twenty subjects,* spread over nine semesters, which are further divided into 3 categories: Pre-clinical (1-2 Semesters), Para-clinical (3-5 Semesters) and Clinical (6-9 Semesters). Biostatistics Speciality (or research methodology) is introduced under the discipline - Community Medicine to a very limited extent. There is no need-based teaching of the subject and also, no any University level examination of the students. Not only this, the Biostatistics Speciality does not get proper attention of students during these semesters due their focus mainly on clinical training. Also, there is no pressure of passing an examination in the subject. Most importantly, there is poor infrastructure of biostatistics in AIIMS like Institutes (new AIIMSs) as well as in other medical schools of the country (e.g., lack of proper faculty, computer laboratory, data analysis tools and good books on Biostatistics etc).

ii) At the Postgraduate Level:

The Postgraduate Medical Education is imparted as per MCI regulations (Amended updated May 2018). Accordingly, Post Graduate training requires that a student should be able to:

a) demonstrate competence in basic concepts of research methodology and epidemiology, and be able to critically analyse relevant published research literature;
b) function as an effective leader of a health team, engaged in health care, research or training; and

c) acquires Thesis skills as well as

d) training in research methodology.

However, there are no laid down norms for teaching & training of Biostatistics. Requisite infrastructure of Biostatistics (like senior faculty positions, new useful books & journals, useful statistical software, computers & internet and healthy learning environment etc) at the medical schools, like the new AIIMSs, to achieve above objectives, is also not there..

3. Establishment of AIIMS like Institutes in the Country

The Government of India, after the establishment of the All India Institute of Medical Sciences (AIIMS), New Delhi in 1956, has established 10 AIIMS like Institutes in the country so far and to the best of our knowledge, 12 more such institutes have been approved by the Government and are in various phases of their establishments. Each of these Institutes is expected to serve as nucleus for nurturing excellence in all aspects of health care.

The mandate for all these centres is that of the main AIIMS, New Delhi and includes establishing standards for patient-care, teaching and research. These Institutes are also expected to bring together, at one place, educational facilities of the highest order for the training of personnel in all branches of medicine, public health, clinical and epidemiological research to address the myriad health problems that differ from place to place in a vast country like ours.

In this connection, it will not be out of place to reiterate that a medical specialist's training would be considered incomplete today without a reasonable acquaintance with the potentialities of applications of bio-statistical techniques to enable him / her to plan research studies with scientifically valid designs and apply appropriate biostatistical methods to arrive at valid and meaningful conclusions. However, unfortunately, this important aspect of biostatistics training has not got its due place in the medical training in the country. This can be realized by the fact that other than the main AIIMS at New Delhi, none of the AIIMS like Institutes in the country - some of them even years after their establishment and also with PG Courses in Medicine, has competent

biostatistics faculty to teach research methods properly and collaborate and assist the working faculty in their research projects and guide Post Graduate students in their thesis works.

4. Current Status of Biostatistical Faculty Positions, Resources & Facilities in the AIIMS like Institutes.

It appears, like medical colleges of the country, proper attention has not been given to *Biostatistics Speciality* in the AIIMS like Institutes also. Since very beginning, there has been only one junior level faculty position in the speciality in these Institutes, viz. *Assistant Professor of Biostatistics*, that too, in the Department of Community & Family Medicine. The person appointed on this position, plays only a very limited role in teaching of the subject to the medical students, training to the young faculty of the Institute and in collaborative medical research. He / She takes only limited number of classes of the subject (lectures as well as practicals) to the undergraduate batches during their stay in the Institutes. This teacher has no role to play in the University examinations of MBBS, PG or Super Speciality Courses. There is almost no formal teaching of biostatistics for PG and Super Speciality Courses' students. Also, there is hardly proper involvement of biostatistics faculty in PG & Ph D Theses work. Further, neither the young medical faculty of these Institutes is trained in biostatistics nor the continuing medical faculty is re-oriented in research methods and advanced data – analysis techniques.

Thus, *Biostatistics Speciality* has no independent status in these Institutes. Its faculty / staffing position as well as infrastructure are poor. So, any bio-statistical consultation or data – analysis help, if required by a medical faculty or postgraduate student of the Departments, other than the Department of Community & Family Medicine, is often not available. This is, in spite of the fact that all over the world, major scientific medical and research journals have made it mandatory for statistical peer reviewing of the papers, to be published scientific research journals.

In an era when advanced scientific research in all areas is galloping with advances in physics and electronics to help the needy to reduce sufferings, lack of much required training in research and biostatistical methods is wanting, even though India is a birth place of several wizards of statistics

who have established their credentials world over. Here it may not be out of place to indicate that one of the reasons for this seems to be the availability of free statistical software which is made use of, without even the basic knowledge of statistical principles - similar to a sufferer, buying drugs across counter from a pharmacy shop without knowing the pharmacopeia. Added to this, is mushrooming of so called scientific journals, ready to publish anything and everything without any established peer reviewing. In an age of artificial intelligence, medical imaging, use of molecular medicine, robotic surgery, and consultation across continents over satellites, it is imperative that our youngsters too are well-trained. Also, by using these advanced techniques, the prognosis of patients could become faster and cost effective. Appropriate biostatistical models can be built for future use and planning.

Some Super Speciality Institutions Have Come-up with Better Biostatistical Man Power & Facilities: There are a few super-speciality Institutes where a separate independent Department of Biostatistics exist. These Departments are imparting need based training to medical students and participating in collaborative research. Some of these Departments are offering courses for biostatisticians also. For example, SGPGIMS, Lucknow (UP), has been the first Institute to propose a 3 years DM / M Ch Program with a compulsory paper on Biostatistics to all MD/DM and M Ch students since 1990. Subsequently, duration of all DM / M Ch Programs in the country was increased to 3 years by MCI and very recently, a Course on Research Methodology has been made compulsory to all PG students. Perhaps due to lack of infrastructure to impart on-site training of biostatistics, a distance learning approach has been recommended[3]. This is, for time being, a welcome step taken by NMC and may improve the learning of research methodology, but on-site support to research and collaboration is still lacking. An article, entitled *Landscaping Biostatistics Education in India*[4] describes the status of training and education of biostatistics in the country. As per this article, there are about 19 institutions including Medical schools, Universities, Public Health Schools, and Research organizations, where some form of training in biostatistics is being imparted. The medical institutions mostly depend on statisticians

trained outside the medical environment (universities) and lack exposure and understanding of requirements. Further there is great deficit of trained Biostatisticians.

To put an end to all this, and enhance the quality of medical scientists and scientific output, it is mandatory that all the newly established and to be established AIIMS like Institutes have well trained personnel in research methods, biostatistics as well as in epidemiological methods. This will enable the young medical trainees to get a firm grounding and use appropriate tools and techniques in their research and publish their work in reputed scientific journals. Thus, it is necessary to have a separate independent *Department of Biostatistics* in each of the AIIMS like Institutes, almost on the pattern of our parent AIIMS, New Delhi.

5. What is the Way Forward?

We, in *ISMS*, strongly believe that quality of medical education and research can be significantly enhanced by improving the present setup of biostatistics in the AIIMS like Institutes. This could be achieved by taking action in two steps, as given below.

Step-I: In all AIIMS like Institutes, where MD / DM / M Ch Programs are running with one or more faculty in biostatistics, a separate independent *Department of Biostatistics* is created on the lines of AIIMS, New Delhi. To begin with, it may be started by pooling all the resources of biostatistics in the Institute, with minimum faculty positions and by providing it necessary additional facilities. It should then slowly be upgraded to a full-fledged Department by creating additional faculty positions, support staff & facilities during a fixed period of, say 5 years. These Departments may be given clear mandate and responsibility on the lines of **Step-II**, given below.

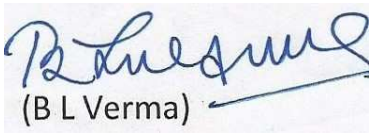
Step-II: Establish the network of Institutions in the country where a separate Department of Biostatistics exists. These Departments may be given mandate to impart teaching of biostatistics in own institution, produce biostatistics manpower and conduct research in own & other collaborative areas of medical and health Sciences. These Departments should help researchers in designing and execution of research projects, provide data analysis-support to the faculty and PG & super speciality courses students and take lead to manage patient care data, using electronic medical record (EMR/HIS). This network may be

used for teaching & training of biostatistics / research methodology to the biostatistics faculty of AIIMS like Institutes, who, in turn, should teach & train faculty of their own Institute on regular basis. Further, if a MSc / PhD program in biostatistics is being conducted in the established Departments, NMC may review these programs, bring uniformity in the nomenclature of the degree, course contents, duration, admission process, exit examination, number of seats and infrastructure required etc and ensure that all such Departments work , in tandem, to produce quality manpower in biostatistics. The efforts should be made to generate manpower in biostatistics speciality at a faster rate in the country by opening new centres of M Sc & Ph D courses in Biostatistics and increasing the number of seats of such courses in the existing ones.

National Medical Commission my constitute an Expert Group, preferably in consultation with the *Indian Society for Medical Statistics (ISMS),* for further deliberation on these issues and to make detailed recommendations on scope, manpower, space, equipments, academic programs etc. for the speciality of biostatistics.

Annexures:

1. World Report on 'Poor Research Output from India's Medical Schools', published in the Lancet, 2016.
2. Article by Delhi Team of Doctors on 'Research Output from Indian Research Institutions', 2016.
3. Recent MCI Notification for Research Methodology Course, 2019
4. Article, entitled: Landscaping Biostatistics Education in India, published in Indian Journal of Public Health, 2012.



Committee - Chair
On behalf of the High Level Committee for Advancement of Biostatistics Speciality,
Constituted by the Indian Society for Medical Statistics

Place: Jhansi (UP) Dated: 25 October 2019

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Poor research output from India's medical schools

India's medical schools have been criticised for their neglect of research after a study showed that the country's colleges produce few publications. Dinesh C Sharma reports from New Delhi.

Medical training in India continues to attract criticism. After the recent report of the Parliamentary Standing Committee on Health, which called for the Medical Council of India (MCI) to be scrapped, the country's Supreme Court has described the state of medical colleges as "rotten".

In a judgment delivered on May 6, in a case relating to private medical college Kalinga Institute of Medical Sciences admitting more students than approved, the court warned that unless the government took corrective steps, the health of the people could suffer because of inadequately educated doctors. Now an important dimension has been added to the ongoing public discourse. A new study found that 332 of 579 (57%) medical colleges did not publish a single research paper between 2005 and 2014. Experts feel such neglect of research in medical colleges has serious implications for the health challenges of the country.

The absence of a focus on research in medical schools and weak infrastructure are among the reasons for the low research output. In large teaching hospitals, huge patient burden leaves little time for faculty to undertake research. Additionally, many private medical colleges do not even have the minimum number of teaching staff recommended by the MCI. "Research is not prioritised in our medical colleges and most faculty members have no prior exposure to research methods", Soumya Swaminathan, secretary of the government's Department of Health Research (DHR), told *The Lancet*.

"Teaching about research methodology in undergraduate and postgraduate courses is given very low priority. Those pursuing postgraduate degrees do some…research because it is mandatory to obtain the degree, but it is inconsequential. And for getting a job in the private sector, a research publication on a CV is of no relevance", pointed out Anoop Misra, chairman of the Fortis-C-DOC Centre of Excellence for Diabetes, Metabolic Diseases and Endocrinology, New Delhi.

> "'…Unless we invest in and strengthen biomedical research capacity now, it is unlikely that we will see the kind of improvements in health outcomes we would like to see in the next 20–30 years'…"

Research output can be measured through available databases and can serve as a proxy for the quality of medical training, Samiran Nundy of Sir Ganga Ram Hospital, New Delhi, who led the recent study, told *The Lancet*. Affiliation searches done in the Scopus database showed that 4% of the 572 medical colleges contributed 40% of total research output but their output was still low in comparison with the research output of medical colleges in the west. "States with the largest number of private medical colleges fared the worst, with the lowest research output from their medical institutions", Nundy added.

Research funding agencies have neglected medical colleges in the past. Only in 2014 did DHR begin supporting the establishment of Multi-disciplinary Research Units in government-run medical colleges. These units are designed to provide infrastructure, human resources, and some funding for research on local priorities. About 50 such units have been approved but just a handful of them are fully functional. The process of setting them up is bureaucratic, beginning with DHR signing an agreement with the state government concerned.

"Funding of medical research in India is terrible. The few funding agencies that do exist are short on funds. Disbursal of funds, even for approved projects, takes more than a year. Researchers are often not paid for considerable periods of time", explained Misra. The Indian Council of Medical Research, he suggests, should support long-term cohort studies that address specific research problems through consortia of good quality researchers instead of giving small grants for projects of a futile nature to researchers with limited capability to do research.

By neglecting biomedical research, India is missing out on the important role it can play in shaping global policies in the health sector. "The value of health research and what it can bring to health policy and practice is underappreciated. Unless we invest in and strengthen biomedical research capacity now, it is unlikely that we will see the kind of improvements in health outcomes we would like to see in the next 20–30 years", said Swaminathan.

Investigating problems relevant to the Indian situation can throw up new solutions. "We need research which is scientifically and socially relevant to us in order to improve the abysmal standard of health care. Indians suffer from diseases that are different from those seen in the west, they present to doctors when the disease is at an advanced stage, and 70% of them go to private facilities, which are expensive and cannot always be trusted", added Nundy.

Dinesh C Sharma

Mark Clarke/Science Photo Library

For the **study** see *Curr Med Res Pract* 2016; **6:** 49–58

The research output from Indian medical institutions between 2005 and 2014

Samrat Ray, Ishan Shah, and Samiran Nundy

Abstract

Background

The research output from Indian medical institutions is generally regarded to be poor but there have been no previous studies to document this especially after the recent proliferation of 263 medical colleges, mainly in the private sector and under the aegis of the National Board of Examinations, as well as the 316, mainly public sector, colleges under the Medical Council of India.

Methods

Using the SCOPUS database we analyzed the research output from 579 Indian medical institutions and hospitals between 2005 and 2014, including the contributions of individual states and compared the output of Indian medical institutions with some of the leading academic centers in the world.

Results

Only 25 (4.3%) of the institutions produced more than 100 papers a year but their contribution was 40.3% of the country's total research output. 332 (57.3%) of the medical colleges did not have a single publication during this period. The states which had the largest number of private medical colleges fared the worst with more than 90% of the medical colleges in Karnataka and Kerala having no publication at all. In comparison, the annual research output of the Massachusetts General Hospital was 4600 and the Mayo Clinic 3700.

Conclusion

The overall research output from Indian medical institutions is poor. This may be because medical education has now become a business and there is little interest in research which is not thought to be a profitable activity. We believe that a drastic overhaul of Indian medical education is necessary similar to that initiated by Flexner in the USA in the beginning of the last century.

Keywords

SCOPUS; Research output; Indian medical institutions; MCI

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1. Background

Assuring a minimal level of healthcare to the expanding population of India has become a major issue over the last decade. Although there has been an overall improvement of medical resources and healthcare since independence, the distribution of these has been very uneven, with the rich having access to a burgeoning and unregulated private sector dominated by the corporate, for-profit hospitals and the poor left to go to underfunded, overcrowded, and inefficient public institutions.[1] There is a shortage of doctors in public hospitals and in rural areas because most of them choose to join the private sector or work in the cities.[2]

In an attempt to increase the number of doctors in India, the government has enhanced the number of seats in existing medical colleges and liberally allowed the creation of new medical institutions financed both by public, but mainly private funds.[3] However, this policy has not been an unqualified success with what is generally perceived to be a fall in the standards of medical education, which has now become a business venture for many politicians and is accompanied by widespread corruption both in its entry and exit processes.[4] and [5]

The primary authority controlling medical education standards in this country is the Medical Council of India (MCI), which was first established in 1934 under the Indian Medical Council Act, 1933. Currently, there are around 316 institutions all over the country that have been recognized by the MCI.[6]

The other body that controls postgraduate medical education, mainly in the private sector, is the National Board of Examinations (NBE). This was set up in 1975 when the General Medical Council in the United Kingdom derecognized Indian medical qualifications because of their varying standards.[7] Mrs. Indira Gandhi, the then Prime Minister, in retaliation, derecognized British qualifications and set up the NBE, an autonomous body under the Ministry of Health, to regulate and oversee postgraduate medical education and the examinations in India in institutions that were outside the ambit of the MCI, as well as to assess foreign qualifications.[8] The NBE now conducts the largest portfolio of examinations in medicine in India, and during 2014, it held them for 150,000 medical graduates and specialists. Currently, there are more than 250 hospitals and institutions all over the country that have been accredited by the NBE for conducting postgraduate and superspecialty courses in this country.[9]

However, it is now generally perceived that the quality of training being imparted by the majority of both MCI and NBE affiliated institutions has deteriorated alarmingly as there has yet been no systematic assessment of their products in terms of their clinical and academic competence or research output.[10], [11] and [12]

It would be difficult to evaluate fairly and objectively clinical competence or teaching, but research output is easy to measure through the available databases and is used by many well-known publications, such as the popular QS World University Rankings. It incorporates indices like the academic peer review, faculty/student ratio, and citations per faculty as tools of assessment of research output.[13], [14] and [15] There are others, such as the US News and World Report, the Shanghai, and the Times Higher Education Ranking Systems that have also been widely used for the same purpose.[16] and [17]

We decided to evaluate the research output of all the MCI and NBE institutions in India using Scopus, the largest database of peer-reviewed literature in existence. It contains around 53 million records, 70% with abstracts, 4.9 million conference proceedings, and 1200 open access journals. It has a 100% Medline coverage, with 20+ million records back to 1996.[18], [19], [20], [21] and [22]

Using Scopus we carried out the following:

- Analyzed the total research output of all medical colleges and hospitals recognized by the MCI and NBE during 2005–2014.
- Assessed the output from individual states of India.
- Compared the research output of India's top medical institutions with some of the well-known ones abroad.

2. Methods

We counted the total number of documents (including original articles, reviews, case reports, and reports of conferences and symposia) published by an individual institute over a period of 10 years (2005–2014). For those established after 2005, we evaluated the number of publications from the year of establishment to 2014. The MCI and NBE institutes were listed in separate league tables.[23]

We ranked them as follows:

Compiled a list of top 25 institutes under the MCI (Fig. 1) and the NBE (Fig. 2) from different states of India.

<img class="figure large" border="0" alt="Distribution of number of publications by Medical Council of India (MCI) ..." src="http://origin-ars.els-cdn.com/content/image/1-s2.0-S235208171630037X-gr1.jpg" data-thumbEID="1-s2.0-S235208171630037X-gr1.sml" data-imgEIDs="1-s2.0-S235208171630037X-gr1.jpg" data-fullEID="1-s2.0-S235208171630037X-gr1.jpg">
Fig. 1.

Distribution of number of publications by Medical Council of India (MCI) recognized institutions (*N* = 101,034). For full form of institutions refer to Appendix 1. Legends indicate the %age of total number of publications.

Figure options

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<img class="figure large" border="0" alt="Distribution of number of publications by National Board of Examinations (NBE) ..." src="http://origin-ars.els-cdn.com/content/image/1-s2.0-S235208171630037X-gr2.jpg" data-thumbEID="1-s2.0-S235208171630037X-gr2.sml" data-imgEIDs="1-s2.0-S235208171630037X-gr2.jpg" data-fullEID="1-s2.0-S235208171630037X-gr2.jpg">
Fig. 2.

Distribution of number of publications by National Board of Examinations (NBE) recognized institutions (*N* = 101,034). For full form of institutions refer to Appendix 1. Legends indicate the %age of total number of publications.

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Listed MCI and NBE institutes according to their State location, as well as their research publications (Table 1 and Table 2).

Table 1.

State wise distribution of publications and highest ranking institutes in each state in MCI recognized institutions.

State	Total institutes (MCI)	Total publications 2005–2014	Total number of zero publication institutes, *n* (% of total)	Publications per institute	Highest ranking institute among the state	No. of publications by highest ranking institute, *n* (% of total)
Andhra Pradesh	36	2038	24 (66.7)	56.61	Nizam Institute of Medical Sciences Hyderabad	939 (46.1)
Assam	3	343	0 (0)	114.33	Guwahati Medical College, Guwahati	175 (51)

State	Total institutes (MCI)	Total publications 2005–2014	Total number of zero publication institutes, *n* (% of total)	Publications per institute	Highest ranking institute among the state	No. of publications by highest ranking institute, *n* (% of total)
Bihar	10	216	7 (70)	21.60	Rajendra Memorial Research Institute of Medical Sciences, Patna	169 (78.2)
Chandigarh	2	9354	0 (0)	4677.00	Postgraduate Institute of Medical Education and Research, Chandigarh	8145 (87.1)
Chhattisgarh	3	96	0 (0)	32.00	Pandit Jawaharlal Nehru Memorial Medical College, Raipur	96 (100)
New Delhi	11	20,113	0 (0)	1828.45	All India Institute of Medical Sciences	11,377 (56.6)
Goa	1	243	0 (0)	243.00	Goa Medical College, Panjim	243 (100)
Gujarat	16	963	7 (43.7)	60.19	Government Medical College, Surat	205 (21.3)
Haryana	3	1417	1 (33.3)	472.33	Postgraduate Institute of Medical Sciences, Rohtak	1283 (90.5)
Himachal Pradesh	2	743	1 (50)	371.50	Indira Gandhi Medical College, Shimla	743 (100)
Jammu & Kashmir	4	1749	1 (25)	437.25	Government Medical College, Srinagar	705 (40.3)
Jharkhand	3	50	2 (66.7)	16.67	Rajendra Medical College, Ranchi	50 (100)
Karnataka	41	11,585	17 (41.5)	282.56	Kasturba Medical College, Manipal	2583 (22.3)
Kerala	23	2454	17 (73.9)	106.70	Sree Chitra Thirunal Institute of Medical Sciences and Technology, Trivandrum	1251 (50.9)
Madhya Pradesh	11	736	6 (54.5)	66.91	Gajara Raja Medical College, Gwalior	208 (28.3)
Maharashtra	43	9035	25 (58.1)	210.12	Tata Memorial Hospital, Mumbai	2506 (27.8)
Manipur	1	626	0 (0)	626.00	Regional Institute	626 (100)

State	Total institutes (MCI)	Total publications 2005–2014	Total number of zero publication institutes, *n* (% of total)	Publications per institute	Highest ranking institute among the state	No. of publications by highest ranking institute, *n* (% of total)
					of Medical Sciences, Imphal	
Meghalaya	1	114	0 (0)	114.00	North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong (2006–2014)	114 (100)
Orissa	6	586	2 (33.3)	97.67	Sriram Chandra Bhanj Medical College, Cuttack	195 (33.3)
Pondicherry	8	2303	5 (62.5)	287.88	Jawaharlal Nehru Institute of Postgraduate Medical Education and Research, Pondicherry	1901 (82.5)
Punjab	8	1758	1 (12.5)	219.75	Dayanand Medical College, Ludhiana	566 (32.2)
Rajasthan	10	1509	4 (40)	150.90	Sawai Maan Singh Medical College, Jaipur	678 (44.9)
Sikkim	1	0	1 (100)	0.00	–	0 (0)
Tamil Nadu	33	5851	24 (72.7)	177.30	Christian Medical College, Vellore	3742 (63.9)
Tripura	2	47	1 (50)	23.50	Agartala Government Medical College, Tripura (2006–2014)	47 (100)
Uttar Pradesh	21	10,845	9 (42.9)	516.43	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	3499 (32.3)
Uttaranchal	5	400	4 (80)	80.00	Himalaya Institute of Medical Sciences, Dehradun	400 (100)
West Bengal	10	4654	3 (30)	465.40	Medical College, Calcutta	1462 (31.4)

Table 2.

State wise distribution of publications and highest ranking institutes in each state in NBE recognized institutions.

State	Total institutes (NBE)	Total publications 2005–2014	Total number of zero publication institutes, *n* (% of total)	Publications per institute	Highest ranking institute among the state	No. of publications by highest ranking institute, *n* (% of total)
Andhra Pradesh	24	1732	16 (66.7)	72.16	LV Prasad Eye Institute	1202 (69.4)
Assam	2	4	1 (50)	2	Down Town Hospital, Guwahati (2004–2006)	4 (100)
Bihar	2	1	1 (50)	0.5	Mahavir Cancer Sansthan, Patna (2012–2014)	1 (100)
Chhattisgarh	3	43	2 (66.7)	14.33	Jawahar Lal Nehru Main Hospital and Research Centre, Bhilai	43 (100)
New Delhi	28	3045	14 (50)	108.75	Sir Ganga Ram Hospital	1067 (35)
Gujarat	9	183	7 (77.8)	20.33	Muljhibhai Patel Urological Hospital, Nadiad	180 (98.3)
Haryana	5	32	4 (80)	6.4	Artemis Health Institute, Gurgaon (2008–2014)	32 (100)
Jharkhand	2	0	2 (100)	0	–	–
Karnataka	29	467	27 (93.1)	16.1	Manipal Hospital, Bangalore	292 (62.5)
Kerala	26	65	24 (92.3)	2.5	Malabar Institute of Medical Sciences, Kozhikode	56 (86.1)
Madhya Pradesh	7	160	5 (71.4)	22.85	Jawahar Lal Nehru Cancer Hospital & Research Centre, Bhopal	86 (53.7)
Maharashtra	47	2549	35 (74.8)	54.23	PD Hinduja National Hospital and Medical Research Centre, Mumbai	677 (26.5)
Manipur	1	0	0 (0)	0	–	–
Mizoram	1	4	0	4	Civil Hospital, Aizawl (2005–2011)	4 (100)

State	Total institutes (NBE)	Total publications 2005–2014	Total number of zero publication institutes, *n* (% of total)	Publications per institute	Highest ranking institute among the state	No. of publications by highest ranking institute, *n* (% of total)
Nagaland	1	0	0 (0)	0	–	–
Odisha	4	80	2 (50)	20	Ispat General Hospital, Rourkela	75 (93.7)
Pondicherry	1	0	0 (0)	0	–	–
Punjab	5	0	0 (0)	0	–	–
Rajasthan	7	0	0 (0)	0	–	–
Sikkim	1	0	0 (0)	0	–	–
Tamil Nadu	36	1217	27 (75)	33.8	Aravind Eye Hospital, Madurai	473 (38.8)
Uttar Pradesh	6	5	5 (83.3)	0.83	Metro Heart Inst, Noida (2005–2011)	5 (100)
West Bengal	13	325	10 (76.92)	13	Vivekananda Institute of Medical Sciences, Kolkata	197 (66.6)

Compiled a cumulative list of the top 25 medical institutions (MCI + NBE) in descending order of the number of publications (Table 3).

Table 3.

Distribution of national and global institutions as per the number of publications during 2005–2014.

Institute	State/country	Publications 2005–2014
National		
All India Institute Medical Sciences	New Delhi	11,377
Postgraduate Institute of Medical Education and Research	Chandigarh	8145
Christian Medical College, Vellore	Tamil Nadu	3742
Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	Uttar Pradesh	3499
King George Medical College, Lucknow	Uttar Pradesh	2878
Kasturba Medical College, Manipal	Karnataka	2583
Tata Memorial Hospital, Mumbai	Maharashtra	2506
National Institute of Mental Health and Neurosciences, Bangalore	Karnataka	2418
Institute of Medical Sciences (Banaras Hindu University), Varanasi	Uttar Pradesh	2140

Institute	State/country	Publications 2005–2014
Maulana Azad Medical College	New Delhi	1968
Jawaharlal Nehru Institute of Postgraduate Medical Education and research, Pondicherry	Pondicherry	1901
Seth Gordhandas Sunderdas Medical College and King Edward Memorial Hospital, Mumbai	Maharashtra	1858
Kasturba Medical College, Mangalore	Karnataka	1719
University College of Medical Sciences	New Delhi	1701
Medical College, Calcutta	West Bengal	1462
Jawahar Lal Nehru Medical College, Aligarh	Uttar Pradesh	1359
Vardhaman Mahavir Medical College and Safdarjung Hospital	New Delhi	1313
Postgraduate Institute of Medical Sciences, Rohtak	Haryana	1283
Sree Chitra Thirunal Institute of Medical Sciences and Technology, Trivandrum	Kerala	1251
Government Medical College, Chandigarh	Chandigarh	1209
LV Prasad Eye Institute, Hyderabad	Andhra Pradesh	1202
Lady Hardinge Medical College	New Delhi	1166
Institute of Postgraduate Medical Education and Research, Kolkata	West Bengal	1081
Sir Ganga Ram Hospital	New Delhi	1067
Amrita Institute of Medical Sciences and Research Centre, Kochi	Kerala	1031
Global		
Massachusetts General Hospital	USA	46,311
Mayo Clinic, Rochester	USA	37,633
All India Institute of Medical Sciences, New Delhi	India	11,377
Peking Union Medical College, Beijing	China	10,102
Postgraduate Institute of Medical Education and Research, Chandigarh	India	8145
Tokyo Medical University	Japan	4856
Christian Medical College, Vellore	India	3742
Faculty of Medicine, University of Geneva	Switzerland	3600
Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	India	3499
Aga Khan University Hospital, Karachi	Pakistan	2332
Sir Ganga Ram Hospital, New Delhi	India	1067
Grant Medical College, Mumbai	India	294
Osmania Medical College, Hyderabad	India	129

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Compared the output of the top Indian institutions with some of the well-known institutes abroad over the same period (Table 3).

3. Results

There are a total of 579 medical institutes in the government and private sectors. 316 institutes were under the MCI and 263 under the NBE. Their total research output during the period 2005–2014 was 101,034 papers, with the average number of publications per institution being 14.5 papers per year.

However, there were 332 (57.3%) institutions that did not publish a single paper during this 10-year period, which included 162 (51.2%) under the MCI and 170 (64.6%) under the NBE.

Fig. 1 shows the cumulative state-wise list of top 25 medical colleges and hospitals under the MCI and their research output from 2005 to 2014. It shows that the top 10 medical institutes under the MCI, in order of their research output, are the All India Institute of Medical sciences (AIIMS) in New Delhi, the Postgraduate Institute of Medical Education and Research (PGIMER) in Chandigarh, the Christian Medical College (CMC) in Vellore, the Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS) in Lucknow, the King George Medical College (KGMC) in Lucknow, the Kasturba Medical college (KMC) in Manipal, the Tata Memorial Centre in Mumbai, the National Institute of Mental Health and Neurosciences (NIMHANS) in Bangalore, the Institute of Medical Sciences Banaras Hindu University (IMS BHU) in Varanasi, and the Maulana Azad Medical College (MAMC) in New Delhi. The total research output from these institutes from 2005 to 2014 was 41,256, constituting about 40.8% of the total cumulative research output from the 579 medical institutions.

Fig. 2 shows the top 25 medical institutes under the NBE and their research output during the same period. The top 10 institutes were the LV Prasad Eye Institute, Hyderabad; Sir Ganga Ram Hospital (SGRH), New Delhi; PD Hinduja National Hospital and Medical Research Centre, Mumbai; Indraprastha Apollo Hospital, New Delhi; Aravind Eye Hospital, Madurai; Fortis Hospital, New Delhi; Jaslok Hospital and Research Centre, Mumbai; Bombay Hospital and Institute of Medical Sciences, Mumbai; Manipal Hospital, Bangalore; and Lilavati Hospital and Research Centre, Mumbai. However, the total research output from these institutes was 5715, constituting only 5.6% of the total cumulative research output from all Indian medical institutions.

Table 1 shows the cumulative output of the individual states of India from the medical colleges under the governance of the MCI. It can be seen that the union territory of Chandigarh tops the list, with an average of 4677 publications per institute, with PGIMER being the highest publisher (n = 8145). The cumulative research output from the MCI-recognized medical colleges of all the states from 2005 to 2014 was 89,828, with an average of 284.26 publications per institute, contributing to 88.9% of the total research output of the country. The southern states of Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra, and Karnataka have 55.6% of the total number of MCI-recognized medical colleges in the country, but a large percentage of these colleges have no publications—Kerala (n = 17; 73.9%), Tamil Nadu (n = 24; 72.7%), Andhra Pradesh (n = 24; 66.6%), Maharashtra (n = 25; 58.1%,), and Karnataka (n = 17; 41.4%).

Table 2 shows the output from the individual states of India from medical institutions under the NBE. New Delhi tops the list, with an average of 108.75 publications per institute, with Sir Ganga Ram Hospital being the most prolific (n = 1067). The cumulative research output from the NBE-recognized medical institutions of all the states from 2005 to 2014 was 9912, with an average of 37.6 publications per institute, contributing to 9.8% of the total research output of the country. Just as for MCI institutions, again Karnataka, Kerala, Tamil Nadu, Maharashtra, and Andhra Pradesh contribute the majority, i.e. 61.5% of the total NBE-recognized institutions in the country (n = 162). However, again a large number of the institutes from these states are found to have no publications at all—Karnataka (n = 27; 93.1%), Kerala (n = 24; 92.3%), Tamil Nadu (n = 27; 75%), Maharashtra (n = 35; 74.4%), and Andhra Pradesh (n = 16; 66.6%).

Table 3 shows a list of the top 25 MCI and NBE medical institutions of the country in descending order of their total research output from 2005 to 2014. This has been compared with some well-known centers abroad (Table 3). Only 25 out of a total of 579 institutions have more than 1000 publications from 2005 to 2014 (4.3%). This compares with some of the well-known institutions abroad, like the Massachusetts General Hospital, Boston, USA, which had a total of 46,311 publications, and the Mayo Clinic, Rochester, USA, which had a total of 37,633 publications during 2005–2014 accounting for more than 4.07 and 3.3 times the number of publications from AIIMS, respectively.

4. Discussion

Our findings suggest that the research output of Indian medical institutes is generally poor, with 57% of them not having a single publication included in the Scopus database between 2005 and 2014, and only 25 (4.3%) institutes (out of 579 that are affiliated to the MCI and NBE) producing more than 100 papers a year. We also found that most of the southern states that have the largest number of private medical colleges produce very little in the way of research publication and finally that even our most prolific research institutions published less than a third of the number of papers than the leading centers abroad.

The reasons for this state of affairs are alleged to be the overwhelming clinical burden in most medical colleges leaving little time to devote to academic activities; but we believe it is more due to the lack of guidance and absence of role models among seniors, who themselves have published little.[24] and [25] There is also little institutional support in the way of funds and infrastructure to carry out projects, which are generally believed to be an unnecessary expenditure of time and effort.[26] and [27] However, probably more important is the lack of incentives to do research and publish, because most faculty promotions, which in other countries depend a lot on research output, are in India usually time bound, based on seniority and, unfortunately, often influenced by political and bureaucratic 'contacts'.[28] and [29] The other reasons are that the lack of guidance results in poor protocol design, and with little help from colleagues with language problems, it results in papers that answer irrelevant questions or duplicate work that has been done elsewhere.[30] and [31] Even if a paper is finally produced, the chances that it might be rejected by a Western journal, to which most are first sent, is high, because of the lack of relevance to its home readership.

Thus, most faculty and students in Indian medical institutions are discouraged from embarking on a research project, let alone writing a paper.

To stimulate research activities in its institutions, the MCI has now issued new guidelines in 2015, which require at least four research publications for the post of associate professor and eight research publications for the post of professor.[32] However, these guidelines, although well intentioned, have included publications in databases of doubtful merit, including only the first and second authors of a paper, excluding journals only published online, and distinguishing Indian and international journals.[33] It has also drawn opposition from some of the editors of leading Indian medical journals.[34]

The heavy clinical load is sometimes proffered as an excuse for the lack of research papers by many who say that their patient care is of the highest quality so that publications should not matter. This is belied by the fact that the most prolific Indian publications come from institutions that also deal with the largest numbers of patients. This is also true of many of the world's great hospitals, which along with providing a high standard of patient care are also leaders in publication. Although correlation of a hospital's research output with the quality of care has been a debatable topic and there have been studies showing a relationship of the teaching status of the hospital with the quality of patient care, very few have shown an association of patient care and research output.[16] and [35] Pons et al. did a cross-sectional analysis of secondary data of inhospital and risk-adjusted mortality for congestive heart failure and myocardial infarction between 2002 and 2004 and several bibliometric measures of publications from 1996 to 2004 in cardiovascular diseases.[36] They found a low-moderate negative correlation between the risk-adjusted mortality ratio and the weighted citations ratio for congestive heart failure and acute MI. They also found a strong correlation between the teaching status and the technological level of the hospital with inhospital mortality.

China, our neighbor, has made great strides in medical research, from being at India's level 10 years ago to now producing more research papers than most other countries.[37] On a global scale, it has emerged as the fifth leading nation in terms of its share of the world's scientific publications.[38] It invests much larger proportion of its GDP in research and development and, among other incentives, many of their medical universities, hospitals, and institutes now give monetary awards to authors with manuscripts published in journals indexed in Science Citation Index (SCI)—the higher the impact factor of the journal, the larger the bonus.[39]

4.1. What is to be done?

We believe that we need to work out our own solutions to our own health problems because they are unique and very few of our colleagues from the developed world will have experienced the difficulties of managing patients with such a different disease spectrum and advancement with such limited resources.[40] The only way to improve our healthcare we believe is to do relevant research with rigorous protocols and disseminate the results via medical journals. To do this, we must collect accurate data, evaluate the effectiveness of appropriate interventions, and set aside funds to support indigenous research projects.

We should collaborate with experienced individuals and good institutions abroad not only to help our investigations but also to train our young researchers. This can be done through organizations like the World Association of Medical Editors, as well as the major medical journals, which have an international outlook like the BMJ.

An almost identical situation existed in the USA and Canada in the beginning of the last century when there were 155 medical schools, which varied greatly in their curricula, methods of assessment, and protocols for admission.[41]

In 1910, the Carnegie Foundation asked Abraham Flexner to propose recommendations for the standardization of the medical education system all over the country.[42] Flexner spent a year in Europe, visiting mainly German medical institutions, which were then the international leaders, and published his famous report in which he issued various recommendations, among which one of the most important was to ensure scientific training of the medical graduates and engaging faculty into active medical research. The report brought about a dramatic change in the existing medical education system of the US, reduced the number of medical schools from 155 to 31, initiated a system of transparent and rigorous inspections, advocated a single exit exam, and consequently made the nation the world's medical research powerhouse a position it maintains today.

Perhaps, it is time that India commissions its own Flexner report.

5. Conclusion

We have found the overall research output from the medical institutions of India to be low, with the majority of publications from only 10 selected institutions. Nearly 60% of them had not had a single publication included in the Scopus database in the last 10 years.

The reasons are mainly a lack of interest in research and publication, as well as lack of incentives.

We believe our system needs a radical overhaul similar to what happened in the USA after the publication of the Flexner Report.

Conflicts of interest

The authors have none to declare.

Appendix 1.

Full form of institutions in alphabetical order.

Abbreviation	Institute	State
AEH, Madurai, TN	Aravind Eye Hospital, Madurai	Tamil Nadu
AIG, Hyderabad, AP	Asian Institute of Gastroenterology, Hyderabad	Andhra Pradesh
AIIMS, Delhi	AII India Institute of Medical Sciences	New Delhi
AIMSRC, Kochi	Amrita Institute of Medical Sciences and Research Centre, Kochi	Kerala
Apollo Hospital, Chennai, TN	Apollo Hospital, Chennai	Tamil Nadu
BCHT, Mumbai, Maharashtra	Breach Candy Hospital Trust, Mumbai	Maharashtra
BHIMS, Mumbai, Maharashtra	Bombay Hospital & Institute of Medical Sciences, Mumbai	Maharashtra
Care Hospital, Hyderabad, AP	Care Hospital, Hyderabad	Andhra Pradesh
CMC, Kolkata, West Bengal	Calcutta Medical College	West Bengal
CMC, Vellore, TN	Christian Medical College, Vellore	Tamil Nadu
Command Hospital, Pune, Maharashtra	Command Hospital, Pune	Maharashtra
DBNH, Mumbai, Maharashtra	Dr. B Nanavati Hospital, Mumbai	Maharashtra
Fortis Healthcare, Delhi	Fortis Healthcare	New Delhi
Ganga Hospital, Coimbatore, TN	Ganga Hospital, Coimbatore	Tamil Nadu
GB Pant Hospital, Delhi	GB Pant Hospital, New Delhi	New Delhi
GEMHIPL, Coimbatore, TN	GEM Hospital India Private Limited, Coimbatore	Tamil Nadu
GMC, Chandigarh	Government Medical College, Chandigarh	Chandigarh
IMS, BHU, Varanasi, UP	Institute of Medical Sciences, Banaras Hindu University, Varanasi	Uttar Pradesh
IP Apollo Hospital, Delhi	Indraprastha Apollo Hospital	New Delhi
IPGMER, Kolkata, West Bengal	Institute of Postgraduate Medical Education and Research, Kolkata	West Bengal
Jehangir Hospital, Pune, Maharashtra	Jehangir Hospital, Pune	Maharashtra
JHRC, Mumbai, Maharashtra	Jaslok Hospital & Research Centre, Mumbai	Maharashtra
JIPMER, Puducherry	Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry	Puducherry
JLNMC, Aligarh, UP	Jawaharlal Nehru Medical College, Aligarh	Uttar Pradesh
KGMC, Lucknow, UP	King George Medical College, Lucknow	Uttar Pradesh
KMC, Mangalore, Karnataka	Kasturba Medical College, Mangalore	Karnataka
KMC, Manipal, Karnataka	Kasturba Medical College, Manipal	Karnataka
LHMC, New Delhi	Lady Hardinge Medical College, New Delhi	New Delhi
LVHRC, Mumbai, Maharashtra	Lilavati Hospital & Research Centre, Mumbai	Maharashtra
LVP Eye Institute, Hyderabad, AP	LV Prasad Eye Institute, Hyderabad	Andhra Pradesh
MAMC, Delhi	Maulana Azad Medical College, New Delhi	New Delhi
Manipal Hospital, Bangalore,	Manipal Hospital, Bangalore	Karnataka

Abbreviation	Institute	State
Karnataka		
MPUH, Nadiad, Gujarat	Mulijhibhai Patel Urological Hospital, Nadiad	Gujarat
NIMHANS, Bangalore, Karnataka	National Institute of Mental Health and Neurosciences, Bangalore	Karnataka
PDHNH&MRC, Mumbai, Maharashtra	PD Hinduja National Hospital and Medical Research Centre, Mumbai	Maharashtra
PGIMER, Chandigarh	Postgraduate Institute for Medical Education and Research, Chandigarh	Chandigarh
PGIMS, Rohtak, Haryana	Postgraduate Institute of Medical Sciences, Rohtak	Haryana
RGCIRC, Delhi	Rajiv Gandhi Cancer Institute and Research Centre	New Delhi
Sant Parmanand Hospital, Delhi	Sant Parmanand Hospital	New Delhi
SCTIMST, Trivandrum	Sree Chitra Thirunal Institute of Medical Sciences and Technology, Trivandrum	Kerala
SGPGI, Lucknow, UP	Sanjay Gandhi Institute for Postgraduate Education and Research, Lucknow	Uttar Pradesh
SGRH, Delhi	Sir Ganga Ram Hospital	New Delhi
SGSMCKEMH, Mumbai, Maharashtra	Seth G S Medical College and King Edward Memorial Hospital, Mumbai	Maharashtra
SIKIMS, Srinagar, J&K	Sher I Kashmir Institute of Medical Sciences, Srinagar	Jammu and Kashmir
SSSIHMS, Bangalore, Karnataka	Sri Sathya Sai Institute of Higher Medical Sciences, Bangalore	Karnataka
St. Stephen's Hospital, Delhi	St. Stephen's Hospital	New Delhi
TMH, Mumbai, Maharashtra	Tata Memorial Hospital, Mumbai	Maharashtra
UCMS, Delhi	University College of Medical Sciences	New Delhi
VMMC and Safdarjung Hospital, Delhi	Vardhaman Mahavir Medical College and Safdarjung Hospital	New Delhi
VNIMS, Kolkata, WB	Vivekananda Institute of Medical Sciences, Kolkata	West Bengal

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NOTICE

ONLINE RESEARCH METHODS COURSE FOR POSTGRADUATE STUDENT AND FACULTY

To comprehend the evidence published in biomedical literature, doctors need to have understanding of research methods. Therefore, acquiring research skills is an integral component of postgraduate training in the country. To ensure that all postgraduate students and faculty acquire the necessary skills, the Board of Governors of the Medical Council of India has decided to introduce an online course in Basic Research Methods for all postgraduate students in the country, and also for the faculty training them.

(i) **The online course in Research Methods is mandatory for all postgraduate students being admitted from the AY 2019-20 onwards.**
(ii) **All PG students will have to complete the online course by the end of their 2nd semester.**
(iii) For faculty who has no prior formal training in research, it is recommended that they too complete this online course.
(iv) The online course will be conducted by the National Institute of Epidemiology (NIE) of the Indian Council of Medical Research. The students will have to register on the NIE portal.
(v) The course allows a flexible time for students/faculty to register and start the course (which would be about 8 weeks in duration with inbuilt time bound assignments and assessments). However, the course completion requires the candidate to appear for an online offsite exam which will be held at fixed times (about twice in a year).
(vi) An online certificate will be generated on successful completion of the course and examination. This document will be taken as proof of completion of the online course.
(vii) There will be no fee for the online course but students will have to pay appropriate fee for the examination (the details of the same will be available when one registers for the course)
(viii) It is expected that the portal for registering for this course for the current academic year will open by the 1st August, 2019. Details of the site, the process of registration, etc will be communicated in due course of time, both on the MCI website and by notification to the college.

9/7/19.

(Dr. R.K. V
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Landscaping Biostatistics Education in India

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Summary

Biostatistics plays an important role in measuring, understanding, and describing the overall health and well-being of a population. Biostatistics as a subject evolved from the application of statistics in various research aspects of biology, biomedical care, and public health. However, with a recent increase in number of health and pharmacy related research, the demand for trained biostatisticians is also increasing. The present paper is an attempt to undertake a situational analysis of biostatistics education in India. A systematic, predefined approach, with three parallel strategies was used to collect and assemble the data regarding training in biostatistics in India. Our study results show that there is paucity of programs providing specialized training in biostatistics in India. Only about 19 institutions in India are offering various courses in biostatistics/medical statistics/health statistics/biometry. It is important to look into the current capacity building initiatives in this domain. Some other means for giving importance to biostatistics could be by making it a separate branch/specialization in a majority of the institutions, particularly in medical colleges.

Key words: Biostatistics, Capacity building, Human resources, Public health education

Introduction

In the context of public health education, subjects, like biostatistics, which have an interdisciplinary nature, play an important role in measuring, understanding and describing the overall health and well-being of a population. Biostatistics is a subject evolved from the application of statistics; therefore, majority of the institutions, where existing courses in statistics are offered, teach biostatistics along with statistics, mostly constituting a relatively small portion of the course content. However, with a recent increase in number of health and pharmacy related research, the demand for trained biostatisticians is also increasing. Hence, there is a need to give proper and practically oriented training in biostatistics to people with relevant background. Against this background, this manuscript is an attempt to list various institutions in India that offer courses in biostatistics/medical statistics/health statistics or biometry to provide an idea about the number of people trained every year in biostatistics in India. This will in turn reveal whether these numbers are compatible with the requirements. Before analysing the current situation in India, this paper also tries to give a brief history of statistics in India and the evolution of biostatistics as a subject from statistics.

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History of Statistics in India

India has a long history of applying statistical concepts in terms of data collection and its simple analysis, which got strengthened during the British period. The origin of statistics in India dates back to the Mauryan period (321 – 296 B.C.) in the Arthasastra by Kautilya, which explained the data collection system in agriculture, population, and economic censuses in villages and towns.[1]This practice related to the original field of statistics, the measurement

of characteristics of towns or states. The practice of collecting and compiling data continued during 1590 A.D., in the period of Emperor Akbar, and during 1596-1597 A.D. in the *Ain-i-Akbari* written by Abul Fazal.[1] Apart from the population data, this document had the best compilation of data during that period with details of systems of legalized measurements, land classification, crop yields, and other information. This traditional system of data collection continues, depending on the kind of requirement; however, it gained momentum and got expanded during the British period.

The East India Company needed acquisition of counts and detailed information of their occupied territories, including area topography information, characteristics and conditions of inhabitants (including religion and customs), and assessment of natural products of the countries like fisheries, mines, agricultural yields and many more - mainly for the purpose of taxation and revenue generation. This compilation of information started in 1807 in India, covering a small portion of India only. The first systematic attempt to collect the information on the whole country was made during 1867 – 1872, which was incomplete. The first complete decennial census of India started in 1881 and since then, it is continuing with minor changes. Later, the need was felt by the Indian Famine Commission and agricultural departments to collect timely and accurate data related to agriculture. In lieu of this, a Statistical Bureau was formed at the centre (New Delhi) in 1895 and a Director General of Statistics was appointed.

Throughout the British period, the development in statistics was mainly geared towards administration, trade, commerce, and other such activities.However, an urgent need for appropriate statistical framework was felt immediately after independence in 1947 for the economic and social development of the country. Hence, Prof. P. C. Mahalanobis, an architect of modern statistical methods in the Indian subcontinent, was appointed as Honorary Statistical Advisor to the Indian Cabinet and a Central Statistical Unit was set up in 1949 under his leadership. Apart from this, some other organizations like the Central Statistical Organization (CSO) and the National Sample Survey (NSS) were also created to synchronize various statistical activities throughout India.

Although Prof. P. C. Mahalanobis, a physicist by training, is considered as the architect of modern statistics in India, the first Indian person with the formal degree in statistics was Prof. P. V. Sukhatme, who completed his Ph.D. in statistics from the University of London in 1936. Dr. Sukhatme, who wrote a book on sampling, devoted a good deal of his time and energy in popularizing statistical methods among the practitioners of agriculture, veterinary medicine, nutrition, and related sciences. He had also set up a research institute – the Maharashtra Association for Cultivation of Sciences (MACS), and started the Department of Biometry and Nutrition in collaboration with Pune University.

Another landmark in the development of statistics as a discipline in India is the establishment of the Indian Statistical Institute (ISI) in Kolkata, West Bengal, set up by Prof. P. C. Mahalanobis in the year 1932. The institute first started short training courses in statistics, which were attended mainly by the officers on study leave in government and other organizations from all over India. Later on, when this institute was declared as an "Institute of National Importance" in 1960, other courses like Bachelor of Statistics (B. Stat.), Master of Statistics (M. Stat.), and Ph.D. in Statistics were introduced. One of the main reasons for the rapid development of statistics in India was the close interaction between ISI and various technical wings of the Government of India.[1] In the mean time, the first post-graduate course in statistics as a separate and full-fledged discipline, and not as a part of mathematics or economics, started in 1941 in Calcutta University. Slowly and slowly, courses in statistics as a subject have been introduced in a number of universities and institutions, and today quite a large number of educational institutions all over India are offering various bachelors, master, and Ph.D. level courses in statistics.

Evolution of Biostatistics

Biostatistics as a discipline evolved from the application of the discipline of statistics to the biological and biomedical areas. It is a branch of applied statistics, which in early part of the 20th century was primarily in agriculture and other areas of biological sciences. Biostatistics provides tools for the summarization and understanding of numerical laboratory and clinical data, including critical reading and understanding of the biomedical literature. It gained momentum in the twentieth century with the rapid advancement of medicine. Before the middle of the twentieth century, conclusions about human illness occurred mainly through the study of anatomy and physiology. Case studies or case series were common ways to 'prove' that a particular treatment was beneficial

or that certain aetiology was the cause of an illness. Use of statistical reasoning for the above purpose took a while to develop, mainly because of differences in opinion among the physicians regarding the two approaches. However, with the emergence of evidence-based approaches, the need for biostatistical concepts was felt, which in turn resulted in greater use of statistical concepts in health-related fields. Globally, the contributions by Sir Ronald Fisher, Austin Bradford Hill, and Archie Cochrane for the development of evidence-based medicine were commendable.[2] With the development of epidemiology and information technology in the last few decades, not only the awareness and use of biostatistical methods in medical, clinical, and public health research have increased many folds, but the computational skills have also been enhanced remarkably. The INCLEN (International Clinical Epidemiological Network) consortium, in collaboration with the Rockefeller Foundation and USAID (United States Agency for International Development), has contributed substantially to the capacity building of biostatisticians working in medical institutions in selected developed and developing nations, including India.

Teaching, Training, Research and Consultancy

As far as statistics is concerned, the number of institutions offering courses in statistics is of substantial number and is increasing, but biostatistics has not been given the importance which it needs. All medical colleges in India do not have separate departments of biostatistics. At the academic level, in the majority of medical colleges, biostatistics is not being taught as a separate discipline even today. This constitutes a very small portion in the curriculum and many a times taught by instructors who are not trained biostatisticians.[3]During their study at the medical school, the majority of students does not give importance to biostatistics and only appreciate and completely understand the concepts when they complete their studies and start clinical practice.[4] Hence, to generate interest among medical students for biostatistics, it is very important to have effective teaching methodologies. Over the years, there are changes and modifications in the ways biostatistics has been taught, but still lot more is required to make the subject more interesting and applicable. It has moved from the conventional theory-based mode to more practical-based. However, there is still scope to include more practical exercise in the teaching of biostatistics.

Biostatisticians develop and apply statistical methods to scientific research in health-related fields, including medicine, epidemiology, and public health. They work closely with other public health disciplines to develop outcome measures to ascertain the effectiveness of programmatic activities and to develop the means to collect such measures, which may include surveys, lab reports, hospital discharge data, etc. Biostatisticians help formulate the scientific questions to be answered, determine appropriate sampling techniques and sample size, coordinate data collection and management procedures, and conduct statistical analyses and its interpretation to answer those scientific questions. They also play a very important role in the preparation of research material for publication.

Biostatistician's functions are increasingly becoming vital in the public policy arena as well. For instance, biostatisticians play a large role in informing policy makers about issues such as risk and protective factors affecting heart and lung disease, formulating new drug policy to combat infectious diseases, etc. By the next generation, biostatisticians are expected to be trained professionals fully equipped with the necessary skills for jobs in academics, government, and industry. In all these settings, biostatisticians are considered consultants to other researchers.[5,6] Teaching consultation skills needs to be an integral part of any applied biostatistical training program. Success of such training might be seen in terms of subsequent statistical consultations offered to the clients in worldwide settings.[7]

In the field of applied health research, many a times it does happen that a group of researchers start a study without including a biostatistician on board and involve them only at a later stage, whenever desired. If any problem at that stage is identified, which cannot be rectified because the major portion of the study has been already completed, then it becomes very difficult for the biostatistician to work out a reasonable solution.

With the above backdrop, the involvement of biostatisticians in any research study from the beginning becomes very crucial. Hence, availability of sufficient people with expertise in biostatistics/medical statistics/health statistics/biometry is very much required. This in turn requires that an adequate number of people be trained in these areas. An extensive search strategy was used to find out existing courses in biostatistics and related fields in India, details of which are given in the following section.

Methodology

The information regarding the existing long term teaching and training programs in biostatistics and related fields like medical statistics, health statistics, and biometry in India was obtained by using systematic search strategies. The Google internet-based search engine was used to get the list of institutions offering courses in biostatistics and its related fields. First of all, key words for the search were identified. The various key words used were: Biostatistics, health statistics, medical statistics, and biometry. The search was limited to the courses that are offered in India only. In the process of the search, information was mainly obtained on name of the course, name of the organization offering the course, location, duration of the course, eligibility criteria for admission, mode of delivery of the course (regular fulltime or correspondence), and if possible, the number of seats available. From the search results, short-term teaching and training programs of duration less than six months were excluded.

Results

Overall, only about 19 institutions in India are offering various courses in biostatistics/medical statistics/health statistics/biometry [Table 1]. As far as the regional distribution of these institutions is concerned, a majority of them are in the southern region of India [Figure 1]. Except for a few institutions like Banaras Hindu University, Amrita School of Medicine, All India Institute of Hygiene and Public Health and West Bengal University of Health Sciences, the majority of the institutions have programmes titled as Biostatistics. There is wide variety of available courses, starting from certificate courses, diploma courses, post graduate diploma courses, master's level courses, and doctoral programmes. An extensive three years fellowship program in biostatistics is being offered by Sanjay Gandhi Post Graduate Institute of Medical Sciences, in Lucknow, which gives a rigorous training including both theory and practical, and also on handling a variety of statistical software.

With the exception of Manipal University, Sardar Patel University, and Global Institute of Medical Sciences, Baroda, which offer six months certificate courses, all other institutes are offering programmes of duration one year or more. All diploma, post-graduate diploma, and M.Phil. courses are of one year duration, master's level courses are of two years duration, and duration for doctoral level programmes are three years and above. Out of all the available institutions, the majority of them run fulltime courses, which is very much required because a subject like biostatistics is better understood when taught face-to-face with lots of discussion and hands-on experience of data analysis by using some statistical software. Cliniminds, a clinical research training institute, runs various post-graduate and advanced post-graduate diploma programs in biostatistics and its related field. These programs are mainly run either as regular weekends or in a distance learning mode, considering the target audience is working individuals. There are institutes in India like Christian Medical College, Vellore, which offers regular training programs of short duration (from three days to one week) in various topics in biostatistics. Short-term training workshops are also organized for building capacity in analysis skills by using some statistical software like STATA, SAS or SPSS.

The eligibility criterion for admission to post-graduate courses varies according to the type of program and also, to a certain extent, from one institution to another. It ranges from a minimum of recognized bachelor's degree with medical subject or any other subject with mathematics or statistics as one of the subjects, to a maximum of master's degree in the field of statistics, depending on the type of course. Doctoral programs have the requirement that students who apply for the course should have a post-graduate degree in statistics or its related branches like biostatistics, medical statistics, health statistics, biometry, etc. For the majority of the master's level programs, a candidate should have a bachelor's degree with mathematics or statistics as the main subjects. However, the M.Sc. course of SRM University, Tamil Nadu, requires a graduate in medicine, AYUSH (Ayurveda, Yoga, Naturopathy, Unani, Siddha, and Homeopathy), engineering, pharmacy, physiotherapy, occupational therapy, dentistry, and arts and science with mathematics at higher secondary level, for admission in the program. The post-graduate diploma course of the Indian Institute of Public Health, Hyderabad has a requirement of a bachelor's degree in any discipline. However, Madurai Kamraj University, Tamil Nadu, requires a candidate with degree in science having mathematics as one of the subjects in 12th grade. Diploma in health statistics courses in various institutions have the criteria of selecting individuals with bachelor's degree (either medical or B.A./B.Sc. with mathematics or statistics as one of the subjects).

Table 1: Matrix of existing courses in Biostatistics and its related field in India

S. No	Name of the Institute/university	Title of the Program	Nature of Program	Duration	Eligibility	Mode of Learning	No. of seats
1	National Institute of Mental Health and Neuro Science, Banglore, Karnataka[8]	Doctor of Philosophy in Biostatistics	PhD	3-5 years	M.Stat (ISI)/MSc in Statistics/ Biostatistics /Medical Statistics/Health Statistics /Agricultural Statistics	Regular	
2	All India Institute of Medical Science, New Delhi[9]	Doctor of Philosophy in Biostatistics	PhD	3 years	Masters degree with minimum merit	Regular	
3	Sanjay Gandhi Post Graduate Institute of Medical Science, Lucknow, Uttar Pradesh[10]	Fellowship in Biostatistics	Fellowship	3 years	Masters degree with merit	Regular	2
4	St. Thomas College, Kottayam, Kerala[11]	M Sc in Biostatistics	Masters	2 years	Bachelor Degree with merit	Regular	20
5	Smt. Devkunvar Nanalal Bhatt Vaishnav College for Women, Chennai, Tamil Nadu[12]	M Sc in Biostatistics	Masters	2 years	Bachelor Degree with merit	Regular	
6	Christian Medical College, Vellore, Tamil Nadu[13]	M Sc in Biostatistics	Masters	2 years	Bachelors degree with statistics	Regular	
7	Manipal University, Manipal, Karnataka[14,15]	M Sc in Biostatistics Certificate course in Biostatistics, epidemiology and research methodology	Masters Certificate	2 years 6 months	BSc Statistics/BSc Mathematics with Statistics as a subsidiary subject with a minimum of 50% marks in aggregate.	Regular	
8	University of Lucknow, Lucknow, Uttar Pradesh[16]	M Sc in Biostatistics M A in Biostatistics	Master	Two years	Graduate with a 50% min marks and Mathematics as one of the subjects at the Intermediate/Higher Secondary (10+2) level	Regular	20 10
9	SRM University, Chennai, Tamil Nadu[17]	M Sc in Biostatistics and Epidemiology	Master	Two years	Graduate in Medicine, Ayush, Engineering, Pharmacy, Physiotherapy, Occupational Therapy, Dentistry, and Arts and Science. Maths at Higher Secondary Level.	Regular	
10	Amrita School of Medicine, Kochi, Kerala[18]	M Sc in Medical Statistics	Master	Two years			
11	Banaras Hindu University, Varanasi, Uttar Pradesh[19]	MSc in Health Statistics	Masters	Two years	B. Sc. (Hons.)/B.Sc. under at least 10+2+3 pattern securing a minimum of 50% marks in the aggregate in Science subjects (considering all the three years of B. Sc. Course). Statistics must be a Hons. subject at B. Sc. (Hons.) level/Studied in all the three parts at Graduation level	Regular	12
12	Berhampur University, Berhampur, Orrisa[20]	M Sc in Ecology Biostatistics and Taxonomy	Masters	2 years	Bachelor Degree with merit	Regular	
13	Indian Institute of Public Health, Hyderabad, Andhra Pradesh[21]	Post Graduate Diploma in Biostatistics and Data Management	PG Diploma	1 year	Bachelors degree in any discipline	Regular	
14	Cliniminds, Academy for Clinical Research and Training Management, Noida, Uttar Pradesh[22]	Advanced PG Diploma in Biostatistics andSAS Advanced PG Diploma in Clinical Data Management PG Dip in Clinical Data Management and SAS Advanced PG Diploma in Clinical Data Management, Biostatistics and SAS	PG Diploma	Six months Six months Six months One year	MD, MS, MBBS, BDS, BHMS, BAMS, BUMS, BPT, B.Pharma, Graduate/Post Graduate Degree in Life Sciences, Mathematics, Pharmacology, Pharmacy, Medical Laboratory, Nursing, Biochemistry, Microbiology, Biotechnology and all professionals working with Pharmaceutical companies, CROs and hospitals	Regular Weekend program/ Distance Learning	

Table 1: (Cont.)

15	Madurai Kamarj University, Tamil Nadu[23]	Post Graduate Diploma in Biostatistics	P G diploma	1 year	A Degree in Science with Mathematics as one of the subject in +2 (XII Std.)	Distance learning
16	West Bengal University of Health Sciences, Kolkata, West Bengal[24]	DHeS	Diploma in Health Statistics	1 year	Registered Medical Graduates (MBBS / BHMS / BAMS) or candidates, who have passed the B.A or B.Sc. or B. Com. Examination with Mathematics or Statistics as one of the subjects from a recognized University	
17	All India Institute of hygiene and public Health, Kolkata, West Bengal[25]	Post Graduate Diploma in Health Statistics	Diploma	1 year	Medical graduates or BA/BSc with mathematics or statistics as one of the subjects	In-house
18	Global Institute of Medical Sciences, Baroda, Gujarat[26]	Diploma in Biostatistics and Research Methodology Certificate in Biostatistics and Research Methodology	Diploma Certificate	1 year 6 months	Graduate (Any), MBBS; BPT, BOT	Correspo-ndence
19	Sardar Patel University, Vallabh Vidyanagar, Gujarat[27]	Certificate course in Biostatistics	Certificate	Six months	Bachelor's degree from any faculty of this University under 10 + 2 + 3 or an examination recognized as equivalent thereto with at least 40 percent of marks. In addition, Biology at XII Std or at later stage of study and a four credit course in statistics / mathematics is required	

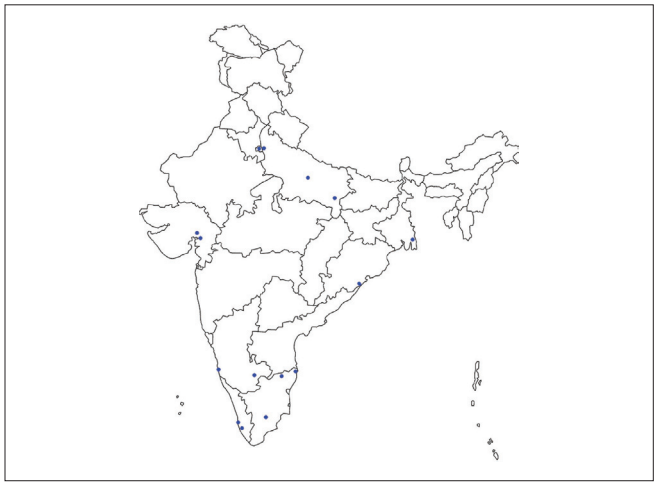

Figure 1: Regional distribution of various institutions offering courses in biostatistics and its related fields in India

Discussion

Biostatistics, being an interdisciplinary subject, is of immense importance in the vast majority of the researches that are being undertaken in the field of health sciences. This manuscript listed the existing institutes and organizations in India, which offers courses in biostatistics and its related field. It cannot be denied that researchers and medical students do need training in biostatistics for better, critical understanding of the biomedical literature and for conducting any research study. With the rising number of researches in the field of health sciences, there is an increase in demand of researchers with biostatistics training. There is also a great need for formally training statisticians in biostatistics applied methodology. Considering the growing need of biostatisticians in health sciences, the University of Poona took the initiative in the 1970s by starting a full-time four-semester interdisciplinary course in mathematics, statistics, and biology i.e. M.Sc. Biometry. In view of this, when we look on the existing courses and training in biostatistics and its related field, the numbers are not satisfactory, and it emerges that still there is a need to increase specialized courses in biostatistics, especially in the northern region. In the majority of the medical colleges, it is taught as a part of preventive and social medicine course rather than as a separate discipline. It has been found that among the medical colleges, biostatistics is considered to be one of those subjects which students dislike the most.[2] It is important to look for the reasons as why the motivation behind learning biostatistics is very low.

With the emergence of evidence based medicine, the demand for application of biostatistics is increasing in India, but this is not in tune with the number of biostatisticians produced. With the personal experience of the first author, it seems that vacancies for a biostatistician in general are not filled very easily. Most of the time, only a few candidates appear for the interviews. The possible reasons for this can be the availability of small numbers of trained persons in the area. Over time, the number of institutions offering courses in medical statistics is increasing gradually; however, the number of teachers is very few. In the majority of medical colleges, biostatistics is been taught by faculty who are not trained biostatisticians. Although the system of teaching is gradually changing from a purely theoretical approach to a more practical approach, there still is a need to be more innovative in teaching biostatistics by taking real life examples to attract students.

Teaching future applied biostatisticians requires teaching consultation skills. Teaching statistical consultancy not only involves statistical methodological training but should also focus on improving interpersonal communication and negotiation skills.[7] Hence, the job of biostatistics faculties becomes more crucial to generate interest and motivate researchers and students to understand the need for the study of biostatistics and its appropriate use.The other means for giving importance to biostatistics is by making it a separate branch/specialization in a majority of the institutions, particularly in medical colleges.

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