High-Cited Papers on Covid-19 Research: A Scientometric Analysis

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ABSTRACT

Aim: The paper presents a bibliometric analysisis of high-cited papers (HCPs) on Covid-19 published during 2019-2021. The study provides evidence on current research trends in the subject, identifies influential countries, organizations, research papers and journals on Covid-19 research. The study evaluates publication and citation performance of highly-cited papers and maps network interactions amongst the key global players using VOSviewer software. **Materials and Methods:** The data for the study was sourced from Web of Science for the period 2019-2021. **Results:** The USA, China and the UK dominate global Covid-19 research in terms of research productivity. In terms of citation performance China leads the tally with the USA at the second position. The USA, China and the UK account for a 88% share of total HCPs in the subject. The study identified top eleven centers of excellence based on the criteria of most productivity as well as most-cited organizations. *New England Journal of Medicine,* *Lancet, JAMA - Journal of the American Medical Association, Science* and *Nature* are the most favoured journals for publishing HCPs. The relationship networks of most productive countries, organizations, and keywords are also given in the paper.

Key words: Covid-19, High-Cited Papers, Social network analysis, Scientometrics, Bibliometrics.

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INTRODUCTION

Of late, Covid science has come to witness a sharp and sudden increase in research articles in the subject initially during the first pandemic wave and later during the second pandemic wave covering the period 2019-21. A recent study reported that well over 100,000 papers related to coronavirus pandemic were published in 2020 alone[1] Some of the underlying factors that seem to have fuelled this kind of trend include 'no proven cure' 'relatively high mortality rate,' 'urgency to discover Covid medicines, and drugs and vaccines discovery'. STM publishers in health and medicines sector have also started witnessing huge rise in the submissions of manuscripts for publication in their journals. They have appropriately responded to the heightened demand trend, like fast speed up their manuscript review and online publication process. In select cases, submission to publication process time has since shirked to just three days.[1] Given the pace at which scholarly publishing trends are changing and in a significant way, it would be relevant if a bibliometric study is undertaken to understand the current research trends as well as ascertain the status of research in Covid-19 at the global, national, institutional, and journal level. High-cited papers tend to highlight breakthrough trends within a given field, regarded as most influential papers, stand a greater chance of visibility and have a greater potential to attract attention of researchers in the subject.[2] Given this context, it will therefore be even more appropriate if such a bibliometric study is conducted based on data relating only to high-cited publications in Covid-19.

Literature Review

A number of bibliometric studies on high-cited papers on Coronovirus and Covid-19 were carried out during the last 2 years. For instance, Khalid Farooq, Ashiq, Siddique, Rehman, Adil, and Ajmal Khan[3] identified and examined in their paper the characteristics of 296 high-cited and hot papers on Coronavirus and Covid-19 from Web of Science database till 18 July 2020. The distributions of high-cited papers and hot papers per year were analyzed by country of publication, organization and journal, as well as analysed by authorship pattern and most frequently used keywords. Ram and Nisha[4] in their paper analyzed 806 high-cited articles published during 1979-2019, using Scopus database till 30 March 2020. The authors analyzed the citation life cycle of the high-cited articles, performance of authors, institutions, country, and journals.

Among studies focusing on Covid-19, Kambhampati, Vasudeva, Vaishya and Patralekh[5] examined the top 50 high-cited articles on Covid-19, using e-utilities in PubMed till 7.2.2021. The top 50 most-cited articles identify the most impactful studies on Covid-19, providing educators a useful resource as well as identifying such trends as are useful in guiding on-going research and publishing efforts. These 50 articles received 123,960 citations, the highest being 10,754 citations to a single article. C. Huang was the most-cited first author. *Lancet* was the most-cited journal, having published 9 articles. Majority of the studies belonged to level-3 of the evidence ladder and were classed as retrospective studies. Thirty per cent of the total articles had an errata published and an average of 7 comments per article. Afshar and Tabrizi[6] examined 100 high--cited papers on Covid-19, using Scopus database on 6 August 2020. The authors identified and analysed the publications for the geographic region, language and number of citations as well as the publishing journal. Twenty-nine countries contributed to the 100 high-cited articles, with China and USA leading with 60 and 21 articles respectively. Sixteen countries made one contribution each. Seventeen articles have been contributed with multi-national collaborations. The mean citation rate for the 100 top-cited articles was 529 ± 62. These 100 high-cited articles were published in 52 journals. The three top journals were *New England Journal of Medicine*

with 15 articles, the *Lancet* with 12 articles, and *JAMA - Journal of the American Medical Association* with 9 articles. The main topics of the 100 high-cited articles were clinical characteristics, diagnosis, prognosis, and epidemiological aspects of Covid-19. Among the 100 top-cited articles, 13 and 87 articles pertained to the basic and clinical sciences respectively. Johnson, Sakya, Sakya, Onkendi and Hallan[7] identified and examined 100 most-cited publications on Covid-19, using both Scopus and Web of Science database and using R-Studio and Bibliometrix for statistical analysis. The top 100 most-cited articles were published in 50 different journals from over 25 countries. They identified the most contributing countries, organizations, authors and the top 5 five most productive journals and the extent of international collaborations involved in such studies. This study will also provide an educational guide to facilitate effective evidence-based medical research and offer insight into the developments of Covid-19 research. ElHawary, Salimi, Diab and Smith[8] summarized the characteristics of the top 50 high-cited Covid-19-related publications that emerged early during the pandemic, by making a systematic search of the Web of Science, Scopus, and Google Scholar. Data extracted included the type of study, journal, number of citations, number of authors, country of publication, and study content. As of May 29th, the top 50 cited articles were cited 63849 times during the last 4 months. On an average, 14 authors contributed to each publication. Over half of the identified articles were published in only 3 journals. Furthermore, 42% and 26% of the identified articles were retrospective case series and correspondence/viewpoints, respectively, while only 1 article was a randomized controlled trial. In terms of content, almost half (48%) of the identified publications reported clinical/radiological findings while only 7 out of the 50 articles investigated potential treatments. Borku Uysal, Islamoglu, Koc. *et al.*[9] bibliometrically analyzed the top 100 most-cited articles, based on their altmetric attention scores and dimension badge scores, using top 100 articles from 27387 articles from Web of Science and PubMed databases till August 31, 2020. They determined the number of citations of top 100 articles, their main topics, the universities that published them, the scientific journals they were published and their level of evidence, social media interests, and the number of citations-Altmetric score correlations.

So far no comprehensive bibliometric study is available on high-cited papers in Covid-19. Most studies cover data pertaining to a few months' period and are restricted to the analysis of top 50-200 high-cited papers. As a result, we decided to undertake the present study which covers all high-cited papers published during 2020-21.

MATERIALS AND METHODS

The publications data on HCPs for the study was sourced from Web of Science. The research papers on Covid-19 were searched using keywords such as Covid-19, novel ccoronavirus, coronavirus disease, severe acute respiratory syndrome coronavirus 2, and SARS-CoV-2. The search was conducted on metadata fields including title, abstract, author keywords, keywords plus. In this process, a total of 127205 records were retrieved from the database covering the publication period 2019-21. The citations to these publications were counted since their publication till 2021.

Some of the studies have defined a high-cited paper (HCP) as one of such cited papers that belong to the top 1% category of total papers in a research field and published in a specified year. But in this study a high-cited paper is defined as one that had accrued 100 or more citations since its publication in 2019. In all, there were 1625 such papers, out of a total of 127205 records retrieved on Covid-19 research. Each of 1625 papers received 100 or more citations since its publication. These 1625 papers account for a 1.27% share of the total output. The publication data pertaining to such 1625 records was downloaded to Microsoft Excel

and subsequently statistically analysed. The data was also analysed using VOSviewer, a software tool for constructing and visualizing bibliometric networks. In WoS, papers are distributed into 22 research fields and an article can be assigned to only one field.

TS= ("Covid 19" or "2019 novel Coronavirus" or "Coronavirus 2019" or "coronavirus disease 2019" or "2019-novel CoV" OR "2019 ncov" or "covid 2019" or "covid19" or "corona virus 2019" or "ncov-2019" or "ncov2019" or "nCoV 2019" or "2019-ncov" or "covid-19" or "Severe acute respiratory syndrome coronavirus 2" or "SARS-CoV-2")

RESULTS

Of the 1625 HCPs that appeared during 2019-21, a 3.38% share (55 papers) accrued 1000 - 9147 citations per paper, 7.75% (126 papers) received 501-1000 citations per paper, and the remaining 89% (1344 papers) received 100-500 citations per paper (Figure 1). A WoS screenshot of top 8 most HCPs shows that these papers were published in as late as March - July 2020 (Figure 1). A short list of most high-cited papers is given in Table 1.

Subject-Wise Distribution

The 1625 HCPs on Covid-19 are distributed over 22 WoS research fields. Medicine general accounts for the most HCPs, a share of 20.49%, followed by infectious diseases (12.18%), immunology (7.51%), etc. (Table 2).

Most Important Journals

The 1625 HCPs on Covid-19 were published in 460 journals. The distribution of HCPS by reporting journals is widely scattered. For instance, as many as 400 journals published just 1-5 papers each, 41 published 6-9 papers each, 10 published 10-28 papers each, and barely 9 journals published 29 - 75 papers each. Table 3 shows top 15 productive journals along with HCPs each journal published and citations received. *New England Journal of Medicine* is the most productive journal, it published 75 HCPs. *Lancet* and *JAMA* rank second with 65 HCPs and 55 HCPs respectively in the list of top 15 productive journals. *New England Journal of Medicine* accrued the most (43220) citations with an average of 576.27 citations per paper.

Top 10 Countries

The 1625 HCPs papers on Covid-19 are distributed across 91 countries. The distribution by country of publication is highly skewed. The top three countries the USA, China, the UK alone account for the most productivity with a combined 88% share of total HCPs. The. USA is the top most productive country with 595 HCPs (a 36.6% share of 1625 HCPS). China ranks second with 582 HCPs (a 35.8% share). The top 10 productive countries are listed in Table 4 (Figure 2). In terms of citations accrued, it is the China that ranks top in the tally with most 212351 citations.
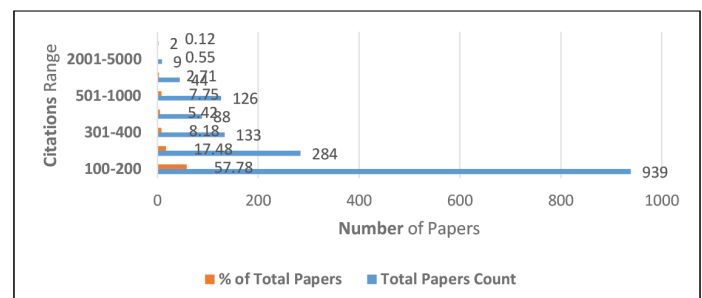

Figure 1 : Distribution of HCPs by Citation Range.

Table 1: Top High-Cited Research Papers in Covid-19 2019-21.

#	Date / Author / Journal	GCS
1	335 Guan W, Ni Z, Hu Y, Liang W, Ou C, *et al.* Clinical Characteristics of Coronavirus Disease 2019 in China NEW ENGLAND JOURNAL OF MEDICINE. 2020 APR 30; 382 (18): 1708-1720	9147
2	146 Zhou F, Yu T, Du RH, Fan GH, Liu Y, *et al.* Clinical course and risk factors for mortality of adult inpatients with Covid-19 in Wuhan, China: a retrospective cohort study, LANCET. 2020	8261
3	262 Wu ZY, McGoogan JM, Characteristics of and Important Lessons From the Coronavirus Disease 2019 (Covid-19) Outbreak in China Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention, JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION. 2020 APR 7; 323 (13): 1239-1242	4767
4	143 Mehta P, McAuley DF, Brown M, Sanchez E, Tattersall RS, *et al.* Covid-19: consider cytokine storm syndromes and immunosuppression LANCET. 2020 MAR 28; 395 (10229): 1033-1034	3199
5	232 Xu Z, Shi L, Wang YJ, Zhang JY, Huang L, *et al.* Pathological findings of Covid-19 associated with acute respiratory distress syndrome, LANCET RESPIRATORY MEDICINE. 2020	3002
6	604 Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, *et al.* Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With Covid-19 in the New York City Area, JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION. 2020 MAY 26; 323 (20): 2052-2059	2294
7	605 Richardson S, Hirsch JS, Narasimhan M, Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With Covid-19 in the New York City Area (vol 323, pg 2050, 2020), JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION. 2020 MAY 26;	2294
8	1037 Wu CM, Chen XY, Cai YP, Xia JA, Zhou X, *et al.* Risk Factors Associated With Acute Respiratory Distress Syndrome and Death in Patients With Coronavirus Disease 2019 Pneumonia in Wuhan, China JAMA INTERNAL MEDICINE. 2020 JUL; 180 (7): 934-943	2289
9	812 Long QX, Liu BZ, Deng HJ, Wu GC, Deng K, *et al.* Antibody responses to SARS-CoV-2 in patients with Covid-19, NATURE MEDICINE. 2020 JUN; 26 (6): 845-+	2257
10	1026 Gautret P, Lagier JC, Parola P, Hoang V, Meddeb L, *et al.* Hydroxychloroquine and azithromycin as a treatment of Covid-19: results of an open-label non-randomized clinical trial, INTERNATIONAL JOURNAL OF ANTIMICROBIAL AGENTS. 2020 JUL;	2204

Table 2: Covid-19 Research: Distribution of HCPS across WoS Subject areas.

Subject Area	Share of HCPs %	HCPs Count	Citations Count
Medicine General Internal	20.49	333	144092
Infectious Diseases	12.18	198	54490
Multidisciplinary Sciences	7.69	125	36676
Immunology	7.51	122	38043
Microbiology	6.71	109	28695
Biochemistry Molecular Biology	5.48	89	24652
Public Environmental Occupational Health	5.42	88	21185
Psychiatry	4.92	80	20494
Virology	4.31	70	16131
Cardiac Cardiovascular Systems	4.25	69	19077
Medicine Research Experimental	4.12	67	19360
Environmental Sciences	3.57	58	12477
Pharmacology Pharmacy	3.02	49	14667
Hematology	2.89	47	13397
Respiratory System	2.77	45	14075
Neurosciences	2.09	34	8195
Clinical Neurology	2.03	33	7285
Surgery	1.85	30	7123
Pediatrics	1.78	29	8011
Oncology	1.42	23	4767
Health Care Sciences Services	0.98	16	2622

Table 3: Covid-19 Research - Top 15 Productive Journals Reporting HCPs.

Journal	Records	Citations	CPP by JL
New England Journal of Medicine	75	43220	576.27
Lancet	65	32027	492.72
JAMA-Journal of the American Medical Association	55	31346	569.93
Science	43	12710	295.58
Nature	40	12039	300.98
Journal of Medical Virology	38	9183	241.66
Clinical Infectious Diseases	33	8096	245.33
Science of the Total Environment	31	5365	173.06
Bmj-British Medical Journal	29	8000	275.86
Lancet Infectious Diseases	26	11101	426.96
Nature Medicine	26	9284	357.08
Journal of Infection	23	5562	241.83
Radiology	23	8899	386.91
Cell	18	5740	318.89
Lancet Respiratory Medicine	18	7237	402.06

The USA in the second position with 163422 citations. The collaboration between countries has been measured in terms of total collaborative link strength. It represents the number of connections between a given country and the countries it collaborated with. The total link strength of top 10 collaborating countries varied between 163 and 804 links. The USA had the most collaboration density with a total of 804 links, followed by the China (529) and U.K (598). The citation interactions between top

10 countries are measured in terms of total citations links strength. For these top 10 countries, it varies between 1316 and 8498 citations links. Interestingly the top 10 most productive countries are also the top 9 most cited countries in the world (Table 4, Figure 2).

Centres of Excellence

At the institution level, the 1625 HCPs were contributed by authors from 3479 organizations around the world. Top 20 most productive organizations in this list account for a 51% share of the total HCPs. Seven of these organizations were from China, five each from the USA and UK, and one each from Singapore, Hong Kong, and Italy.
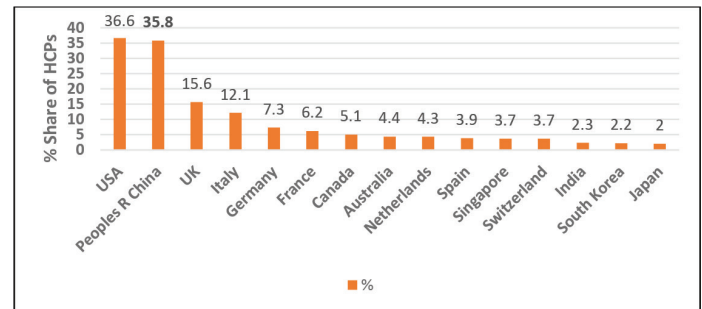
These top 20 organizations were ranked on their productivity in HCPs and also on citations that these organizations received during the period.

Both the listings were compared for their productivity performance and citations performance. The study found that eleven out of the top 20 organizations from the high-productivity organizations list were also listed in the high-cited organizations list. This implies that eleven of these organizations are in common to both the listings; these must be recognized as the centres of excellence in COVID science research around the world. The names of these eleven organizations are; (1) Huazhong University of Science & Technology, China (107 papers), (2) Wuhan University, China (76 papers), (3). Harvard Medical School, USA (59 papers), (4) University of Oxford, U.K. (46 papers), (5). Icahn School of Medicine at Mount Sinai, USA (41 papers), (6) Chinese Academy of Sciences (38 papers), (7) University College London (UCL), U.K. (34 papers), (8) Sun Yat- Sen University, China (33 papers), (9) Capital Med University, China (32 papers), (10) Shanghai Jiao Tong University, China (30 papers) and (11) University of Washington, USA (30 papers). These may be regarded as the centres of excellence in Covid-19 medical science research. (Table 5, Figure 3)

Figure 3 represents the relationship between organizations (nodes), a bidirectional intensity of asymmetric collaboration. The font size of the node is proportional to the volume of its publications and citations. The

Table 4: Covid-19 Science Research: A Profile of Top 10 Productive Countries 2019-21.

S No	Country	HCPs	% Share	Citations	CPP	Total Collaborative Link Strength	Total Citation Link Strength
1	USA	595	36.6	163422	274.66	804	8498
2	China	582	35.8	212351	364.86	529	9278
3	UK	253	15.6	78493	310.25	598	4243
4	Italy	196	12.1	48462	247.26	420	2962
5	Germany	118	7.3	37234	315.54	400	2258
6	France	100	6.2	27330	273.3	320	1810
7	Canada	83	5.1	22851	275.31	311	1561
8	Australia	71	4.4	18980	267.32	290	1220
9	Netherlands	70	4.3	23510	335.86	288	1644
10	Switzerland	60	3.9	18736	312.27	163	1316

Figure 2: Covid-19 Research: Share of HCPS by Country of Publication.

Table 5: Covid-19 Research - Global List of Centres of Excellence.

#	Institution	Country	Records	% Share	Citations	Most Productivity Rank	Most Citations Rank
1	Huazhong Univ Sci & Technol	China	107	6.6	49284	1	1
2	Wuhan Univ	China	76	4.7	23521	2	3
3	Harvard Med Sch	USA	59	3.6	19230	3	6
4	Univ Hong Kong	K.Kong	57	3.5	28728	4	2
5	Univ Oxford	U.K.	46	2.8	19165	5	7
6	Icahn Sch Med Mt Sinai	USA	41	2.5	12972	6	19
7	Chinese Acad Sci	China	38	2.3	10964	7	11
8	Fudan Univ	China	34	2.1	10972	8	0
9	UCL	UK	34	2.1	14287	9	16
10	Columbia Univ	USA	33	2	10808	10	0
11	Sun Yat Sen Univ	China	33	2	18807	11	8
12	Capital Med Univ	China	32	2	19622	12	5
13	Imperial Coll London	U.K.	32	2	9362	13	0
14	Natl Univ Singapore	Singapore	32	2	10325	14	0
15	Univ Milan	Italy	31	1.9	9737	15	0
16	Shanghai Jiao Tong Univ	China	30	1.8	12475	16	20
17	University Washington	USA	30	1.8	13007	17	18
18	Univ Cambridge	U.K.	29	1.8	11262	18	
19	Kings College London	U.K.	29	1.8	9628	19	0
20	Stanford University	USA	29	1.8	7554	20	0

Note - Organizations in bold font are in common to both the listings, ranked on productivity of HCPs and ranked on most cited organizations.

size of concentric circles reflects their collaboration rate. The node color means that it belongs to an aggregate cluster (institutional sector). Every node is placed in the space according to its dependence. The closeness or distance between the circles is related to the total number of links of an organization with the others. The lower left part of the representation shows the different levels of aggregation that the user can choose in order to develop analysis by sector.
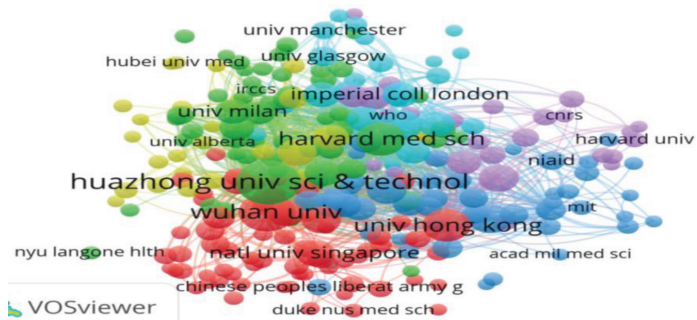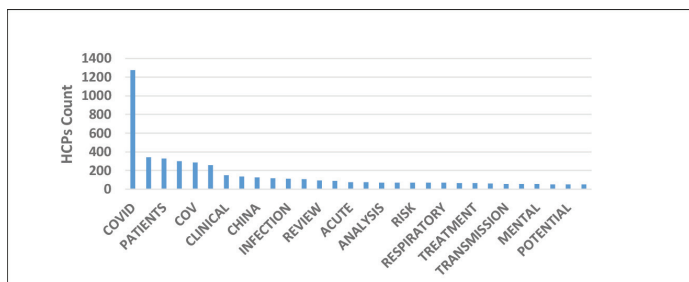
Keywords Analysis

Table 6 shows keywords used in HCPs to characterize Covid-19 research along with the frequency of their occurrence, their per cent share in the overall HCPs output, and the citations the keyword received during the period. The most common keywords used are Covid, Patients, CoV, clinical and China. Keyword analysis is important because it opens up a secondary approach to understand and find evidence regarding research trends in the subject (Figure 4).

Co-occurrence of keywords is a concept which refers to the common presence, frequency of occurrence, and close proximity of similar keywords present across HCPs (Table 7). Biblioshiny software tool was used for co-occurrence analysis (Figure 5). The network co-occurrence link strength of keywords is very strong varying between 272 and 2600 links.

Figure 3: Network Analysis of Organizations in HCPs on Covid-19.

Table 6: Keywords used in HCPs to Characterize Covid-19 Science Research.

#	Keyword	Records	% Share	Citations	#	Keyword	Records	% Share	Citations
1	Covid	1277	78.6	363391	31	Pneumonia	50	3.1	16328
2	Coronavirus	343	21.1	116863	32	Impact	48	3	10674
3	Patients	330	20.3	110880	33	Cases	46	2.8	19222
4	Sars	302	18.6	89930	34	Hospitalized	44	2.7	20386
5	Cov	287	17.7	84329	35	Human	44	2.7	12049
6	Disease	258	15.9	92534	36	New	43	2.6	13798
7	Clinical	149	9.2	64211	37	Systematic	43	2.6	12368
8	Pandemic	135	8.3	29369	38	Mortality	40	2.5	21547
9	China	128	7.9	67067	39	Children	39	2.4	10404
10	Severe	118	7.3	36819	40	Evidence	39	2.4	8775
11	Infection	111	6.8	29303	41	Based	38	2.3	12663
12	Health	107	6.6	26513	42	Epidemic	38	2.3	13766
13	Review	94	5.8	27764	43	Factors	38	2.3	22196
14	Outbreak	90	5.5	27971	44	Features	37	2.3	12031
15	Acute	75	4.6	23028	45	Meta	36	2.2	10038
16	Novel	73	4.5	18577	46	Immune	35	2.2	9920
17	Analysis	72	4.4	20629	47	Italy	34	2.1	11144
18	Characteristics	69	4.2	40703	48	Severity	34	2.1	7938
19	Risk	69	4.2	25473	49	Management	33	2	8381
20	Associated	68	4.2	24755	50	Cohort	32	2	18079
21	Respiratory	68	4.2	24602	51	Diagnosis	32	2	8144
22	Syndrome	66	4.1	22649	52	Effect	32	2	7238
23	Treatment	65	4	20600	53	System	32	2	8475
24	Care	62	3.8	14850	54	Vaccine	31	1.9	7765
25	TransmissiON	55	3.4	17042	55	Viral	31	1.9	10511
26	Wuhan	55	3.4	30220	56	Cell	30	1.8	8216
27	Mental	54	3.3	15371	57	Global	30	1.8	7678
28	Outcomes	52	3.2	18796	58	Early	29	1.8	7041
29	Potential	52	3.2	13630	59	Hospital	29	1.8	7976
30	Case	50	3.1	11467	60	Psychological	29	1.8	8097

Figure 4: Distribution of HCPs by Keywords in COVID Reseach.

Table 7: Keyword Co-occurrence Analysis of HCPs in Covid-19 Science Research.

Keyword	Occurrences	Total Link Strength
Covid-19	555	2600
Coronavirus	371	1786
SARS-CoV-2	283	1535
Pneumonia	213	1246
SARS	177	1000
Acute Respiratory Syndrome	116	621
Infection	112	601
Outbreak	93	578
Respiratory Syndrome Coronavirus	64	452
China	86	451
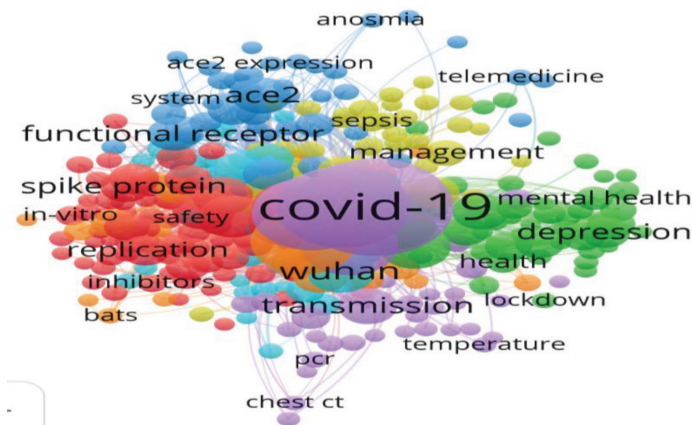
Figure 5: Network Analysis of Keyword Occurrences in HCPs on Covid-19.

SUMMARY

This study has analysed HCPs in Covid-19 research using bibliometric indicators with the aim to identify key countries and organizations in Covid-19 research. The analysis is based on research publications data published during 2019-21. The research data was sourced from Web of Science. Only such cited papers were covered in this study which accrued 100 or more citations per paper. The Covid-19 research by subject covered in HCPs is focused on top select areas involving medicine-general internal, infectious diseases, immunology and microbiology. The USA, China, and the UK dominate global Covid-19 research in terms of productivity of HCPs. But evaluating their performance in terms of citations received, China leads the tally with the USA at the second position. The USA, China, and the U.K. together account for an 88% world share of HCPs in the subject. The study identified top 11 centers of excellence based on the criterion of most productivity of HCPs by an organization coupled with the criterion of most citations that an organization received for HCPs it published. Four of eleven organizations each are located in USA and China, and one each in the UK, Italy and Hong Kong. The eleven organizations are Huazhong University of Science and Technology, Wuhan University, Harvard Medical School, University of Oxford, Icahn School of Medicine, Mt Sinai, Chinese Acadaemy of Sciences, University College London, Sun Yat- Sen University, Capital Medical University, Shanghai Jiao Tong University and University of Washington. These organizations may be regarded as the centres of excellence in Covid-19 medical science research. The most favored research journals for publication of HCPs are *New England Journal of Medicine, Lancet, JAMA-Journal of The American Medical Association, Science* and *Nature*. The relationship networks of most productive organizations and keywords based on VOSviewer software are also given.

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