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Mapping of Coronavirus Research Output at Global level : A Scientometric Study

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Abstract:

The Present Study analyzed research output for a period of 5 years between 2015 to and 2019. Web of Science database a service from Clarivate Analytics has been used to download citation and source data. Histcite application software have been used to present the datasets. Analysis part focuses on the parameters like citation impact at local and global level, influential authors and their total output, ranking of contributing institutions and countries. In addition to this scientographical mapping of data is presented through graphs using VOSviewer software mapping technique.

Keywords: *Mapping, Scientometric Analysis, Histcite, VOSviewer, Coronavirus.*

Introduction: Coronavirus (COVID-19) was first reported in December 2019 in Wuhan City in China. Coronaviruses (CoV) are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). A novel coronavirus (nCoV) is a new strain that has not been previously identified in humans. Coronaviruses are zoonotic, meaning they are transmitted between animals and people. Detailed investigations found that SARS-CoV was transmitted from civet cats to humans and MERS-CoV from dromedary camels to humans. Several known coronaviruses are circulating in animals that have not yet infected humans.

Common signs of infection include respiratory symptoms, fever, cough, shortness of breath and breathing difficulties. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even death. Standard recommendations to prevent infection spread include regular hand washing, covering mouth and nose when coughing and sneezing, thoroughly cooking meat and eggs. Avoid close contact with anyone showing symptoms of respiratory illness such as coughing and sneezing.

As on dated 02 March 2020 The coronavirus COVID-19 is affecting 70 countries and territories around the world and 1 international conveyance. The China most is affecting Country in the world, its economy is damaged by this virus. Therefore the Scientometric study is important on Coronavirus at global level.

Review of Literature:

There is no scientometric study had been published so far on “Coronavirus”one Bibliometric study was done on Global research trends of Middle East respiratory syndrome coronavirus: a bibliometric analysis however, there are few other scientometric studies available, which quantitatively and qualitatively analyze global literature on individual other viruses , dengue, such as Cancer. Influenza, AIDS, Ebola virus, Nipha virus and many more studies. In the recent years, the study on Scientometric analysis in different subject field conducted by many researchers. The following few studies related to the objectives of this study have been reviewed in the research paper.

Bansal M. et. al (2018) The present study examines 521 Indian publications on “Chikungunya” as covered in Scopus database during 2006-15, experiencing an annual average growth rate of 17.56% and citation impact per paper of 10.79. The global publications on Chikungunya from top 10 most productive countries accounted for 87.93% publication share during 2006-15. The top 15 organizations and authors contributed 46.45% and 42.03% publication share and 63.5% and 101.67% citation share respectively of the Indian output and citations. Medicine among subjects, contributed the largest publication share of 77.35% followed by immunology and microbiology (29.75%), biochemistry, genetics and molecular biology (23.22%), agricultural & biological sciences (9.6%), pharmacology, toxicology & pharmaceuticals (6.91%) etc. during 2006-15. Of the total global publications, top 15 journals contributed 34.93% of the total Indian output.

Gupta B.M. et.al (2018) The present study examined 1181 global publications in Nipah virus, as covered in multidisciplinary and bibliographic Scopus database during 1999-

2018, with a view to understand their growth rate, global share, citation impact, international collaborative papers share, distribution of publications by broad subjects, productivity and citation profile of top organizations and authors, preferred media of communication and bibliographic characteristics of high cited papers.

Bhardwaj R.K (2016) The study covers a scientometric analysis of publications on Ebola virus worldwide. It revealed that 2446 papers have been published on Ebola virus in 159 journals, originating from 84 countries till December 31, 2013. These publications have received 69,960 citations until March 1, 2015. The maximum literature on this deadly virus is published in the form of articles and review, 2040 (83.40%). The highest number of papers was published in 2012, i.e., 198 (8.1%). Eighty-four countries have contributed in Ebola research with at least one publication. Top ten countries produced 2124 (86.8%) of the total research publications on Ebola virus. The United States is the leading country with 1146 (46.9%) in research outcome. The majority of papers is published in English language, 2149 (87.9%). Overall, 157 journals produced the Ebola virus research and “Journal of Virology” has published 257 (10.5%) of the papers.

Alvi K.S. et.al (2014) The study analyses the Hepatitis C virus research output from around the world during 1999-2013 on different parameters including the growth, global publications, international conference papers, contribution of major collaborative partner countries, contribution of various subject fields and by type of Hepatitis C, most productive institutions and authors and patterns of research communication in most productive journals. Scopus Citation Database has been used to retrieve the data for 15 years (1999-2013) by searching different relevant keywords in its combined title, abstract and keywords fields; totally 60434 records were retrieved from the database. The study reveals that the year-wise research output in the last two years were only in increasing trend. Among the top twelve listed sources “articles” occupies the first position with 41442 records.

Selvraj A.D.(2018) This paper analyses publication output in the field of Avian Influenza virus as indexed in CAB Direct Online database covering the period 1961 – 2016. It is observed that a total of 11,628 publications were published during the year 1961 to 2016 as per CAB Direct Online. The average number of publications published per year was 207 papers. The highest number of papers i.e. 1084 was published in the year 2010. The spurt in literature output was reported during 1998-2013. China is the top producing country with 1618 papers (13.91%) followed by the USA with 738 papers (6.34%). The top five most preferred journals by the scientists were: Avian Diseases with 688 papers (5.91%). The

prolific author is Swayne, D.E who contributed 349 papers (3%) followed by Suarez, D.L with 318 papers (2.73%).

Zyoud S.H.(2016) Study the total of 883 MERS-CoV research publications were published across the world. The MERS-CoV-associated publications were originated from 92 countries/territories, indicating the international spread of MERS-CoV research. The USA was the largest contributor, with 319 articles published over 4 years, followed by KSA (113 articles). The total number of citations for these publications has already achieved 8,015, with an average of 9.01 citations per each publication. The *h*-index for MERS-CoV-associated publications was 48. The USA also have the highest *h*-index (32), followed by KSA (26) and UK (22). Netherland produced the greatest proportion of publications with international research collaboration (72.7 %) followed by the UK (71 %) and Germany (69.1 %) out of the total number of publications for each country.

OBJECTIVES

The main objective of this study was to use Scientometric mapping and analyze the key features of Coronavirus research activities at global level such as : the rate of growth and doubling time on Coronavirus research,

- to identify document wise distribution of publications.
- to analyze the authorship pattern and examine the extent of research collaboration.
- to identify the ranking of authors based on publications.
- to identify journal wise distribution of publications and
- to assess the Institution wise research concentration and Global citation score of the publications.
- To find out the most common key word used while publication

METHODOLOGY

The research publications were retrieved from the Web of Science core collections database on the topic Coronavirus, which is scattered over the period from 2015 to 2019. The data was collected during the first week of Feb 2020. The search was carried out using the keyword “Coronavirus” in the ‘topic field.. A total of 3509 publications were downloaded and the same was analyzed using the software HistCite, VoSviewer and Microsoft Excel as per the objectives of the study.

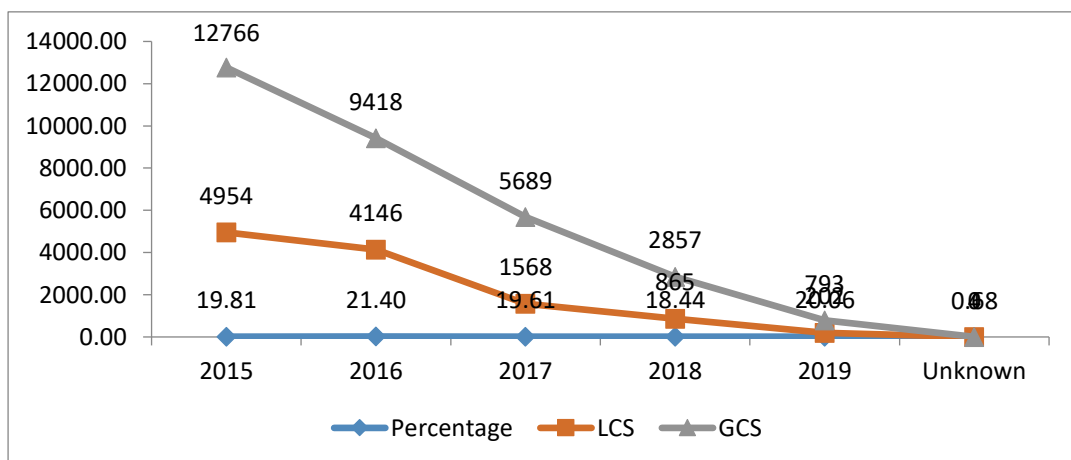
Table No. 1. Details of the Important Points of the Data Sample During 1990 to 2020

Sr.No.	Details about Sample	Observed Values
1	Duration	2015-2019
2	Collection Span	05 year
3	Total No. of Records	3509
4	Total No. of Authors	14167
5	Frequently Used Words	5752
6	Document Types	14
7	Languages	13
8	Contributing Countries	114
9	Contributing Institutions	3265
10	Institutions with Sub Division	7025
11	Total Cited References	78166
12	Total Local Citation Scores	11735
13	Total Global Citation Scores	31527
14	H-Index	60

Discussion and Result:

Table No. 2. Annual Distribution of Publications and Citations:

Publication Year	Recs	Percentage	LCS	GCS
2015	695	19.81	4954	12766
2016	751	21.40	4146	9418
2017	688	19.61	1568	5689
2018	647	18.44	865	2857
2019	704	20.06	202	793
Unknown	24	0.68	0	4
	3509	100.000		



Graph no. 1: Annual Distribution of Publications and Citations

The table no. 2. Reveals that the numbers of research documents published from 2015 to 2019 are gradually increased. According to the publication output from the table no. 2. The year wise distribution of research documents, 2016 has the highest number of research documents 751 (21.40%) with 4146of total local citation score and 9418 global citation score. The year 2019 has 704 (20.06) research documents and it stood in second position with 202 of total local citation score and 793 of total global citation score were scaled. It is followed by the year 2015 with 695 (19.81%) of records and it stood in third position along with 4954 of total local citation score and 12766 of total global citation score measured. The year 2017 has 688 (19.61%) research documents and it stood in fourth position with 1568 of total local citation score and 5689 of total global citation score were scaled. It is noticed that the increase in publications may not create impact on citation score yet the quality matters on total local citation scores and on total global citation scores. Graph number one mull over the year wise publications and depicts the citation score. It clearly indicates on the fact that the increased publication rate is not bringing the increased citation rate.

Table No. 3. Publication output of Top 20 Authors and Citation Score.

Sr. No	Author	Recs	Percent	LCS	LCS/t	LCSx	GCS	GCS/t	LCR	LCSb	LCSe
1	Perlman S	59	1.7	666	130.3833	527	1208	254.85	325	224	107
2	Yuen KY	56	1.6	476	88.48333	325	1028	205.85	220	173	96
3	Baric RS	55	1.6	405	74.38333	305	986	208.65	274	165	62
4	Drosten C	50	1.4	683	131	533	992	194.25	203	269	118
5	Lau SKP	45	1.3	315	57.85	198	623	121.0667	190	153	74
6	Woo PCY	45	1.3	314	57.65	198	627	122.0667	222	153	73
7	Jiang SB	44	1.3	395	76.01667	262	797	170.9667	341	131	57
8	Memish ZA	43	1.2	472	95.86667	336	751	157.6667	389	173	62
9	Al-Tawfiq JA	39	1.1	209	41.21667	144	498	107.3	403	97	30
10	Gerber SI	34	1	502	98.5	419	670	135.15	170	148	37
11	Haagmans BL	33	0.9	365	77.23333	283	531	113.75	271	62	7
12	Peiris M	32	0.9	368	78.13333	306	479	101.5	142	139	50
13	Zhang Y	32	0.9	206	44	183	464	95.48333	113	11	-27
14	Du LY	31	0.9	385	73.36667	263	637	129.8333	290	119	66
15	Xiao SB	31	0.9	150	32.35	93	354	80.56667	204	7	-23
16	Corman VM	30	0.9	555	103.3833	433	755	142.5167	103	226	102
17	Feng L	30	0.9	85	17.88333	58	263	58.73333	126	8	-24
18	Bosch BJ	29	0.8	494	105.9667	355	647	142.25	298	102	28
19	Wang D	29	0.8	175	37.21667	115	374	84.76667	193	2	-25
20	Kim Y	28	0.8	89	20.66667	64	256	55.63333	122	23	-3

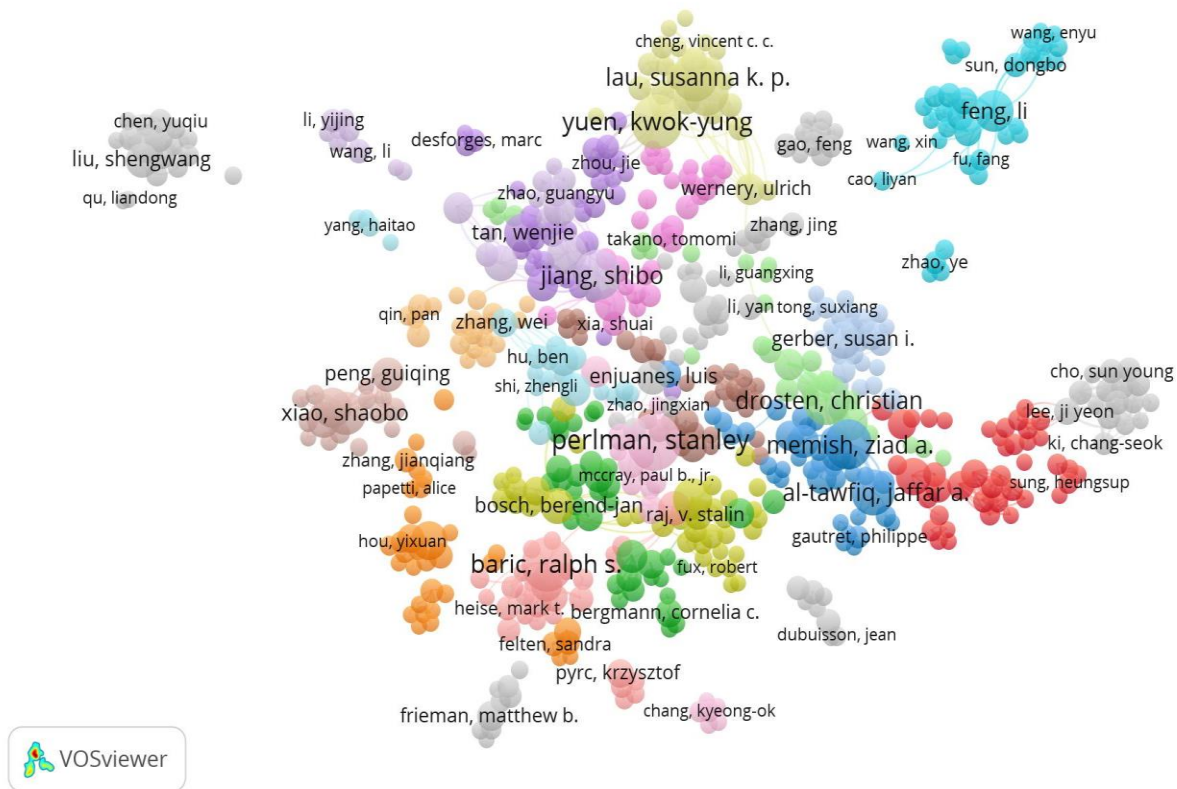


Figure 1: Showing Highly Prolific Authors

Analysis of the Publication Output of Top 25 Authors.

Table No. 3. and figure 1 displays the ranking of authors of research articles. In the rank analysis the authors who have published more than 5 articles or more are considered into account to avoid a long list. It was observed that there is total of 14167 authors for 3509 records and it shows the top 20 most productive authors during 2015-2019. Perlman S. published 59 (1.7%) articles with 1208 TGCS articles, followed by Yuen K.Y.56 (1.6%) with 1028 TGCS articles, Baric R. S. 55(1.6%) with 986 TGCS articles, Drosten C.50 (1.4%) with 992 TGCS articles, Lau S.K.P. 45 (1.3%) with 630 TGCS article, other authors have contributed less than 1.2% during the period of study. The data set clearly depicts that no matter how many publications that an author brings out yet the quality publications alone shows impact in the form of total local citations score and total global citations score.

Table No. 4. Ranking of Institutions and their Research Performance

Institution	Recs	Percent	LCS	GCS
Univ Hong Kong	137	3.9	1110	2156
Chinese Acad Sci	92	2.6	682	1206
Chinese Acad Agr Sci	91	2.6	277	665
Minist Hlth	82	2.3	856	1213
NIAID	72	2.1	309	1353

Ctr Dis Control & Prevent	71	2	462	1049
Univ Iowa	68	1.9	701	1317
Fudan Univ	65	1.9	459	976
Seoul Natl Univ	62	1.8	303	518
Univ Utrecht	60	1.7	574	974
King Saud bin Abdulaziz Univ Hlth Sci	57	1.6	237	453
King Saud Univ	55	1.6	137	312
Huazhong Agr Univ	53	1.5	312	605
Univ Minnesota	53	1.5	363	765
Univ N Carolina	49	1.4	413	903
Alfaisal Univ	48	1.4	443	739
Chinese Acad Med Sci	47	1.3	261	501
Erasmus MC	47	1.3	388	712
Johns Hopkins Aramco Healthcare	45	1.3	387	694
Ohio State Univ	45	1.3	463	1022

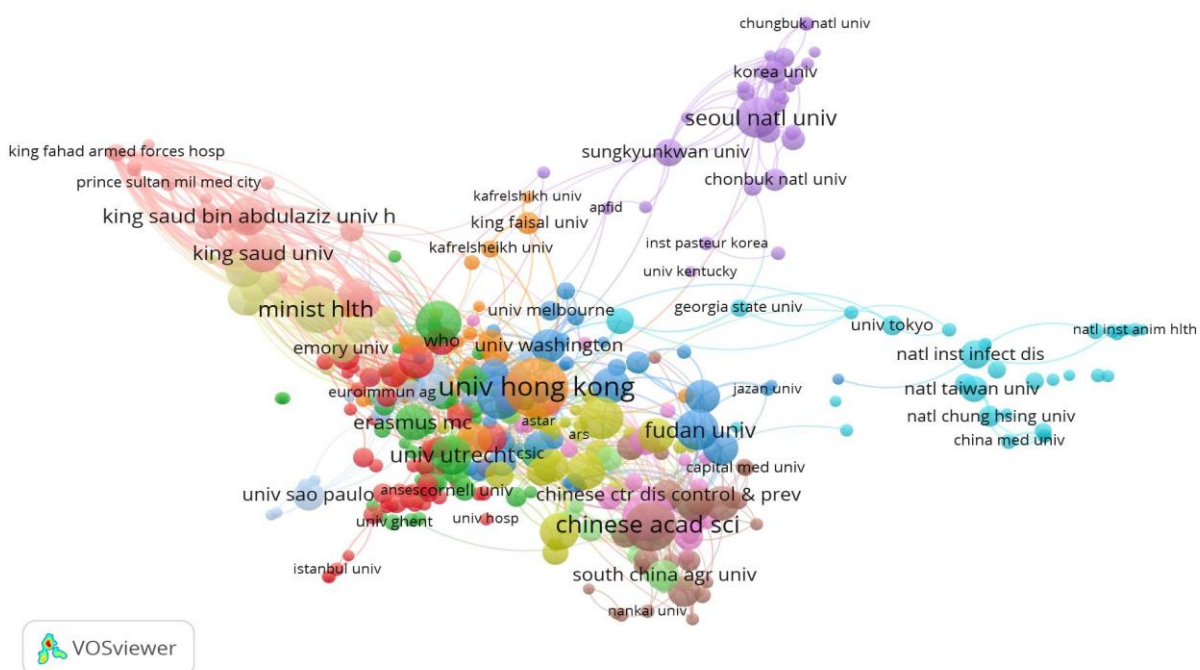


Figure 2: Collaboration of Institutions and their clusters

Analysis of the Publication Output of Top 20 Institutions

The individualities of 20 most productive institutions were analyzed in this part, Institutions which published more than 25 and above publications have considered as highly productive institutions. Table 4 summarizes articles, the global citation score, local citation score and average author per paper of the publications of these institutions. In total,

3265 institutions, including 7025 subdivisions published 3509 research papers during 2015-2019. The topmost twenty prolific institutions involved in this research have published 26 and more research articles. The institution “Univ Hong Kong” holds the first rank and the institution published 137 (3.9%) research papers with 1110 local and 2156 global citation scores, The second rank holds by “Chinese Acad Sci” the institution published 92 (2.6%) research papers with 419 local and 3347 global citation scores. The “Chinese Acad Agr Sci” holds the 3rd rank, the institution published 91 (2.6%) research papers with 277 local and 665 global citation scores. The “Minist Hlth” holds the 4th rank, the institution published 82 (2.3%) research papers with 856 local and 1213 global citation scores. The “NIAID” holds the 5th rank; the institution published 72 (2.1%) research papers with 309 local and 1353 global citation scores. It is clear from the analysis that following institutions Ctr Dis Control & Prevent, Univ Iowa, Fudan Univ and Seoul Natl Univ were identified the most productive institutions based on the number of research papers published

Table No. 5. Distribution of the Publication Output of Top 25 Countries.

Country	Recs	Percent	LCS	GCS
USA	1209	34.5	5697	15312
Peoples R China	897	25.6	4030	8868
Saudi Arabia	294	8.4	1992	3602
UK	237	6.8	1059	2926
South Korea	236	6.7	918	1846
Germany	228	6.5	1355	2835
France	171	4.9	681	1479
Netherlands	160	4.6	1054	2175
Canada	145	4.1	282	1273
Japan	142	4	279	844
Australia	109	3.1	417	1386
Egypt	100	2.8	495	974
Italy	99	2.8	306	922
Switzerland	87	2.5	473	978
Singapore	84	2.4	246	972
Brazil	76	2.2	120	438
Spain	76	2.2	292	741
Taiwan	65	1.9	90	336
India	57	1.6	59	265
Thailand	48	1.4	99	347

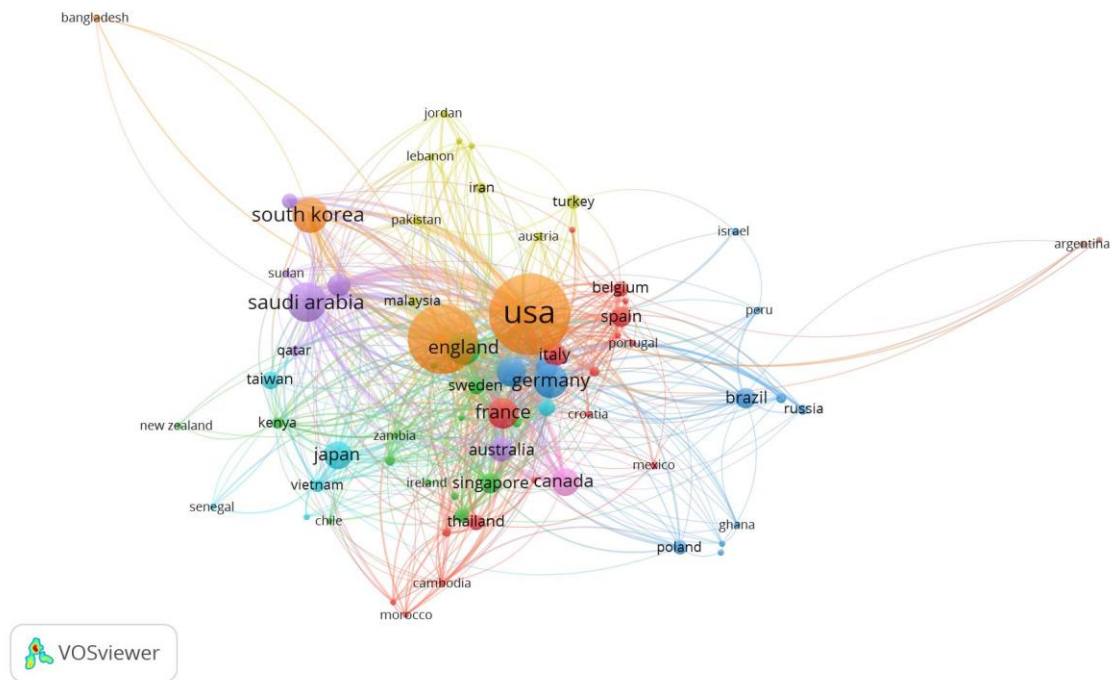


Figure 3: Showing Ranking of Country wise Distribution

Analysis of the Publication Output of Top 20 Countries.

Table No. 5. and figure 3 displays the publication output of the top twenty countries by number of papers and USA acquired 1st rank among the top twenty countries under consideration with its total global citation score 15312. In all 114 countries participated in research during 2015-2020. The countries that rank between 2nd and 25th position are Peoples R China, Saudi Arabia, UK, South Korea, Germany, France, Netherlands, Canada, Japan, Australia, Egypt, Italy, Switzerland, Singapore, Brazil, Spain, Taiwan, India and Thailand. We have found by using this country mapping analysis that there are nodes with clarity of linking between each node, which indicates that there are countries linking and associated with other associated countries. It could be identified that the country wise analysis the following countries USA, Peoples R China, Saudi Arabia, UK, South Korea were identified the most productive country based on the number of research papers published.

Analysis of the top 20 journal wise distribution of publications.

Sr. No.	Journal	Recs	Percent	LCS	LCS/t	GCS	GCS/t	LCR
1	Journal Of Virology	180	5.1	1141	200.1333	2341	490.7333	675
2	Viruses-Basel	119	3.4	79	13.16667	568	141.9667	922
3	Plos One	101	2.9	0	0	676	148.3167	192
4	Scientific Reports	81	2.3	0	0	710	158.8667	249
5	Virology	77	2.2	417	91.85	719	157.35	313
6	Emerging Infectious Diseases	74	2.1	1054	204.5	1385	271.1667	228
7	Virus Research	67	1.9	489	94	850	168.2	307

8	Archives Of Virology	62	1.8	160	33.06667	345	73.65	143
9	Veterinary Microbiology	58	1.7	309	67.5	521	115.5667	208
10	Journal Of General Virology	57	1.6	230	46.88333	443	92.06667	110
11	Antiviral Research	43	1.2	196	45.41667	459	105.4667	253
12	Emerging Microbes & Infections	42	1.2	15	7.5	352	86.66667	287
13	Infection Genetics And Evolution	41	1.2	204	45.06667	450	99.2	152
14	Transboundary And Emerging Diseases	41	1.2	222	57.36667	402	103.4005	189
15	Virology Journal	41	1.2	0	0	565	103.8167	139
16	Journal Of Virological Methods	39	1.1	77	18.83333	241	53.55	55
17	International Journal Of Infectious Diseases	33	0.9	160	33.5	242	51.26667	82
18	Mbio	32	0.9	0	0	559	121.1833	117
19	Plos Pathogens	32	0.9	0	0	443	108.9667	129
20	Journal Of Medical Virology	31	0.9	37	10.03333	143	34.96667	48

The study found that the total research output of the Coronavirus for the study period (2015–2019) published in 780 journals. In Table 6 The journal “Journal Of Virology” topped with 180(5.1%) publications with the Global Citation Score of 2341, next “Viruses-Basel ” with 119(3.4%) publications with the Global Citation Score of 568 and third position by “Plos One with 101(2.9%)publications with the Global Citation Score of 676 respectively. “Scientific Reportsplaced in fourth position got global citation score of 710.Virology is on fifth position and 77(2.2%) with Global Citation Score 719and Emerging Infectious Diseases is on sixth position with 74(2.2%)and Global Citation Score 1385, Remaining journals are having less than 2% of total literature.

Analysis of the top 20 Most Productive Keywords

Sr. No.	Keyword	Occurrences	Total Link Strength
1	Coronavirus	931	6284
2	Respiratory Syndrome Coronavirus	469	2956
3	Infection	433	2842
4	Mers-Cov	409	3053
5	Virus	353	2487
6	Saudi-Arabia	303	2261
7	Spike Protein	296	2475
8	Identification	287	2058
9	Transmission	228	1547
10	Outbreak	204	1423
11	Replication	193	1394

12	Protein	192	1305
13	Disease	191	1247
14	Dromedary Camels	184	1537
15	Sars	183	1185
16	Epidemiology	174	1304
17	Antibodies	154	1124
18	Pathogenesis	151	1147
19	Prevalence	143	1010
20	Evolution	139	1079

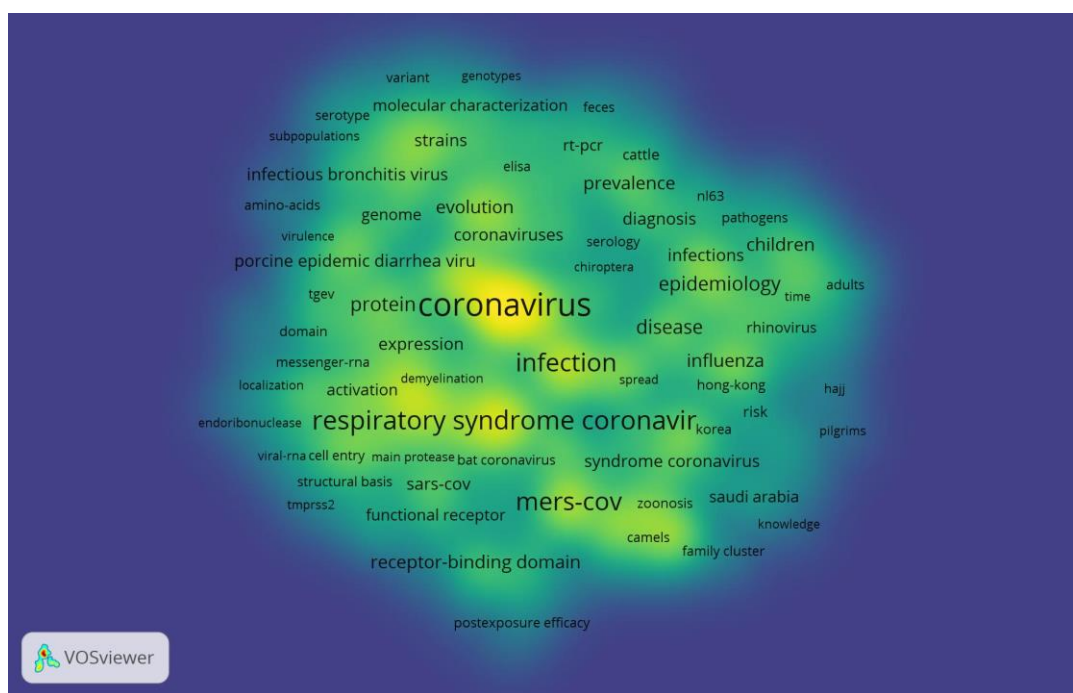


Figure No.4 keywords density visualization

Table No.7 presents the top 20 keywords used by the researchers in their publications. It is clearly seen from the table that the word Coronavirus has been used 931 times by the researchers with total link strength is 6284. Followed by Respiratory Syndrome Coronavirus is 469 occurrences with 2956 total links strength, Infection with 433 times with total links strength 2842, Mers-Cov 409 times occurrences with 3053 total links strength and Virus is on fifth position with 353 occurrences and total links strength is 2487.

Conclusion:

The number of papers published in “Coronavirus” has gradually increased during 2015-2019 and the study has shown that 3905 research documents have been published in Coronavirus during the period. It could be identified that the author's wise analysis the following authors Perlman S., Yuen, K.Y., Baric R.S. and Drosten C. were acknowledged the

most prolific authors based on the number of research papers contributed. It could be identified that the institutions wise analysis the following institutions Univ Hong Kong, Chinese Acad Sci, Chinese Acad Agr Sci, Minist Hlth, NIAID were acknowledged the most prolific institutions based on the number of research papers output they published. It could be identified that the country wise analysis the following countries USA, Peoples R China, Saudi Arabia, UK, South Korea, Germany, France, Netherlands, Canada, Japan, were identified the most productive country based on the number of research papers published. The network visualization depicting collaboration trends among major authors, countries and institutions is expected to be useful to the scientific community in analysing the research trends on 'Coronavirus'. The findings of this study will also be useful to the institutions and policy makers to prepare the course of action to fill the research gaps.

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