

**Table 2.** List of 15 universities from India that made it to the CWUR top 1000 in 2017

Rank	University	Overall score
397	University of Delhi	43.61
399	Indian Institute of Technology Delhi	43.60
470	Indian Institute of Science	43.27
550	Panjab University	43.06
607	Indian Institute of Technology Madras	42.93
616	Indian Institute of Technology Kharagpur	42.92
617	Indian Institute of Technology Roorkee	42.92
631	Tata Institute of Fundamental Research	42.90
673	Banaras Hindu University	42.83
683	Indian Institute of Technology Bombay	42.82
722	Jawaharlal Nehru Centre for Advanced Scientific Research	42.76
790	All India Institute of Medical Sciences, New Delhi	42.68
831	Indian Institute of Technology Kanpur	42.64
907	Jadavpur University	42.57
922	University of Calcutta	42.55

Table 2 is the list of 15 universities from India that make it to the CWUR top 1000 in 2017. A less than 1% change can alter the rank from 397 to 922. This is usually the case when the protocol for developing a single overall score telescopes a vast range into a very narrow band. The overall score-rank dispersion in Figure 1 reflects the same.

The picture portrayed by the CWUR Subject Rankings has important lessons for our policy makers. The government has recently announced its intention to provide Rs 10,000 crores to 20 universities, 10 private and 10 government, to make them 'world class'. It seems possible that even if this goal is achieved, there is no assurance that in any of the 226 remaining subject areas, we will

have an institution that figures in the top 10 globally. So far, for reasons to be understood, only Annamalai University has made the cut. Hence it may be meaningful to precision target funding by choosing subject areas in universities most likely to be able to make it to the top 10 in that category. Singapore seems to have achieved precisely this (its two universities appear 47 times in the top 10 in subject categories).

1. <http://cwur.org/about.php> (accessed between 25 and 29 December 2017).
2. <http://cwur.org/2017/subjects.php> (accessed between 25 and 29 December 2017).
3. <http://cwur.org/methodology/subject-rankings.php>

GANGAN PRATHAP

*Vidya Academy of Science and Technology,  
Thrissur 680 501, India, and  
A. P. J. Abdul Kalam Technological  
University,  
Thiruvananthapuram 695 016, India  
e-mail: gangan@vidyaacademy.ac.in*

## Emerging trend of pharmacoeconomics and health outcomes research in India

Pharmacoeconomics and health outcomes research is an emerging field in India. Pharmacoeconomics is a part of healthcare economics which identifies, measures and compares the cost and consequences of pharmaceutical product and service provision<sup>1</sup>. This field gives significant information about healthcare coverage and access decisions. Research in this field provides evidence to policy makers and healthcare providers to make decisions that help patients in terms of affordability and rational use of drugs<sup>2</sup>.

Research in this area is still at a budding stage in India. However, in the last five years significant contributions have been made by Indian researchers in this challenging area of healthcare sector. International collaborations with foreign authors in pharmacoeconomics and health outcomes studies are also on the rise.

The aim of the present study was to evaluate the trend of pharmacoeconomics

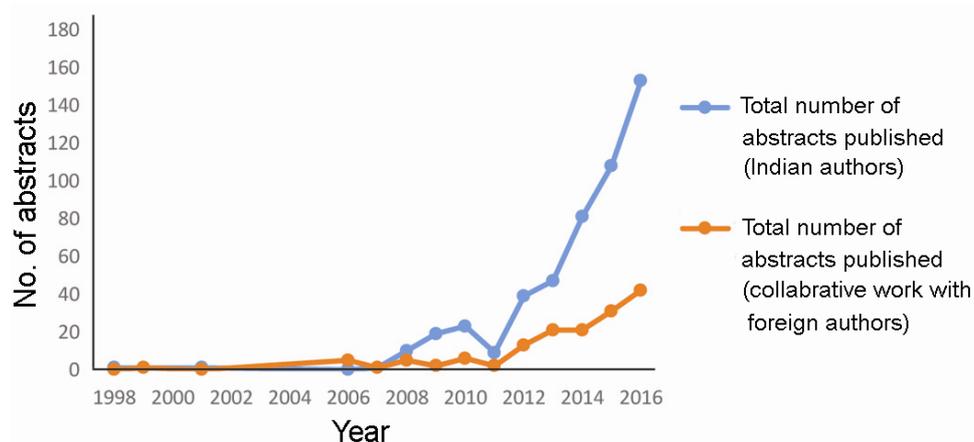
and health outcomes studies in India. Further, research area of pharmacoeconomics and health outcomes is elaborated in brief. In order to meet the objective, the required information was collected through the scientific presentations database of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR). This is an international, multi-disciplinary, professional membership society. The society aims to advance the policy, science and practice of health economics and outcomes research focusing on patient-centred outcomes<sup>3</sup>. The scientific presentations database was searched with keyword 'India'. The website includes presentations from all ISPOR international meetings since 1998. The abstracts published till 2016 were included in this study. The inclusion criteria were taken as study specific for India<sup>4</sup>.

Figure 1 shows the total number of abstracts published by Indian authors and

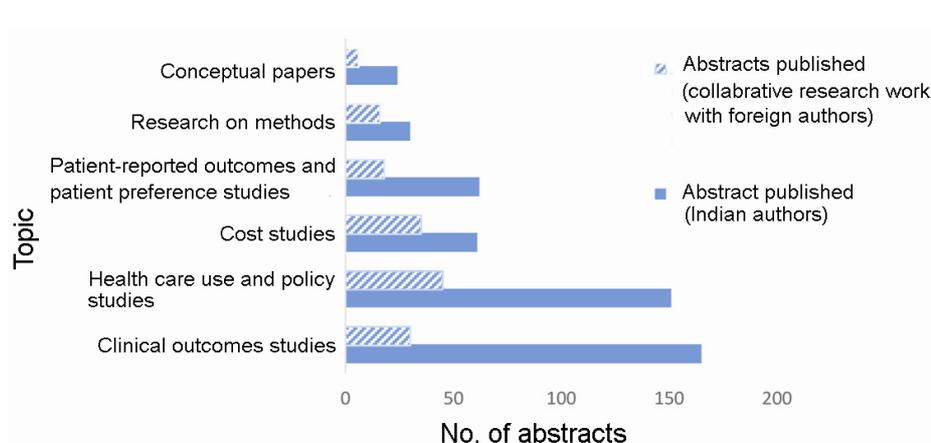
international collaborative research work contributed by Indian authors in the ISPOR international meetings. There were 493 publications during the study period (1998–2016). It can be seen from the figure that the number of papers published has increased steadily over the last five years. The highest number of papers published was during 2016, with a total of 153 abstracts.

International collaboration is becoming more significant in this era of globalization. It is encouraging to note that the number of collaborative research papers with foreign authors has also been increasing over the last five years. There were 150 publications during the study period (1998–2016). The highest number of papers published was during 2016, with a total of 42 abstracts.

Figure 2 shows different areas of research in pharmacoeconomics and health outcomes studies. Some significant and promising areas include cost studies,



**Figure 1.** Decadal output of research papers contributed by Indian authors.



**Figure 2.** Area of research in pharmacoconomics and health outcomes studies.

clinical outcome studies, healthcare use and policy studies, research methods, and patient-reported outcome and patient preference studies. These are explained in brief below.

Let us first consider cost studies. Different economic evaluation methods are available to measure and value the cost of healthcare interventions. These studies can be broadly classified as cost-effectiveness analysis (CEA), cost-benefit analysis, cost-minimization analysis (CMA), cost comparison (CC) and cost of treatment (CoT). CEA compares the relative costs and outcomes (effects) of different courses of action. It is different from cost-benefit analysis, which assigns a monetary value to the measure of effect. CC compares the costs and consequences of drug therapy to healthcare systems and society. CMA involves determination of the least costly alternative when comparing two or more treatments.

Cost of treatment includes costs which can be categorized as direct medical, direct non-medical, indirect non-medical, intangible, opportunity and incremental. Basically, all these methods provide the means to compare competing treatment options and are similar in the way they measure costs. However, they differ in their measurement of outcomes and expression of results<sup>5</sup>.

Let us now consider clinical outcome studies. Efficacy/effectiveness/comparative effectiveness: These research studies provide evidence on the effectiveness, benefits and harms of different treatment options. Comparative effectiveness research studies give insight regarding new and emerging clinical interventions and identify gaps between present medical research and future needs of clinical practice. These studies promote and generate new scientific evidence and analytic tools<sup>6</sup>.

Pharmacoepidemiology: This focuses on the use and effects of medicines in large populations. It also helps estimate the probability of adverse effects of medicines. Basically it involves continual monitoring of unwanted effects and other safety issues arising due to medications<sup>7</sup>.

Comorbidity: This indicates a medical condition with one or more additional diseases or disorders.

Health policy can be defined as the 'decisions, plans, and actions that are undertaken to achieve specific healthcare goals within a society'.

Healthcare research mainly examines how people or patients get health services. It involves access, cost and result of healthcare services provided by any country. The main goals of health services research are to identify the most effective ways to organize, manage, finance and deliver high-quality care,

reduce medical errors and improve patient safety<sup>8</sup>.

**Healthcare expenditure:** Cost of healthcare has become a major concern for patients world over. These studies highlight optimal health expenditure, pharmaceutical expenditure and various drug alternatives.

**Prescribing behaviour:** These studies focus on the prescribing behaviour of physicians and its impact on patients.

Let us consider research on methods. In these studies statistical inference and hypothesis testing is done. Different research methodologies are adopted like quasi-experimental, survey, quantitative and qualitative models, principles of literature searching and critical appraisal.

The patient-reported outcome (PRO) and patient preference studies are related to health outcomes reports of patients undergoing overall treatment. Efficacy of treatment can be identified based on patient-reported outcomes. Aspects of well-being, health status, health-related quality of life, etc. can be assessed from these studies. The use of digitized PROs, or electronic patient-reported outcomes (ePROs), is on the rise in today's health research industry<sup>9</sup>.

In the case of conceptual papers, some are published based on latest pharmacoeconomics concepts. Conceptual research focuses on the concept or theory that explains or describes the phenomenon being studied. These papers are based on secondary data sources, such as facts and figures.

Research in the area of pharmacoeconomics and health outcomes studies has increased in India over the last five years. Compared to the Western countries, research is still at a nascent stage in India. Collaborative research with foreign authors is also increasing, which is an encouraging trend in this area. However, there some challenges like shortage of skilled technical workforce, establishing standard guidelines, insufficient funding for the said research, lack of authenticated and organized database of healthcare system, and awareness about relevant features of pharmacoeconomics and health outcomes research for healthcare professionals, government officials and all healthcare members associated with it<sup>10</sup>.

Due to increased cost of overall healthcare, pharmacoeconomic and outcomes research evaluation plays an important role in cost-effective health services. The rapid development of such studies in India may be more beneficial to society in the coming years.

1. Muragundi, P. M., *Curr. Sci.*, 2014, **106**, 1051.
2. Ahmad, A., Patel, I., Parimilakrishnan, S., Mohanta, G. P., Chung, H. C. and Chang, J., *J. Res. Pharm. Pract.*, 2013, **2**, 3–9.
3. <https://www.ispor.org/about-ispor.asp> (accessed on 12 November 2016).
4. Koçkaya, G., Yenilmez, F. B. and Tuna, E., In Proceedings of ISPOR 19th Annual

European Congress, Vienna, Austria, Abstr, no. PHP 243, October 2016.

5. <http://accesspharmacy.mhmedical.com/content.aspx?bookid=462&sectionid=4110076> (accessed on 16 November 2016).
6. <http://effectivehealthcare.ahrq.gov/index.cfm/what-is-comparative-effectiveness-research1/> (accessed on 5 December 2016).
7. <http://www.hopkinsmedicine.org/gim/research/content/pharmacoepi.html> (accessed on 8 December 2016).
8. <http://depts.washington.edu/hserv/hs-research-definitions> (accessed on 12 December 2016).
9. [https://en.wikipedia.org/wiki/Patient-reported\\_outcome](https://en.wikipedia.org/wiki/Patient-reported_outcome) (accessed on 25 December 2016).
10. Lyles, A., *Eur. J. Pharm. Sci.*, 2008, **34**, 7–24.

B. S. SUHAS<sup>1</sup>

D. PAVAN<sup>1</sup>

K. GAURAV<sup>1</sup>

P. D. AHIAWODZI<sup>2</sup>

V. S. LIGADE<sup>1,\*</sup>

<sup>1</sup>Department of Pharmacy Management, Manipal College of Pharmaceutical Sciences, Manipal University, Manipal 576 104, India

<sup>2</sup>Department of Public Health, Campbell University College of Pharmacy and Health Sciences, Buies Creek, North Carolina 27506, United States  
\*e-mail: [virendra123sl@gmail.com](mailto:virendra123sl@gmail.com)

## NEWS

### Representation of physical processes in weather and climate models\*

The improvement of numerical models for predicting weather and climate at different spatial and temporal scales is being carried out globally. While much progress has been achieved, there are still significant challenges, particularly in the backdrop of enhanced extreme weather events, which need to be addressed with better understanding of physical processes, based on observations and subsequent representation of these processes through improved parameterization. To discuss these issues with emphasis on tropical weather and climate, and also to motivate a good number of students/postdocs/early career scientists, a four-day international work-

shop on 'Representation of Physical Processes in Weather and Climate Models' was held at Indian Institute of Tropical Meteorology, Pune during 13–16 February 2017. Experts and eminent scientists in model development from across the world and from all the leading centres attended and delivered lectures during the workshop. In the panel discussion, it was unanimously recommended that such workshops on parameterization should take place at various places in the country so that they can provide a platform for dialogue between scientists and students involved in research in the field. All the presentations, scripts related to hands-on exercises and video recordings

of the talks are available on-line ([https://www.youtube.com/playlist?list=PLgQC-KqNw6z\\_AndRt11yu5Fr0ZXrV1C6KK](https://www.youtube.com/playlist?list=PLgQC-KqNw6z_AndRt11yu5Fr0ZXrV1C6KK)) and presentations are available at the following website: <http://www.tropmet.res.in/introspect/>. This note is intended to draw the attention and motivate younger researchers to use the techniques discussed in the workshop for future applications in climate modelling.

**P. Mukhopadhyay\*** and **Ravi S. Nandjundiah**, Indian Institute of Tropical Meteorology, Pune 411 008, India  
\*e-mail: [mpartha@tropmet.res.in](mailto:mpartha@tropmet.res.in)