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Research Note

Nipah Virus: An Exploratory Scientometrics Analysis, 1999-2018

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ABSTRACT
The objective of the study is to perform scientiometrics analysis of the published literature related to NIPAH Virus globally using the Web of Science database, for the period 1999-2018 and to compare the results with two earlier studies. The analysis was based on the quantification by the type of publications, year, citations, geographical productivity, keywords, most preferred journals, leading publications, mapping of authors, priority research areas and productive institutes. There were 1301 Nipah articles with 64% research articles, 38849 citations, country USA with more productive authors, 'Nipah virus' the commonly used keyword, 'Journal of Virology' as preferred journal, Wang LF as productive author of a research group, Infectious diseases as the priority research area and the most productive institute as Commonwealth Scientific and Industrial Research Organization, Australia. The main findings of the two earlier studies agree with the current study. The recently reported outbreaks in Kerala and Siliguri would increase the research database and alert among the Indian researchers.

Keywords: Nipah virus, Scientometrics analysis, Web of Science, Global.

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INTRODUCTION

Scientometrics studies refer to the quantification of all available written communication and their authorship by means of citation studies.[1] Nipah virus (member gene of Henipavirus) in the Paramyxoviridae family, has drawn attention as an emerging zoonotic virus in South-East and South Asian region.[2] It has become a great public health concern all over the world.

Nipah virus infections in humans were reported in Malaysia for the first time in 1998[3] where pig farming was a major industry.[4] Cases continued and later emerged in Bangladesh/India region in 2001. In 2015, there was a Nipah Virus outbreak in the Philippines, which affected 17 individuals.[5] In May 2018, an outbreak was reported in southern India for the first time, in Kozhikode and Malappuram districts of Kerala.[3] Currently, there exists limited published literature about NIPAH virus. Two earlier reported studies about Nipah virus were using WoS (1990-2010) database and Scopus database (1999-24 May 2018). The objective of the current study was to explore the published literature about NIPAH virus globally using Science Citation Index Expanded Web of Science (WoS) all database from the period 1999 to August 2018 and to compare the similarity of the results with the two earlier studies.

METHODS

In the current study, we preferred the use of Web of Science Core Collection is painstakingly selected, actively curating a database of the journals that researchers have judged to be the most important and useful in their fields.[6] Due to its wider coverage from 1900, it has gained importance and it picks up all original research articles, reviews, meeting abstracts, editorials, written communications like books, conference proceedings letters and reprints. The database was downloaded on 31st August 2018 and the results were refined for the period1999 to 2018. The keyword used for the search was 'NIPAH VIRUS'(*n*=1301) by 'TOPIC' and were retrieved using the WoS database. The retrieved data were exported to Microsoft excel 2007 and Endnote software for descriptive analysis. The Impact factor of the published papers was obtained from Thomson Reuters Journal citation reports. The study was explored based on type of publication, publication by language, quantification of NIPAH virus by year of publication and number of citations, geographical distribution and productivity of the Nipah virus articles, keywords, preferred

journals with the impact factors, leading Nipah publications with their citations and mean citation per year, Visualization and mapping of the authors, Nipah virus articles by research areas and productive institute in publication of Nipah articles.

RESULTS

The type of publication retrieved

The global Nipah virus WoS database consisted of a majority of Research Articles 839 (64.5%), Review articles 162 (12.5%), Meeting abstracts 59(4.5%), Editorials 33 (2.5%) Proceeding paper and other documents (Table 1).

Publication of NIPAH article by language

The majority of the published articles were in English (1288; 97.8%). The other languages used for publication were French, German, Polish, Spanish, Dutch and Romanian (Table 2).

Quantification of NIPAH virus publication by year with number of citations

There were 1301 publications indexed in Web of science for the period 1999 to 2018. The average number of publications during the study period was 65 documents per year. The growth of research publication increased from 10 in 1999 reached a maximum of 108 in the year 2013 and decreased to 45 in 2018. The growth rate was fluctuating in the study period and the maximum decline occurred in 2014 (2018 being partial and not complete). The total number of citations for the publication on NIPAH was 38849 with an average citation per item (29.86). The number of citations also gradually increased from 832 along with publications reached a maximum 3372 in 2006 and decreased to 17 in 2018 and the maximum decline occurred in the year 2015 (Figure 1).

Table 1: Type of Nipah virus documents retrieved using WoS, 1999-2018.

Type of document	Frequency	Percentage
Research article	839	64.5
Review	162	12.5
Meeting abstract	59	4.5
Editorials	33	2.5
Proceeding paper	31	2.4
Book Chapter	21	1.6
News items	21	1.6
Letter	13	1.0
Others (correction, reprint etc.)	112	9.4
Total	**1301**	**100.00**

Table 2: Language of publications of Nipah virus using WoS, 1999-2018.

Languages	Frequency	Percentage
English	1272	97.8
French	13	1.0
German	6	0.5
Polish	4	0.3
Spanish	3	0.2
Dutch	2	0.2
Romanian	1	0.1
Total	**1301**	**100.0**

Geographical distribution and production of Nipah virus articles.

The map (Figure 2) portrays the geographical distribution of a number of publications of Nipah virus articles at the global level. The data was exported to excel and the map was generated using ArcGIS 10.1 software. The regions without any colour show that there was no research output using the WoS database. The United States of America had published the maximum number of articles of 674 (52%), next highest was Australia with 265 (20%), the United Kingdom with 178 (14%), China with 70 (5.4%), India with 36 (3%) articles and more shown on the map. The country (regions) with red color had the

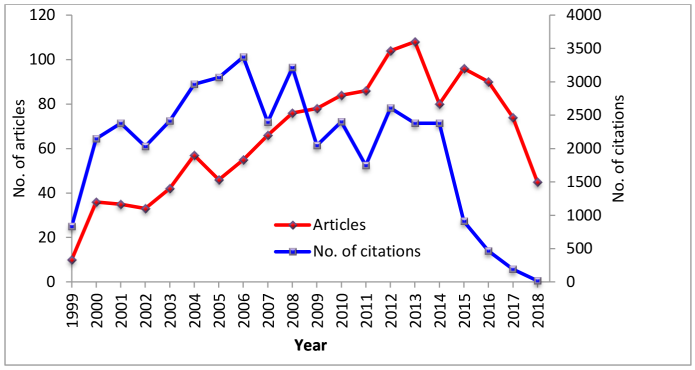

Figure 1: Year wise publication of articles with citations on NIPAH virus using WoS, 1999-2018.

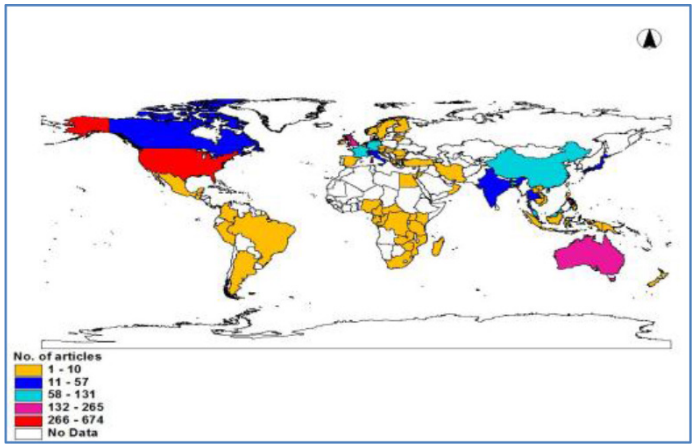

Figure 2: The geographical distribution of number of publications in Nipah virus using WoS, 1999-2018.

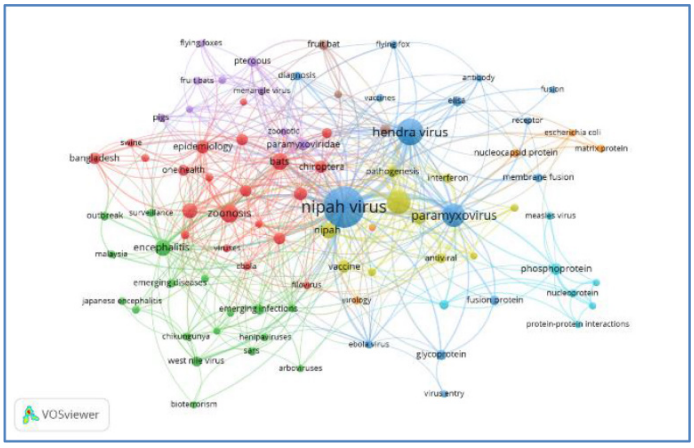

Figure 3: The author's keywords in Nipah virus articles using WoS, 1999-2018.

highest productivity while regions with mustard color had the lowest productivity.

Keywords

The authors' keywords of the Nipah articles were visualized using the freely downloadable software VOSviewer[7] and shown in (Figure 3). In VOSviewer, based on the minimum number of occurrences authors' keywords, the data was mapped. The size of the node for each keyword in the map represents its magnitude of occurrence in the retrieved Nipah articles. The larger the size of the node denotes the higher frequency of occurrence of the keyword. The keywords with yellow color denote the most recently used author keywords. In the current study, the most commonly used keywords by the authors were 'Nipah Virus' followed by 'Hendra Virus' and 'paramyxovirus'. The recently used keywords by authors in the articles are 'Nipah', 'Vaccine', 'Pathogenesis', 'Interferon' and 'Antiviral'.

NIPAH publications in the first ten preferred journals with the impact factors

The most preferred journals were Journal of Virology, Emerging Infectious Diseases, PLOS One, Virology and more shown in (Table 3). Emerging Infectious Disease had the highest impact factor of 8.22 as per Thomson Reuters Journal citation reports. Out of the 10 top preferred journals, the country USA had published in 7 journals with the highest number of articles followed by England.[8]

The ten-top leading Nipah publications with their citations and mean citation per year

The article published in the journal 'Science' by Li *et al.* in the year 2005 was cited the maximum number of times (838) and mean citation was 60 per year (Table 4). The second highly cited article was in the journal 'Cell' in the year 2008 with 718 citations and with a mean of 65 per year.

Table 3: Ten preferred journals for Nipah publication at global level with their impact factor (Thomas Reuters) using WoS, 1999-2018.

Journal	Articles published	Impact factor JCR 2016	Country	Percentage Contribution
Journal of virology	133	4.663	USA	10.4
Emerging Infectious Disease	58	8.222	USA	4.4
PLOS One	54	2.806	USA	4.1
Virology	35	3.353	USA	2.6
Journal of General Virology	31	2.838	England	2.3
EcoHealth	29	2.252	USA	2.2
PLOS Pathogens	29	6.608	USA	2.2
Virology Journal	22	2.139	England	1.6
American Journal of Tropical Medicine and Hygiene	21	2.549	USA	1.6
International Journal of Infectious Diseases	21	2.532	England	1.6

Visualization and mapping of the authors.

The Nipah downloaded database was visualized using VOS-viewer portrays visualization of similarities and mapping of scientometrics networks. Using visualization techniques, the density maps were generated in which the color, circle size, font size and thickness of the connecting lines showed about the author's contribution and connectivity. Units with a similar color indicated one cluster or group of close units that of the authors. The link and strength of the co-authorship were measured by the thickness and connecting lines (Figure 4). The numbers of publications two researchers have co-authored also have been considered. There may be more than one link between any pair of authors. The higher the relative link strength suggested, the stronger the co-authorship. The larger circle size or font size indicated greater productivity of the articles.[9] The map shows ten colours representing different closely related research groups. The maximum productivity co-authored group was shown as Wang IF followed by Daszak P, Broder CC, Luby SP, Lee B, Maisner A, Ksiazek T and Cunningham AA.

NIPAH virus articles by research areas

WoS showed 61 research areas or categories and the top 10 research areas in Nipah, with the number of publications in each area, are shown in the (Table 5). Majority of the articles were from Infectious disease (87%) followed by Virology (72-76%) and Microbiology (70-73%) during the year 1999 to 2008 and it is also analyzed that during the year 2009-2018 the majority of the articles were from infectious disease (88-96%) followed by Microbiology (69-71%) and virology (65-73%). Table 5 shows the difference in shift pattern of

Table 4: Top ten leading publications on Nipah virus with the authors and their citations.

S. No.	Article	Total citations	Mean citation per year
1	Li W, Shi Z, Yu M, Ren W, Smith C, Epstein JH, Wang H, Crameri G, Hu Z, Zhang H, Zhang J, McEachern J, Field H, Daszak P, Eaton BT, Zhang S, Wang LF. Bats are natural reservoirs of SARS-like coronaviruses. Science. 2005 Oct 28;310(5748):676-9	838	59.86
2.	Pasquale EB. Eph-ephrin bidirectional signaling in physiology and disease. Cell. 2008 Apr 4;133(1):38-52.	718	65.27
3	Chua KB, Bellini WJ, Rota PA, Harcourt BH, Tamin A, Lam SK, Ksiazek TG, Rollin PE, Zaki SR, Shieh W, Goldsmith CS, Gubler DJ, Roehrig JT, Eaton B, Gould AR, Olson J, Field H, Daniels P, Ling AE, Peters CJ, Anderson LJ, Mahy BW. Nipahvirus: a recently emergent deadly paramyxovirus. Science. 2000 May 26;288(5470):1432-5	667	35.11
4	Calisher CH, Childs JE, Field HE, Holmes KV, Schountz T. Bats: important reservoir hosts of emerging viruses. Clin Microbiol Rev. 2006 Jul;19(3):531-45.	606	46.62
5	Daszak P, Cunningham AA, Hyatt AD. Anthropogenic environmental change and the emergence of infectious diseases in wildlife. Acta Trop. 2001 Feb 23;78(2):103-16	440	24.44
6	Chua KB, Goh KJ, Wong KT, Kamarulzaman A, Tan PS, Ksiazek TG, Zaki SR, Paul G,Lam SK, Tan CT. Fatal encephalitis due to Nipah virus among pig-farmers in Malaysia. Lancet. 1999 Oct 9;354(9186):1257-9.	399	19.95
7	Patz JA, Daszak P, Tabor GM, Aguirre AA, Pearl M, Epstein J, Wolfe ND, Kilpatrick AM, Foufopoulos J, Molyneux D, Bradley DJ; Working Group on Land Use Change and Disease Emergence. Unhealthy landscapes: Policy recommendations on land use change and infectious disease emergence. Environ Health Perspect. 2004Jul;112(10):1092-8.	384	25.60
8	Chua KB, Koh CL, Hooi PS, Wee KF, Khong JH, Chua BH, Chan YP, Lim ME, Lam SK. Isolation of Nipah virus from Malaysian Island flying-foxes. Microbes Infect. 2002 Feb;4(2):145-51	332	19.53
9	Yin HS, Wen X, Paterson RG, Lamb RA, Jardetzky TS. Structure of the parainfluenza virus 5 F protein in its metastable, prefusion conformation. Nature. 2006 Jan 5;439(7072):38-44	294	22.62
10	Solomon T, Ni H, Beasley DW, Ekkelenkamp M, Cardosa MJ, Barrett AD. Origin and evolution of Japanese encephalitis virus in southeast Asia. J Virol. 2003 Mar;77(5):3091-8.	293	18.31

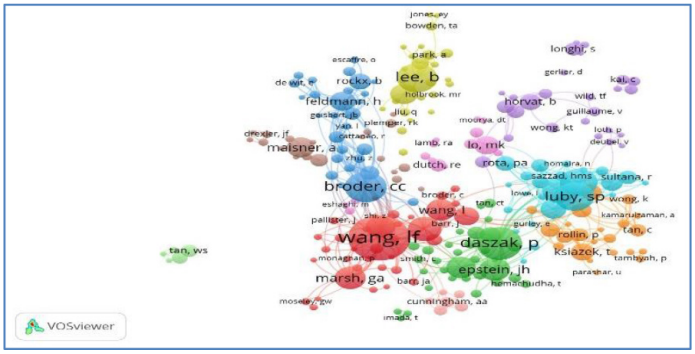

Figure 4: Network visualization map of author co-authored.

research areas like molecular biology, cell biology during the year 1999 to 2018.

Productive Institute in publication of Nipah articles

The total number of institutes that contributed to NIPAH was 346. The ten top productive institutes in NIPAH research are shown in (Table 6). The maximum was shown by Commonwealth Scientific and Industrial Research Organization, Australia of 197 (15.14%) articles, followed by the Center for Disease Control and Prevention, the USA with 134 (10.3%).

DISCUSSION

The current study portrays the global scenario of Nipah virus related articles over a period of years (1999–2018) using the web of science database. The exploratory analysis was based on the type of publication, quantification by year and citations, the geographical distribution of productivity, keywords, most preferred journals for publication, priority publications with authors and citations, mapping of authors, priority research areas and most productive institute. Majority of the publications were research articles 839 (64.5%) and maximum publication (108) was in the year 2013 with 38849 citations. The productive authors were from the country in the USA and 'Nipah Virus' was the most commonly used keyword. Most of the articles were published in the Journal of Virology and mapping of authors with co-authorship related research group identified the leading researcher as Wang LF. The priority research area was Infectious diseases and the most productive institute was the Commonwealth Scientific and Industrial Research Organization, Australia.

The rare disease Nipah, has generated a countable number of research articles (839 out of 1301) across the country and when India viewed at a glance it was (25 research articles out of 36) and the maximum (8) was published in the year 2008,

Table 5: Top 10 research areas of Nipah articles using WoS from 1999-2018.

During 1999-2003			During 2004-2008		
Research areas	**No. of articles**	**Percentage**	**Research areas**	**No. of articles**	**Percentage**
Infectious diseases	136	87.74%	Infectious diseases	264	87.12%
Virology	119	76.77%	Virology	219	72.27%
Microbiology	114	73.54%	Microbiology	213	70.29%
Public environmental occupational health	80	51.61%	Biochemistry molecular biology	160	52.80%
Veterinary sciences	75	48.38%	Immunology	138	45.54%
Immunology	58	37.41%	Veterinary sciences	135	44.55%
Neuroscience neurology	54	34.83%	Genetics heredity	128	42.24%
Zoology	48	30.96%	Zoology	110	36.30%
Biochemistry molecular biology	43	27.74%	Cell biology	108	35.64%
Genetics heredity	32	20.64%	Public environmental occupational health	107	35.31%

During 2009-2013			During 2014-2018		
Research areas	No. of articles	Percentage	Research areas	No. of articles	Percentage
Infectious diseases	401	96.98%	Infectious diseases	371	88.54%
Microbiology	328	71.15%	Microbiology	290	69.21%
Virology	324	70.28%	Virology	273	65.15%
Biochemistry molecular biology	261	56.61%	Biochemistry molecular biology	220	52.50%
Zoology	206	44.68%	Immunology	172	41.05%
Veterinary sciences	195	49.29%	Zoology	169	40.33%
Immunology	181	39.26%	Genetics heredity	158	37.70%
Genetics heredity	178	38.61%	Veterinary sciences	156	37.23%
Public environmental occupational health	157	34.05%	Public environmental occupational health	139	33.17%
Cell biology	128	27.76%	Pathology	108	25.77%

Table 6: Top ten productive institutes in publishing NIPAH article using WoS, 1999-2018.

Institutes	No. of articles	Percentage
Commonwealth Scientific and Industrial Research Organization, Australia.	258	19.83
Center for Disease Control and Prevention, USA.	240	18.45
University of Malaysia, Malaysia.	126	9.68
University of California, Los Angeles.	80	6.11
Uniformed Services University of the Health Sciences, USA.	67	5.15
University of Texas System, USA	67	5.15
National Institute of Health, USA.	64	4.92
University of Texas Medical branch Galveston, USA.	64	4.92
International Centre for Diarrhoeal Disease Research, Bangladesh.	59	4.53
INSERM, France	47	3.59

Table 7: Comparison of two earlier scientometrics studies with the current study.

	Safahieh *et al.*	Gupta M *et al.*	Current study
Study period	**1999-2010**	**1999- 24 May 2018**	**1999-31Aug 20118**
Database	SCI-Expanded database, (Web of Science) and 'TOPIC' search	Scopus database	SCI-Expanded database, (Web of Science) and 'TOPIC' search
No. of Nipah articles	462	1181	1301
Statistics used	Descriptive, figures and tables	Quantitative and qualitative	Descriptive and exploratory approach
Growth of the article	Incremental but there is a decrease in 2005	Fluctuating and decrease in 2003, 2005, 2007, 2011 and continuously decreasing from 2015.	Fluctuating and decrease in 2001, 2005, 2014, 2016 and continuously decreasing from 2015.
Actively contributing countries	• USA (41.0%) • Australia (19.3%) • Malaysia (16.0%) • England (6.5%) • France (5.6%)	• USA (46.0%) • Australia (16.8%) • Malaysia (11.1%) • France (8.0%) • UK (7.7%)	• USA (52%) • Australia (20%) • UK (14%) • Malaysia (10.1%) • France (7.5%)
Publication output	Only articles and reviews considered	• Research article (58.5%) reviews (22.9%) • Book chapters (4.4%) • Conference papers (3.7%), • Editorials (3.1%), • Notes (2.8%), • Short surveys (1.95%), • Letters (1.69%), • Books (0.42%) • Others (erratum, conference reviews) (0.37%).	• Research article (64.5%) • Reviews (12.5%) • Meeting abstract (4.5%), • Editorials (2.5%) • Proceeding paper (2.4%) • Book chapter (1.6%) • News items (1.6%) • Letter (1.0%) • Others (correction, reprint etc.) (9.4%)
Average citation per publication	24.8	28.05	29.86
Top research areas	• Not available	• Medicine (51.0%) • Immunology and microbiology (42.5%) • Biochemistry, genetics and molecular biology (21.3%) agricultural and biological sciences (11.9%) • Others (<6%)	• Infectious disease (86.9%), • Microbiology (69.3%) • Virology (68.6%) • Biochemistry Molecular Biology (50.5%) Veterinary Science (42.0%) • Immunology (40.7%) • Zoology (39.3%) • Genetic Heredity (37.0%) • Public Environmental Occupation Health (35.4%), • Cell Biology (26.9%)
Most productive institute in Nipah virus research as per rank.	• Center for Disease Control and Prevention USA • University of Malaya Malaysia • CSIRO, Australia • Uniformed Services University of the Health Sciences, USA • CSIRO Livestock Industries, Australia • University of California, USA • University of Kentucky, USA • University of Marburg, Germany • University Putra Malaysia, Malaysia • Veterinary Research Institute, Malaysia	• CSIRO, Animal Health Laboratory, Australia. • Centre for Disease Control and Prevention, USA. • University of Malaya, Malaysia. • Uniformed Services University of Health Science, Bethesda, USA. • National Institute of Health, Bethesda, USA. • University of Texas Medical Branch at Galveston, USA • University of California at Los Angles, David Geffen School of Medicine, USA • International Centre for Diarrheal Disease Bangladesh • INSERM, France • Mount Sinai School of Medicine, New York, USA	• CSIRO, Australia. • Centre for Disease Control and Prevention, USA. • University of Malaysia, Malaysia. • Uniformed Services University of the Health Sciences, USA. • University of California, Los Angeles. • University of Texas System, USA. • National Institute of Health, USA. • University of Texas Medical branch Galveston, USA • International Centre for Diarrhoeal Disease Research, Bangladesh. • INSERM, France

Table 7: Comparison of two earlier scientometrics studies with the current study.

Productive authors in Nipah as per production.	• LFWang, CSIRO, Australia. • TGKsiazek, USA • CC Broder, Uniformed Services. University of Health Science, Bethesda, USA • BT Eaton, Australia • Rota PA, USA • G Crameri, Australia • KB Chua, Malaysia • PE Rollin, USA • Be Lee, University of California at Los Angles USA • SK Lam, Malaysia	• LF Wang, CSIRO, Animal Health Laboratory, Australia • CC Broder, Uniformed Services. University of Health Science, Bethesda, USA • B Lee, University of California at Los Angles • David Geffen, School of Medicine, USA • P Daszak, Consortium for Conservation Medicine, New York, USA • SP Luby, International Centre for Diarrheal Disease Bangladesh	• LF Wang, CSIRO, Australia • P Daszak, Consortium for Conservation Medicine, New York, USA • CC Broader Uniformed Services, University of Health Science, Bethesda, USA • SP Luby, International Centre for Diarrheal Disease, Bangladesh • B Lee, University of California at Los Angles, USA • David Geffen School of Medicine, USA
Author's preferred journal	• Journal of Virology • Virology • Emerging infectious diseases • Journal of general virology • Journal of Virological methods • Virology journal • Archives of virology • Neurology Asia • Microbes and infection • Virus research	• Journal of Virology • Emerging Infectious Diseases • PLOS One • Journal of General Virology • PLOS Pathogens • Virology • Journal of Virological methods • Virology Journal • Science • Virus Research	• Journal of Virology • Emerging Infectious Disease • PLOS One • Virology • Journal of General Virology • EcoHealth, • PLOS Pathogens • Virology Journal • American Journal of Tropical Medicine Hygiene • International Journal of Infectious Diseases

which included transmission not only in human but also in animals.

Majority of the article were published in the Indian Journal of Medical Research and 'National Institute of Virology' was found to be the most productive institute. The article by Chadha MS *et al*. published in the journal 'Emerging Infectious Disease' in the year 2006 was cited a maximum number of times (*n*=235) with average citation per year was 18.08.

The current WoS database of Nipah articles does not show any definite, pattern of growth. The findings were almost consistent with earlier reported studies (Table 7). A study by Safahieh[10] using WoS for the period 1999-2010 also showed that the publication growth was incremental up to the year 2010 and the average citations per publication were 24.8. The active contributing country was USA (41%) and the most productive institute and author were Centre for Disease Control and Prevention, USA and LF Wang respectively. Another study using the Scopus database for the period (1999-2018) by Gupta *et al.* (Table 7) also showed that the growth pattern was not steadily increasing but fluctuating.[11] The country USA accounted for the highest publication share (46%) of Nipah virus articles with average citation per year as 28.1% and the most productive institute and author were CSIRO, Australia and Wang LF respectively.

CONCLUSION

The scientometrics about rare disease Nipah virus shows the productivity of the scientific community across the globe. The main findings using the scientometrics analysis for a shorter period (1999-2010) and using the Scopus database does not show major changes. Every search tool has its own accessibility (cost) and style (like a categorization of research areas) and also strengths and weaknesses[12] but keeps the major findings alike.

The recent outbreak of Nipah virus in May 2018, was reported in Kerala and India's first Nipah virus victim town Siliguri after Kerala outbreak has created an alarming sign to health authorities. According to the World Health Organization (WHO), more than 600 cases of Nipah virus human infections were reported from 1998 to 2015.[13] The above outbreak research would lead to incremental growth in the existing databases (like WoS, Scopus, PubMed, Google Scholar, etc.) and alert among the Indian researchers.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

WoS: Web of Science; **SCI:** Science Citation Index; **CSIRO:** Commonwealth Scientific and Industrial Research Organisa-

tion; **INSERM:** The Institut National de la Santé et de la Recherche Médicale.

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