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COVID-19 research output in 2020: The Global Perspective using Scientometric Study

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Abstract

This study presents the global level perspective of COVID-19 research output from January to April 2020, and these analyses include global publication share, patterns of research communication channels, the most productive Sources, Authors and Institutions. Data were extracted from the Web of Science citation database using the search string of “Coronavirus” OR “COVID-19” and limited to 2020, a total of 1658 publications were retrieved, which have received 4804 citations and the overall H-index is 29. On the basis of literature analysis around the world, it is found that the 1658 publications came from 78 Countries. As expected China is the most productive country with 523 papers (31.5%) and received 3521 Citations followed USA with 315 and recorded 912 Citations, UK with 142 and recorded 351 Citations, Italy with 116 and recorded 154 Citations, Germany 66 and recorded 188 Citations and Canada 58 and recorded 139 Citations, India ranked 10th position among the countries in the year of 2020. There were 2027 institutes involved the research in COVID-19. Huazhong University, Science & Technology Wuhan-China, recorded highest publications of 46 (583 Citations) and 12 Institutes from China with top 12 ranked and covered one-third of Publications out of 1658. BMJ-BRITISH MEDICAL JOURNAL in the first journal with the highest number of publications with 181 and Impact Factor value is 27.60 followed by LANCET 86 and Impact Factor value is 59.10. The most top impact factor journal is NEW ENGLAND JOURNAL OF MEDICINE 70.67.

Keywords: Scientometrics, Citations, COVID-19, Collaboration Network, Co-Citations

INTRODUCTION

Scientometric approaches is measuring and mapping research activities and outputs, used to (i) track the temporal and spatial development of research fields and topics, (ii) assess the productivity and impact of researchers and research institutions, as well as (iii) study patterns in gender balance in academia, interdisciplinary, and peer review processes. Scientometrics is “the study of the measurement of scientific and technological progress” (Garfield, 1979b). Its origin is in the quantitative study of science policy research, or the science of science, which focuses on a wide variety of quantitative measurements, or indicators, of science at large. They can also be used to measure research collaborations, to map scientific networks and to monitor the evolution of scientific fields. Scientometric indicators give policy-makers objective.

About COVID-19

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with

underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. The best way to prevent and slow down transmission is be well informed about the COVID-19 virus, the disease it causes and how it spreads. Protect yourself and others from infection by washing your hands or using an alcohol based rub frequently and not touching your face. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it's important that you also practice respiratory etiquette (for example, by coughing into a flexed elbow). At this time, there are no specific vaccines or treatments for COVID-19. However, there are many ongoing clinical trials evaluating potential treatments. 30,90,445 confirmed, deaths is 2,34,105 people and Recovered 10,39,195 (WHO 2020).



Related literature

Thulasi, K., & Arunachalam, S. (2010) Cholera research in India over the past six decades has been mapped using HistCite. The analysis based on data from *Science Citation Index Expanded* reveals not only the significant papers, key players, important institutions and core journals, but also provides a visual representation of evolution of knowledge in the field showing the cognitive links between key papers both from within India and elsewhere.

Laksham S. et al. (2020) have presented the global level perspective of Coronavirus research output during the period of 1989 to March 2020 and these analyses included year wise research growth, global publication share and patterns of research communication channels and the most productive journals. Data was extracted from the Web of Science citation database using the search string of “Coronavirus” OR “Covid 19” and limited to Open Access Publications during 1989 to 2020, a total of 7381 publications were retrieved. The highest numbers of publications (561) were published in 2019, which have received 848 citations. Thus this article can be concluded by collaborative author's productivity dominates compared to the single author's contribution. On the basis of literature analysis around the world, it is found that the 7381 publications came from 127 countries. United States (USA) is the most productive country with 2801 publications (37.9% and received 107738

Citations. India (80) has to improve in the field of Coronavirus research in future. The research articles published in peer-reviewed journals of Open Access will create a global impact on the Country, Institutions with subdivision and scientists. These contributions will help the research community to get required information for the research and encourage the researcher in the field of Coronavirus.

Laksham S. et al. (2020) have examined the publications on Coronavirus from India indexed in web of science online database. The search term “Coronavirus” or “COVID 19” with topic field has been used as keyword and limited to India. A total of 281 unique records over the year 1975–2020 have been downloaded and analyzed under various categories considered for this study. The highest number of articles are published in the year 2016, 2017, 2018 and 2019. Year 2015 has highest number of Citations with 531 for 17 (6.2 %) Publications. The study found that 1369 authors concentrated the research in this field and 281 papers published in indexed journals. International Centre for Genet Engineering & Biotechnology stood in the first with the highest number of publications with 20 (7.3 %) and received 549 Citations followed by All India Institute of Medical Science with 12 (4.4 %) Publications and received 67 Citations, Guru Ghasidas Vishwavidyalaya with 10 (3.7%) Publications and received 482 Citations, Indian Institute of Technology with 10 (3.7 %) Publications and received 86 Citations, University of Delhi with 8(2.9 %) Publications and received 128 Citations, Indian Institute of Science with 6 (2.2%) and received 61 Citations. India has collaborated with 38 countries. CSIR, DBT India, UGC, USDHHS, DST India and ICMR are most funded agencies in the field of Coronavirus. Furthermore, this study also identified that document wise distribution, Journal wise, institution with subdivision wise, and geographical collaboration of the literature and citation analysis is also distinguished.

Structure of RESEARCH DESIGN

The research design is analytical that adopts detailed analysis of secondary data using a range of bibliometric and scientometric tools, techniques and formula along with standard statistical techniques.

OBJECTIVES OF THE STUDY

According to the World Health Organization, COVID-19 is the infectious disease caused by the most recently discovered coronavirus. This new virus and disease were unknown before the outbreak began in Wuhan, China, in December 2019. In view of this research activities are being carried out around the world to cope with the issues related to this Virus. A scientometric study in this area will help the scientists to understand the progress in research and development. In particular, the study was confined to the following:

- To examine the growth of literature on COVID-19 during the period January to April 2020;

- To identify the country-wise research contribution of Publications, Citations and Collaboration Network;
- To identify the worldwide COVID-19 research in context of sub domain of subject areas;
- To identify the highly productive institutions with Citations;
- To identify the most productive authors with Citations and indexes;
- To identify the most productive journals with Impact Factor;
- To Identification of core journals in the field of COVID-19 and the application of Bradford's law as an indicator of the dispersion of scientific literature;
- To identify the Most Cited documents includes author, Source and Title;
- To find the Authorship pattern and Most productive authors and impact;
- To find out the Bibliographical form wise distribution of Publications.

3.2 MATERIAL AND METHODS

The data for this study has been obtained from Web of Science multidisciplinary database and it was originally produced by the Institute for Scientific Information and is currently maintained by Clarivate Analytics. Web of Science is a multidisciplinary bibliographic database that provides information from approximately 21294 Journals and is used to map worldwide science and technology data including medical Sciences. With the aim of covering all the available citations on the subject, the above mentioned database was searched using the following term: 'Coronavirus' OR 'COVID-19' with topic field. A total of 1658 records were collected in 2020 (January to April) and data were tabulated using Histcite and Biblioshiny. The coded variables were as follows: number of authors contributing to the articles and country/institute to which they belong, the names of journal in which articles were published, the subject areas covered by journals, Highly Cited Papers, Cited References and Bibliographical forms.

DATA ANALYSIS AND INTERPRETATIONS

Geographical wise Distribution of Publications and Citations

A total of 1658 publications were published in COVID-19 during January to April 2020 and these publications received 4804 Citations. The overall H-index 29 is high impact within the short period. Out of 1658 publications, China had the highest number of publication with 523 and recorded 3521 Global Citation Scores followed USA with 315 and recorded 912 Citations, UK with 142 and recorded 351 Citations, Italy with 116 and recorded 154 Citations, Germany 66 and recorded 188 Citations and Canada 58 and recorded 139 Citations, India ranked 10th position among the countries in the year of 2020. The data witnessed the importance of research in COVID-19 to solution to the

problem. It also found 80 Publications (Advance Publications) are recorded from May to December 2020 and received 123 Citations.

Table 1 shows that Geographical wise distribution of Publications and Citations

#	Country	Records	%	TGCS	Country	Records	%	TGCS
1	Peoples R China	523	31.5	3521	Turkey	5	0.3	0
2	USA	315	19.0	912	U Arab Emirates	5	0.3	3
3	UK	142	8.6	351	Argentina	4	0.2	10
4	Italy	116	7.0	154	Austria	4	0.2	4
5	Germany	66	4.0	188	Bangladesh	4	0.2	3
6	Canada	58	3.5	139	Ghana	4	0.2	5
7	Switzerland	54	3.3	77	Nigeria	4	0.2	12
8	Australia	44	2.7	245	Senegal	4	0.2	12
9	South Korea	44	2.7	84	Vietnam	4	0.2	37
10	India	42	2.5	21	Mali	3	0.2	4
11	Singapore	36	2.2	54	Mexico	3	0.2	2
12	France	35	2.1	75	Poland	3	0.2	0
13	Iran	31	1.9	12	Venezuela	3	0.2	1
14	Japan	30	1.8	56	Qatar	2	0.1	0
15	Netherlands	30	1.8	145	Rep Congo	2	0.1	55
16	Saudi Arabia	30	1.8	99	Brunei	1	0.1	0
17	Brazil	29	1.7	30	Bulgaria	1	0.1	0
18	Thailand	23	1.4	30	Cote Ivoire	1	0.1	7
19	Spain	22	1.3	19	Croatia	1	0.1	0
20	Sweden	19	1.1	26	DEM REP CONGO	1	0.1	0
21	Taiwan	17	1.0	26	Ecuador	1	0.1	0
22	Denmark	16	1.0	64	Gabon	1	0.1	0
23	Belgium	15	0.9	73	Ireland	1	0.1	0
24	Hungary	15	0.9	2	Jordan	1	0.1	0
25	South Africa	14	0.8	8	Kenya	1	0.1	0
26	Egypt	12	0.7	15	Luxembourg	1	0.1	7
27	Portugal	9	0.5	0	Maldives	1	0.1	2
28	Russia	9	0.5	16	Mauritius	1	0.1	0
29	Norway	8	0.5	8	Oman	1	0.1	54
30	Colombia	7	0.4	13	Panama	1	0.1	0
31	Israel	7	0.4	4	Paraguay	1	0.1	0
32	Pakistan	7	0.4	1	Peru	1	0.1	2
33	Greece	6	0.4	32	Romania	1	0.1	0
34	Chile	5	0.3	3	Sudan	1	0.1	0
35	Ethiopia	5	0.3	20	Tanzania	1	0.1	0
36	Finland	5	0.3	3	Uganda	1	0.1	1
37	Malaysia	5	0.3	8	Ukraine	1	0.1	0
38	Nepal	5	0.3	4	Viet Nam	1	0.1	8
39	New Zealand	5	0.3	2	Unknown	359	21.7	190

Country Scientific Production

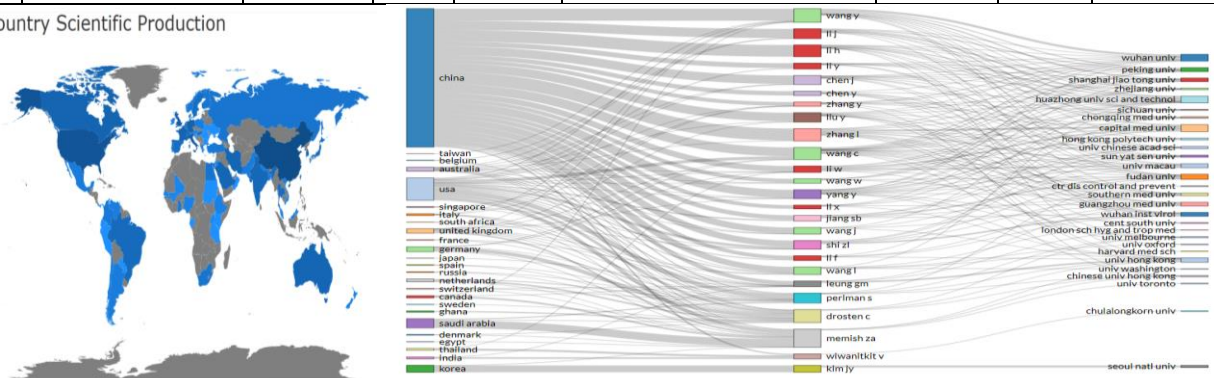


Figure 1. shows that Scientific Production of Countries

Figure 2 shows Three Field Plot (Country, author and Institutions)

International Collaboration

In recent years, every Scientist has realized the importance of collaborative research to find the solution to the particular problem through international collaborations. China has the highest number of collaborative publications with countries like the USA (80), UK(26), Canada (18), Australia (15) and India (15) respectively, Germany (14), Italy and Thailand (11) respectively followed by USA to UK (35), USA to Italy (25), USA to Saudi Arabia (15). The below table and figure are shows, how Countries are Internationally Collaboration with other Countries. Collaboration Index is 4.96.

Table 2 shows that International research Collaboration of Countries

From	To	Frequency	From	To	Frequency
CHINA	USA	80	CANADA	SAUDI ARABIA	9
USA	UNITED KINGDOM	35	ITALY	GERMANY	9
CHINA	UNITED KINGDOM	26	CANADA	AUSTRALIA	8
USA	ITALY	25	CANADA	ITALY	8
CANADA	USA	19	CHINA	NETHERLANDS	8
CHINA	CANADA	18	CHINA	SINGAPORE	8
ITALY	UNITED KINGDOM	18	CHINA	SPAIN	8
CHINA	AUSTRALIA	15	ITALY	SWITZERLAND	8
CHINA	INDIA	15	KOREA	USA	8
USA	SAUDI ARABIA	15	UK	AUSTRALIA	8
CHINA	GERMANY	14	UK	NETHERLANDS	8
INDIA	THAILAND	14	UK	SWEDEN	8
USA	AUSTRALIA	14	USA	SPAIN	8
UK	GERMANY	13	FRANCE	GERMANY	7
CANADA	UNITED KINGDOM	12	GERMANY	SWEDEN	7
UK	SINGAPORE	12	ITALY	FRANCE	7
CHINA	ITALY	11	ITALY	NETHERLANDS	7
CHINA	THAILAND	11	NETHERLANDS	GERMANY	7
UK	SWITZERLAND	11	UK	FRANCE	7
USA	GERMANY	11	UK	SOUTH AFRICA	7
USA	SWITZERLAND	11	USA	DENMARK	7
ITALY	SPAIN	10	USA	INDIA	7
USA	FRANCE	10	USA	JAPAN	7
USA	NETHERLANDS	10	EGYPT	SAUDI ARABIA	6
BRAZIL	ITALY	9	FRANCE	BELGIUM	6

Table 3 shows Corresponding Author Country

Country	Articles	Freq	Single Country Publications	Multiple Country Publications	MCP_Ratio
CHINA	501	0.375	395	106	0.212
USA	186	0.139222	147	39	0.21
ITALY	86	0.064371	68	18	0.209

UK	85	0.063623	58	27	0.318
GERMANY	42	0.031437	29	13	0.31
KOREA	38	0.028443	32	6	0.158
SWITZERLAND	32	0.023952	23	9	0.281
CANADA	29	0.021707	13	16	0.552
IRAN	25	0.018713	21	4	0.16
JAPAN	24	0.017964	19	5	0.208
SINGAPORE	24	0.017964	18	6	0.25
AUSTRALIA	21	0.015719	11	10	0.476
FRANCE	21	0.015719	12	9	0.429
INDIA	19	0.014222	14	5	0.263
THAILAND	18	0.013473	5	13	0.722
SAUDI ARABIA	17	0.012725	5	12	0.706
BRAZIL	15	0.011228	12	3	0.2
HUNGARY	15	0.011228	15	0	0
TAIWAN	14	0.010479	11	3	0.214
NETHERLANDS	13	0.009731	5	8	0.615

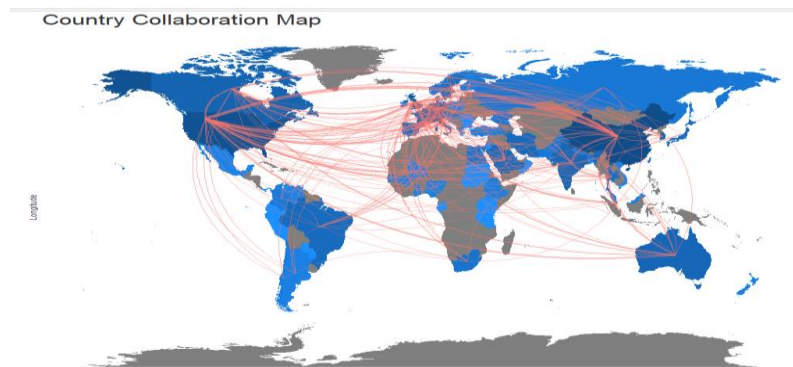


Figure 3 shows International Collaboration among the Countries

Collaboration Network

Table Collaboration networks show how countries relate to others in a specific field of research (COVID-19). For example, the figure below is a Country network. It discovers groups of Countries in Coronavirus research and their relations. It is calculated based on Number of Cluster with Btw Centrality.

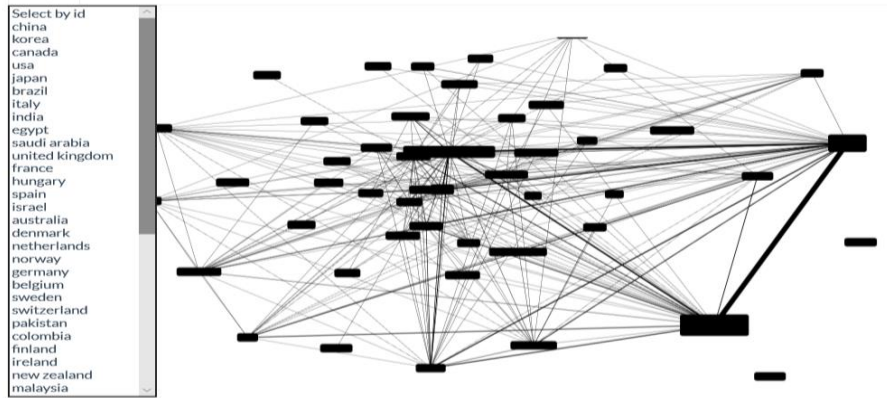


Figure 4 shows Collaboration Network of the Countries in Coronavirus research

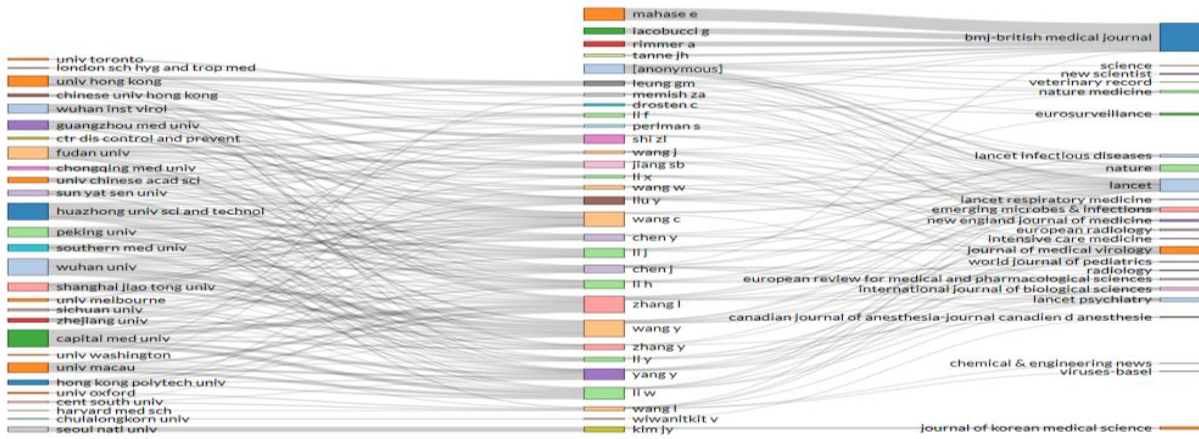
Institution wise distribution of Publications WHO 9 (16)

There were 2027 institutes involved the research in COVID-19. Huazhong University Science & Technology Wuhan-China recorded highest publication of 46 (583 Citations) in the area of COVID-19 followed by University of Hong Kong 43(635 Citations); Wuhan University 36(704 Citations); Fudan University 35(240 Citations); Chinese Academy of Science 33(1116 Citations). It found top 12 Universities are from China and covered one third of Publications out of 1658. Table 4 provides top 40 institutes as per Publications with Citations. It also found WHO also contributed 9 publications and received 16 Citations.

Table 4 shows Institution wise distribution of Publications and Citations

#	Institution	Records	%	TGCS	Institution	Records	%	TGCS
1	Huazhong University Science & Technology	46	2.8	583	Harvard Med Sch	15	0.9	1
2	University of Hong Kong	43	2.6	635	Sichuan University	15	0.9	29
3	Wuhan University	36	2.2	704	Southern Medical University	15	0.9	59
4	Fudan University	35	2.1	240	Chongqing Med University	14	0.8	17
5	Chinese Academy of Science	33	2.0	1116	Minist Hlth	14	0.8	80
6	Capital Med University	29	1.7	803	NIAID	14	0.8	143
7	Zhejiang University	28	1.7	75	Cent South University	13	0.8	31
8	Chinese Academy of Medical Science	22	1.3	510	China Med University	13	0.8	31
9	Peking University	22	1.3	102	Hong Kong Polytech University	13	0.8	53
10	Sun Yat Sen University	21	1.3	146	Natl Univ Singapore	13	0.8	24
11	Guangzhou Med University	19	1.1	90	Tsinghua University	13	0.8	428
12	Shanghai Jiao Tong University	19	1.1	281	University Washington	13	0.8	100
13	UCL	19	1.1	80	University Milan	12	0.7	6
14	University Toronto	19	1.1	62	Charite University Med Berlin	11	0.7	111
15	London Sch Hyg & Trop Med	18	1.1	30	Chinese Acad Med Sci & Peking Union Med Coll	11	0.7	461
16	University Oxford	18	1.1	103	Kings Coll London	11	0.7	27
17	University Macau	17	1.0	32	Hainan Med University	10	0.6	5
18	Chinese University Hong Kong	16	1.0	98	Imperial Coll London	10	0.6	16
19	University Chinese Academy of Science	16	1.0	363	University Melbourne	10	0.6	18
20	Emory University	15	0.9	71	Zhengzhou University	10	0.6	15

Figure 5 shows Three Field Plot (Institutions, Author and Source)



Collaboration Network of Institutions

Collaboration networks show how institutions (e.g. universities or departments) relate to others in a specific field of research (COVID-19) and relevant institutions and their relations through research Collaboration. It is based on Cluster and Btw Centrality.

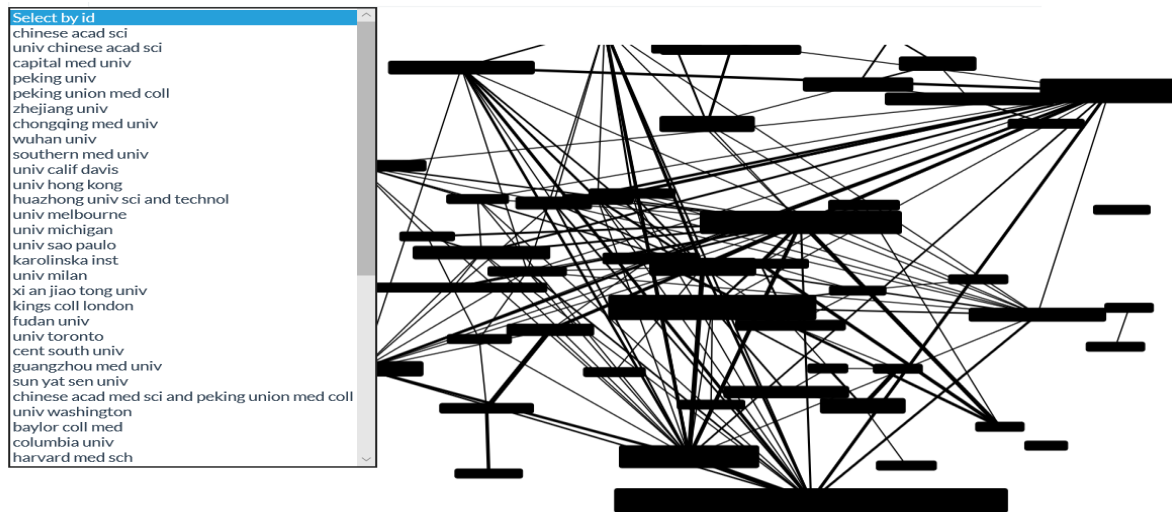


Figure 6 shows Collaboration Network of Institutions

Bibliographical form wise distribution of Publications

A total 1658 publications 453 (27.3%) are articles published in Journal articles followed by Editorial Material 367 (22.1%), News Item 222(13.4%), Letters 156 (9.4), Article; Early Access 145(8.7%), Editorial Material Early Access 111(6.7); and remaining less than five percent of Publications are published different forms. The study found that COVID-19 publications are shared in 13 forms and 6 forms are recorded highest number of publications. It also found researcher given the preference to publish in different form not only Journal articles.

Table 5 shows Bibliographical form wise distribution of Publications

#	Document Type	Records	%	TGCS
1	Article	453	27.3	2908
2	Editorial Material	367	22.1	704
3	News Item	222	13.4	80
4	Letter	156	9.4	365
5	Article; Early Access	145	8.7	266
6	Editorial Material; Early Access	111	6.7	28
7	Review	79	4.8	265
8	Letter; Early Access	71	4.3	47
9	Review; Early Access	30	1.8	60
10	Correction	19	1.1	0
11	Correction; Early Access	3	0.2	80
12	Article; Data Paper	1	0.1	0
13	Reprint	1	0.1	1

Source Impact

Table 6 indicates that the source title wise distribution of total research output on Coronavirus research literature in 2020. BMJ-BRITISH MEDICAL JOURNAL in the first journal with the highest number of publication with 181 (g-index-7 and h-index-4, Citations-112) and Impact Factor value is 27.60 followed by LANCET 86 (g-index-10 and h-index-35, Citations-1249) and Impact Factor value is 59.10. It found more than 10 Sources are more than 10 Impact factor out of top 10 in the list. The highest impact factor journals are NEW ENGLAND JOURNAL OF MEDICINE 70.67 LANCET (59.10) among the top 20 titles.

Table 6 shows the source Impact of the titles

Source Title	h_index	g_index	m_index	TC	NP
BMJ-BRITISH MEDICAL JOURNAL –(IF: 27.60)	4	7	4	112	181
LANCET – IF: (59.10)	10	35	10	1249	86
JOURNAL OF MEDICAL VIROLOGY – 2.37	8	14		280	72
CHEMICAL & ENGINEERING NEWS – 1.13	0	0	0	0	41
EUROSURVEILLANCE – 5.98	5	11	5	126	36
NATURE – 43.07	6	22		506	29
SCIENCE – 41.06	3	6	3	40	28
EMERGING MICROBES & INFECTIONS – 6.21	4	8	4	80	24
NEW SCIENTIST – 4.4	1	1	1	1	21
NATURE MEDICINE – 30.64	3	5		28	20
JOURNAL OF KOREAN MEDICAL SCIENCE – 1.29	4	6	4	51	19
INTENSIVE CARE MEDICINE – 18.96	4	5		45	18
CANADIAN JOURNAL OF ANESTHESIA-JOURNAL CANADIEN D ANESTHESIE – 3.37	3	7		52	16
LANCET INFECTIOUS DISEASES – 27.51	3	5	3	32	16
LANCET RESPIRATORY MEDICINE – 22.99	4	8	4	78	16
ARCHIVES OF IRANIAN MEDICINE – 0.56	0	0	0	0	15
NEW ENGLAND JOURNAL OF MEDICINE – 70.67	8	15	8	663	15
EUROPEAN REVIEW FOR MEDICAL AND PHARMACOLOGICAL SCIENCES – 1.57	2	2	2	9	14
VIRUSES-BASEL – 3.81	3	6	3	42	14
JOURNAL OF CLINICAL MEDICINE – 5.68	5	7	5	64	13

Bradford postulated the division into three equal zones of one third article is each zone. Based on the Bradford law, each zone should follow a linear geometric expression in the form of 1: n : n². In context of present literature on Coronavirus, it is found that 12 journals constitute first zone have 575 articles and consider as Core Sources in the field of Coronairus, next zone with 93 journals have 546 articles and much larger group of 442 journals have 517 articles. On analysis of the data, it is found that the literature on Coronavrus does not follow this rule and each zone represents the Bradford expression as 12: 93:442 which does not fit into the expression.

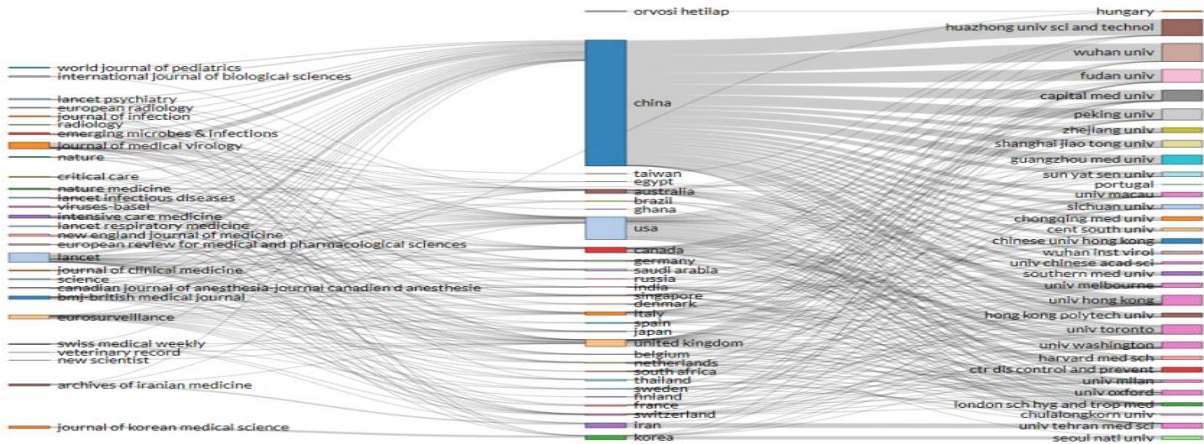


Figure 7 shows Three Field Plot (Source, Country and Institutions)
Co-Citation of Source

Citation analysis is one of the main classic techniques in bibliometrics/Scientometrics. It shows the structure of a specific field through the linkages between nodes (journal to Journals), while the edges can be differently interpreted depending on the network type, that are namely co-citation, direct citation, bibliographic coupling. (Aria, Cuccurullo (2017)). It shows relations between Journals and its based on number of Citations, Clusters and Notes.

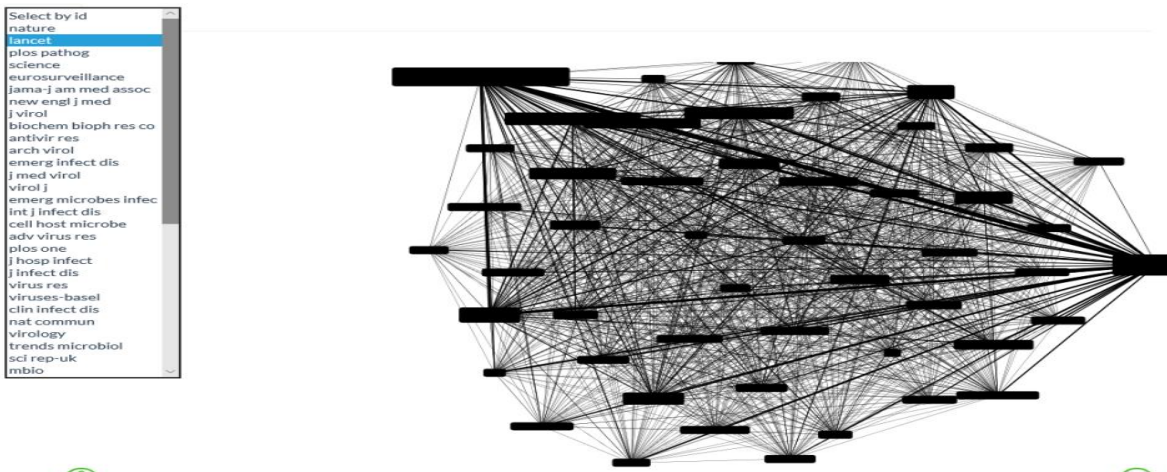


Figure 8 shows Co-Citations of Sources

Author Impact

There were a total number of 8307 name occurrences of the authors contributing 1658 Publications in the field of Coronavirus during of January to April 2020. The top 25 authors are listed below in Table. This table ranks authors by the number of publications. Findings revealed that out of 1658 Publications, a total number of 37 Publications were contributed by “Mahase E” (h-index-3, g-index-3) and recorded 29 Citations followed by “Wang Y” with 21 (h-index-3, g-index-6) and recorded 43 Citations, “Iacobucci G” with 18 Publications. It found 18 authors are recorded more than 10 publications. The highest number of Citations (982) by “Shang L” for 15 publications followed by Zhang FX (753), Huang CL (738), Li XW (638) and Wei Y (64 Citations). It was interesting to know some authors published less number of publications and received highest number of Citations. 15 authors recorded more than 500 Citations within short period and 95 authors recorded 100 and above Citations.

Table 7 shows author impact of publications in COVID-19

Author	h_index	g_index	m_index	Citations	Publications
MAHASE E	3	3	3	29	37
WANG Y	3	6		43	21
IACOBUCCI G	1	1	1	4	18
RIMMER A	1	1	1	2	15
LI J	3	12		152	14
ZHANG L	6	14		980	14
CHEN J	4	12		517	12
LIU Y	5	12		543	12
WANG J	2	12		144	12
WIWANITKIT V	1	1		5	12
YANG Y	3	12		205	12
LI H	3	11		574	11
LI Y	3	4		22	11
SHI ZL	5	11		458	11
WANG L	2	11		146	11
CHEN Y	5	10		413	10
JIANG SB	5	7		61	10
LI F	3	7		55	10
LEUNG GM	4	9		257	9
LI X	3	7		57	9

Author Collaboration Network

It represents the Collaboration networks show how authors relate to others in a specific field of Coronavirus research. For example, the figure below is a Collaboration network based on Nodes, Cluster and Btw Centrality.

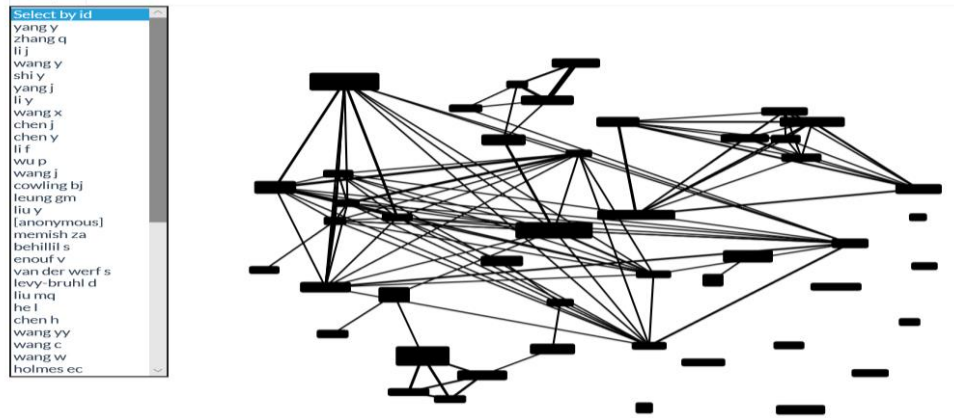


Figure 9 shows Collaboration Network of Authors

Co-Citation of Authors

Citation analysis is one of the main classic techniques in bibliometrics/Scientometrics. It shows the structure of a specific field through the linkages between nodes (e.g. authors), while the edges can be differently interpreted depending on the network type, that are namely co-citation, direct citation, bibliographic coupling. (Aria, Cuccurullo (2017)). First, a co-citation network that shows relations between cited-reference works (nodes). The useful dimensions to comment the co-citation networks are: (i) centrality and peripherality of nodes, (ii) their proximity and distance, (iii) strength of ties, (iv) clusters, (iiv) bridging contributions.

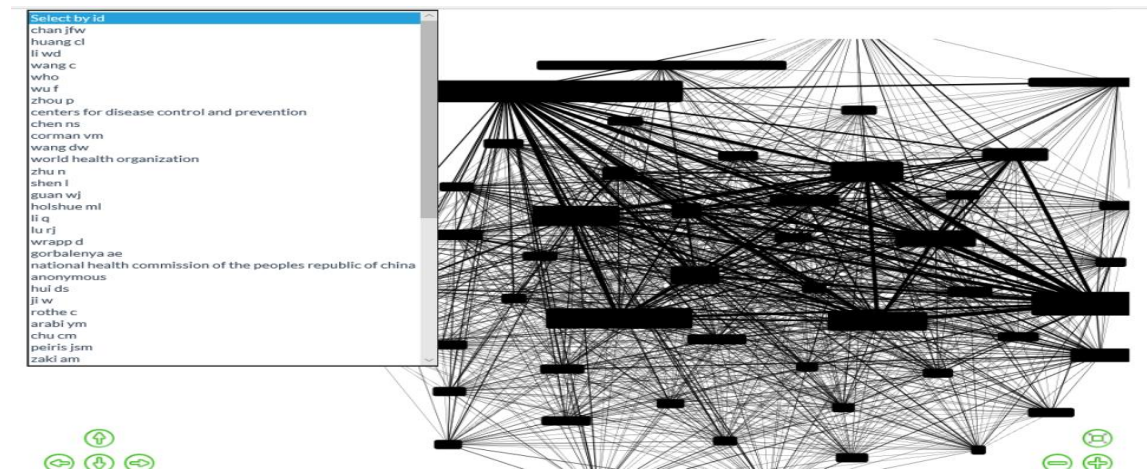


Figure 10 shows Co-Citations of Authors

Most Global Cited Documents

80 Publications have received more than 10 citations and 9 Publication and recorded more than 100 Citations, besides this the citations count has been taken as the number of citations received by each paper since these were published till April 2020. Table presents the pattern of frequently cited papers. The most cited paper “Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China, LANCET. 2020 FEB 15; 395 (10223): 497-506 bu Huang CL, Wang YM, Li XW, Ren

LL, Zhao JP, et al.” recorded 381 Citations followed by “A Novel Coronavirus from Patients with Pneumonia in China, 2019, NEW ENGLAND JOURNAL OF MEDICINE. 2020 FEB 20; 382 (8): 727-733by Zhu N, Zhang DY, Wang WL, Li XW, Yang B, et al.” recorded 257 Citations, “Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study LANCET. 2020 FEB 15; 395 (10223): 507-513by Chen NS, Zhou M, Dong X, Qu JM, Gong FY, et al.” recorded 216 Citations.

Table 8 shows most Global Cited documents

Paper	Total Citations
HUANG CL, 2020, LANCET	381
ZHU N, 2020, NEW ENGL J MED	257
CHEN NS, 2020, LANCET	216
ZHOU P, 2020, NATURE	178
ZHOU P, NA, NATURE	178
CHAN JFW, 2020, LANCET	172
LI Q, 2020, NEW ENGL J MED	162
WANG DW, 2020, JAMA-J AM MED ASSOC	150
LU RJ, 2020, LANCET	140
HOLSHUE ML, 2020, NEW ENGL J MED	94
WU JT, 2020, LANCET	77
WANG C, 2020, LANCET	72
WU F, 2020, NATURE	66
WU F, NA, NATURE-a	66
WANG ML, 2020, CELL RES	63
HUI DS, 2020, INT J INFECT DIS	54
LU HZ, 2020, J MED VIROL-a	43
CORMAN VM, 2020, EUROSURVEILLANCE	42
WAN YS, 2020, J VIROL	39
ZOU LR, 2020, NEW ENGL J MED	38

Research Areas and Thematic Occurrence of words

The highest publications were in GENERAL INTERNAL MEDICINE (466) followed by VIROLOGY (127), INFECTIOUS DISEASES(126). Table 9 provides sub-domain share of publications in various COVID-19 sub-domains.

Table 9 shows research Areas of Publications

Research Areas	records
GENERAL INTERNAL MEDICINE	466
VIROLOGY	127
INFECTIOUS DISEASES	126
SCIENCE TECHNOLOGY OTHER TOPICS	98
PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	81
MICROBIOLOGY	80
IMMUNOLOGY	77

RESEARCH EXPERIMENTAL MEDICINE	74
BIOCHEMISTRY MOLECULAR BIOLOGY	72
PHARMACOLOGY PHARMACY	62
RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING	62
ENGINEERING	53
VETERINARY SCIENCES	53
CHEMISTRY	52
CELL BIOLOGY	49
ONCOLOGY	43
PEDIATRICS	42
RESPIRATORY SYSTEM	41
CARDIOVASCULAR SYSTEM CARDIOLOGY	33
LIFE SCIENCES BIOMEDICINE OTHER TOPICS	32
HEALTH CARE SCIENCES SERVICES	28
SURGERY	27
ANESTHESIOLOGY	26
PSYCHIATRY	23
BIOTECHNOLOGY APPLIED MICROBIOLOGY	20

Table 10 shows Thematic Occurrences

Thematic occurrences				Co-Occurrence of Network		
Total	Words	Cluster	Cluster_Label	Term	Cluster	Btw Centrality
96	SARS	1	sars	cov	3	4.919862886
83	coronavirus	1	sars	spike protein	3	48.94153477
62	infection	3	infection	functional receptor	3	20.03104147
60	pneumonia	1	sars	vaccine	3	0.052631579
53	acute respiratory syndrome	1	sars	mers-cov	3	4.597902767
49	respiratory syndrome coronavirus	5	respiratory syndrome coronavirus	sars-cov	3	4.805553424
48	virus	2	virus	receptor-binding domain	3	4.399217908
38	outbreak	1	sars	nucleocapsid protein	3	0.108653846
35	protein	2	virus	sars coronavirus	2	7.805640828
31	transmission	1	sars	inhibition	2	5.651372853
31	identification	2	virus	infection	2	112.656059
30	wuhan	1	sars	virus	2	128.3432149
29	receptor	3	infection	pathogenesis	2	11.00709045
28	spike protein	5	respiratory syndrome coronavirus	protein	2	69.52266496
26	china	1	sars	expression	2	1.15879999
25	sars coronavirus	2	virus	replication	2	12.20852987
20	functional receptor	5	respiratory syndrome coronavirus	respiratory syndrome coronavirus	2	126.211957
19	pathogenesis	2	virus	sars-coronavirus	2	0.668362202
19	replication	2	virus	binding	2	0.055555556
18	east respiratory syndrome	1	sars	recombination	2	4.269918524
17	influenza	1	sars	performance	2	0.555919191
16	epidemiology	1	sars	recognition	2	0.637851494
16	expression	2	virus	evolution	2	3.528822931
15	mers	1	sars	activation	2	5.05031254
15	disease	1	sars	bats	2	0.289574469

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