Mapping the Research output on Hantavirus: The Global Perspective

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Abstract

Bibliometric and scientometric techniques have been applied to present a quantitative and qualitative analysis of the publication output on Hantavirus. Data for the study have been collected from the Web of Science database for the period 1984 to March 2020. Among the 3678 papers published in the span of 37 years by 10152 authors from 122 Countries. 13 Countries contributed more than 100 publication each and 19 Countries recorded more than 1000 Citations each. The highest number of Citations (8388), h-index(54), g-index is 91 received by "Peters CJ"(54). It was interesting to know some authors published less number of publications and received highest number of Citations. Centers Disease Control & Prevent (USA) has highest Citation value (11551) closely followed by University of New Mexico (USA) (10279). EMERGING INFECTIOUS DISEASES in the first journal with the highest number of publication with 161 (g-index-77 and h-index-43, Citations-6906) and Impact Factor value is 7.42 and 13 journals published 50 and above publications. The highest impact factor journal is LANCET (59.10) among the top 20 titles.

Keywords: Scientometric, Bibliometric, Hantavirus, Scientometric Mapping

INTRODUCTION

Hantaviruses are a family of viruses spread mainly by rodents and can cause varied disease syndromes in people worldwide. Infection with any hantavirus can produce hantavirus disease in people. Hantaviruses in the Americas are known as "New World" hantaviruses and may cause hantavirus pulmonary syndrome (HPS). Other hantaviruses, known as "Old World" hantaviruses, are found mostly in Europe and Asia and may cause hemorrhagic fever with renal syndrome (HFRS). Each hantavirus serotype has a specific rodent host species and is spread to people via aerosolized virus that is shed in urine, feces, and saliva, and less frequently by a bite from an infected host. The most important hantavirus in the United States that can cause HPS is the **Sin Nombre virus**, spread by the deer mouse. (CDC-USA 2020).

Scientometric tools could be used to measure and compare the scientific activities at various levels of aggregation including institutions, author productivity, countries and impact of Journals and authors. This could also be used to measure research collaborations, to map scientific networks and to monitor the evolution of scientific fields.

Laksham S. et al. (2020) This study presents 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.

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.

OBJECTIVES OF THE STUDY

The major objectives are framed with the exclusive notion of the present study as mentioned below:

- To identify the pattern of distribution of Hantavirus research output at Global level.
- To examine the effectiveness of various sources of research publications and journal impact.
- To examine the growth of research productivity on Hantavirus during 1984 – March 2020.
- To identify the authorship pattern of Hantavirus research output.
- To identify the country-wise distribution of publications, Citation and research

Collaboration.

- To assess the Institution wise research concentration on Hantavirus.
- To identify the h-index, g-index, and m-index.

METHODOLOGY

This study is based on the research output on Hantavirus as reflected in Web of Science online database. The time period is from 1984 to March 2020. A search was carried out to get an overall picture of the size of the Hantavirus literature. It provides author profiles which cover affiliations, number of publications and Citations and their bibliographic data, references, Geographical wise distribution of publications. It has a facility to calculate h-index, g-index, m-index and Impact Factor of journals. The query: [Topic: Hantavirus] was used to retrieve details of research publications and application tools (Histcite, VosViewer and Biblioshiny) are used for tabulate the data and visualize the Concepts.

DATA ANALYSIS AND INTERPRETATIONS

Geographical wise distribution of Publications and Citations

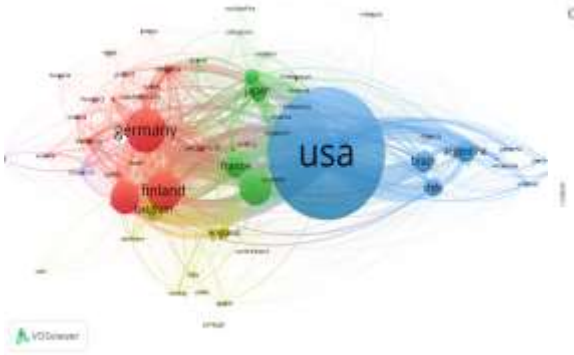
Table 1 shows the countries with the largest shares of all articles between 1984 and March 2020. As expected, the United States (1310) is at the top of the list of countries and recorded 44522 Global Citation Scores, followed by Germany (395) with 7720 Citations, Finland (329) and received 10439 Citations, China (309) and 4528 Citations, Sweden (246) and 7081 Citations as the countries contributing the largest numbers of articles and Citations. India appears 23 in the total number of articles with 33 and recorded 319 Citations. 13 Countries contributing more than 100 publications and 19 Countries recorded more than 1000 Citations. Top of the list of countries in terms of research collaboration Sweden to Finland with 88 articles followed by Korea to USA (60), Germany to Slovakia (57), China to USA (49), USA to Chile (49), USA to Argentina (46), USA to Canada (41), USA to France (38), Russia to USA 36), USA to Germany (35), USA to Japan (35), Germany to Switzerland (34), Sweden to Germany (31) and USA to Brazil (30). The study found that United States 866 (SCP 585 and MCP 283) is at the top of the list of countries and the MCP ratio is 0.326 followed by Germany, China, Finland, Mexico, Brazil, Sweden, Belgium and Japan. India is not listed in top 50 of the countries in terms of research collaboration.

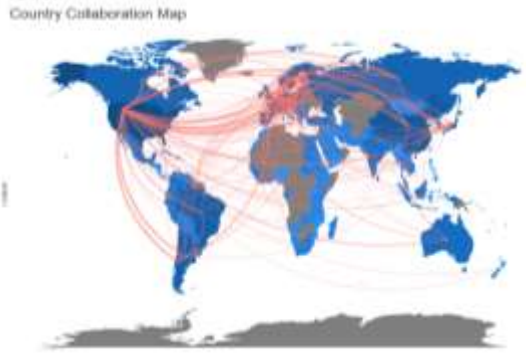
Table 1 shows Country wise distribution of Publications and Citations

Publications and Citations						Research Collaboration		
#	Country	Records	TLCS	TGCS	ACPP	From	To	Frequency
1	USA	1310	24369	44522	33.99	SWEDEN	FINLAND	88
2	Germany	395	4951	7720	19.54	KOREA	USA	60
3	Finland	329	7356	10439	31.73	GERMANY	SLOVAKIA	57
4	China	309	1636	4528	14.65	CHINA	USA	49
5	Sweden	246	4773	7081	28.78	USA	CHILE	49
6	Brazil	179	1778	2868	16.02	USA	ARGENTINA	46
7	France	177	1265	3702	20.92	USA	CANADA	41
8	Argentina	159	2581	3485	21.92	USA	FRANCE	38
9	Belgium	159	1776	3383	21.28	RUSSIA	USA	36
10	Japan	156	1958	3055	19.58	USA	GERMANY	35
11	UK	136	954	3177	23.36	USA	JAPAN	35
12	Chile	124	1016	1998	16.11	GERMANY	SWITZERLAND	34
13	South Korea	114	1361	2245	19.69	SWEDEN	GERMANY	31
14	Canada	94	999	3904	41.53	USA	BRAZIL	30
15	Russia	79	773	1020	12.91	USA	FINLAND	29
16	Netherlands	58	484	1161	20.02	FINLAND	FRANCE	28
17	Slovakia	58	1271	1651	28.47	SWEDEN	BELGIUM	26
18	Switzerland	51	480	964	18.90	FRANCE	BELGIUM	25
19	Slovenia	47	670	1101	23.43	GERMANY	LITHUANIA	23
20	Australia	37	310	1020	27.57	GERMANY	FRANCE	22
21	Greece	34	577	790	23.24	BELGIUM	NETHERLANDS	21
22	Spain	34	139	682	20.06	FINLAND	BELGIUM	21
23	India	33	82	319	9.67	GERMANY	FINLAND	21
24	Turkey	32	105	257	8.03	USA	SWEDEN	20
25	Czech Republic	31	207	380	12.26	CHINA	FINLAND	19
26	Mexico	27	167	441	16.33	CHINA	AUSTRALIA	18
27	Poland	27	91	249	9.22	GERMANY	BELGIUM	18
28	Croatia	26	215	330	12.69	USA	BELGIUM	18
29	Austria	25	112	476	19.04	USA	MEXICO	18
30	Italy	25	81	375	15.00	GERMANY	UK	17

Table 2 shows that Single Country and Multiple Country Collaboration

Country	Articles	Freq	SCP	MCP	MCP_Ratio
USA	868	0.251012	585	283	0.326
GERMANY	297	0.085888	165	132	0.4444
CHINA	283	0.081839	206	77	0.2721
FINLAND	223	0.064488	145	78	0.3498
MEXICO	181	0.052342	116	65	0.3591
BRAZIL	154	0.044534	124	30	0.1948
SWEDEN	149	0.043088	85	64	0.4295
BELGIUM	138	0.039907	69	69	0.5
JAPAN	118	0.034124	73	45	0.3814
ARGENTINA	114	0.032967	83	31	0.2719
FRANCE	105	0.030364	57	48	0.4571





Country wise Citation Link Country wise Collaboration

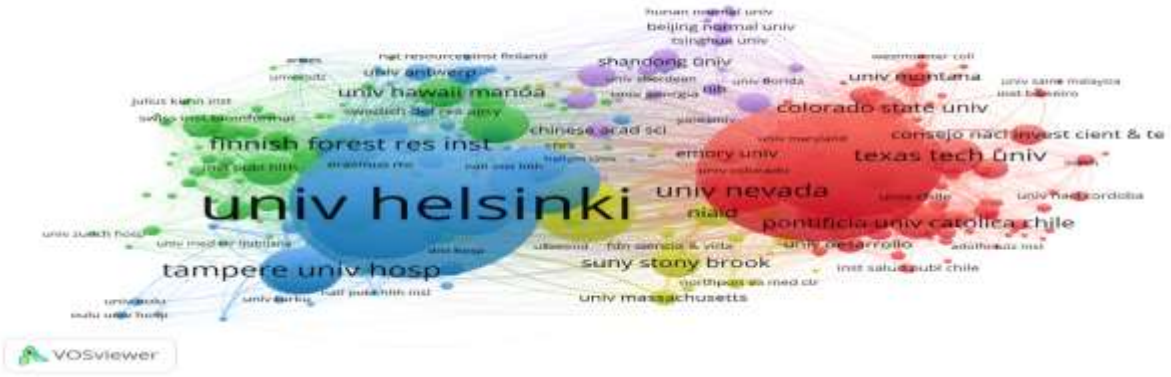
Institution wise distribution of Publications and Citations

Table 3 shows the Publications along with the Global Citations Scores of top 30 Institutions working in the field of Hantavirus during the period 1984-March 2020. University of Helsinki from Finland computed highest 283 (9186 Citations) followed by University of New Mexico from USA 267 (10279 Citations), Centers Disease Control & Prevent (USA) with 214 (11551 Citations), Karolinska Inst (Sweden) with 150, Hokkaido University (Japan) with 111 and Swedish Inst Infect Dis Control (Sweden) with 102 Publications. 6 Institutions contributed more than 100 publications and 18 Institutions with 50 and above. The study found that Finland, USA, Sweden and Japan occupied top 10 Positions. It indicates Centers Disease Control & Prevent (USA) has highest Citation value (11551) closely followed by University of New Mexico (USA) (10279), University of Helsinki from Finland (9186), Karolinska Institute from Sweden (5267), and Swedish Inst Infect Dis Control (Sweden) (4800). 34 Institutions recorded 1000 and above Citations and 422 Institutions 100 and above Citations.

Table 3 shows Institution wise distribution of Publications and Citations

#	Institution	Records	TLCS	TGCS	ACPP
1	University of Helsinki (Finland)	283	6447	9186	32.46
2	University of New Mexico (USA)	267	7445	10279	38.50
3	Centers Disease Control & Prevent (USA)	214	7579	11551	53.98
4	Karolinska Inst (Sweden)	150	3675	5267	35.11
5	Hokkaido University (Japan)	111	1510	2204	19.86
6	Swedish Inst Infect Dis Control (Sweden)	102	3297	4800	47.06
7	Umea University (Sweden)	91	1536	2507	27.55
8	Tampere University Hospital (Finland)	76	1533	2054	27.03
9	University Tampere (Finland)	75	1539	2051	27.35
10	University of Nevada (USA)	71	1675	2210	31.13
11	Finnish Forest Res Inst	65	2260	2993	46.05
12	Fourth Mil Med University	64	284	648	10.13

13	Inst Pasteur	63	469	1066	16.92
14	Korea University	62	1025	1495	24.11
15	Univ Sao Paulo	61	940	1241	20.34
16	Slovak Acad Sci	60	1512	1926	32.10
17	Charite	59	853	1253	21.24
18	Texas Tech Univ	58	650	1375	23.71
19	Robert Koch Inst	48	605	1071	22.31
20	Pontificia Univ Catolica Chile	46	416	888	19.30
21	Univ Hawaii Manoa	46	828	1220	26.52
22	SUNY Stony Brook	45	1567	2246	49.91
23	Colorado State Univ	44	694	1096	24.91
24	Queen Astrid Mil Hosp	42	793	1091	25.98
25	NIAID	38	350	1126	29.63
26	Univ Ljubljana	37	533	847	22.89
27	Friedrich Loeffler Inst	35	397	504	14.40
28	Chinese Ctr Dis Control & Prevent	34	354	746	21.94
29	University of Texas	33	607	1251	37.91
30	Katholieke Univ Leuven	32	446	726	22.69



Year wise distribution of Publications and Citations

Table 4 presents data on the distribution of Hantavirus research papers and Citations impact at global level by year along with the number of times these papers have been cited up to March 2020. 121 Countries there is a perceptible increase in the number of papers published in recent years. For example, the number of papers published jumped from 164 in 2013 to 209 in 2014. In 2014 accounted for a very large number of papers with 209. The highest numbers of publications have recorded and followed by 2019 with 198, 2012 with 179. After 1995 onwards the publication growth rate gradually increases. In 1995 recorded highest number of Citations with 5000 for 101 Papers followed by 2008 with 4595, 2003 with 4285. More than 1000 citations recorded from 1992-2016. The publication and Citations are started from 1984 from BELGIUM by DESMYTER J (DESMYTER, J); DESTRIHOU CV (DESTRIHOU, CV); VANDERGROEN G (VANDERGROEN, G).

Table 4 shows year wise distribution of publications and Citations

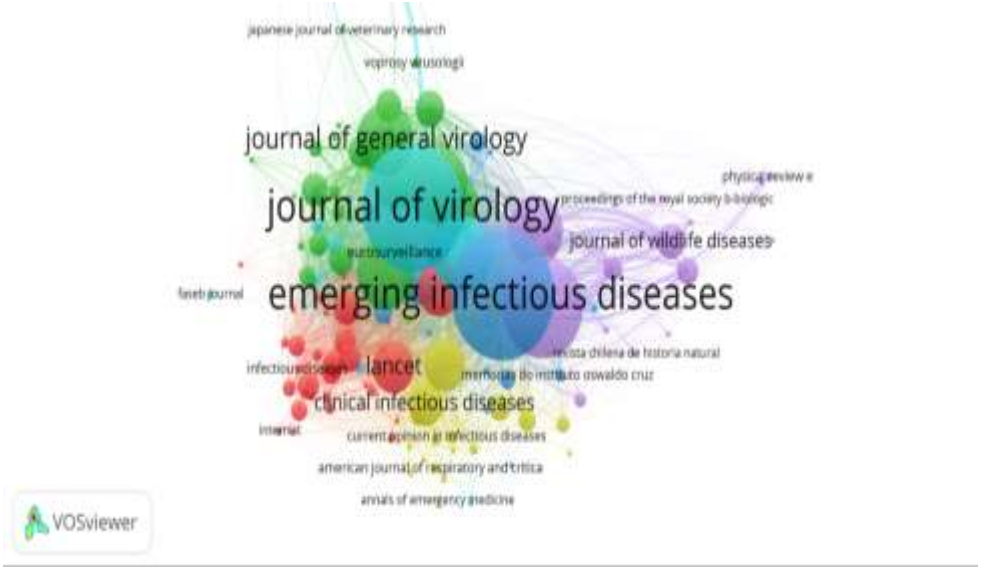
#	Year	Records	TLCS	TGCS	Mean TC per Article	Mean TC per Year	Citable Years
1	1984	1	10	14	14.00	0.39	36
2	1985	2	2	6	3.00	0.09	35
3	1986	4	77	114	28.50	0.84	34
4	1987	13	151	198	15.23	0.46	33
5	1988	12	126	170	14.17	0.44	32
6	1989	9	174	217	24.11	0.78	31
7	1990	14	224	255	18.21	0.61	30
8	1991	32	540	767	23.97	0.83	29
9	1992	28	740	1024	36.57	1.31	28
10	1993	51	1507	2009	39.39	1.46	27
11	1994	112	3113	3726	33.27	1.28	26
12	1995	101	3455	5000	49.50	1.98	25
13	1996	95	2443	3794	39.94	1.66	24
14	1997	90	2798	3363	37.37	1.62	23
15	1998	87	2237	3822	43.93	2.00	22
16	1999	93	2742	4033	43.37	2.07	21
17	2000	101	1894	3206	31.74	1.59	20
18	2001	103	2378	3831	37.19	1.96	19
19	2002	108	2229	3856	35.70	1.98	18
20	2003	101	1924	4285	42.43	2.50	17
21	2004	112	1920	3235	28.88	1.81	16
22	2005	105	1571	2784	26.51	1.77	15
23	2006	114	1490	2800	24.35	1.74	14
24	2007	144	2213	4136	28.72	2.21	13
25	2008	162	2188	4595	28.36	2.36	12
26	2009	160	2037	4019	25.12	2.28	11
27	2010	158	2052	4172	26.41	2.64	10
28	2011	162	1419	3500	21.60	2.40	9
29	2012	179	1321	2931	16.37	2.05	8
30	2013	164	1378	2927	17.85	2.55	7
31	2014	209	1149	3077	14.72	2.45	6
32	2015	146	600	1418	9.65	1.93	5
33	2016	167	360	1455	8.71	2.18	4
34	2017	175	280	866	4.92	1.64	3
35	2018	136	197	427	3.14	1.57	2
36	2019	198	43	171	0.86	0.86	1
37	2020	25	1	1	0.04		0

Source Title wise distribution of Publications, Citations and Indexes

Below the table 5 indicates that the source title wise distribution of total research output on Hantavirus research literature. EMERGING INFECTIOUS DISEASES in the first journal with the highest number of publication with 161 (g-index-77 and h-index-43, Citations-6906)

and Impact Factor value is 7.42 followed by JOURNAL OF VIROLOGY with 156 (g-index-77 and h-index-54, Citations-7616) and Impact Factor value is 4.32. 18 countries are published more than 50 publications and received 69921 Citations at global level. They published highly impact journals with good number of IF and Citations. 13 journals published 50 and above publications. The highest impact factor journal is LANCET (59.10) among the top 20 titles.

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 Hantavirus, it is found that 14 journals constitute first zone have 1218 articles, next zone with 77 journals have 1249 articles and much larger group of 676 journals have 1211 articles. On analysis of the data, it is found that the literature on Hantavirus does not follow this rule and each zone represents the Bradford expression as 14: 77:676 which does not fit into the expression.



Country wise Citations Network

Table 5 shows that Source title wise distribution of Publications and Indexes

Source	h_index	g_index	m_index	TC	NP	PY_start
EMERGING INFECTIOUS DISEASES – (IF: 7.42)	43	77	1.65	6906	161	1995
JOURNAL OF VIROLOGY -4.32	54	77	2.00	7616	156	1994
AMERICAN JOURNAL OF TROPICAL MEDICINE AND HYGIENE – 2.45	36	55	1.20	3453	121	1991
VIRUS RESEARCH – 2.73	30	42	1.00	2396	92	1991
VIRUSES-BASEL – 3.81	15	24	1.25	777	87	2009
JOURNAL OF MEDICAL VIROLOGY - 2.37	30	47	0.94	2547	84	1989

JOURNAL OF GENERAL VIROLOGY - 2.80	33	48	1.00	2700	82	1988
VECTOR-BORNE AND ZOONOTIC DISEASES	24	35	1.20	1563	80	2001
VIROLOGY – 2.65	36	60	1.16	3718	70	1990
ARCHIVES OF VIROLOGY -2.26	22	37	0.63	1544	63	1986
PLOS ONE – 2.78	19	29	1.46	1001	61	2008
LANCET – 59.10	18	35	0.49	1301	57	1984
JOURNAL OF INFECTIOUS DISEASES – 5.18	32	56	0.89	3327	56	1985
CLINICAL INFECTIOUS DISEASES 9.11	21	48	0.78	2545	48	1994
EPIDEMIOLOGY AND INFECTION – 2.07	17	29	0.61	924	48	1993
INFECTION GENETICS AND EVOLUTION – 2.61	13	20	0.72	465	38	2003
JOURNAL OF WILDLIFE DISEASES – 1.35	17	25	0.68	710	37	1996
JOURNAL OF CLINICAL VIROLOGY – 3.02	12	19	0.57	401	36	2000
JOURNAL OF VIROLOGICAL METHODS – 1.74	13	21	0.45	497	35	1992
PLOS NEGLECTED TROPICAL DISEASES -4.48	10	17	0.91	345	33	2010
VIROLOGY JOURNAL – 2.46	14	23	0.88	573	33	2005
JOURNAL OF CLINICAL MICROBIOLOGY – 4.95	21	32	0.70	1396	32	1991
VIRUS GENES -1.61	12	21	0.40	479	32	1991
ANTIVIRAL RESEARCH	17	29	0.61	876	29	1993
KIDNEY INTERNATIONAL	8	19	0.22	386	28	1985
BMC INFECTIOUS DISEASES	9	15	0.82	237	27	2010
EUROPEAN JOURNAL OF CLINICAL MICROBIOLOGY & INFECTIOUS DISEASES	11	22	0.42	495	27	1995
JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	3	5	0.11	31	27	1993
JOURNAL OF MAMMALOGY	15	24	0.56	582	27	1994
NEPHROLOGY DIALYSIS TRANSPLANTATION	12	19	0.44	366	25	1994

Single Vs Multiple Authors

The table 6 shows the details about the single and multi-authored papers. Out of total of 3678, the maximum number of contributions i.e. 3458 (94.02%) have been contributed by multiple authors and followed by the minimum number of contributions i.e. 220(5.98%) by single author.

Table 6 shows single Vs Multiple Author Contribution of Publications

Authorship Pattern	Publications	%
Single Author	220	5.98
Multiple Authors	3458	94.02
Total	3678	100.00

The table 6 shows the details about the degree of collaboration. Degree of collaboration is a prominent area of research in bibliometric or Scientometric studies which indicate tends in

single and joint authorship during 1984 to March 2020, as shown in above Table. The average degree of collaboration is 0.93. The degree of collaboration is calculated by using the following formula (K. Subramanyam, 1982):

The formula is Where

C= Degree of Collaboration
Nm = Number of multiple authors
Ns = Number of single authors

$$C = \frac{N_m}{N_m + N_s}$$

$$C = \frac{3458}{3458+220} = 0.93$$

In the present study the value of C is C= 0.93

As a result, it was found that the degree of collaboration in the subject of Hantavirus is 0.93, which openly indicates its dominance upon multiple contributions.

Author Impact

There were a total number of 23489 name occurrences of the authors contributing 3678 articles in the field of Hantavirus during of 1984-March2020. The top 30 authors are listed below in Table. This table ranks authors by the number of publications. Findings revealed that out of 3678 articles, a total number of 216 articles were contributed by “Vaheri A” (h-index-49, g-index-76) and recorded 7865 Citations followed by “Lundk Vist A” with 147 (h-index-44, g-index-67) and recorded 5681 Citations, “Hjelle B” and “Plyusnin A” with 126 respectively. It found that the highest number of Citations (8388), h-index(54), g-index is 91 received by “Peters CJ”(54). It was interesting to know some authors published less number of publications and received highest number of Citations.

Table 7 shows that author wise publication, Citations and Indexes

Author	h_index	g_index	m_index	Citations	Publications	PY_start
VAHERI A	49	76	1.63	7865	216	1991
LUNDKVIST A	44	67	1.47	5681	147	1991
HJELLE B	41	70	1.46	5559	126	1993
PLYUSNIN A	39	63	1.44	4829	126	1994
VAPALAHTI O	41	68	1.41	4987	122	1992
KRUGER DH	38	54	1.46	3637	115	1995

ARIKAWA J	25	37	0.83	1921	101	1991
KSIAZEK TG	49	86	1.63	7449	95	1991
PETERS CJ	54	91	1.93	8388	95	1993
YOSHIMATSU K	24	35	0.83	1775	93	1992
HENTTONEN H	31	55	1.15	3181	81	1994
CLEMENT J	22	35	0.61	1370	78	1985
MUSTONEN J	25	50	0.89	2645	78	1993
ROLLIN PE	35	73	1.09	5612	73	1989
MILLS JN	33	60	1.27	3772	72	1995
YANAGIHARA R	31	44	0.91	2113	71	1987
NICHOL ST	40	69	1.43	5603	69	1993
AHLM C	22	38	0.81	1600	67	1994
ULRICH RG	21	32	1.50	1147	61	2007
KLEMPA B	26	43	1.44	1940	58	2003
KARIWA H	20	33	0.69	1289	57	1992
SONG JW	21	38	0.78	1529	56	1994
KLINGSTROM J	18	35	0.95	1280	49	2002
ZHANG Y	12	22	0.80	588	45	2006
MAKELA S	18	30	0.86	993	47	2000
VAN RANST M	14	26	0.64	753	47	1999
TAKASHIMA I	18	28	0.56	908	46	1989
FIGUEIREDO LTM	16	33	0.76	1166	44	2000
FELDMANN H	22	43	0.79	2479	43	1993
MAES P	15	27	0.83	788	43	2003

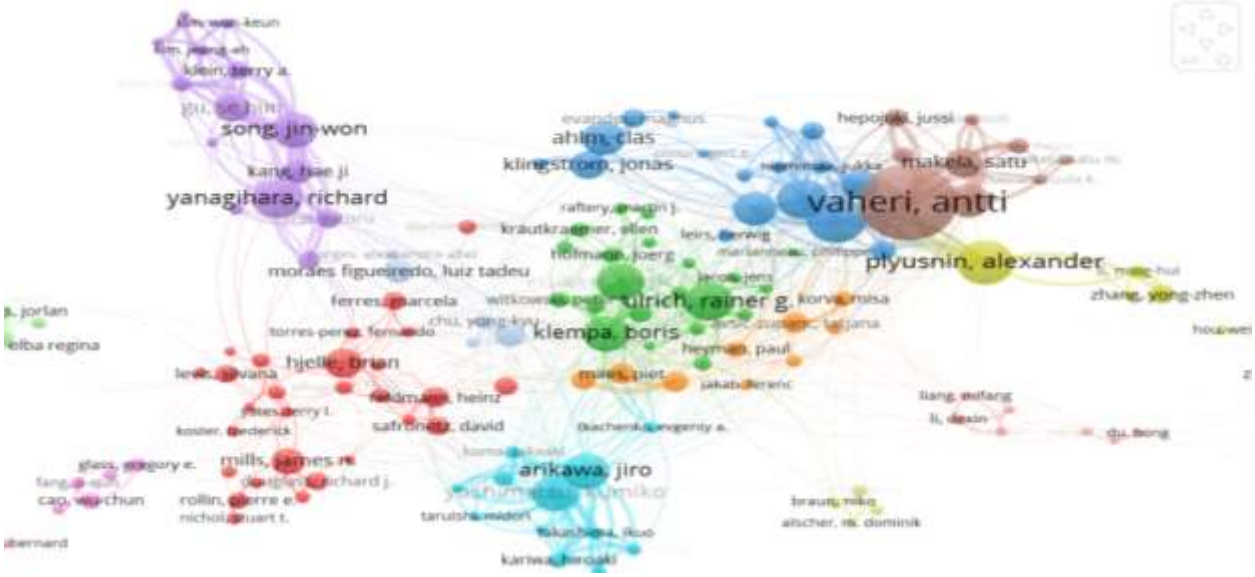


Figure shows authors citation Network

FINDINGS AND CONCLUSION

Based on the analysis undertaken the present study reveals the following findings:

- The study found that 3678 publications are published in Hantavirus.
- It found that 10152 authors are contributed in the field of Hantavirus and they referred 141775 publications as reference.
- It found that 48983 citations are cited within the collection.
- It found that 13 Countries contributing more than 100 publications and 19 Countries recorded more than 1000 Citations.
- The study found that the highest number of Citations (8388), h-index(54), g-index is 91 received by "Peters CJ"(54). It was interesting to know some authors published less number of publications and received highest number of Citations.
- The study found that It indicates Centers Disease Control & Prevent (USA) has highest Citation value (11551) closely followed by University of New Mexico (USA) (10279).
- The study found EMERGING INFECTIOUS DISEASES in the first journal with the highest number of publication with 161 (g-index-77 and h-index-43, Citations-6906) and Impact Factor value is 7.42 and 13 journals published 50 and above publications. The highest impact factor journal is LANCET (59.10) among the top 20 titles.

The reputation of any Scientist can be measured on the basis of its publication output. The quality of publications should be measured by means of quantitative (papers) as well as qualitative (citations, h-index, g-index, m-index and Impact Factor) analysis. It is the responsibility of the Library and Information Science community to study the research trend of the subject areas of research through bibliometric/scientometric analysis and help them to do further research in their field.

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