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A Scientometric Analysis of Global literature on Hydroxychloroquine based on SCOPUS

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ABSTRACT

This paper deals with the scientometric analysis of the global literature on Hydroxychloroquine as indexed in SCOPUS database from its first publication in 1946 to 2020. The objective of the study was to perform a scientometric analysis of Hydroxychloroquine publications. The study analyzed 25,163 publications which were contributed by 88,834 individual authors affiliated to 159 countries. The results showed momentum in the research publications during the 1980s and accelerated immediately from the beginning of the 21st century. It was observed a fluctuating trend for the Annual Growth Rate and CAGR recorded to 0.129635. The Relative Growth

Rate recorded between 0.04 and 0.56 for different years. The Degree of Collaboration (DC) noted was 0.88 and 5.27 Collaboration Index (CI). The Journal of Rheumatology was the most preferred journal with 864 publications; Didier A. Raoult was the most productive author in Hydroxychloroquine (HCQ) research. The AP-HP Assistance Publique - Hopitaux de Paris, France was the top productive institution globally, and the USA was the most productive country in terms of the number of publications.

Keywords: Chloroquine, Corona Virus, COVID-19, Drug Repurposing, Hydroxychloroquine, Lupus, Malaria, Rheumatoid Arthritis, Scientometric Analysis

Introduction

The recent pandemic Coronavirus disease (COVID-19) posed a severe threat to public health globally and risked people's lives due to the initial lack of drug or vaccine to treat it. The World Health Organization's report on COVID-19 Situation Dashboard (2020) stated that COVID-19 affected more than 219 countries and territories. More than ten crores of people got infected, and more than 22 lack people have dead (as on 2nd of February 2021). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is the cause of coronavirus disease-2019 (COVID-19) started from Wuhan, China, on 31 December 2019. The rapid increase of Coronavirus disease led to an outbreak with high mortality and morbidity (Lai et al., 2020). The World Health Organization named the novel coronavirus disease as COVID-19 on February 11, 2020. COVID-19 is similar to Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MARS) that can cause fever and severe respiratory symptoms, such as cough, wheezing, and dyspnea (Chan et al., 2020; Huang et al., 2020; and Wu et al. 2020). Many countries announced the total lock-down, which ceases the complete human activities. Due to the impact of COVID-19, there was a substantial economic loss to the governments and private organisations and affected the operations in all spheres, including health care and public work activities. In some countries, scientists worked 24*7 to determine the drug or vaccine to treat the COVID-19 affected people.

Moreover, "Vaccine development is a long, complex process, often lasting 10-15 years and involving a combination of public and private involvement" (History of Vaccines, 2018). Hence, many Research and Development (R & D) organizations and drug control authorities stressing upon 'Drug Repurposing'. Drug Repurposing is also known as drug repositioning, a strategy to use existing approved drugs to new diseases. Drug Repurposing will reduce time, cost and human labour involved in new drug development and production. With such efforts, the World Health Organization (2020) announced "Solidarity" clinical trial for COVID-19 treatments using clinical drug repurposing for

various drugs like Remdesivir, Lopinavir / Ritonavir, Chloroquine and Hydroxychloroquine. The Chloroquine and Hydroxychloroquine are closely related and used to treat Rheumatology conditions and Malaria, respectively. Hydroxychloroquine was used for many decades to treat Malaria and autoimmune diseases like rheumatoid arthritis and Lupus.

What is Hydroxychloroquine?

Quinoline based molecules have long been used for the treatment of Malaria, beginning with quinine. The chemical modifications of quinine led to more potent and inexpensive Aminoquinoline (AQ) drug molecules such as Chloroquine (CQ) and Hydroxychloroquine (HCQ) etc. The most widespread disease in the world is Malaria. World Health Organization (WHO) has estimated around 40% world population presently lives under malaria threats, and annually Malaria occurs approximately 300–500 million cases, leading to 1–3 million deaths. Mainly, mortality is higher in children below the age of 5 years and statistics reveals that about 25% of child deaths are found in Africa (Chew et al. 2019; Marmor et al. 2011; and Wang et al. 2017). In this line, CQ generally used for the treatment of malarial infections, followed by HCQ. The entire world has witnessed a COVID-19 pandemic, due to which, there is a sudden increase in the interest of antimalarial and anti-inflammatory drug molecules, more particularly Hydroxychloroquine.

Hydroxychloroquine (Plaquenil) is also considered a Disease-Modifying Anti-Rheumatic Drug (DMARD). It can reduce the pain and swelling of arthritis. It may prevent joint damage and reduce the risk of long-term disability. Earlier the Hydroxychloroquine was used intensively to treat Malaria across the world. Presently, HCQ is also used to treat childhood arthritis, some lupus symptoms, rheumatoid arthritis and other autoimmune diseases. It is believed that Hydroxychloroquine interferes with the communication of cells in the immune system (American College of Rheumatology). This may be one of the reasons why HCQ is used effectively in treating autoimmune diseases. Hydroxychloroquine is very similar to Chloroquine. However, it has lesser side effects, but one of the best known antimalarial drugs. According to Das (2020), HCQ has some antiviral properties because it was selectively used in coronavirus treatment.

Review of Related Literature

The authors have made an effort to present the review of literature in two parts. In the first part, the papers pertaining to the treatment, therapeutic drugs, antiviral vaccines and traditional clinical results are highlighted. The latter part deals with the literature on Scientometric analysis. The

Coronavirus pandemic has posed many challenges to all the nations (both developed and developing), be it economic, socio-cultural activities, etc. Due to which people's lives have badly affected. On the other hand, it has triggered an avalanche of scientific research, both within and outside the medical domain, to help communities, overcome this challenge by minimising its adverse impacts (Haghani et al.).

The plethora of scientists, pharma companies are trying to find out the vaccine for this pandemic. Many traditional clinical practice results across the world playing a significant role in the treatment of COVID-19 but efficacy and safety remain unclear.

In their paper, Ren et al. (2020) discuss that the traditional clinical practices/medicines play a significant role in the treatment of COVID-19. Early intervention, especially Traditional Chinese Medicines (TCM), can effectively prevent the COVID-19 from transforming into severe disease. However, Gray and Belessis (2020) report that the benefits of TCM in the treatment of Corona Virus disease remain unproven and injurious to health. On the other hand, a Chinese team published results of a study demonstrating that Chloroquine, an antimalarial, and its hydroxyl analogue, Hydroxychloroquine inhibit SARS-CoV- 2 *in vitro* with EC50 = 0.72%μM found to be more potent than Chloroquine (EC50 = 5.47%μM) (Yao et al., 2020). In support of this, a French paper reveals that Hydroxychloroquine with azithromycin is more effective in treating COVID-19 patients (Gautret et al., 2020).

The Hydroxychloroquine (HCQ) drug has been initially used to treat Malaria, since it may inhibit the plasmodial heme polymerase. However, several clinical observations and experiments have also proved that it is an effective drug for various diseases, including Dyslipidemias, Coagulopathies, Diabetes Mellitus, Malignancies and Autoimmune diseases Systematic Lupus Erythematosus (SLE), Rheumatoid Arthritis and Sjogren's Syndrome (Olsen et al., 2013). Considering that there is no alternative and better option presently, HCQ is regarded as god sent the drug to treat COVID-19. Large-scale basic and clinical research is still needed to clarify its specific mechanism (Chen et al., 2020). The available data show that the use of HCQ in patients with SLE is effective and safe. HCQ can be used to treat constitutional symptoms of Lupus, such as joint pain and swelling, rashes, and fatigue. However, the drug may also be given along with steroids and immunosuppressive drugs to improve the life expectancy of patients with SLE and in reducing lupus flares and organ damage accrual (Ponticelli and Moroni, 2017). Another study conducted by Srivastava et al. (2020) reveal that the application of graphene-based materials for combating SARS-CoV-2 virus and associated COVID-19, their outstanding physicochemical and antimicrobial properties suggest that these materials may play a crucial role on various fronts in the war against COVID-19. Ultimately, Immunization is the most effective way to fight against many diseases (Castro et al., 2018).

The published literature reveals that very few Scientometric studies have been conducted on various vaccines to treat fever, Malaria, Artemisia, Plasmodium vivax and Coronavirus disease. Garg et al. (2009) conducted a bibliometric analysis of global malaria vaccine research based on the publication records extracted from PubMed databases during 1972-2004. A total of 2007 publication records were analysed, which published in 352 journals from 40 different countries. 37.2% of malaria vaccine research was published by the USA, followed by the United Kingdom. The National Institutes of Health (USA) and the Naval Medical Research Institute (USA) were the most prolific institutes. *Infection and Immunity* was the most preferred journal, followed by *Vaccine*.

Ram (2011) conducted a bibliometric study to analyse the research publications on "Artemisia" which is a herb used to treat Malaria. The study examined 1484 research publications indexed in the PubMed database for the period from 1996 to 2010. The author observed a consistent growth of literature year by year. China contributed maximum, i.e. 24% of the total publications, followed by the USA (16%). The *Journal of Ethnopharmacology* was the most preferred journal, followed by *Planta Medica*. The study further analysed India's contribution to Artemisia research. A total of 214 Indian authors contributed in 56 publications.

Yao et al. (2012) attempted to analyse publications on Artemisia annua, which is Chinese traditional medicine to treat fever and Malaria. A total of 4076 Publications were extracted from the Science Citation Index (SCI), and 4065 publications data were extracted from Medline till December 2011. The research outputs were considered for the study to evaluate the global scientific production and developing trend of artemisinin research. The study found that the research on Artemisia annua started in 1980 but boosted only after 2000. Though Artemisia annua is Chinese traditional medicine, the highest number of research papers were published by the scientists affiliated to the USA, followed by the UK. The Chinese Academy of Sciences and Thailand Mahidol University published a maximum number of research papers. Fu et al. (2015) conducted a bibliometric analysis of malaria research in China. They have retrieved Five thousand one hundred twenty-six records from China National Knowledge Infrastructure (CNKI), Wanfang database, Cqvip and PubMed from 2004 to 2014. The study found that 2013 was the most productive year. China Centers for Disease Control and Prevention (CDC) was the most productive institute, and *China Tropical Medicine* was the most preferred journal to publish malaria research.

Garrido-Cardenas et al. (2019) analysed the global research on Malaria and Plasmodium vivax extracted from Scopus database with 11,166 documents published between 1916 and 2018. The analysis showed that the year 2012 was the most productive year with the highest number of

publications. The United States of America, United Kingdom and India were the most productive countries in Malaria and Plasmodium vivax. Mahidol University and the University of Oxford were the most productive institutes during the period of study. Whereas, Tran et al. (2019) analysed HIV/AIDS and economic evaluation articles published between 1990 and 2017 as indexed in the Web of Science database. There were 2,50,270 publications indexed on HIV/AIDS; 372 publications were on economic evaluations in HIV/AIDS. However, this study analysed 372 research publications and found that 2013 was the most productive year and publications in the year 2001 received the highest number of citations. Overall, 46 countries contributed, and out of which the USA and the UK contributed the highest number of publications.

Singh and Mahanty (2019) conducted a bibliometric study of research trends on Malaria in India. A total of 2,334 publications covered in Web of Science during 1909 and March 2019 were considered for the study. The first prominent peak in the malaria research in India was noticed during 1991. From 2002 to 2013 increasing trend was noticed, with the highest rise in 2016 and a continuous downfall was noticed afterwards. The most preferred collaborating country was the USA, followed by the UK. The *Journal of Vector-Borne Diseases* was the most preferred journal by the researchers. Malaria and India were the most preferred keywords. Academic institutions followed by research institutions are the major contributors to the output of malaria research. Most of the highly productive institutions are located in the USA and the UK.

Shettar and Hadagali (2020) analysed world research publications on Coronavirus indexed in the Scopus database from 1951 to 2019. A total of 18,116 publication records were analysed which published in 2,562 journals from 150 different countries. The study found the Journal of Virology was a most preferred journal with 6.55% articles of overall publications. Luis Enjuanes from Centro Nacional de Biotecnologia Consejo Superior de Investigaciones Cientificas (CNB, CSIC), Spain was the leading author; the University of Hong Kong was the leading institution in the field Coronavirus research. The USA has contributed 31.22% of the overall publication.

Lou et al. (2020) analysed the publications on COVID-19 to provide references to recent publications of 183 publications till 1st March 2020. The study was based on the records retrieved from the PubMed database. The study found that corresponding authors of these publications were from 20 different countries, and 78 corresponding authors worked in hospitals. Out of 183 corresponding authors, 123 were from China, followed by the USA (18). The *Journal of Medical Virology* has the highest publications.

From the above review, no single study was conducted on the scientometric analysis of the literature on Hydroxychloroquine, and this research would try to bridge the gap.

Objectives of the Study

The present study's main objective is to identify and analyse the global publications' productivity in the field of Hydroxychloroquine from 1946 to 2020. The specific objectives are to:

1. study the publications pattern in the field of Hydroxychloroquine;
2. determine the Annual Growth Rate (AGR), Relative Growth Rate (RGR) and Doubling Time (Dt.) in the field of Hydroxychloroquine;
3. analyse the Degree of Collaboration (DC), Collaborative Coefficient (CC) and Collaboration Index (CI);
4. study the top twenty-five most productive journals, fruitful authors, prolific institutions and countries; and
5. identify the top five highly cited papers in the field of Hydroxychloroquine.

Materials and Methods used

For this study, the data were collected from the Elsevier Scopus database for the period from 1946 to 2020. A total of 25,163 bibliographic records indexed in the Scopus database were retrieved in the CSV (comma-separated values) file format and further analysed using MS-Excel and online tools. The search syntax was used to retrieve the data from Scopus as *TITLE-ABS-KEY (Hydroxychloroquine)*. The mathematical formulae were used to compute the records using various parameters on Hydroxychloroquine.

ANALYSIS AND INTERPRETATION OF DATA

Year-wise distribution of publications

Table 1 depicts the year-wise distribution of publications on Hydroxychloroquine, and figure 1 presents the Annual Growth of publications and citations. The first publication on Hydroxychloroquine (in Scopus database) was found in the year 1946. A total of 25,163 publications were published from 1946 to 2020 and received a total of 5,67,632 citations. Up to 1961, there was less number of publications (with single-digit). The highest numbers of publications, i.e. 5,736 were published during 2020, followed by 1,361 (in 2019) and 1,281 (in 2018). The highest numbers of

citations were received for publications of the year 2020 (52,753) followed by publications in 2006 (32,840 citations) and 2009 (32,496 citations). The overall average citations per paper (ACPP) recorded for the period of the study is 22.56 and highest ACPP of 49.93 recorded for the publications in the year 2003 followed by 2005 (48.07 ACPP) and 2006 (44.74 ACPP).

Table 1: Year-wise distribution of publications

Year	Total Publications	Total Citations	ACPP	Year	Total Publications	Total Citations	ACPP
1946	1	1	1.00	1985	116	3531	30.44
1948	2	3	1.50	1986	111	1906	17.17
1949	1	1	1.00	1987	78	1840	23.59
1952	1	4	4.00	1988	93	2228	23.96
1953	1	0	0.00	1989	96	1741	18.14
1954	1	6	6.00	1990	117	2851	24.37
1955	2	9	4.50	1991	178	4697	26.39
1956	2	17	8.50	1992	197	4998	25.37
1957	2	14	7.00	1993	256	6107	23.86
1958	2	24	12.00	1994	259	7391	28.54
1959	2	56	28.00	1995	278	8131	29.25
1960	4	21	5.25	1996	262	9496	36.24
1961	2	12	6.00	1997	204	7090	34.75
1962	16	110	6.88	1998	243	5369	22.09
1963	29	697	24.03	1999	287	9460	32.96
1964	22	54	2.45	2000	305	10292	33.74
1965	22	214	9.73	2001	350	13886	39.67
1966	15	291	19.40	2002	460	19835	43.12
1967	16	269	16.81	2003	500	24964	49.93
1968	10	204	20.40	2004	571	21376	37.44
1969	9	149	16.56	2005	644	30960	48.07
1970	14	149	10.64	2006	734	32840	44.74
1971	16	251	15.69	2007	798	30621	38.37
1972	7	26	3.71	2008	847	28388	33.52
1973	40	313	7.83	2009	884	32496	36.76
1974	35	673	19.23	2010	884	31144	35.23
1975	52	679	13.06	2011	870	27978	32.16

1976	50	683	13.66	2012	961	26169	27.23
1977	62	721	11.63	2013	1056	23948	22.68
1978	55	518	9.42	2014	926	19705	21.28
1979	69	1250	18.12	2015	970	17947	18.50
1980	84	1184	14.10	2016	1052	15489	14.72
1981	73	722	9.89	2017	1198	13639	11.38
1982	108	1735	16.06	2018	1281	10056	7.85
1983	101	2171	21.50	2019	1361	6310	4.64
1984	95	1641	17.27	2020	5736	52753	9.20
Total					**25163**	**567632**	**22.56**

ACPP: Average Citation per Publication

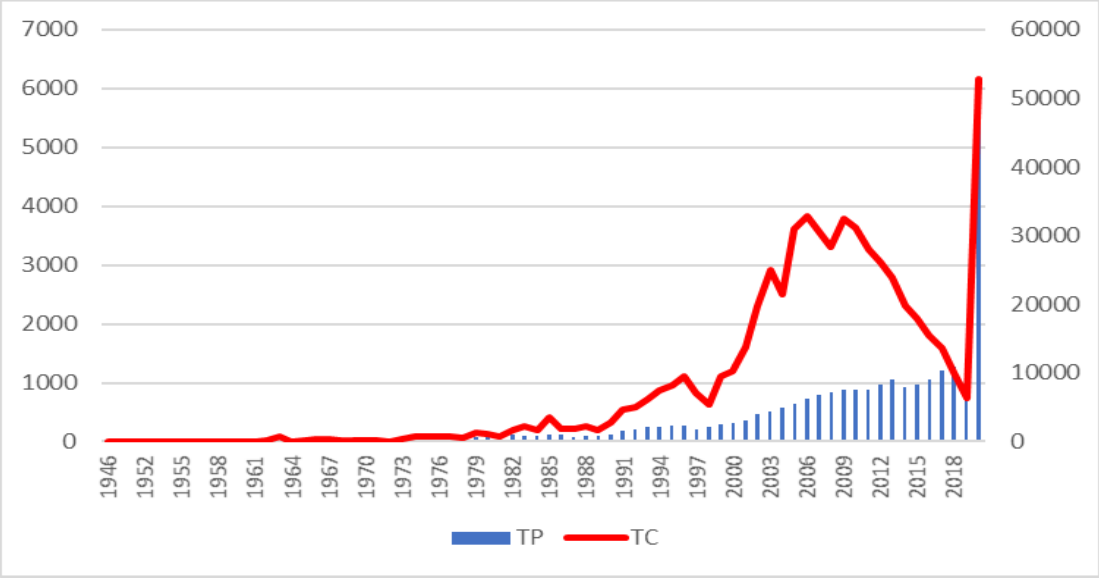

Fig. 1: Annual growth rate of publications and citations

(TP: Total Publications; TC=Total Citations)

Annual Growth Rate (AGR) of publications

The Annual Growth Rate (AGR) is calculated on the formula given by Gracio et al. (2013). AGR is a simple and standard for measuring the growth in a particular year using only two parameters, i.e. First Value and End Value. According to Choi et al. (2011), the Growth rate is being measured with Compound Growth Rate (CAGR). CAGR is a standard for measuring the growth for the overall period of study. Table 2 presents the annual growth rate (AGR) and Compound Annual Growth Rate (CAGR). There was a fluctuating trend observed for AGR throughout the study period.

The maximum AGR, i.e. 700 was recorded for 1962, followed by 471.43 during 1973 and 321.45 recently in the year 2020. While the minimum AGR was recorded, i.e. -56.25 for the year 1972. The Compound Annual Growth Rate (CAGR) for the total period has arrived at 0.129635.

Table 2: Annual Growth Rate (AGR) of publications

Year	Total Publications	AGR	Year	Total Publications	AGR
1946	1	0.00	1985	116	22.11
1948	2	100.00	1986	111	-4.31
1949	1	-50.00	1987	78	-29.73
1952	1	0.00	1988	93	19.23
1953	1	0.00	1989	96	3.23
1954	1	0.00	1990	117	21.88
1955	2	100.00	1991	178	52.14
1956	2	0.00	1992	197	10.67
1957	2	0.00	1993	256	29.95
1958	2	0.00	1994	259	1.17
1959	2	0.00	1995	278	7.34
1960	4	100.00	1996	262	-5.76
1961	2	-50.00	1997	204	-22.14
1962	16	700.00	1998	243	19.12
1963	29	81.25	1999	287	18.11
1964	22	-24.14	2000	305	6.27
1965	22	0.00	2001	350	14.75
1966	15	-31.82	2002	460	31.43
1967	16	6.67	2003	500	8.70
1968	10	-37.50	2004	571	14.20
1969	9	-10.00	2005	644	12.78
1970	14	55.56	2006	734	13.98
1971	16	14.29	2007	798	8.72
1972	7	-56.25	2008	847	6.14
1973	40	471.43	2009	884	4.37
1974	35	-12.50	2010	884	0.00
1975	52	48.57	2011	870	-1.58
1976	50	-3.85	2012	961	10.46

1977	62	24.00	2013	1056	9.89
1978	55	-11.29	2014	926	-12.31
1979	69	25.45	2015	970	4.75
1980	84	21.74	2016	1052	8.45
1981	73	-13.10	2017	1198	13.88
1982	108	47.95	2018	1281	6.93
1983	101	-6.48	2019	1361	6.25
1984	95	-5.94	2020	5736	321.45
CAGR (1946-2020)			**0.129635**		

(AGR: Annual Growth Rate and CAGR: Compound Annual Growth Rate)

Relative Growth Rate (RGR) and Doubling Time (Dt.) of publications

The Relative Growth Rate (RGR) increases the number of articles/pages per unit of time. This definition is derived from the definition of relative growth rates in the study of growth analysis of individual plants and is effectively applied in the field of botany (Hunt, 1978 & 1982; Poorter & Garnier, 1996; Hoffmann & Poorter, 2002). Doubling time (Dt.) is defined as the time to be taken to double in the size or value and exists a direct equivalence between the relative growth rate and the doubling time. The Doubling time can be calculated by dividing the natural logarithm of 2 by the RGR calculated for the time period. Doubling time (Dt.) is calculated on the formula suggested by Mahapatra (1985). It is observed from Table 3 that the value of Relative Growth Rate (RGR) decreased from 0.55 in 1948 to 0.25 in 2020. The fluctuating trend was observed throughout the study period. The values of Doubling Time (Dt.) of publications increased from 1.26 in 1948 to 19.35 during 1972 again decreased to 10.19 during 2019, recently in 2020 it is recorded at 2.80. A fluctuation trend was observed in Dt during the study period. Figure 2 presents the data on year-wise Relative Growth Rate (RGR) and Doubling Time (Dt.).

Table 3: Relative Growth Rate (RGR) and Doubling Time (Dt.) of publications

Year	Total Publications	Cumulative Total Publications	W1	W2	RGR	Dt
1946	1	1	0.00	0.00	0.00	0.00
1948	2	3	0.00	1.10	0.55	1.26
1949	1	4	1.10	1.39	0.29	2.41
1952	1	5	1.39	1.61	0.07	9.32

1953	1	6	1.61	1.79	0.18	3.80
1954	1	7	1.79	1.95	0.15	4.50
1955	2	9	1.95	2.20	0.25	2.76
1956	2	11	2.20	2.40	0.20	3.45
1957	2	13	2.40	2.56	0.17	4.15
1958	2	15	2.56	2.71	0.14	4.84
1959	2	17	2.71	2.83	0.13	5.54
1960	4	21	2.83	3.04	0.21	3.28
1961	2	23	3.04	3.14	0.09	7.62
1962	16	39	3.14	3.66	0.53	1.31
1963	29	68	3.66	4.22	0.56	1.25
1964	22	90	4.22	4.50	0.28	2.47
1965	22	112	4.50	4.72	0.22	3.17
1966	15	127	4.72	4.84	0.13	5.51
1967	16	143	4.84	4.96	0.12	5.84
1968	10	153	4.96	5.03	0.07	10.25
1969	9	162	5.03	5.09	0.06	12.12
1970	14	176	5.09	5.17	0.08	8.36
1971	16	192	5.17	5.26	0.09	7.96
1972	7	199	5.26	5.29	0.04	19.35
1973	40	239	5.29	5.48	0.18	3.78
1974	35	274	5.48	5.61	0.14	5.07
1975	52	326	5.61	5.79	0.17	3.99
1976	50	376	5.79	5.93	0.14	4.86
1977	62	438	5.93	6.08	0.15	4.54
1978	55	493	6.08	6.20	0.12	5.86
1979	69	562	6.20	6.33	0.13	5.29
1980	84	646	6.33	6.47	0.14	4.97
1981	73	719	6.47	6.58	0.11	6.47
1982	108	827	6.58	6.72	0.14	4.95
1983	101	928	6.72	6.83	0.12	6.01
1984	95	1023	6.83	6.93	0.10	7.11
1985	116	1139	6.93	7.04	0.11	6.45
1986	111	1250	7.04	7.13	0.09	7.45
1987	78	1328	7.13	7.19	0.06	11.45

1988	93	1421	7.19	7.26	0.07	10.24
1989	96	1517	7.26	7.32	0.07	10.60
1990	117	1634	7.32	7.40	0.07	9.33
1991	178	1812	7.40	7.50	0.10	6.70
1992	197	2009	7.50	7.61	0.10	6.71
1993	256	2265	7.61	7.73	0.12	5.78
1994	259	2524	7.73	7.83	0.11	6.40
1995	278	2802	7.83	7.94	0.10	6.63
1996	262	3064	7.94	8.03	0.09	7.75
1997	204	3268	8.03	8.09	0.06	10.75
1998	243	3511	8.09	8.16	0.07	9.66
1999	287	3798	8.16	8.24	0.08	8.82
2000	305	4103	8.24	8.32	0.08	8.97
2001	350	4453	8.32	8.40	0.08	8.47
2002	460	4913	8.40	8.50	0.10	7.05
2003	500	5413	8.50	8.60	0.10	7.15
2004	571	5984	8.60	8.70	0.10	6.91
2005	644	6628	8.70	8.80	0.10	6.78
2006	734	7362	8.80	8.90	0.11	6.60
2007	798	8160	8.90	9.01	0.10	6.73
2008	847	9007	9.01	9.11	0.10	7.02
2009	884	9891	9.11	9.20	0.09	7.40
2010	884	10775	9.20	9.28	0.09	8.10
2011	870	11645	9.28	9.36	0.08	8.92
2012	961	12606	9.36	9.44	0.08	8.74
2013	1056	13662	9.44	9.52	0.08	8.61
2014	926	14588	9.52	9.59	0.07	10.57
2015	970	15558	9.59	9.65	0.06	10.76
2016	1052	16610	9.65	9.72	0.07	10.59
2017	1198	17808	9.72	9.79	0.07	9.95
2018	1281	19089	9.79	9.86	0.07	9.98
2019	1361	20450	9.86	9.93	0.07	10.06
2020	5736	26186	9.93	10.17	0.25	2.80

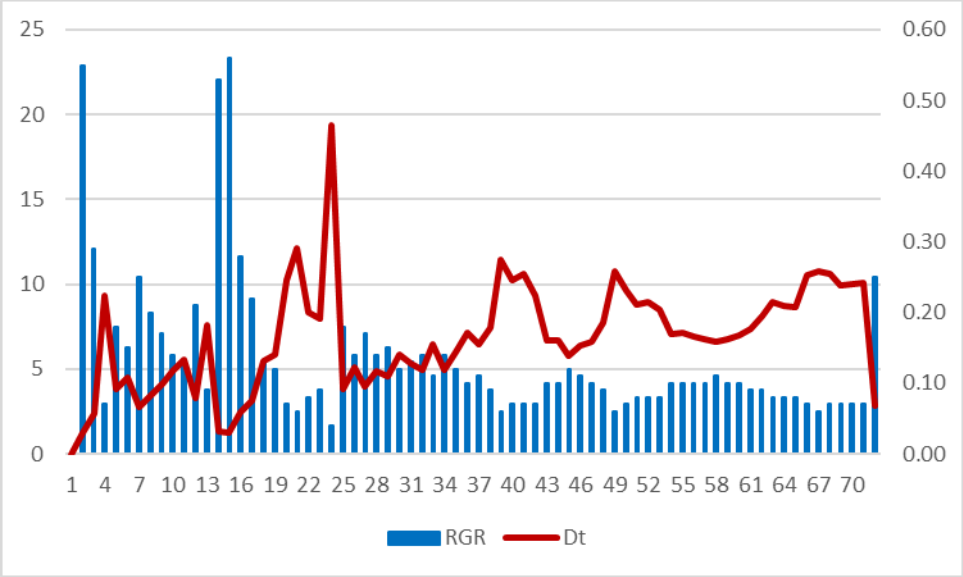

Fig. 2: Year-wise Relative Growth Rate and Doubling Time
(RGR=Relative Growth Rate; Dt.=Doubling Time)

Degree of Collaboration (DC)

The Degree of Collaboration in different years was calculated as per the mathematical formula proposed by Subramanyam (1983) based on two parameters in publications, i.e. Single authored papers, and Multi-authored papers. Table 4 presents the block year-wise Degree of Collaboration (DC) in the field of Hydroxychloroquine. The block period 1946-1950 witnessed the lowest DC, i.e. 0.50 (2 out of 4 publications) single-authored papers and the block period 2016-2020 has recorded DC of 0.94 with the highest (9915) multi-authored papers. The Degree of Collaboration (DC) varied from 0.50 to 0.94 throughout the study period. The mean value of DC throughout the study period was 0.88. The block periods from 2001-05, 2006-10, 2011-2015 and 2016-2020 have more than 0.8 DC. The block period 2016-2020 has seen the highest (0.94) DC.

Table 4: Degree of Collaboration (DC): Block wise

Publication Years (5 Years Block)	No. of Authors	%	Single authored (Ns)	%	Multi authored (Nm)	%	Total (Ns + Nm)	Degree of Collaboration
1946-50	0	0.00	2	0.06	2	0.01	4	0.50
1951-55	0	0.00	2	0.06	3	0.01	5	0.60
1956-60	0	0.00	4	0.13	8	0.04	12	0.67

1961-65	1	0.47	35	1.12	55	0.24	90	0.61
1966-70	1	0.47	19	0.61	44	0.19	63	0.70
1971-75	3	1.42	50	1.60	97	0.42	147	0.66
1976-80	3	1.42	137	4.37	180	0.79	317	0.57
1981-85	11	5.19	187	5.97	295	1.29	482	0.61
1986-90	11	5.19	147	4.69	337	1.48	484	0.70
1991-95	27	12.74	280	8.93	861	3.77	1141	0.75
1996-2000	21	9.91	309	9.86	971	4.25	1280	0.76
2001-05	42	19.81	433	13.82	2050	8.98	2483	0.83
2006-10	21	9.91	519	16.56	3607	15.79	4126	0.87
2011-15	20	9.43	348	11.10	4415	19.33	4763	0.93
2016-20	51	24.06	662	21.12	9915	43.41	10577	0.94
	212	100.00	3134	100.00	22840	100.00	25974	0.88

Collaborative Coefficient (CC) and Collaboration Index (CI)

The table 5 shows that multi-authored publications (87.23%) dominate over the single-authored publications (11.97%). There were a few research papers with anonymous authors (0.81%). The authorship pattern shows that the number of publications by mega-authored (five and above) papers dominated with 11,196 (42.76%) publications, followed by two authored papers with 4,284 (16.36%) publications and three authored papers with 3,898 (14.89%) publications. Collaboration Coefficient (CC) as defined by Ajiferuke et al. (1988) lies between 0 and 1, with 0 correspondings to single-authored papers. The CC during the study ranges between 0, and 0.80, with an average, are 0.63. If the CC's value is more than 0.5, then the collaboration rate among the authors is found better. Up to 1991 except 4 years (1949, 1952, 1968 & 1986) the collaboration rate was below 0.5. After 1992, exponential growth in collaboration was observed till 2019 (CC=0.71); however, in 2020, a small dip in CC (0.68). The Collaboration Index (CI) provides the mean number of authors per paper for the study period (proposed by Lawani, 1980), i.e. an average number of authors per paper for a particular year. It considers the total number of authors, including single-author and the total number of papers to calculate. The average number of authors per paper to the whole study period was 5.275. The highest collaboration index 7.26 is recorded in 2020 with 5,736 articles being contributed by 41,667 authors.

Table 5: Collaborative Coefficient (CC) and Collaboration Index (CI)

Year	No Authors	Single Author	Two Authors	Three Authors	Four Authors	Five & Above	Total	CC	Total Authors of Multi Authored Papers	CI
1946	0	1	0	0	0	0	1	0.00	0	1.00
1948	0	1	1	0	0	0	2	0.25	2	1.50
1949	0	0	0	0	0	1	1	0.80	5	5.00
1952	0	0	0	0	0	1	1	0.80	5	5.00
1953	0	0	0	1	0	0	1	0.67	3	3.00
1954	0	1	0	0	0	0	1	0.00	0	1.00
1955	0	1	1	0	0	0	2	0.25	2	1.50
1956	0	1	0	1	0	0	2	0.33	3	2.00
1957	0	0	1	1	0	0	2	0.58	5	2.50
1958	0	1	1	0	0	0	2	0.25	2	1.50
1959	0	0	1	0	1	0	2	0.63	6	3.00
1960	0	2	0	2	0	0	4	0.33	6	2.00
1961	0	1	0	1	0	0	2	0.33	3	2.00
1962	0	7	5	2	2	0	16	0.33	24	1.94
1963	0	14	5	8	2	0	29	0.32	42	1.93
1964	0	7	8	4	2	1	22	0.41	43	2.27
1965	1	6	8	4	3	0	22	0.45	40	2.09
1966	0	5	7	2	0	1	15	0.38	25	2.00
1967	0	3	6	5	2	0	16	0.49	35	2.38
1968	1	2	3	1	2	1	10	0.55	23	2.50
1969	0	3	5	1	0	0	9	0.35	13	1.78
1970	0	6	4	3	1	0	14	0.34	21	1.93
1971	1	5	6	1	1	2	16	0.44	30	2.19
1972	0	3	2	1	1	0	7	0.35	11	2.00
1973	1	13	10	9	5	2	40	0.43	77	2.25
1974	1	14	9	7	4	0	35	0.38	55	1.97
1975	0	15	11	17	6	3	52	0.46	116	2.52
1976	1	21	14	5	7	2	50	0.36	82	2.06
1977	0	26	15	15	3	3	62	0.36	103	2.08
1978	1	26	12	7	5	4	55	0.34	87	2.05

1979	0	34	9	17	5	4	69	0.33	111	2.10
1980	1	30	22	13	12	6	84	0.41	166	2.33
1981	2	27	16	16	8	4	73	0.41	137	2.25
1982	0	45	26	19	12	6	108	0.37	188	2.16
1983	3	38	27	15	11	7	101	0.40	189	2.25
1984	2	37	19	16	10	11	95	0.40	188	2.37
1985	4	40	18	30	14	10	116	0.44	244	2.45
1986	4	24	33	26	8	16	111	0.51	266	2.61
1987	2	18	26	15	10	7	78	0.49	177	2.50
1988	1	26	18	17	7	24	93	0.49	254	3.01
1989	1	30	28	10	16	11	96	0.44	214	2.54
1990	3	49	17	15	15	18	117	0.40	248	2.54
1991	3	50	41	27	18	39	178	0.48	494	3.06
1992	6	49	52	30	21	39	197	0.50	537	2.97
1993	2	68	49	36	38	63	256	0.51	750	3.20
1994	4	56	48	47	32	72	259	0.54	816	3.37
1995	12	57	79	28	29	73	278	0.54	858	3.29
1996	5	56	61	32	40	68	262	0.54	853	3.47
1997	4	51	49	27	18	55	204	0.51	624	3.31
1998	3	63	53	48	25	51	243	0.50	688	3.09
1999	4	70	63	43	29	78	287	0.52	924	3.46
2000	5	69	58	43	33	97	305	0.54	1039	3.63
2001	12	69	76	50	49	94	350	0.56	1144	3.47
2002	8	99	88	69	66	130	460	0.55	1540	3.56
2003	5	75	108	86	66	160	500	0.59	1985	4.12
2004	10	98	131	89	72	171	571	0.57	2058	3.78
2005	7	92	138	99	103	205	644	0.60	2465	3.97
2006	6	111	150	115	96	256	734	0.59	2945	4.16
2007	4	93	166	139	82	314	798	0.62	3349	4.31
2008	6	114	157	136	121	313	847	0.61	3583	4.36
2009	1	113	168	128	125	349	884	0.61	3993	4.64
2010	4	88	165	138	128	361	884	0.64	4075	4.71
2011	4	86	145	151	117	367	870	0.64	3962	4.65
2012	6	86	166	167	140	396	961	0.65	4740	5.02
2013	4	76	164	150	171	491	1056	0.67	5247	5.04

2014	4	49	148	139	120	466	926	0.68	5188	5.66
2015	2	51	144	142	163	468	970	0.69	5474	5.70
2016	2	58	131	168	155	538	1052	0.69	6199	5.95
2017	0	46	139	178	179	656	1198	0.71	7352	6.18
2018	7	48	134	176	195	721	1281	0.71	8472	6.65
2019	6	50	153	181	216	755	1361	0.71	9033	6.67
2020	36	460	666	729	640	3205	5736	0.68	41202	7.26
	212 (0.81%)	3134 (11.97%)	4284 (16.36%)	3898 (14.89%)	3462 (13.22%)	11196 (42.76%)	26186	0.63	134840	5.27

Form-wise distribution of publications

Hydroxychloroquine related publications have been published in a variety of bibliographic forms. Table 6 depicts the overall distribution of the publications by bibliographic forms as indexed in the Scopus database. Majority of the publications have been published in the form of journal articles (16,089) which constitute 61.44 percentage of the overall publications, followed by Reviews (5,291; 20.21%) and Letters (2,504; 9.56%). The other details are presented in table 6.

Table 6: Distribution of the publications by bibliographic forms

Bibliographic form	Total Publications	Percentage (%)
Journal Articles	16,089	61.44
Reviews	5,291	20.21
Letters	2,504	9.56
Notes	718	2.74
Editorials	570	2.18
Conference Papers	454	1.73
Short Surveys	442	1.69
Book Chapters	75	0.29
Erratums	30	0.11
Data Paper	4	0.02
Retracted	3	0.01
Book	1	0.00
Undefined	5	0.02
Total	26,186	100.00

Top twenty-five Productive Journals in the field of Hydroxychloroquine

The data in Table 6 indicates that out of 16,186 total publications, 16,089 publications found to be Journal articles. A total of 13,380 publications were published in 2,952 journals by the scientists/authors in Hydroxychloroquine. The *Journal of Rheumatology* found to be the most preferred avenue for the publications in Hydroxychloroquine, with 864 publications that received 27,942 citations, followed by *Lupus* published 782 publications (SAGE publisher) and *Annals of the Rheumatic Diseases* published 519 publications (by BMJ Publishing Group). Out of the top twenty-five journals, 10 Journals are being published from the United States of America, followed by eight journals from the United Kingdom. Among the top twenty-five journals, the journal *Annals of the Rheumatic Diseases* has the highest Impact Factor (IF) (14.299) published by BMJ Publishing Group, United Kingdom, followed by the journal *Arthritis and Rheumatism* (9.002) published by Wiley-Blackwell, USA. Six publications were published by Elsevier, followed by four publications by Wiley-Backwell both from the USA. The journal *BMJ Case Reports* do not have an Impact Factor since case studies are rarely cited. Out of twenty-five highly productive journals, seven are being published by Wiley-Blackwell and five are by Elsevier.

Table 7: Top twenty-five Productive Journals in the field of Hydroxychloroquine

Journal Title	Impact Factor (2019)	Publisher	Country	Total Publications	Total Citations
Journal Of Rheumatology	3.634	Journal of Rheumatology Publishing Co., Ltd.	Canada	864	27942
Lupus	2.924	SAGE	UK	782	14664
Annals Of The Rheumatic Diseases	14.299	BMJ Publishing Group	UK	519	34531
Clinical Rheumatology	2.293	Springer Nature	UK	466	6520
Clinical And Experimental Rheumatology	3.238	Pacini Editore SpA	Italy	417	8252
Rheumatology	5.149	Oxford University Press	UK	311	15335
Arthritis And Rheumatism	9.002	Wiley-Blackwell	USA	304	42869
Journal Of The American Academy Of Dermatology	7.102	Elsevier	USA	298	11062
Rheumatology International	2.2	Springer Nature	Germany	296	3258
Journal Of Clinical Rheumatology	1.897	Future Medicine Ltd.	USA	275	2483

Arthritis Care And Research	4.53	Wiley-Blackwell	Wiley	266	12607
Seminars In Arthritis And Rheumatism	5.072	Elsevier	USA	210	8513
Arthritis Research And Therapy	4.148	Springer Nature	UK	168	5880
BMJ Case Reports	#N/A	BMJ Publishing Group	UK	167	399
Scandinavian Journal Of Rheumatology	2.706	Taylor & Francis	Norway	165	2980
Archives Of Dermatology	7.995	American Medical Association	USA	156	6741
Current Opinion In Rheumatology	3.851	Wolters Kluwer Health	USA	152	2587
British Journal Of Dermatology	6.714	Wiley-Blackwell	UK	144	4594
Dermatologic Therapy	1.74	Wiley-Blackwell	USA	144	1163
Autoimmunity Reviews	7.716	Elsevier	USA	142	4962
Joint Bone Spine	3.278	Elsevier	France	139	1855
International Journal Of Dermatology	1.794	Wiley-Blackwell	USA	138	3570
Clinical And Experimental Dermatology	1.771	Wiley-Blackwell	UK	137	1729
International Journal Of Rheumatic Diseases	1.938	Wiley-Blackwell	Australia	136	1127
Rheumatic Disease Clinics Of North America	3.527	Elsevier	USA	125	3358

Top twenty-five most fruitful authors in the field of Hydroxychloroquine

A total of 88,834 unique authors (Overall 1,37,974 authors, including multiple papers) contributed 26,186 papers. Table 8 depicts the top twenty-five most fruitful authors in the field of Hydroxychloroquine. Among the top twenty-five authors, Didier A. Raoult from Aix Marseille University, Marseille of France has published 131 papers with 9,004 citations to his credit, followed by Michelle A. Petri from Johns Hopkins School of Medicine, Baltimore of USA with 109 publications (6,901 citations) and Jean Charles Piette of AP-HP Assistance Publique-Hopitaux de Paris, France with 96 publications (4,333 citations) ranked first to third respectively. Among the top twenty-five authors, nine authors belong to the USA, followed by six authors belong to France. Though the author Maxime R. Dougados ranked nineteenth but received the highest citations, i.e. 10,170 (highest ACPP with 172.37), Paul D. Emery followed 9,715 citations (with highest 140.80

ACPP) ranked second. Didier A. Raoult and Michelle A. Petri have the highest h-index (43), followed by Munther A. Khamshta with 40 h-index among the top twenty-five most productive authors in the field of Hydroxychloroquine.

Table 8: Top twenty-five productive authors in the field of Hydroxychloroquine

Name of Author	Affiliation	Country	TP	TC	ACPP	h-index
Didier A. Raoult	Aix Marseille University, Marseille	France	131	9004	68.73	43
Michelle A. Petri	Johns Hopkins School of Medicine, Baltimore	USA	109	6901	63.31	43
Jean Charles Piette	AP-HP Assistance Publique - Hopitaux de Paris, Paris	France	96	4333	45.14	37
Zahir Amoura	Hôpital Universitaire Pitié Salpêtrière, Paris	France	87	4103	47.16	35
Munther A. Khamashta	Guy's and St Thomas' NHS Foundation Trust, London	UK	85	6706	78.89	40
Nathalie CostéDoat-Chalumeau	Hopital Cochin AP-HP, Paris	France	85	3506	41.25	33
Angela A. Tincani	Università degli Studi di Brescia, Brescia	Italy	78	3892	49.90	33
Hannu J. Kautiainen	Folkhälsan, Helsinki	Finland	72	3418	47.47	25
Yehuda Shoenfeld	Chaim Sheba Medical Center Israel, Tel Aviv-Yafo	Israel	70	4173	59.61	35
Paul D. Emery	University of Leeds, Leeds	UK	69	9715	140.80	31
Tom W.J. Huizinga	Leiden University Medical Center - LUMC, Leiden	Netherlands	67	6224	92.90	30
Victoria P. Werth	VA Medical Center	USA	66	1813	27.47	23
James R. O'Dell	University of Nebraska Medical Center, Omaha	USA	65	7569	116.45	25
Jeffrey P. Callen	University of Louisville Health Sciences Center, Louisville	USA	63	2431	38.59	25
Daniel J. Wallace	Cedars-Sinai Medical Center, Los Angeles	USA	63	4027	63.92	28
Tuulikki M. Sokka	Jyvaskyla Central Hospital, Jyvaskyla	Finland	62	4135	66.69	31
Daniel Eric Fürst	UCLA Health Sciences, Los Angeles	USA	61	4751	77.89	25

Marjatta T. Leirisalo-Repo.	Helsingin Yliopisto, Helsinki	Finland	60	3166	52.77	25
Maxime R. Dougados	Universite Paris-Saclay, Saint-Aubin	France	59	10170	172.37	28
Jeffrey R Curtis	University of Alabama at Birmingham	USA	58	5017	86.50	29
Olivier Fain	Sorbonne Universite, Paris	France	57	1697	29.77	23
Eric L. Matteson	Mayo Clinic, Rochester	USA	56	4076	72.79	28
Theodore P. Pincus	Rush University Medical Center, Chicago	USA	56	3434	61.32	29
Bernardus A.C. Dijkmans	Amsterdam UMC - Vrije Universiteit Amsterdam, Amsterdam	Netherlands	54	3935	72.87	31
Guillermo Ruiz-Irastorza	Osakidetza, Cruces University Hospital, Baracaldo	Spain	53	3480	65.66	22

(TP-Total Publications; TC-Total Citations and ACPP-Average Citations per Paper)

Top twenty-five prolific institutions

Table 9 indicates the top twenty-five most prolific institutions in the field of Hydroxychloroquine. Out of top twenty-five most prolific institutions, AP-HP Assistance Publique-Hopitaux de Paris has published the highest papers, i.e. 465, followed by Institut national de la santé et de la recherche médicale (Inserm), Paris with 464, Harvard Medical School with 385 publications ranked first to third respectively. Among the listed institutes Harvard Medical School has received highest 20,115 citations, followed by Inserm (16931) and Brigham and Women's Hospital (16847). Ranking list according to h-index by top-25 institutes is topped by Harvard Medical School (64) followed by Inserm (63) and AP-HP Assistance Publique - Hopitaux de Paris (62) respectively.

Out of the top twenty-five institutions, six institutions are based in Paris alone, followed by two institutions based at Boston, Birmingham, London, and New York. Among the country affiliation, 13 institutions belong to the USA, whereas six institutions belong to France and two from the Netherlands and the United Kingdom.

Table 9: Top twenty-five prolific institutions

Institution Affiliation	City	Country	Total Publications	Total Citation	h-Index
AP-HP Assistance Publique - Hopitaux de Paris	Paris	France	465	15045	62

Inserm	Paris	France	464	16931	63
Harvard Medical School	Boston	USA	385	20115	64
Brigham and Women's Hospital	Boston	USA	335	16847	60
University of Toronto	Toronto	Canada	300	12198	56
Mayo Clinic	Rochester	USA	288	13856	56
Université de Paris	Paris	France	266	13639	53
Hôpital Universitaire Pitié Salpêtrière	Paris	France	259	9790	53
Sorbonne Universite	Paris	France	229	7433	42
University of California	San Francisco	USA	224	11986	50
University of Pennsylvania	Philadelphia	USA	220	10446	51
University College London	London	United Kingdom	218	11188	54
VA Medical Center	Washington	USA	213	6971	44
Hospital Cochin AP-HP	Paris	France	211	12239	51
Johns Hopkins School of Medicine	Baltimore	USA	210	8839	50
Università degli Studi di Milano	Milan	Italy	208	5653	40
The University of Alabama at Birmingham	Birmingham	USA	204	11231	54
Leiden University Medical Center - LUMC	Leiden	Netherlands	189	15861	58
Weill Cornell Medicine	New York	USA	188	7564	41
Università degli Studi di Roma La Sapienza	Rome	Italy	178	5713	34
Aix Marseille Université	Marseille	France	178	8725	45
Charité – Universitätsmedizin Berlin	Berlin	Germany	175	12501	51
Cleveland Clinic Foundation	Cleveland	USA	173	5231	35
Massachusetts General Hospital	Boston	USA	170	8635	42
Hospital Clinic Barcelona	Barcelona	Spain	168	7232	43

Distribution of top twenty-five Publications by Country wise

Table 10 presents the data on the country-wise distribution of publications. Totally there were 159 countries contributed to Hydroxychloroquine research field. Among the top twenty-five countries,

the United States of America has published the highest publications, i.e. 8,490 (the USA alone has contributed 32.42% of the total publications), followed by France with 2152 publications (8.22%), the United Kingdom with 2146 (8.20%) publications ranked first to third respectively. The top twenty-five counties contributed nearly 85% of the total publications, whereas 134 countries contributed 4077 (15.57%) publications.

Table 10: Distribution of top twenty-five Publications by Country wise

Name of Country	Total Publications	%	Name of Country	Total Publications	%
United States	8490	32.42	South Korea	504	1.92
France	2152	8.22	Switzerland	429	1.64
United Kingdom	2146	8.20	Taiwan	422	1.61
Italy	1928	7.36	Iran	412	1.57
India	1203	4.59	Israel	398	1.52
Germany	1175	4.49	Greece	346	1.32
Canada	1108	4.23	Belgium	322	1.23
Spain	1072	4.09	Sweden	305	1.16
China	1040	3.97	Finland	279	1.07
Netherlands	870	3.32	Japan	241	0.92
Australia	770	2.94	Egypt	209	0.80
Turkey	655	2.50	Portugal	205	0.78
Brazil	514	1.96	134 Countries	4077	15.57

Mapping of Keyword Co-occurrence

The map was constructed using VOSviewer visualization software, and the required data was extracted from the Scopus citation database. The Keyword co-occurrence map visualises the terms which have appeared at least 2000 times as keyword in all documents included. There are three clusters in the above map with 73 keywords and 2612 links. The links between two keywords in the network show number of times the keywords linked appeared together in the publications. Higher the number of links between two keywords, higher the number of times they have co-occurred in the documents. The network based on keywords determines the nature of research and research hotspots in the area of Hydroxychloroquine (HCQ). The keywords (male and female, and adults, child, adolescents, middle-aged, aged etc.) indicate that HCQ drug research was based on gender and age

criteria. Controlled and clinical studies were frequently used in research methods. The keywords like "Covid-19", "Coronavirus disease 2019", "Coronavirus infections", "betacoronavirus", "pandemic" have prominently placed in these highly used keywords and created a separate cluster, in blue colour, due to recent drug repurposing experiments and case studies of Hydroxychloroquine in the treatment for COVID-19 in 2020. The safety and efficacy of drug HCQ in the treatment of diseases such as "rheumatoid arthritis" and "Systemic lupus erythematosus (SLE)" were also found to be the prominent research area.

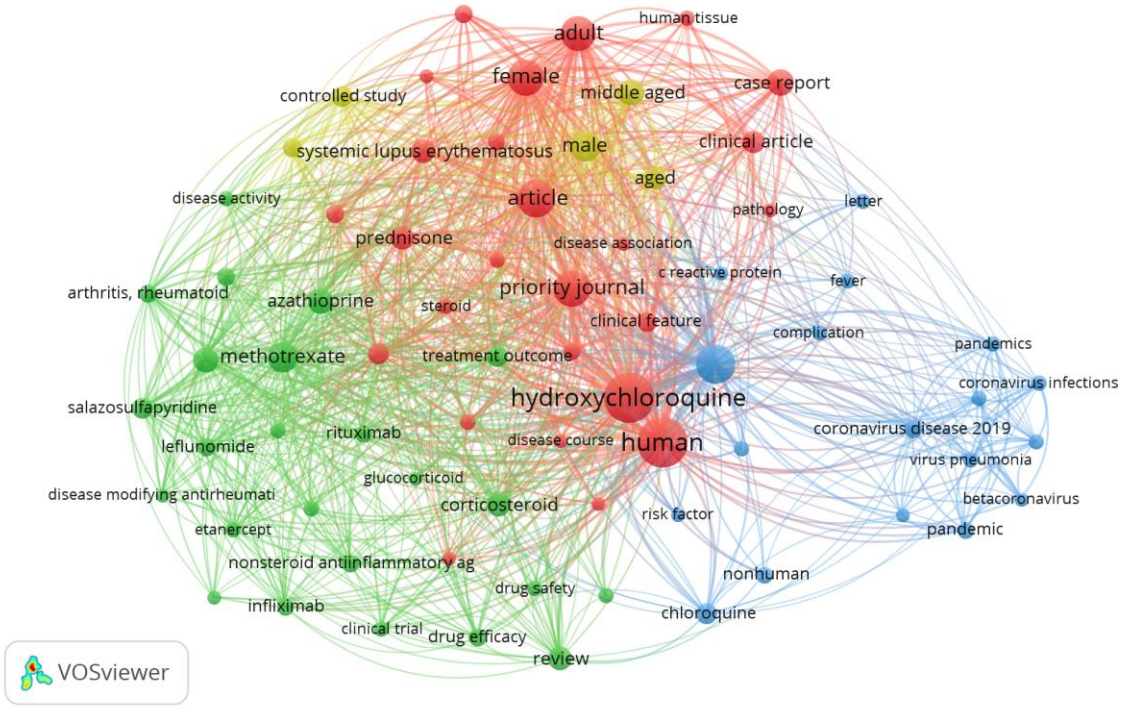

Figure 4: Mapping of Keyword Co-occurrence

Top five highly cited publications

The table 11 depicts the top five highly cited publications in the field of Hydroxychloroquine. 18 articles have received more than 1000 citations. The article titled, "Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial" by Gautret P. et al. (total 18 authors) published online since 20 March 2020 in *International Journal of Antimicrobial Agents* have received the highest 1864 citations in a years' time, whereas, the paper entitled, "Rheumatoid arthritis" by Scott, D.L.; Wolfe, F. and Huizinga, T.W.J. published in *The Lancet* has received 1788 citations. The other details are presented in table 10.

Table 11: Top five highly cited publications in the field of Hydroxychloroquine

Article Title	Author/s	No of Author/s	Source	Number of Citations
Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial	Gautret P. et al.	18	2020, *International Journal of Antimicrobial Agents*, 56 (1): 105949	1864
Rheumatoid arthritis	Scott, D.L.; Wolfe, F. and Huizinga, T.W.J.	3	2010, *The Lancet* 376 (9746), pp. 1094-1108	1788
Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)	Habib G. et al.	56	2009, *European Heart Journal* 30 (19), pp. 2369-2413	1489
Interferon-inducible gene expression signature in peripheral blood cells of patients with severe Lupus	Baechler E.C.et al.	12	2003, *Proceedings of the National Academy of Sciences of the United States of America* 100 (5), pp. 2610-2615	1497
Mechanisms of disease: Systemic lupus erythematosus	Tsokos G.C.	1	2011, *New England Journal of Medicine* 365 (22), pp. 2110-2121	1357

Findings and Conclusion

The recent pandemic, COVID-19, is a threat to the whole of humankind. COVID-19 seems to be the most dangerous virus among the Coronavirus family. Until November 2020, there was no proper vaccine to treat COVID-19. In the process to find the right vaccine, the part of scientist and researcher community also worked on 'drug repurposing', Hydroxychloroquine which was used for the treatment of Malaria is being clinically tested as the prospective drug. Thousands of researchers have published their research works on Hydroxychloroquine in the form of journal articles, conference papers, case studies, commentary, lab trails, book chapters, notes, surveys etc. Which has resulted in 22.8% overall publication on 'Hydroxychloroquine' has published in the year 2020 only. This study presents the published literature on 'Hydroxychloroquine' and its clinical evidence to evaluate the safety and effectiveness of the treatment of COVID-19. It also analysed the research publications on 'Hydroxychloroquine' by using various Scientometric indicators.

Out of 26,186 publications, 10,463 (39.9%) papers were published as open access and received 2,77,404 (48.87%) of the total citations. A fluctuating trend was observed for AGR, and the value of the Compound Annual Growth Rate (CAGR) for the total period of study was 0.129635. The maximum RGR 0.56 recorded in the year 1963 and minimum of 0.04 in the year 1972. The maximum 19.35 doubling time was recorded in 1972, and minimum 1.26 doubling time was recorded in 1948, the recent lowest doubling time is 2.80 recorded for the publications in the year 2020. Many multi-authored publications dominate over the single authored publications with a 0.88 Degree of Collaboration and 5.27 Collaborative Index. The Journal of Rheumatology was the most preferred avenue to publish the research papers. The journal Annals of the Rheumatic Diseases has the highest, i.e. 14.299 Impact Factored among the top twenty-five journals. Although Didier A. Raoult of Aix Marseille University was the most productive author (131 publications), Maxime R. Dougados of the Universite Paris-Saclay, Saint-Aubin received the maximum number of citations and the highest average citations per paper among the other authors. AP-HP Assistance Publique - Hopitaux de Paris was the most productive institute with the maximum number of publications, and Harvard Medical School of Boston received the maximum number of citations. The United States of America was the most productive country among the 159 countries contributed. The study concludes that there has been a consistent trend towards increased literature in 'Hydroxychloroquine' in general. In particular, exponential growth in literature observed in 2020 due to COVID-19 pandemic.

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