

Research Output and Visualization of All India Institute of Medical Sciences (AIIMS), India: A Special Reference to Open Access

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Abstract: The paper presents an analysis of bibliographic data from 12,157 research papers published by six prestigious All India Institutes of Medical Sciences (AIIMS) namely AIIMS Raipur, AIIMS Bhopal, AIIMS Jodhpur, AIIMS Rishikesh, AIIMS Bhubaneswar, and AIIMS Patna and indexed in the Scopus database between 2013 and 2023. The results indicate that these AIIMS institutions have generated 12,157 documents with an average of 8.266 citations per document. The yearly growth rate of publications stands at 35.73%. The study identifies that the most preferred format among researchers is the article (7,495). Out of the total documents, 7,133 were published in open access between 2013 and 2023. Of these, 5,302 were in green open access, 4,034 in gold open access, 1,561 in bronze open access, and 387 in hybrid gold open access. AIIMS Jodhpur has the highest total number of publications (3,056), while AIIMS Rishikesh leads with the most open access articles (1,758) across green, gold, and bronze categories. The highest average total citations per article (19.22) and average total citations per year (3.84) were recorded in 2020. BMJ Case Reports, with 335 articles, is the journal with the most publications. Notably, P.K. Panda and I.K. Sharawat have contributed 45 publications with 57 citations. The most frequently used keywords are "human," "article," and "male."

Keywords: Data visualization, Citation analysis, Data analysis, Annual growth rate, Open access, Research Productivity, AIIMS.

1. Introduction

Six AIIMS-like institutions have been constructed up under the PMSSY scheme: one each in the states of Madhya Pradesh (Bhopal), Uttarakhand (Rishikesh), Bihar (Patna), Rajasthan (Jodhpur), and Orissa (Bhubaneswar) and Chhattisgarh (Raipur). The All-India Institute of Medical Sciences Act, 1956 has been amended by the AIIMS Amendment Act, 2012, giving the six AIIMS autonomous status. The Institute Body for every new AIIMS was established. Additionally, the six new AIIMS have established their Academic Committee,

Standing Finance Committee, and Governing Body. At each of the six AIIMS, the medical and nursing colleges opened up to operations in September 2012 and September 2013, respectively. All six AIIMS now have operational OPD facilities. Additionally, IPD has started operating at the new AIIMS with partial bed capacity (<http://pmssy-mohfw.nic.in/>). Open access (OA) is the unrestricted, immediate, online availability of research publications, such as books or journal articles or combined along with the unlimited access rights to these publications in the digital space. Anyone can access OA content without paying any fees. By making all research outputs freely available and accessible, we can increase the impact of our work and contribute to the resolution of some of the most significant global problems (<https://www.springernature.com/gp/open-science/about/the-fundamentals-of-open-access-and-open-research>). There are several open access models and terminology that are used to characterize them. It's critical to understand what the publisher offers: -Gold-instant open access publication in a version prepared by the publisher and distributed through the publisher's web-based distribution facilities. Green-A copy of the publication is sometimes stored online, for example in a repository, and is known as the "author accepted manuscript (AAM)".The term "diamond open access" is occasionally used interchangeably with "gold open access," which denotes a publication that is made publicly available on the publishing platform without charging the author or their research organization any money.Bronze articles are available for free reading on the publisher's website and hybrid open access is in which authors can choose to pay to make individual articles publicly accessible or in which access is provided on a subscription basis. Ghent University (n.d.). OAPEN Foundation (n.d.)

2. Objectives

This paper seeks to accomplish the following objectives as outlined below:

- To measure and analyze the research publications produced by the six AIIMS institutions over a specified period;
- To assess the extent to which research outputs from these institutions are available through open access platforms;
- To investigate the citation patterns of the research outputs. This includes analyzing how open access publications influence citation rates compared to traditional subscription-based publications;
- To use visualization tools and techniques to present the data on research outputs and open access trends;
- To identify the disciplines of research in which the results are published in 2013–2023;
- To identify the journal most preferred by the faculties of AIIMS to publish their research output;
- To identify authorship patterns and collaboration among the faculties of AIIMS;

- To identify the most prolific keywords.

3. Literature Review

Many studies in the past have been published in literature dealing with the research performance of countries, different subjects and institutions. For instance, Nishavathi and Jeyshankar (2018), demonstrates the growth of research publications produced by AIIMS during 2007 to 2016. 14410 records were obtained from the Scopus database. At a 95.0% confidence level, descriptive statistics for the research publication output indicated the mean was 1441, Standard deviation was 318.92. The surge in research publications published by AIIMS was fitted using the curve fitting technique. The most popular publication pattern has been observed in journals (69.42%). A total of 56.77% of productivity is generated by the research output of the top 20 departments. Additionally, this study determined the top 20 journals (ex- Indian Journal of Pediatrics, Indian Journal of Medical Research and so on) that AIIMS faculty members favored. Parida et al. (2020) conducted a scientometric study of research Productivity and visualization of the All India Institute of Medical Sciences (AIIMS) Bhubaneswar (papers published during 2012-2019) the average citation received by per paper (ACPP) and HICP is highest for the year 2019 and increasing trends towards multi-authorship publications could be seen. Wani et al. (2013) carried a scientometric study to analyse the research productivity of AIIMS using various parameters for 53 years from 1959 to 2011. The result of the course indicated that the publications produced from the field of medicine received the highest rate of productivity of 14381 articles. Further, it was observed that the collaboration of AIIMS authors represented at 14.25%, 5.66%, and 80.09% at national, international, and Local levels, respectively. Baskaran (2013) studied research output of Alagappa University during 1999-2011 and analysed authors productivity, preferred discipline for publishing and institution-wise collaboration. Thomas and George (2021) analysed the research performance of PGIMER, Chandigarh during 2011-2020. Kaur and Preeti (2012) conduct scientific research to analyse and compare the results of two treatises on medical institutions, AIIMS and PGIMER, the research publication from 1999 to 2008. It was clear from the study's findings that AIIMS produced a higher number of papers, 9838 with a total citation counts of 209995, whereas PGIMER contributed 5552 articles at a citation rate of 11439. Further, the authors also performed subject wise analysis, growth pattern of publications, authors collaborations, an h-index of both the institutions.

4. Methodology

The study was undertaken based on the data downloaded from Scopus database for the period 2013-2023 using the following search strategy under “Affiliation search” ((AF-ID("All India Institute of Medical Sciences Raipur" 60108610)) OR (AF-ID("All India Institute of Medical Sciences Rishikesh" 60110819)) OR

(AF-ID("All India Institute of Medical Sciences Jodhpur" 60108918)) OR (AF-ID("All India Institute of Medical Sciences Bhubaneswar" 60110821)) OR (AF-ID("All India Institute of Medical Sciences Bhopal" 60110820)) OR (AF-ID("All India Institute of Medical Sciences Patna" 60110818))) AND (LIMIT-TO (PUBYEAR,2013) OR LIMIT-TO (PUBYEAR,2014) OR LIMIT-TO (PUBYEAR,2015) OR LIMIT-TO (PUBYEAR,2016) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2022) OR LIMIT-TO (PUBYEAR,2023)). For the data analysis, the researchers used R software packages, and VOSviewer was employed for data visualization.

Main Information	
Description	Results
MAIN INFORMATION ABOUT DATA	
Time span	2013:2023
Sources (Journals, Books, etc)	2410
Documents	12157
Annual Growth Rate %	35.73
Document Average Age	3.56
Average citations per doc	8.266
References	0
DOCUMENT CONTENTS	
Keywords Plus (ID)	33389
Author's Keywords (DE)	21504
AUTHORS	
Authors	28988
Authors of single-authored docs	224
AUTHORS COLLABORATION	
Single-authored docs	441
Co-Authors per Doc	9.06
International co-authorships %	11.17
DOCUMENT TYPES	
article	7495
book	19
book chapter	363
conference paper	62
data paper	3
editorial	206
erratum	41
letter	2046
note	542
retracted	9
review	1312

short survey	59
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Based on the data analysis from Scopus, researchers from six AIIMS institutions have produced a total of 12,157 documents, authored by 28,988 individuals, between 2013 and 2023. The annual growth rate of publications is 35.73%, with an average of 8.266 citations per document. The total number of author keywords is 21,504. There are 224 authors who have single-authored 441 documents. The average number of co-authors per document is 9.06.

The data indicates that the researchers from six AIIMS contributed more in journal articles (7,495), which highlight their central role in research dissemination. A considerable chunk is also made up of letters (2,046), which suggests that there are a substantial number of brief communications. The researchers are also contributed in reviews (1,312), notes (542) The frequency of book chapters (363) and conference articles (62) is lower, indicating the researchers contributed in this format less. Books (19), data papers (3), errata (41), retracted articles (9), and books (19), short surveys (59) are the least prevalent.

5. Scope and Limitation

This paper is confined only to the six All Indian Institute of Medical Sciences (AIIMS Raipur, AIIMS Bhopal, AIIMS Jodhpur, AIIMS Rishikesh, AIIMS Bhubaneswar, AIIMS Patna) established by the Ministry of Health & Family Welfare, Government of India under the Pradhan Mantri Swasthya Suraksha Yojna (PMSSY).

6. Data Analysis

Table 1- Open Access publications by six AIIMS

All open access	7133
Green	5,302
Gold	4,034
Bronze	1,561
Hybrid gold	387

Analysis of the open access publications contributed by six AIIMS depicted in Table 1. A total of 7133 documents were published during 2013-2023. Out of which 5,302 documents were in green open access, 4034 documents were in gold, 1561 documents were in bronze and 387 documents were in hybrid gold open access respectively.

Table 2- Open access publications of AIIMS

	AIIMS RISHIKESH	AIIMS RAIPUR	AIIMS JODHPUR	AIIMS BHUBAN ESWAR	AIIMS BHOPAL	AIIMS PATNA
Total publication	2884	1199	3056	2534	1 6 5 6	1 3 2 5
All open access	1,758 (60.95%)	677 (56.46%)	1,748 (57.19%)	1,507 (59.47%)	9 5 9 (5 7. 9 1 %)	8 1 6 (6 1. 5 8 %)
Green	1,279	496	1,296	1,158	7 4 0	5 9 4
Gold	951	408	950	890	5 5 9	4 9 2
Bronze	416	143	391	287	2 0 1	1 7 7
Hybrid gold	102	41	124	60	3 8	5 2

Among AIIMS institutions, AIIMS Rishikesh holds a highest green (1279) and gold (951) open access presence. Despite having the fewest publications (1199) overall, AIIMS Raipur retains a large percentage (677, 56.46%) of its documents open access. Substantial contributions to open access are made by AIIMS Jodhpur (57.19%) and AIIMS Bhubaneswar (59.47%), with AIIMS Jodhpur (3056) leading in the highest publications. A Noteworthy open access rates may also be seen at AIIMS Bhopal (959, 57.91%) and AIIMS Patna (816, 61.58%), with AIIMS Patna obtaining a high proportion in open access overall (61.58%). All of the institutions actively promote open access, but they vary greatly in volume and focus.

Table 3- Annual Scientific Production

Year	Articles
2013	110
2014	247
2015	288
2016	377
2017	441
2018	691
2019	1005
2020	1757
2021	2531
2022	2375
2023	2335

Table 3 depicts a clear picture of the annual scientific production. Findings revealed that the greatest number of publications 2531 was published in the year of 2021 followed by the year 2022 (2375 articles). The least number of publications 110 was published in the year of 2013.

Table 4- Average Citations Per Year

Year	MeanTCperArt	N	MeanTCperYear	CitableYears
2013	13.91	110	1.16	12
2014	10.5	247	0.95	11
2015	10.96	288	1.1	10
2016	9.19	377	1.02	9
2017	9.29	441	1.16	8
2018	18.69	691	2.67	7
2019	9.41	1,005.00	1.57	6
2020	19.22	1,757.00	3.84	5
2021	7.98	2,531.00	2	4
2022	2.97	2,375.00	0.99	3
2023	0.97	2,335.00	0.48	2

$$\text{MeanTCperyear} = \frac{\text{Number of Years}}{\frac{\text{Total Number of Citations}}{\text{Total Number of Articles}}} \text{MeanTC perArt}$$

$$= \frac{\text{Total Number of Citations}}{\text{Total Number of Citations}}$$

The average citations per article and year are shown in table 2. It reflects the highest number of average total citations per article (19.22), average total citations per year (3.84) recorded in the year 2020 followed by 18.69 (Mean Total Citations per Article) and 2.67 (Mean Total Citations per year) respectively.

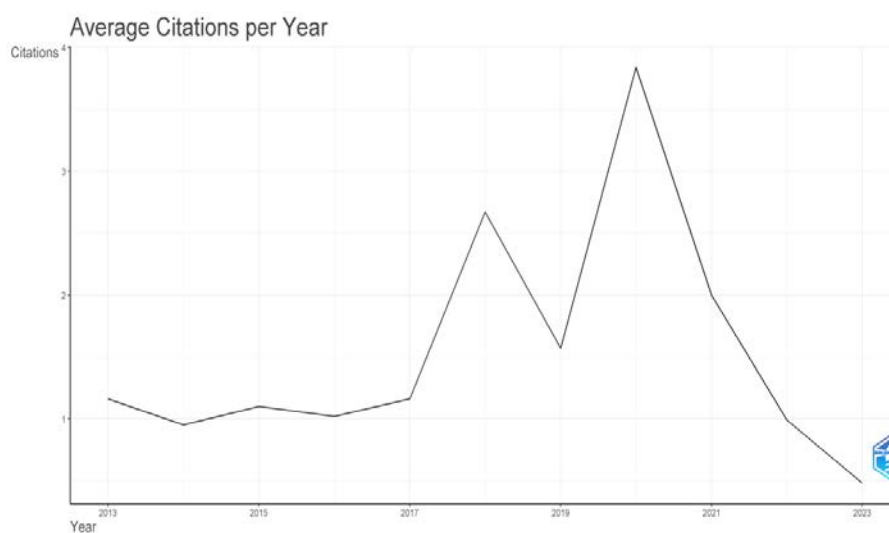


Figure 1

Table 5- Top 20 most relevant sources

	Sources	Art icl es
1	BMJ CASE REPORTS	335
2	JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH	185
3	INDIAN JOURNAL OF ANAESTHESIA	176
4	INDIAN JOURNAL OF PEDIATRICS	159
5	INDIAN JOURNAL OF OPHTHALMOLOGY	156
6	INDIAN JOURNAL OF CRITICAL CARE MEDICINE	140

7	INDIAN JOURNAL OF OTOLARYNGOLOGY AND HEAD AND NECK SURGERY	135
8	SAUDI JOURNAL OF ANAESTHESIA	115
9	INDIAN JOURNAL OF COMMUNITY HEALTH	110
10	NEUROLOGY INDIA	109
11	INDIAN PEDIATRICS	101
12	INDIAN JOURNAL OF CLINICAL BIOCHEMISTRY	100
13	INDIAN JOURNAL OF PSYCHIATRY	96
14	JOURNAL OF NEUROSCIENCES IN RURAL PRACTICE	96
15	INDIAN DERMATOLOGY ONLINE JOURNAL	85
16	INDIAN JOURNAL OF SURGERY	82
17	JOURNAL OF INDIAN ACADEMY OF FORENSIC MEDICINE	82
18	ASIAN JOURNAL OF PSYCHIATRY	78
19	INDIAN JOURNAL OF PSYCHOLOGICAL MEDICINE	78
20	JOURNAL OF EDUCATION AND HEALTH PROMOTION	78

A total of 7495 articles were published during 2013-2023. The top twenty most popular journals are presented in Table 5. The journal with the most significant publications was BMJ CASE REPORTS with 335 articles, followed by JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH with 185 articles and INDIAN JOURNAL OF ANAESTHESIA with 176 articles respectively.

Table 6- Sources production over time

Year	BMJ CASE REPORTS	JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH	INDIAN JOURNAL OF ANAESTHESIA	INDIAN JOURNAL OF PEDIATRICS	INDIAN JOURNAL OF OPHTHALMOLOGY
2013	3	5	1	0	0
2014	4	18	5	3	0
2015	5	43	12	6	0

2016	13	90	16	12	2
2017	19	141	21	14	4
2018	39	185	39	18	9
2019	78	185	60	27	22
2020	126	185	95	43	50
2021	225	185	127	88	91
2022	287	185	143	115	123
2023	335	185	176	159	156

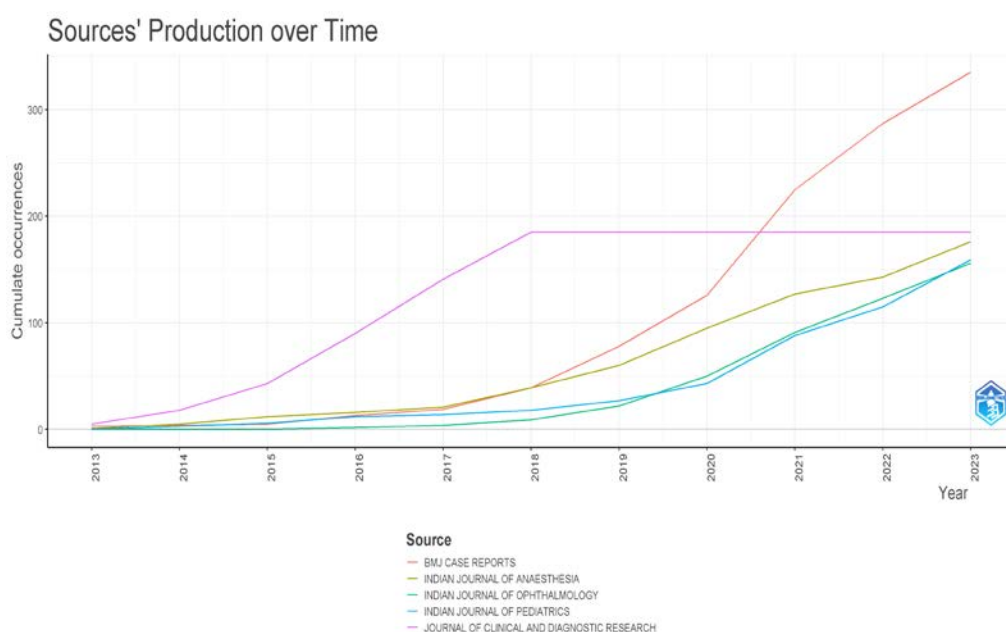


Figure 2- Sources production over time

BMJ Case Reports have had the most significant rise, growing from 3 in 2013 to 335 in 2023, indicating exponential growth, according to a review of report patterns. The number of papers published in the Journal of Clinical and Diagnostic Research peaked in 2016 at 90 and then stabilised around 185 each year starting in 2017. From one report in 2013 to 176 in 2023, the Indian Journal of Anaesthesia expanded steadily, with a noteworthy spike in publication between 2019 and 2020. Consistent developments were also observed in the Indian Journal of Paediatrics and the Indian Journal of Ophthalmology, especially starting in 2020, which suggests that research production and interest are increasing.

Co authorship organization

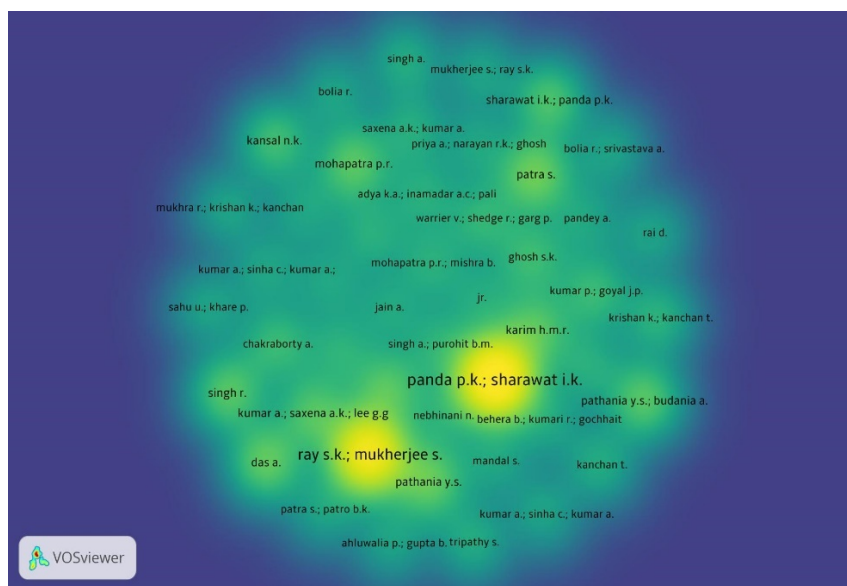


Figure 3: Density visualization of authors

Figure 3 examines the co-authorship of authors. It shows that P.K. Panda and I.K. Sharawat have contributed 45 publications with 57 citations. P.R. Mohapatra has contributed 11 publications. Additionally, S. Mukherjee and S.K. Ray have co-authored 5 documents, which have received 14 citations.

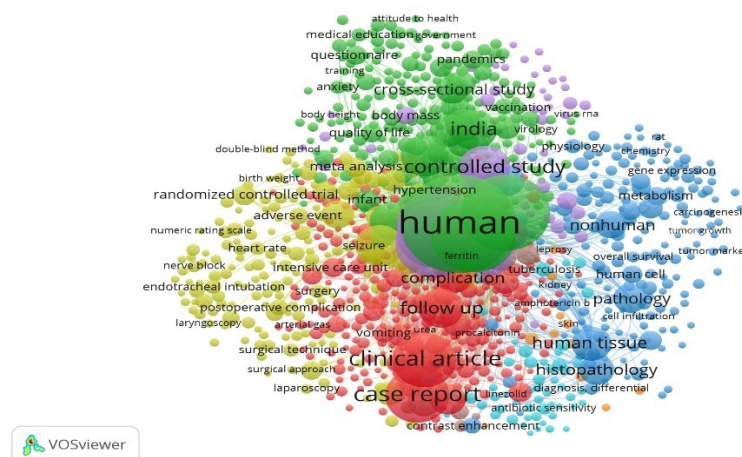


Figure 4: Keywords network visualization

Figure 4 illustrates the co-occurrence of keywords in this study. A total of 48,752 keywords were initially considered; however, to manage the volume, the study was restricted to keywords that appeared more than five times, resulting in 8,901 keywords. The most frequently used keywords include "human" (9,021 occurrences), "article" (4,923 occurrences), "male" (4,188 occurrences), "female" (4,176 occurrences), and "adult" (4,157 occurrences), among others.

7. Findings and Discussions

To the best of the authors' knowledge, this is the very first bibliometric study examining the research output and visualization of six All India Institute of Medical Sciences (AIIMS) institutions, with a special focus on open access. The six All India Institute of Medical Sciences (AIIMS) institutions have collectively produced a total of 12,157 documents authored by 28,988 individuals. The annual growth rate of publications is 35.73%, with an average of 8.266 citations per document. Among these publications, 224 authors have single-authored 441 documents. The institutions have contributed predominantly in the form of journal articles, with a total of 7,495 such articles. Over the period from 2013 to 2023, 7,133 documents were published, including 5,302 in green open access, 4,034 in gold open access, 1,561 in bronze open access, and 387 in hybrid gold open access. AIIMS Rishikesh leads with the highest numbers of green (1,279) and gold (951) open access publications, while AIIMS Jodhpur is noted for the highest total number of publications (3,056). AIIMS Patna has achieved a high overall proportion of open access publications (61.58%). The peak publication year was 2021 with 2,531 documents. The year 2020 recorded the highest average total citations per article (19.22) and average total citations per year (3.84). BMJ Case Reports is the journal with the most significant number of publications, totaling 335 articles. Notably, P.K. Panda

and I.K. Sharawat have contributed 45 publications with 57 citations. The most frequently used keywords include "human" (9,021 occurrences), "article" (4,923 occurrences), and "male" (4,188 occurrences).

8. Conclusion

The analysis indicates that the six AIIMS institutions collectively produce a substantial volume (12,157) of high-quality research. Publication trends over the year demonstrate consistent growth, which reflects the institutions' devotion to advancing medical science.

These institutions have contributed a significant portion of the research output (7,133) in open access journals during 2013 and 2023. Out of which, 5,302 were in green, 4,034 in gold, 1,561 in bronze, and 387 in hybrid gold open access. In terms of total publications, AIIMS Jodhpur has the most (3,056), whereas AIIMS Rishikesh has the most (1,758) open access articles in the gold, bronze, and green categories.

The use of visualization tools (vosviewer) has effectively potrait the density visualization of authors and keywords. Graphs and charts provide a clear picture of how research productivity and open access availability have evolved.

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