

Convalescent Plasma Therapy and COVID-19: A Scientometric Analysis

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Call to action condition during COVID-19 epidemic outbreak, where no specific antiviral agents were available to treat, convalescent plasma transfusion was used worldwide to prevent severity and disease progression. Since the late 19th century, convalescent plasma therapy was used worldwide to weaken several outbreaks caused by human respiratory viruses like 1918 Spanish flu pandemic, 1958 Argentine hemorrhagic fever in Argentina, 2003 SARS epidemic (SARS-CoV-1), and 2019 COVID-19 pandemic.

This scientometric analysis focuses on the research done on CP therapy and COVID-19 during 2019 to 2022 to know the most productive authors with their affiliation, keyword analysis and highly cited publications to get overview of research progress. A total of 1,56,071 publications was found in Web of Science for the years 2019 to 2022. VoSViewer and Bibliometrix R were used for data analysis. Harvard Medical School having highest publications. USA, China, UK, Italy, India, Germany, Canada, Australia, Iran and France are the top 10 contributing countries.

Purpose: COVID-19 virus outbreak all over the world. An increasing number of researches for the use of CP therapy in COVID-19 patients are upcoming research and this report aims at performing scientometric analysis of all the available researches to get the detailed analysis.

Introduction

COVID-19 is a big threat to the global health which shut down the whole world and created a tremendous pressure on medical science professionals to overcome from this situation. Pneumonia associated with severe acute respiratory syndrome coronavirus 2 (SARS – Cov – 2) also called as COVID-19 disease emerged in December 2019 in a Wuhan Laboratory of China and reported 64 lakhs deaths globally as per World Health Organization (WHO). The unavailability of any approved antiviral agent to treat this infectious disease, Remdesivir was the only antiviral drug to treat critical patient. As promising evidence of old therapeutic agent “Convalescent Plasma therapy”, also called antibody therapy or immunotherapy, in which the blood plasma collected from the patients recovered from an infection has been used to treat critical patients. Over the past two decades, CP therapy was successfully used to treat H1N1, MERS, SARS and several bacterial and viral infections. During the pandemic period, when the worldwide medical professionals and researchers were doing quick research and get supported through global funding, most of the publishers created the COVID-19 databases accessible to anyone to support scientific community. Ripoll. et. al (2021)

expressed that CP therapy should be considered an empiric therapy and the first line defence against novel infectious diseases.

Objectives

The objectives of the article are mentioned below:

- i. To investigate type of Publications
- ii. To explore Author Productivity Pattern and Applicability of Lotka's Law
- iii. To explore Top 10 Relevant Institutions
- iv. To explore Top 10 Highly Cited Journal
- v. International Collaboration
- vi. To visualize word clouds and three-field plots (Authors, Country, Affiliation)

2. Literature Review

Aggarwal (2021) analysed twenty researches blasting in medical field due to coronavirus outbreak. Authors from USA were highly contributed and Chinese authors got the highest citations. Authors also warned that due to emergence of research, rigorous research review process was compromised. Cunningham (2021) studied nature of collaboration and found the diversity of collaboration due to pandemic. Multidisciplinary researches with smaller portion but with varied subjects were found. Jain (2022) analysed top 100 most cited research articles on COVID-19 imaging to highlight the research trends and most cited works and found that China is the leading country to contribute highest research as well as highest citations. This research also helps radiologists to refer to the most popular articles. Karla (2021) analysed 616 research articles from Web of Science to retrieve data for COVID-19 and ophthalmology and concluded that more global contribution toward COVID-19 related ophthalmic research as viral infection not only affects the respiratory system but has the potential effect to other organs also. Reuven (2021) observed publication pattern changed in biomedical publications due to COVID-19 pandemic and found that the pandemic makes the non-COVID research slower in biomedical sciences. Senel (2021) performed the holistic scientometric analysis to evaluate COVID publications periodically. This study found that in 2000s, China became the leading contributing nation because of the SARS outbreak in China based on the 13,833 research documents published during 1980 to 2019 on coronavirus indexed in Web of Science. Tovalino (2022) analysed 2071 scientific publications on COVID-19 and dentistry form MeSH (Medical Subject Headings) and found that India is one of the highest contributed country and having a major collaboration with UK.

3. Research Methodology

The publications of the Convalescent plasma therapy and COVID-19 retrieved from Web of Knowledge with applicable query TS=(Convalescent plasma therapy AND COVID-19 OR sars-cov-2 OR coronavirus). A total number of 156075 publications found indexed in the Science Citation Index, Social Science Citation

Index and Arts and Humanities Citation Index during the period of 2019-2022. The data were collected on 29th August 2022. The “Bibliometrix”, R package used to perform various quantitative analyses on the extracted plain text format file of Web of Science for publications and citations data and visualize word clouds. VOSviewer was used to demonstrate the collaboration-mapping analysis and three-field plots (Authors, Country, and Affiliation) visualized through Sankey diagram.

4. Data Analysis and Discussion

4.1 Type of Publications

The main information about the data of 156075 publications published during 2019-2022 are shown in the below Table 1. The mentioned publications published in 11143 sources like journal, Books, etc. The average citation per document is 17.46 and average age of document is 1.03. The annual growth rate is 18.92%.

Table 1: Types of Publications

Description	Results
Main Information About Data	
Timespan	2019:2022
Sources (Journals, Books, etc)	11143
Documents	156075
Annual Growth Rate %	18.92
Document Average Age	1.03
Average citations per doc	17.46

The published publications categorized into the articles, book chapters, proceeding papers, editorial materials, letters, notes, reviews, meeting abstract, poetry, corrections etc. are mentioned below in the Table 2. There are 23 withdrawn publications which were listed in the published publications and removed from the list of publications.

Table 2: Type of Documents

Document Types	Results	Document Types	Result
Article	102967	editorial material; early access	157
article; book chapter	155	expression of concern	3
article; data paper	109	item withdrawal	1
article; early access	5566	Letter	9076
article; early access; retracted publication	1	letter; early access	381

article; proceedings paper	94	meeting abstract	3790
article; publication with expression of concern	2	news item	692
article; retracted publication	8	Poetry	4
article; withdrawn publication	1	proceedings paper	1360
Bibliography	2	Reprint	6
biographical-item	4	Retraction	21
Book	5	retraction; publication with expression of concern	1
book review	69	Review	21311
book review; early access	4	review; book chapter	52
Correction	808	review; early access	691
correction; early access	48	review; publication with expression of concern	1
editorial material	8673	review; retracted publication	3
editorial material; book chapter	8	review; withdrawn publication	1

4.2 Author Productivity pattern and Applicability of Lotka's Law

Authors Productivity and publications containing Bibliometrics aspects, have been extracted through Bibliometrix R package. The co-authorship network diagram was generated as shown to represent the collaborative works by two or more authors on publications. As shown below in the Table 3, there are total number of 498038 authors published the 156075 publications during 2019-2022. Author of single-authored documents is 8749. The authors collaboration of single-authored documents is 11167, co-authors per documents is 7.79 and international co-authorships indexed as 23.48%.

Table 3: Authorship and Publications Pattern

Authors	
Authors	498038
Authors of single-authored docs	8749
Authors Collaboration	
Single-authored docs	11167
Co-Authors per Doc	7.79
International co-authorships %	23.48

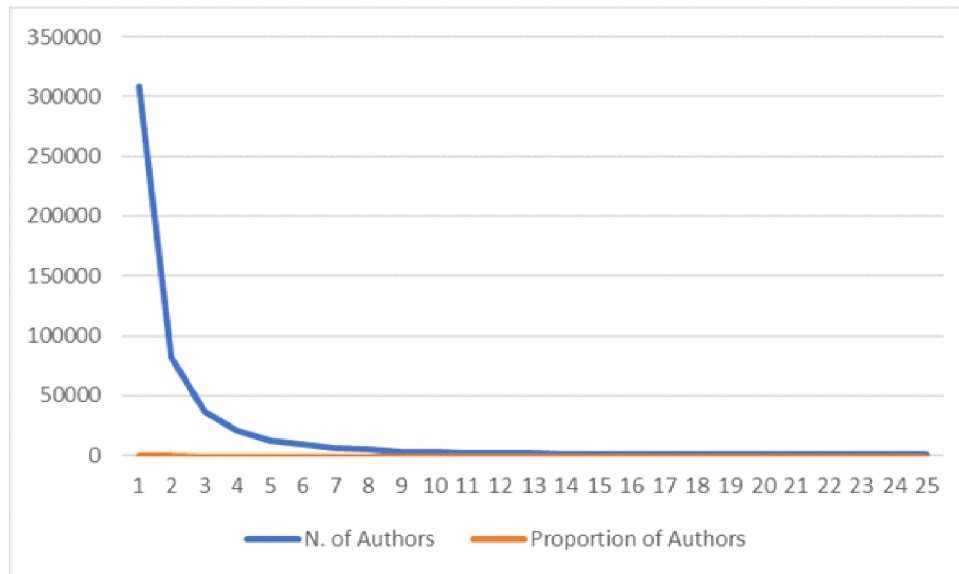


Figure 2: Author's Productivity through Lotka's Law

The ten most productive authors calculated based on the number of publications, publications fractionalization, and h-index, that extracted from the Bibliometrix R package as shown in Table 5. It observed that the author named Zhang Y is on 1st rank in terms of the number of publications (667), 2nd rank in terms of article fractionalized (76.52) and H index (66). Kumar S is on 1st rank in terms of the articles fractionalized (76.59) and 8th rank in terms of articles (459). Liu Y is on 1st rank in terms of H Index (72), 5th rank in terms of Liu Y (568) and 6th rank in terms of article fractionalized.

Table 5: Most Productive Authors

Authors	Articles	Authors	Articles Fractionalized	Author	H_index
Zhang Y	667	Kumar S	76.59	Liu Y	72
Wang Y	600	Zhang Y	76.52	Zhang Y	66
Wang J	570	Wang Y	73.57	Wang J	61
Li Y	568	Kumar A	72.96	Wang Y	61
Liu Y	568	Wang J	69.58	Li Y	59
Li J	509	Liu Y	69.00	Liu J	58
Zhang L	499	Li Y	67.13	Liu L	58
Kumar S	459	Li J	59.48	Zhang J	57
Kumar A	452	Zhang L	54.92	Zhang L	57
Liu J	440	Liu J	50.68	Chen Y	55

4.3 Top 10 Relevant Institutions

Institution-wise distribution of publications published during the Year 2019-2022. Harvard Medical School contributed highest 3276 publications, Huazhong University Science and Technology comes to the second position contributing 3249 publications, and University of Oxford in the third position contributing 2600 articles followed by Univ Toronto contributing 2510 publications and so on.

Table 6: Top 10 Relevant Institutions

Affiliation	Articles
Harvard Med Sch	3276
Huazhong Univ Sci and Technol	3249
Univ Oxford	2600
Univ Toronto	2510
Univ Tehran Med Sci	2384
Icahn Sch Med Mt Sinai	2350
Univ Washington	2323
Univ Sao Paulo	2245
Wuhan Univ	2217
Univ Milan	2181

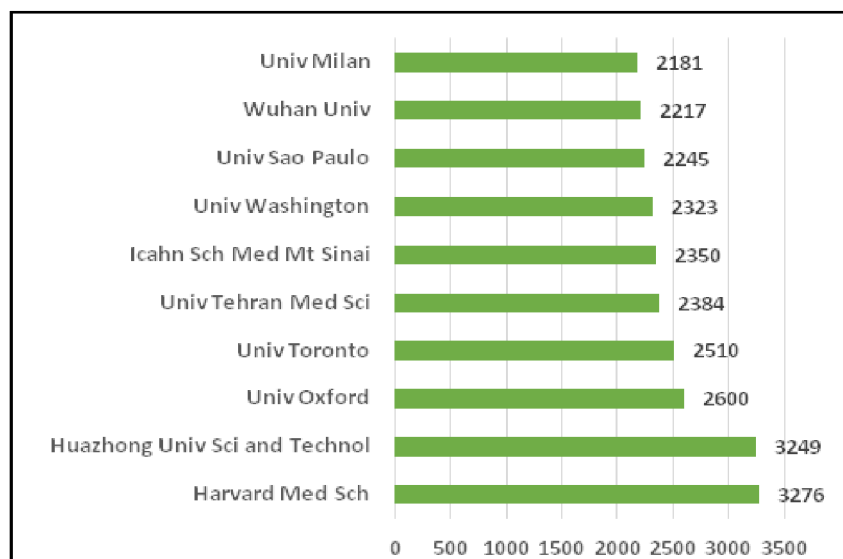


Fig. 3: Top 10 Relevant Institutions

4.4 Top 10 Highly Cited Journal

As per table 7 and Figure 4, the top 10 highly cited journal during the year 2019-2022. International Journal of Environmental Research and Public Health have been contributed highest article 1991, PLOS One comes to the second position contributing 1778 articles, and Scientific Reports in the third position contributing 1423 articles followed by Journal of Medical Virology contributing 1384 articles, Frontiers in Immunology contributing 1256 articles and so on.

Table 7: Top 10 highly Cited Journals

Sources	Articles
International Journal of Environmental Research And Public Health	1991
PLOS One	1778
Scientific Reports	1423
Journal of Medical Virology	1384
Frontiers in Immunology	1256
Viruses-Basel	1232
Cureus Journal of Medical Science	1194
Clinical Infectious Diseases	1164
Vaccines	1054
Frontiers In Public Health	1002

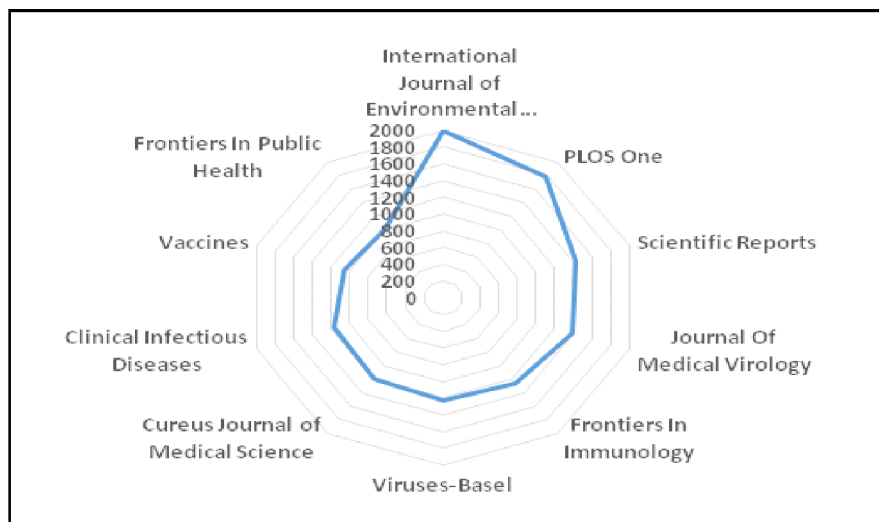


Figure 4: Top 10 Highly Cited Journals

4.5 International Collaboration

Fast research requirements during COVID -19 situation encouraged collaboration and funding. Collected data from Web of Science, evaluated through Bibliometrix R and found that highest collaboration done by the USA authors followed by China, UK, Italy, India, Germany, Canada, Australia, Iran and France. International collaboration by authors from the same country publications and it is denoted as SCP, it means such publications represent intra-country collaboration. The multiple country publications (MCP) mean authors belong to different countries and publications represent inter-country collaboration. USA contributed 32436 highest publications firstly and France contributed 3601 publications and secured the 10th place as shown in Table 8. The software tool VoSViewer is used to demonstrate the country collaboration – mapping network. Figure 5 depicts the network intends to show many countries are associated together for publications.

Table 8: Most Relevant Countries by Corresponding Authors

Country	Articles	SCP	MCP	Freq	MCP_Ratio
USA	32436	26714	5722	0.208	0.176
China	17917	14085	3832	0.115	0.214
United Kingdom	7127	4586	2541	0.046	0.357
Italy	10517	8414	2103	0.067	0.2
India	8918	7334	1584	0.057	0.178
Germany	5231	3754	1477	0.034	0.282
Canada	3371	2157	1214	0.022	0.36
Australia	2652	1522	1130	0.017	0.426
Iran	4056	2962	1094	0.026	0.27
France	3601	2666	935	0.023	0.26

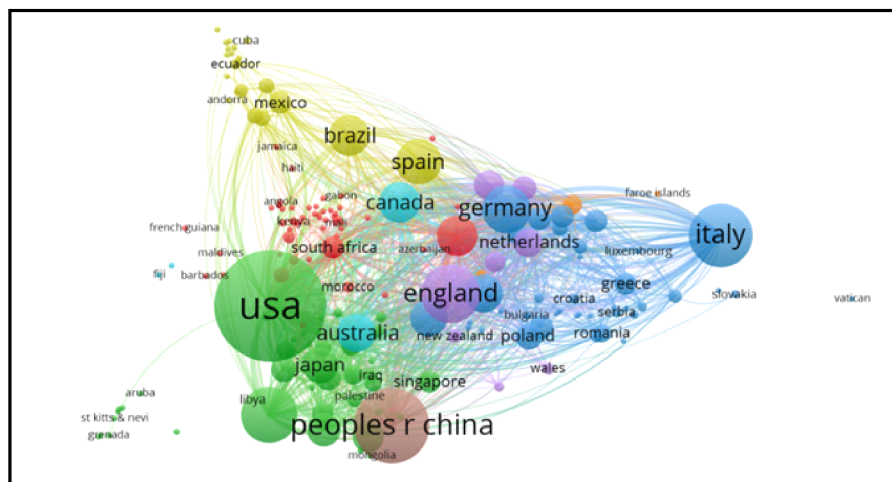


Figure 5: Countries Collaboration

5. Conclusion

In this study, researchers had extracted the publications from Web of Science database during 2019 – 2022 which includes 156075 total publications out of which covered 102967 research articles. It has been observed that 8749 research articles contributed by single authors whereas 498038 were contributed research which conveyed that the emergence of research invited more collaboration. It has been observed that the author named Zhang Y is on 1st rank in terms of the number of publications (667), Kumar S is on 1st rank in terms of the articles fractionalized (76.9) and Liu Y is on 1st rank in terms of H Index (72). It has been also observed that International Journal of Environmental Research and Public Health and PLOS one were the prior choices to publish research in this area. Top leading countries contributed are, USA, China, UK, Italy, India, Germany, Canada, Australia, Iran, and France. Harvard Medical School, Huazhong University Science and Technology, University oxford, University of Toronto, University of Tehran Medical Science, Icahn School Medical Mt. Sinai, University Washington, University Sao Paulo, Wuhan University and University of Milan are top leading contributed organizations. Word Cloud visualized as most frequently used terms in the journal and three field plots visualized the interactions among the most relevant author, county and affiliation.

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