An altmetric study: Social attention based evaluation of top-100 publications about the COVID-19 pandemic from notification of the first case to the 6th month

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ABSTRACT

Objective: Altmetrics, or alternative-metrics, have recently emerged as a web-based metrics measuring the impact of an individual article in social media accounts with an emphasis on the public attention/engagement with the research output. Aim of this study is to perform mid-2020 altmetric analysis of top-100 articles about COVID-19 that provoked the most online attention.

Methods: Altmetric Explorer search was performed in June 3rd, 2020. After ranked by altmetric attention score (AAS: an automatically calculated weighted count of all of the attention a research output has received in social media), articles that are not related by COVID-19 were excluded and the first-100 COVID-19-related articles were analyzed. Variables evaluated were (I) AAS, (II) dimensions-badge (interactive visualizations that showcase the citation data origins for individual publications), (III) month of publication, (IV) distribution of web-sources, (V) demographic-breakdown type distributions of citations, (VI) geographic-breakdown type distributions of citations, (VII) level-of-evidence (decided using SIGN-Criteria) (VIII) Q-categories of

ÖZET

Amaç: “Altmetrik” veya “alternatif” ölçümler, tek bir makalenin sosyal medya hesaplarındaki etkisini ölçen yeni bir değerlendirme türüdür ve kamuoyunun makaleye gösterdiği ilgiyi dikkate alan web tabanlı ölçümlerdir. Bu çalışmanın amacı, 2020 ortalarında COVID-19 hakkında en fazla çevrimiçi ilgiyi uyandıran ilk 100 bilimsel yayının altmetrik analizini yapmaktır.

Yöntem: Makale taraması 3 Haziran 2020 tarihinde Altmetric Explorer web sitesinde gerçekleştirilmiştir, tüm makalelerin AAS (Altmetric Attention Score; bir araştırma çıktısının sosyal medyada aldığı tüm ilginin otomatik olarak hesaplanan ağırlıklı sayısı) değerine göre yüksekten düşüğe sıralandıktan sonra COVID-19 ile ilişkisi olmayanlar elenmiş ve COVID-19 ile ilişkili ilk 100 makale analiz edilmiştir. Araştırılmada incelenen değişikler şunlardır: (I) AAS, (II) dimensions-badge (tek bir yayın için atf verilerinin kökenlerini gösteren etkileşimi görselleştirmeye), (III) makalenin yayılımı, (IV) web kaynaklarının dağılımı, (V) atıfların demografik dağılımı, (VI) atıfların coğrafi dağılımı, (VII) SIGN-kriterlerine göre makalenin kanıt
scientific journals, and (IX) h-index. Descriptive and correlative statistics were performed. Kruskal-Wallis test was used for AAS and dimensions-badge value comparisons while post-hoc analyses were performed by Dunn test. Spearman correlation coefficients were calculated to detect linear relationship between numerical variables. Analyses were performed by SPSS-23.0 and p<0.05 was considered statistically significant.

**Results:** Most (74%) of the disseminated articles were published in Q1-journals while evidence levels were mostly level-3/level-4. Content of the first 3 articles was about the impact of non-pharmaceutical interventions, origin of COVID-19 and chloroquine usage, respectively. There was no significant difference between AAS in different months (p=0.673) but dimensions-badges in January were significantly higher (p<0.05). There was a weak positive correlation between AAS and dimensions-badge (r=0.250; p=0.017).

**Conclusion:** Dimensions-badge and AAS results revealed that academia discussed COVID-19 much more in the first-month of pandemic, but then interests continued parallely in academia and other social media platforms, including public. Academicians have discussed experiences of large-patient series but public preferred what is potentially protective or risky for them. Although enormously fast accumulation and dissemination of new scientific publications were witnessed, it seems sens-clinique rather than strict evidence-based-advice transferred to journals. Because infodemic is another emerging problem, every scientist should be ethically more responsible about the publication they choose to disseminate. Interpretations/public-messages of scientists might also be critical, given the fact that only 15% of discussed Covid-19 articles was in level-1/level-2 evidence.

**Key Words:** Altmetrics, COVID-19, public health, social attention, infodemic, web-based metrics, electronic platforms, level-of-evidence
The rapidly spreading outbreak of SARS-CoV-2, which first emerged in Wuhan, Hubei Province in China in December 2019, was declared a global pandemic on 11th March 2020 and the disease officially named COVID-19 on February 12, 2020, by the World Health Organization (WHO) (1,2). Propagation of the pandemic is so fast and devastating that there were 6287771 confirmed cases and 379941 deaths globally on June 3, 2020, when the web search was performed in this Altmetric Explorer study (3). COVID-19 is so new and secretive that attracts attention in every walk of life. Because there is very limited background about this new virus and disease, newly generated scientific knowledge being shared intensely with great interest in electronic platforms creating a huge flow of information in a short time interval.

Altmetrics are “a spectrum of social media-based metrics” (4) or a newly emerged web-based-metrics promptly measuring the “dissemination impact” of an individual article in social media accounts (5) and stands for the abbreviation for “alternative metrics” or “article-level metrics” (6). Contrary to citation-based metrics (such as journal impact factor and h-index) which reflect the citing dynamics of articles or books, this new method also detects, lists, and evaluates articles most discussed/disseminated in electronic literature, social media accounts, blogs, podcasts, and news media (7). Altmetrics reflect the attention of the general public; in other words, they emphasize the public attention/engagement with the research output. Altmetrics therefore complete citation-based metrics with qualitative data (8). Citation-based methods are criticized because they are slow (9), weak (10), and based on journals, not the articles they contain (11). On the other hand, altmetrics are “quicker to accumulate” and “capture more diverse impacts” (www.altmetric.com) (12). Because citations take a long time to accumulate but altmetrics eliminate time-cite-based bias and reflecting the social media interest in a standard mathematical approach, we decided altmetric analysis is a good quantification way for the evaluation of COVID-19 pandemic related article-burst.

This study aims to perform an Altmetric Explorer search at the 6th month of the declaration of the first case of SARS-CoV-2 and to evaluate top-100 publications about COVID-19 that provoked the most online attention; thus, exhibiting an insight into the impact of scientific milieu on different platforms in mid-year of the pandemic.

MATERIAL and METHOD

This web-based study does not necessitate approval by an ethics committee because the authors performed a secondary analysis of the published documents and no patient data was used. All authors declare that the research was conducted following the World Medical Association Declaration of Helsinki “Ethical Principles for Medical Research Involving Human Subjects”. “The Altmetric Explorer” web database used in this study is available on a site license basis, so approval was gained from its original organization in the United Kingdom.

Altmetric Explorer search was performed on 03rd June 2020, within the 6th month of the declared initial case of COVID-19. Because publications about the COVID-19 pandemic were already on the top-ranked ones on the Altmetric Explorer website, there was no need to use keyword-based search. Therefore, all publications are ranked by their Altmetric Attention Score (AAS: an automatically calculated weighted count of all of the attention a research output has received in social media), publications that are not related to COVID-19 were excluded and the first 100 COVID-related publications were analyzed. This method enabled us to avoid key-word related misses and reflected the real rating of articles in Altmetric Explorer (www.altmetric.com).

Variables evaluated in this study are listed below:
(I) Altmetric Attention Score (AAS): The Altmetric attention score is an automatically calculated, weighted count of all of the attention a research output has received. The score of a publication rises as more people mention it. It simply shows where citations originate from; namely, they originate from public policy documents, mainstream media, online reference managers (Mendeley), post-publication peer-review platforms (Publons, Pubpeer), Wikipedia, Open Syllabus Project, patent offices (IFI CLAIMS), blogs, citations (including Web of Science), research highlights from Faculty Opinions, social media (Twitter, LinkedIn, Google+, Sina Weibo and Pinterest) or Multimedia and other online platforms (YouTube, Reddit). In the webpage of Altmetric Explorer (www.altmetric.com) each web source has given a unique color and citation origins exhibited in donut shape in a weighted manner. The amount of each color in the donut changes depending on which sources a research output has received attention from, so one can understand at a glance that where an individual publication was cited most (12).

(II) Dimensions-badge: Dimensions-badge is the summary of the web origin of citations about the publication in concern. It is a special calculation that summarizes 4 different metrics of a publication: (a) total citations, (b) recent citations, (c) Field Citation Ratio (FCR) indicating the relative citation performance of an article when compared to similarly-aged articles in its Fields of Research area and (d) Relative Citation Ratio (RCR) is an article-level metric that indicates the relative citation performance of an article when compared to other articles in its area of research, as defined by the subject area of the articles that cite it (12).

(III) Month of publication: In this study, we evaluated how AAS and dimensions-badge values distributed and changed on monthly basis for top-100 publications. Distribution of AAS and dimensions-badge mean values of articles are given in scientific journal basis, also. Correlation between dimensions-badge and AAS values were evaluated and detailed with regression analysis.

Additionally, (IV) distribution of web sources, (V) demographic breakdown type, and (VI) geographic breakdown type distributions of citations/disseminations for top-100 COVID-19 publications were summarized.

(VII) Level of evidence of the research: SIGN (Scottish Intercollegiate Guidelines Network) Criteria were used to decide evidence levels of publications in concern (13) (https://www.sign.ac.uk/media/1052/sign100.pdf). Briefly; Level-1: meta-analyses, systematic reviews of RCTs, or RCTs; Level-2: systematic reviews of case-control or cohort studies; cohorts, case-control studies; Level-3: Nonanalytical studies, such as case reports, case series; Level-4: Expert opinion, animal studies, physiologic laboratory studies. In this altmetric study, the level of evidence distribution of top-100 COVID-19 publications is summarized.

Among those top-100 publications, articles published in scientific journals are also evaluated according to some bibliometric aspects, as given in items (H) and (I).

(VIII) Q-categories of journals that contain the articles in concern. The Q categories of the journals reflect the citation performance of a given journal and its place in the community of journals in the given scientific category (14). In this study, journal ranking quartiles (Q1 to Q4) of those articles detected from the webpage of Scimago (15) and summarized with descriptive statistics.

(IX) Hirsh (h)-index: The h-index is an author-level metric that measures both the productivity and citation impact of the publications of a scientist or scholar (16). After h-index of the author in concern in the publication were noted from Web of Science; bibliometric (h-index) and altmetric parameters (AAS and dimensions-badge) were compared and interpreted.
Statistical analysis

Descriptive and correlational statistics were performed; mean±SD/min-max for numerical and number/percentage for categorical values are given. Kruskal-Wallis test was used for altmetric and dimensions-badge value comparisons while post-hoc analyses were performed by Dunn test. Spearman correlation coefficients were calculated to detect a linear relationship between numerical variables. Beta coefficients were estimated by univariate linear regression analysis. All statistical analyses were performed by using SPSS (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA) 21.0 package program and p<0.05 was considered statistically significant.

RESULTS

Descriptive Data

Among the top-100 publications with the highest AAS in Altmetric Explorer homepage (https://www.altmetric.com/), 67 was related to COVID-19 and the top-100 COVID-19 publications were extracted amongst the first 145 AAS-ranked publications. The top-100 publication list is given in Appendix 1 with some basic descriptive values such as where it is published; the main subject, AAS, and dimensions-badge values of each publication. Briefly, the content of the first 3 articles was about the impact of non-pharmaceutical interventions on virus transmission, the origin of SARS-CoV-2 and, chloroquine usage, respectively. Publication-year was 2020 for 96% of publications; two were published in 2015 while one in 2007 and one in 2005. The distribution of top-100 publications on monthly basis is shown in Figure 1.

Figure 1. Monthly distribution of top-100 publications

Articles in June, July, and August are the ones declared to be accepted for publication for that month.

*4 (4%) of the articles published in different years, not in the first 6 months of the pandemic, and categorized differently (#16 published in December 2015; #35 published in October 2007; #3 published in March 2005; #20 published in August 2015)
The number of publications in January and February is only 5 and 7 respectively, while a nearly equal number of publications exist in March (n=26), April (n=25), and May (n=24).

The main scientific areas of top-100 COVID-19 publications are summarized in Figure 2 while the main content/main idea of publications is given in Figure 3 and Table 1. Predominated scientific areas

Figure 2. Main scientific areas of top-100 COVID-19 publications

Figure 3. The main content of top-100 COVID-19 publications
| Main Content | Main Idea of Publication                                                                 | N |
|--------------|-----------------------------------------------------------------------------------------|---|
| Community    |                                                                                         |   |
| (n=29)       | Scenario comparisons to predict the impact of nonpharmacological preventive methods for public | 1 |
|              | Broader evaluation of the situation-Lessons from the disease                            | 1 |
|              | Broader evaluation of the situation in a specific area                                   |   |
|              | *Cities, places...                                                                       | 6 |
|              | *Approach evaluation                                                                     | 2 |
|              | *In cruise ship                                                                          | 2 |
|              | *Dynamics in a specific area                                                              | 1 |
|              | Broader evaluation of the situation in a specific area and time                           | 5 |
|              | 1st case in a specific area                                                               | 1 |
|              | Broader evaluation of the situation in a specific group                                    |   |
|              | * General                                                                                | 3 |
|              | * In children                                                                            | 1 |
|              | *Fitness dance class                                                                     | 1 |
|              | *Research risks in specific groups                                                       | 1 |
|              | *Specific groups dynamics                                                                 | 1 |
|              | *Outbreak dynamics                                                                        | 1 |
|              | Remote effects on population-psychological                                               | 1 |
|              | Different effects of country-based measures                                               | 1 |
| Transmission | Seroprevalence; estimated population prevalence                                          | 1 |
| (n=27)       | Spread                                                                                   | 1 |
|              | Lack of documentation of spread                                                          | 1 |
|              | Protective equipment                                                                      | 6 |
|              | Transmission in general                                                                   | 5 |
|              | Viral persistence on surfaces                                                             | 1 |
|              | Viral pathogenicity/ viability of virus on surfaces                                       | 1 |
|              | Viral shedding                                                                           | 1 |
|              | Virus load                                                                               | 1 |
|              | Incubation period                                                                        | 1 |
|              | Indoor transmission                                                                       | 1 |
|              | Transmission-temperature humidity                                                         | 1 |
|              | Reducing the transmission in the community                                               | 1 |
|              | Airborne transmission                                                                     | 1 |
|              | Transmission-case                                                                        | 2 |
|              | Transmission dynamics                                                                     | 1 |
|              | Transmission via asymptomatic person                                                     | 1 |
of top-100 COVID-19 publications are medical and health sciences; followed by public health/health services and clinical medicine. Clinical microbiology, comparative genetics/genomics, pharmacology, social sciences, and economics are the other prominent aspects. The main contents of publications can be grouped in order as (A) community-related (evaluation of the situation in specific places and groups in specific times; especially estimates about the impact of nonpharmacological preventive methods for the public; n=28), (B) transmission (seroprevalence, spread, experimental and theoretic estimates;
n=27), (C) treatment (mainly hydroxychloroquine, azithromycin, ivermectin, remdesivir, ritonavir, plasma; n=16), (D) clinical course and prognosis (clinical and laboratory characteristics, biases in severity estimates, severe outcomes, mortality risk; n=8), (E) genetics (virus genomics and spike protein; n=7), (F) social (including economic aspects and global spread origin; n=6), (G) prophylaxis (in general and with BCG; n=5), (H) other (seroconversion and prevention of reinfection; n=2).

Journal Q Categories And Level Of Evidence

While 84 of those top-100 publications were published in journals, 16 were found in electronic resources other than journals. Q categories of publications in journals were listed as follows; seventy-four (88,1%) were in Q1, nine (%10,7) in Q2, and one (%1,2) in Q4 categories. Percentages of publications are 5%, 7%, 28%, and 47% for Level 1, Level 2, Level 3, and Level 4 evidence, respectively. Figure 4 summarizes the distribution of top-100 COVID-19 publications based on journal Q categories and level of evidence.

![Figure 4. Distribution of top-100 COVID-19 publications based on journal Q categories and level of evidence](image-url)

*SIGN (Scottish Intercollegiate Guidelines Network) Criteria were used to decide evidence levels of publications in concern (Sign 100, 2015) (https://www.sign.ac.uk/media/1052/sign100.pdf).
Level-1: meta-analyses, systematic reviews of RCTs, or RCTs;
Level-2: systematic reviews of case-control or cohort studies; cohorts, case-control studies;
Level-3: Non-analytic studies, such as case reports, case series;
Level-4: Expert opinion, animal studies, physiologic laboratory studies

Journal categories (Q1, Q2, Q3, and Q4) detected from Web of Science. Publications that are not published in scientific journals but published only in electronic sources such as Medrxiv, Biorxiv, Mendeley, etc. categorized as “Not Journal”.

![Figure 4. Distribution of top-100 COVID-19 publications based on journal Q categories and level of evidence](image-url)
Altmetric Attention Score And Dimensions-Badge

Mean AAS was 9958.07±7543.15 (min-max: 5178-66129) and mean dimensions-badge value was 270.21±566.96 (min-max: 1-3800). Dimensions-badge value and AAS representation of the #3 article of top-100 COVID-19 publications given as an example in Figure 5. The distribution of mean values of altmetric attention score (AAS) and dimensions-badge on scientific journal-basis and publication-year basis are shown in Table 2. There was no significant difference in AAS on monthly comparisons (p=0.673) but the dimensions-badge mean value in January was significantly higher than in other months (p<0.05) (Table 3).

Table 2. Journal-based and publication-year-based distributions of mean values of altmetric attention score (AAS) and dimensions-badge

| Publication Years | %  | AAS mean | Dimensions-badge mean |
|-------------------|----|----------|-----------------------|
| 2020              | 96 | 9714,62  | 274,40                |
| 2015              | 2  | 12722,50 | 119,50                |
| 2007              | 1  | 9167,00  | 206,00                |
| 2005              | 1  | 28348,00 | 276,00                |
| TOTAL             | 100|          |                       |

Figure 5. Altmetric attention score (AAS) and dimensions-badge of the #3 article of top-100 COVID-19 publications.
Table 2 (cont.). Journal-based and publication-year-based distributions of mean values of altmetric attention score (AAS) and dimensions-badge

| Journals                                                   | %  | AAS mean | Dimensions-badge mean |
|------------------------------------------------------------|----|----------|------------------------|
| New England Journal of Medicine                            | 19 | 9301,42  | 413,84                 |
| The Lancet                                                 | 12 | 8074,00  | 551,83                 |
| Nature                                                     | 8  | 13038,50 | 113,63                 |
| JAMA                                                       | 7  | 8758,71  | 581,29                 |
| Medrxiv*                                                   | 6  | 10301,50 | 46,00                  |
| Science                                                    | 6  | 10920,67 | 89,50                  |
| Emerging Infectious Diseases                               | 4  | 9076,75  | 23,75                  |
| MMWR (Morbidity and Mortality Weekly Report)               | 4  | 8576,75  | 47,75                  |
| BMJ (British Medical Journal)                              | 3  | 8266,00  | 33,00                  |
| Annals of Internal Medicine                                | 2  | 7745,50  | 176,50                 |
| BIorxiv*                                                   | 2  | 7449,00  | 35,00                  |
| Proceedings of the National Academy of Sciences of the USA | 2  | 7434,50  | 30,50                  |
| SSRN Electronic Journal                                    | 2  | 10135,50 | 38,50                  |
| Antiviral Research                                         | 1  | 12525,00 | 61,00                  |
| Bioscience Trends                                          | 1  | 8033,00  | 363,00                 |
| Cell Research                                              | 1  | 7286,00  | 740,00                 |
| Clinical Microbiology Reviews                              | 1  | 9167,00  | 206,00                 |
| International Journal of Antimicrobial Agents              | 1  | 9912,00  | 530,00                 |
| Journal of Hospital Infection                              | 1  | 12802,00 | 242,00                 |
| Journal of Medical Virology                                | 1  | 5532,00  | 159,00                 |
| Journal of Travel Medicine                                 | 1  | 5712,00  | 48,00                  |
| Medecine & Maladies Infectieuses                           | 1  | 5540,00  | 74,00                  |
| National Science Review                                    | 1  | 7234,00  | 140,00                 |
| Pediatrics                                                 | 1  | 7410,00  | 252,00                 |
| Travel Medicine and Infectious Disease                     | 1  | 6829,00  | 6,00                   |
| Virology Journal                                           | 1  | 28348,00 | 276,00                 |
| **Subtotal**                                               | 90 | 9438,80  | 270,21                 |

Dimensions-badge value cannot be calculated by altmetrics.com**

| **Subtotal**                                               | **10** | **1320,11** | --- |
| **TOTAL**                                                  | **100** | **9958,07** | **270,21** |

*Not journal but an electronic area accumulating pre-print versions of articles in the peer-review process; so, AAS and dimensions-badge values of those articles can be calculated by altmetrics.com, thus grouped in "journal" categories in this table.

**#1, #33, #50, #53, #12, #26, #41, #45, #71, #82
a) Details of specific electronic sources

Specific electronic sources that give citations to top-100 COVID-19 publications in concern, number of citations given in this specific electronic source to the publication (only top-3 publications are given due to page/space limitations), ranking number of the publication based on AAS, some other descriptive (Mean±SD, min-max) values of citations of top-100 COVID-19 articles are summarized in Table-4. Also, a detailed version covering top-10 publications disseminated in each electronic source is given in Appendix 2. When carefully look at what is disseminated, one can notice different electronic sources interested in different articles in general. Top-10 interested publications in Twitter (the leader and the representative of public part of disseminations) was #1, #2, #10, #3, #13, #8, #5, #6, #11, #28 while #73, #21, #16, #35, #3, #13, #48, #20, #63, #51 for Mendeley (reflecting mostly academicians).

b) Geographic breakdown type distributions

The geographic breakdown type distribution of citations is given in Figure 6. The first 5 country contributing citations for each publication were documented; then total distribution for 100 publications calculated and summarized in that Figure. United States (19%), United Kingdom (18%), and Canada (11,6%) were the countries generating half of the citations. Mean values of the distribution of citations/electronic disseminations from different demographic groups for top-100 articles are given in Table 5 and the demographic breakdown type distribution of each of those 100 publications summarized in Figure 7. The mean value of citations from members of the public is the highest (13076,54; min-max:1423-140452); followed by scientists, practitioners, and science communicators such as journalists, bloggers, or editors.

c) Demographic breakdown type distributions

Mean values of citations/electronic disseminations from different demographic groups for top-100 articles are given in Table 5, while the demographic breakdown type distribution of citations/electronic disseminations for each of those top-100 publications summarized in Figure 7.

| Table 3. The monthly based comparisons of altmetric attention score (AAS) and dimensions-badge mean values |
|---------------------------------------------------------------|-----------------------------------------------|
| Altmetric attention score (AAS) | Dimensions-badge |
| Mean±SD | Median | P | Mean±SD | Median | P |
| January | 8284,50±4058,28 | 6667,5 | 0,673 | *1177,75±1776,20 | 449,5 | 0,009 |
| February | 8201,71±2884,49 | 6812,0 | | *477,57±769,55 | 242,0 | |
| March | 10930,41±11457,39 | 8436,0 | | *333,83±467,65 | 144,5 | |
| April | 10430,75±7175,37 | 7294,5 | | *237,83±496,43 | 58,0 | |
| May | 8386,52±3427,03 | 7364 | | *58,86±91,94 | 23,0 | |
| June | 10461,50±4560,76 | 8601,5 | | *242,00±71,53 | 252,0 | |
| July | 11711,00±3234,13 | 11295,0 | | *49,67±23,63 | 58,0 | |
| August | 13605,67±12797,49 | 7114,0 | | *93,33±158,20 | 3,0 | |

P-value was obtained from the Kruskal-Wallis test. (post hoc test: Dunn).
Table 4. Some descriptive values about specific electronic sources that give citations to top-100 COVID-19 publications in concern (short top-3 version)

| The specific electronic source that gives citations to top-100 COVID-19 publications in concern | Number of citations given in this specific electronic source (only top-3)* | Ranking number of publication based on AAS | Mean±SD of citations of top-100 COVID-19 articles in concern on this specific electronic source | Min-Max values of citations of COVID-19 articles in concern on this specific electronic source |
|---|---|---|---|---|
| Tweeters&tweets | 154442 | #1 | 14781,77±17971,95 | 0-154442 |
| | 73357 | #2 | | |
| | 63684 | #10 | | |
| Mendeley downloads& saves | 3442 | #73 | 113,06±467,24 | 0-3442 |
| | 2581 | #21 | | |
| | 1065 | #16 | | |
| News outlets | 933 | #4 | | |
| | 626 | #1 | 238,41±166,55 | 4-933 |
| | 604 | #37 | | |
| Facebook pages& posts | 132 | #54 | 25,48±21,68 | 0-135 |
| | 102 | #2 | | |
| | 91 | #44 | | |
| Blogs&Blog posts | 117 | #1 | 25,48±19,62 | 0-117 |
| | 92 | #4 | | |
| | 74 | #2 | | |
| Reddit(ors)& reddit threads | 33 | #17 | 10,64±8,52 | 0-33 |
| | 33 | #89 | | |
| | 32 | #74 | | |
| Policy source& documents | 7992 | #83 | 2,18±1,47 | 1-6 |
| | 6 | #14 | | |
| | 6 | #28 | | |
| Videos&video uploaders | 17 | #32 | 2,26±3,24 | 0-17 |
| | 13 | #2 | | |
| | 11 | #14 | | |
| Wikipedia pages&references | 12 | #69 | 1,89±1,47 | 0-12 |
| | 11 | #14 | | |
| | 10 | #31 | | |
| Q&A thread | 3 | #17 | 0.20±0,51 | 0-3 |
| | 2 | #1 | | |
| | 2 | #14 | | |
| F1000 reviews | 1 | #17 | 0,32±0,47 | 0-1 |
| | 1 | #14 | | |

*The top-10 version of this table is given in Appendix 2 to clarify the different scattering patterns of articles in specific electronic sources. There were no citations to those top-100 publications from Academic Source, News Media Stories, Publons, Pubpeer, LinkedIn, Pinterest pins, SinaWeibio posts. Electronic sources giving only one citation in total were Research Highlight Platforms (for #2); CiteULike (for #35) and Book Reviews (for #28). Peer-Review Site posts gave only two citations, one for #85 and one for #94. Patent Websites created a total of 3 citations (two for #3 and one for #35). Google+ posts gave a total of 6 citations (three citations for #33, two for #20, and one for #16) to top-100 publications in concern.
d) Correlation and regression analysis of altmetric and bibliometric parameters

Correlation analysis of AAS, dimensions-badge, and h index summarized in Table 6. There was a weak positive correlation between two altmetric parameters (namely, AAS and dimensions-badge) \((r=0.250; \ p=0.017)\). But when correlations between altmetric (AAS and dimensions-badge) and bibliometric (h-index) parameters were analyzed, there was no significant correlation \((p>0.05)\). Regression analysis of AAS and dimensions-badge summarized with the scatterplot given in Figure 8. Univariate linear regression analysis reveals that 6.2% of the variation in AAS was explained by dimensions-badge. 1 unit increase in dimensions-badge resulted in a 1.1 increase in AAS. Model to estimate AAS was

\[
Y = \text{Altmetric Attention Score} = 9188.61 + 1.1 \times \text{Dimensions-Badge}.
\]
Figure 7. Demographic breakdown type distribution of citations and electronic disseminations for each of those top-100 publications

“Member of the public” is defined as “person who do not tweet links to scholarly publications” on the Altmetric Explorer website.

Table 6. Correlation analysis of altmetric attention score (AAS), dimensions-badge, and h index

|                  | AAS     | Dimensions-badge |
|------------------|---------|-------------------|
| Dimensions-badge | r       | 0.250             |
|                  | p       | 0.017             |
|                  | n       | 90                |
| H Index          | r       | -0.002            |
|                  | p       | 0.982             |
|                  | n       | 84                |

r was obtained from the spearman rank correlation coefficient.
DISCUSSION and CONCLUSION

In the first 6th month of COVID-19 pandemic, there was a surge of scientific knowledge dissemination globally. COVID-19 is the most popular scientific content disseminated in social media at the beginning of June 2020; namely, 6-months-after the notification of the first case by the Chinese Government or 3-months-after the declaration of the pandemic by the World Health Organization. The matter is so popular that 100 of the first 145 most remarkable publications is about COVID-19 regardless of the publication date, discipline, or scientific area on the Altmetric Explorer website.

The content of the most-disseminated 100 publications seems parallel to the incognita phase of the pandemic. The main content of publications can be listed in descending order as follows: community-related (evaluation of the situation in specific places and groups in specific times, especially estimates about the impact of nonpharmacological preventive methods for the public); transmission (seroprevalence, spread, experimental and theoretic estimates); treatment (mainly hydroxychloroquine, azithromycin, ivermectin, remdesivir, ritonavir, plasma); clinical course and prognosis (clinical and laboratory characteristics, biases in severity estimates, severe outcomes, mortality risk); genetics (virus genomics and spike protein), social (including economic aspects and global spread origin), prophylaxis (in general and with BCG); seroconversion and prevention of reinfection. Eventually, what shapes the publications as well as the share-tendencies in electronic sources are the needs of people who are confronted with an unfamiliar threat, the curiosity, and some expert assumptions with previous connotations. For example, the top-3 publications were about the impact of non-pharmaceutical interventions on virus transmission (17), the origin of SARS-CoV-2 (18), and, chloroquine usage (19), respectively.
Scientifically productive 3 countries [United States (19%), United Kingdom (18%), and Canada (11.6%)] generated the half of the citations. The other foremost countries were Spain, Japan, France, Brazil, Australia, Mexico, India, Italy, Thailand, Turkey, Germany, Chile, China, Korea, Argentina, Colombia, Austria, Ireland, Malesia, Uruguay, Paraguay, Philippines, Nigeria, Indonesia. Some of those countries were the ones effected by the pandemic badly. So, the relationship between the fluctuations in the epidemic curve in global context and the citations of countries can be searched in future studies.

Not surprisingly, publication year was 2020 for all top-100 publications, except 4 of them: (A) #3 discussing chloroquine is a potent inhibitor of SARS coronavirus infection and spread (August 2005) reflecting a hope for COVID-19 treatment (B) #16 laboratory study discussing a SARS-like cluster of circulating bat coronaviruses shows potential for human emergence (November 2015) probably reflecting the curiosity about the origin of the pandemic (C) #20 cluster-randomized trial comparing cloth masks with medical masks in healthcare workers (March 2015) reflecting the prioritized protective need for healthcare workers and (D) #35 severe acute respiratory syndrome coronavirus as an agent of emerging and reemerging infection (October 2007) reflecting a need for a background knowledge that potentially related to COVID-19. All other publications are newly generated and cited/disseminated during the epidemic.

Although enormously fast accumulation and dissemination of new scientific publications were witnessed, it seems sens clinique rather than strict evidence-based advice has transferred to Q1 scientific journals as well as to policy documents within the 6th month of the pandemic. Most (74%) of the disseminated publications were published in Q1 scientific journals but evidence levels of those articles were mostly level-4 (n=47) and level-3 (n=38). In epidemiology, the level of evidence is very crucial for what we can or cannot conclude from a publication. On 7th and 8th of April, the WHO Information Network for Epidemics (EPI-WIN) held a global online consultation on managing the COVID-19 infodemic and the first principle declared was “interventions and messages must be based in science and evidence” (20). Infodemic is a new terminology gathering the terms “information” and “epidemic” defined by the WHO as “overabundance of information - some accurate and some not - that occurs during an epidemic” (21). Publications with controversies or with a low level of evidence status (namely level III or level IV) may be kept back for journals by scientists, while scientists/practitioners/science communicators may prefer to share publications with more concrete results with a high level of evidence (namely level I or level II) in their electronic sources during this pandemic. Eventually, scientists do their share of diminishing infodemic about COVID-19.

When we carefully look at what kind of scientific knowledge was disseminated during the first 6-months of the pandemic, one can easily notice that different electronic sources were interested in different articles in general.

In Twitter, which is the leader and the representative of the public part of disseminations, top-10 publications were #1 (is there a benefit of personal protective equipment usage on COVID-19 mortality or healthcare demand?), #2 (can the origin of the virus be pangolins rather than bats?), #10 (urgent and undeferrable need of personal protective equipment for healthcare facilities), #3 (chloroquine treatment effectiveness on SARS-CoV-1), #13 (successful treatment with convalescent plasma), #8 (evidence about surgical face masks could prevent transmission of human coronaviruses and influenza viruses from symptomatic individuals), #5 (seroprevalence and estimate of how many people infected in Santa Clara County, California), #6 (understanding the future effects of COVID-19 transmission), #11 (COVID-19 outbreak associated with air conditioning in a restaurant in China) and #28 (clinical characteristics of coronavirus disease
2019 in China).

In Mendeley, on the other hand, reflecting mostly academic part of disseminations, preferentially shared #73 (clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan), #21 (characteristics of and important lessons from 72,314 cases from China), #16 (a SARS-like cluster of circulating bat coronaviruses shows potential for human emergence), #35 (severe acute respiratory syndrome coronavirus as an agent of emerging and reemerging infection), #3 (chloroquine for SARS-CoV-1 treatment), #13 (treatment with convalescent plasma), #48 (response to COVID-19 in Taiwan big data analytics, new technology, and proactive testing), #20 (cloth masks compared with medical masks in healthcare workers), #63 (experience about 5700 patients hospitalized with COVID-19 in the New York City), #51 (turbulent gas clouds and respiratory pathogen emissions, potential implications for reducing transmission of COVID-19).

Thus, we can easily understand that within the 6th month of the pandemic academicians preferred to disseminate experiences of large-patient series while the public preferred to disseminate implications about what is potentially protective or risky for them. But interestingly, treatment modalities are disseminated not only by academicians/scientists but also by the public. Therefore, it is wise not to share uncertain treatment options on electronic platforms. For example, articles about hydroxychloroquine (that had been used in SARS-CoV-1 treatment) shared as a worth-trying drug in SARS-CoV-2 in electronic platforms and the record-breaking number of citations and disseminations were given to articles related to chloroquine in our study 10% of articles related to chloroquine/hydroxychloroquine; #3,#27,#32,#42,#47,#55,#58,#67,#90,#95). Later on, preliminary large-scale randomized controlled trials and meta-analyses have failed to show any survival benefit and even some authors declared about potential harms of hydroxychloroquine prophylaxis/treatment in COVID-19 (22-24); eventually, controversies about the efficacy and safety of hydroxychloroquine in COVID-19 treatment had emerged (25). While innocent scientific prudence turned into a gain for authors, journals, and websites in terms of citations; it had probably risen the infodemic in public. Because infodemic is another emerging problem adding on COVID-19 pandemic, information generator groups should remind themselves honesty is crucial and misleading messages for the public may have enormous consequences compared to easily repairable or revisable consequences in the world of science.

Another clue for this suggestion comes from the analysis of dimension-badge and AAS in our study. Results reveal that academia discussed and disseminated publications related to COVID-19 much more in the first month of pandemic (dimensions-badge mean value in January was significantly higher than in other months); but then knowledge transfer propagated parallelly in academia and other platforms, including the public (there was no significant difference in AAS on monthly comparisons). Tweets are the main distributor of publications (Table 4) and publications forwarded mostly by public members rather than scientists, practitioners, or science communicators (journalists, bloggers, editors) (Table 5). Because the discussions propagated parallelly in those groups for each of the top-100 publications (Figure 7), we may assume that the initiator of the dissemination was the scientists, practitioners, and science communicators. Consequently, every scientist/practitioner/communicator should be careful, or more ethically responsible, about the publication they choose to disseminate. Although EPI-WIN specifically works for diminishing infodemic, scholarly also undertaken the responsibility.

On the other hand, because the public shares knowledge that seems beneficial or risky for them, dissemination of important scientific knowledge about COVID-19 in social media platforms may be a good device for health professionals who wants
to affect the public’s knowledge and attitudes. Their interpretation and clear explanatory public messages might also be critical, considering only 15% of discussed COVID-19 articles were in level-1 and level-2 evidence.

Eventually, the results of our study emphasize the importance of communication of scientists with the public. A recent digital epidemiological study investigating the COVID-19 related web search behaviors using Google trends revealed that Google searches related to COVID-19 in Turkey rapidly increased following around 30th January 2020 when the epidemic was announced in China, then clear peak was seen around 26th February 2020 when the number of infections rapidly increased in Italy, the apex point was seen around 11th March 2020 when the announcements of the first case in the country (synchronized with the declaration of the pandemic) and public attention continued parallerly with the massive precaution measures for 26 days (26). Since scientific knowledge affects everyday life, scientists should be aware of their hidden impact; should not forget they are talking with the public when they are discussing or sharing something on electronic platforms.

We found a positive correlation between the weighted count of all of the attention a research output has received (namely, AAS) and the summary of the web origin of citations about the publication in concern (namely, dimensions-badge). Although the correlation is weak, two altmetric parameters are related to each other. Eventually, the relative citation performance of an article when compared to similarly-aged articles in its fields of research area, relative citation performance of an article when compared to other articles in its area of research (namely, dimensions-badge) effects the raised score of a publication by people’s mentions (namely, AAS). Expectedly, we found that those two altmetric parameters (namely, AAS and dimensions-badge) that measures the “dissemination impact” of an individual article in social media accounts were not significantly correlated with h-index (a bibliometric parameter and an author-level metric measuring productivity and citation impact of the publications of a scientist or scholar). These relatively new “altmetric parameters” gives an insight about the what is “hot” in the web or what is “popular nowadays” for people, independent from the “words of popular authors. Thus, altmetric look to COVID-19 in this mid-year evaluation reflects what is more popular for people rather than what most cited-authors said.

Altmetric analysis may be a good quantification way for the evaluation of COVID-19 pandemic related article-burst, but it has some limitations (27). First of all, altmetrics “don’t tell the whole story” (12). Unless we give a detailed look at “who talks and says what” in electronic platforms, we may not interpret the situation completely by altmetrics. Although the main dissemination route is Twitter for Altmetric Explorer, it gathers other disseminations generated by very different platforms in a limited amount. Within the 6th month of pandemic contribution of electronic sources were as follows in descending order: Tweeters&tweets, Mendeley downloads&saves, news outlets, Facebook pages&posts, blogs&blog posts, Reddit(ors)&reddit threads, policy source&documents, videos&video uploaders, Wikipedia pages&references, Q&A thread, F1000 reviews (Table 4). Remarkably, one publication in policy document group (#83: an editorial about “war of US with COVID-19”, published in April 2020 and summarizing “the six steps to mobilize and organize the nation... that enables...to defeat COVID-19 by early June, in 10-weeks) (28) doubles the cites of the most popular publication in Mendeley (article #73 summarizing the clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus in Wuhan) (7992 versus 3442 citations) (29). In other words, an opinion may be more popular than strict scientific observations, in electronic platforms. Thus, we should admit the qualitative aspects of altmetrics, even though we list publications via using mathematically calculated scores, namely AAS.
In conclusion, the first 6 month of pandemic

- COVID-19 was highly attractive topic in both scientific and public platforms worldwide, but evidence levels were unsatisfactory in general.
- There was a surge of scientific knowledge dissemination globally on electronic platforms but most have a relatively poor scientific evidence level
- Academicians preferred to disseminate experiences of large-patient series while the public preferred to disseminate implications about what is potentially protective or risky for them.
- Altmetrics may reflect what is more popular for people rather than what most cited-authors said.
- Treatment modalities for COVID-19 are disseminated not only by academicians/scientists but also by the public. Therefore, it is wise for academicians/scientists not to share uncertain treatment options on electronic platforms, to be ethically more responsible about the publication chosen to disseminate, and eventually to combat with infodemia.

Appendix 1. The top-100 publication list with some basic descriptive values of each publication

| Rank Of Article | Title Of the Publication                                                                 | First Author           | Main Subject Of The Article                                                                 | Where Published                      | Type Of The Publication | Level Of Evidence | AAS      | Dimensions-Badge |
|-----------------|-----------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------|--------------------------------------|------------------------|-------------------|----------|-------------------|
| #1              | Report 9: Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand | Neil M. Ferguson  | Scenario comparisons to predict the impact of nonpharmacological preventive methods for public | Imperial College COVID-19 Response Team Report, London | Projection, via scenarios | 4                 | 66129    | NC                |
| #2              | The proximal origin of SARS-CoV-2                                                       | Kristian G. Andersen | Viral genomics / genetic origin                                                               | Nature Medicine                      | Comment, letter         | 4                 | 34244    | 247               |
| #3              | Chloroquine is a potent inhibitor of SARS coronavirus infection and spread               | Martin J Vincent      | Drug treatment- chloroquine                                                                   | Virology Journal                     | Laboratory study, cell culture | 4                 | 28348    | 276               |
| #4              | Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1                 | Neeltje van Doremalen | Viral pathogenicity/ viability of the virus                                                   | New England Journal of Medicine      | Laboratory study, comparison | 4                 | 24951    | 610               |
| #5              | COVID-19 Antibody Seroprevalence in Santa Clara County, California                      | Eran Bendavid         | Community-seroprevalence; estimated population prevalence                                     | Medrxiv                              | Cross sectional, seroprevalence | 3                 | 21146    | 42                |
| #6              | Projecting the transmission dynamics of SARS-CoV-2 through the post-pandemic period    | Stephen M. Kissler    | Transmission-spread                                                                           | Science                              | Projection              | 4                 | 20034    | 99                |
| #7              | Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2) | Ruiyun Li              | Transmission- lack of documentation of spread                                                  | Science                              | Simulative estimation   | 4                 | 17233    | 308               |
| #8              | Respiratory virus shedding in exhaled breath and efficacy of face masks                  | Nancy H. L. Leung    | Transmission-protective equipment                                                             | Nature Medicine                      | RCT                    | 1                 | 17029    | 79                |
| #9              | COVID-19— Navigating the Uncharted                                                      | Anthony S. Fauci      | Transmission                                                                                 | New England Journal of Medicine      | Comment, editorial      | 4                 | 16706    | 149               |
| #10             | In Pursuit of PPE                                                                        | Andrew W. Artenstein  | Transmission-protective equipment                                                             | New England Journal of Medicine      | Comment, letter         | 4                 | 16658    | 2                 |
| Rank Of Article | Title Of The Publication                                                                 | First Author       | Main Subject Of The Article          | Where Published | Type Of The Publication | Level Of Evidence | AAS  | Dimensions-Badge |
|-----------------|--------------------------------------------------------------------------------------------|--------------------|--------------------------------------|-----------------|-------------------------|-------------------|------|------------------|
| #11             | COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020   | Jianyun Lu         | Transmission                         | Emerging Infectious Diseases | Case-series        | 3                 | 15133 | 23               |
| #12             | WITHDRAWN. Uncanny similarity of unique inserts in the 2019-nCoV spike protein to HIV-1 gp120 and Gag | Prashant Pradhan   | Genetic-spike protein                | Withdrawn (And put on Biorxiv till editors complete the review process) | Comment, in Biorxiv | 4                 | 14900 | 17               |
| #13             | Treatment of 5 Critically Ill Patients With COVID-19 With Convalescent Plasma             | Chenguang Shen     | Treatment-plasma                     | JAMA             | Case-series            | 3                 | 14895 | 191              |
| #14             | Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China       | Chaolin Huang      | Clinical features                    | The Lancet       | Case report            | 3                 | 14271 | 3800             |
| #15             | Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study | Fei Zhou           | Clinical course-risk-mortality       | The Lancet       | Retrospective cohort   | 2                 | 13376 | 1500             |
| #16             | A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence | Vineet D Menachery | Genetic                              | Nature Medicine  | Laboratory study       | 4                 | 13214 | 186              |
| #17             | Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents | Guenter Kampf      | Transmission-persistence of the virus on surfaces | Journal of Hospital Infection | Review               | 4                 | 12802 | 242              |
| #18             | The FDA-approved drug Ivermectin inhibits the replication of SARS-CoV-2 in vitro         | Leon Caly          | Treatment-ivermectin                 | Antiviral Research | Laboratory study, cell culture | 4         | 12525 | 61               |
| #19             | Remdesivir in adults with severe COVID-19: a randomized, a double-blind, placebo-controlled, multicentre trial | Yeming Wang        | Treatment-remdesivir                 | The Lancet       | RCT, multicenter       | 1                 | 12244 | 63               |
| #20             | A cluster-randomized trial of cloth masks compared with medical masks in healthcare workers | C Raina MacIntyre  | Transmission-protective equipment   | BMJ Open         | RCT, cluster           | 1                 | 12231 | 53               |
| #21             | Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72,314 Cases From the Chinese Center for Disease Control and Prevention | Zunyou Wu          | Community-lessons from disease- broader evaluation of the situation | JAMA             | Case series            | 3                 | 11727 | 1300             |
| #22             | Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) - United States, February 12- March 16, 2020. | Stephanie Bialek   | Prognosis-severe outcomes            | Morbidity and Mortality Weekly Report (MMWR) | Cross-sectional     | 3                 | 11699 | 156              |
| Rank Of Article | Title Of The Publication | First Author | Main Subject Of The Article | Where Published | Type Of The Publication | Level Of Evidence | AAS | Dimensions-Badge |
|-----------------|--------------------------|--------------|-----------------------------|----------------|-------------------------|-----------------|-----|------------------|
| #23             | Temporal dynamics in viral shedding and transmissibility of COVID-19 | Xi He        | Transmission-viral shedding | Nature Medicine | Estimation via cases    | 3               | 11626 | 101              |
| #24             | Indoor transmission of SARS-CoV-2 | Hua QIAN     | Transmission-indoor         | Medrxiv        | Cross-sectional evaluation of cases | 3               | 11381 | 3                |
| #25             | High Temperature and High Humidity Reduce the Transmission of COVID-19 | Jingyuan Wang | Transmission-temperature humidity | SSRN Electronic Journal | Case-control | 2               | 11295 | 58               |
| #26             | Reducing the transmission of SARS-CoV-2 | Kimberly A. Prather | Transmission-community reducing the transmission | Science | Comment | 4               | 11262 | NC               |
| #27             | Outcomes of hydroxychloroquine usage in United States veterans hospitalized with COVID-19 | Joseph Magagnoli | Treatment-hydroxychloroquine | Medrxiv | Two group comparison for treatment, interventions | 2               | 10488 | 57               |
| #28             | Clinical Characteristics of Coronavirus Disease 2019 in China | Wei-Jie Guan | Community-broader evaluation of the situation in a specific area | New England Journal of Medicine | Cross-sectional, descriptive | 3               | 10431 | 2100             |
| #29             | High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice – Skagit County, Washington, March 2020 | Lea Hamner   | Community-broader evaluation of the situation in a specific area | Morbidity and Mortality Weekly Report (MMWR) | Cross-sectional, descriptive | 3               | 10253 | 3                |
| #30             | Universal Screening for SARS-CoV-2 in Women Admitted for Delivery | Desmond Sutton | Community-broader evaluation of the situation in a specific group | New England Journal of Medicine | Comment, letter | 4               | 10145 | 49               |
| #31             | First Case of 2019 Novel Coronavirus in the United States | Michelle L Holshue | 1st case in a specific area | New England Journal of Medicine | Case report | 3               | 9948  | 828              |
| #32             | Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial | Gautret P    | Treatment-azithromycin/hydroxychloroquine | International Journal of Antimicrobial Agents | Two group comparison for treatment, nonrandomized | 2               | 9912  | 530              |
| #33             | Engineered bat virus stirs debate over risky research | Declan Butler | Other-research risks-risk in specific groups | Nature News & Comments | Comment | 4               | 9619  | NC               |
| #34             | Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany | Camilla Rothe | Transmission-case | New England Journal of Medicine | Case report | 3               | 9394  | 626              |
| #35             | Severe Acute Respiratory Syndrome Coronavirus as an Agent of Emerging and Reemerging Infection | Vincent C C Cheng | Prophylaxis | Clinical Microbiology Reviews | Review | 4               | 9167  | 206              |
| #36             | Compassionate Use of Remdesivir for Patients with Severe Covid-19 | Jonathan Grein | Treatment-remdesivir | New England Journal of Medicine | Retrospective analysis of treatment effects | 3               | 9000  | 166              |
| #37             | The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application | Stephen A Lauer | Transmission-incubation period | Annals of Internal Medicine | Estimation via cases | 3               | 8976  | 19               |
| Rank Of Article | Title Of The Publication                                                                 | First Author       | Main Subject Of The Article                                                                 | Where Published          | Type Of The Publication | Level Of Evidence | AAS  | Dimensions-Badge |
|----------------|------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------|--------------------------|-------------------------|-------------------|------|-----------------|
| #38            | Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu | Sergio Correia     | Other-economic effects                                                                     | SSRN Electronic Journal  | Review                  | 4                 | 8919 | 339             |
| #39            | Offline: COVID-19 and the NHS—"a national scandal"                                        | Richard Horton     | Situation                                                                                  | Lancet                   | Comment                 | 4                 | 8711 | 15              |
| #40            | High Contagiousness and Rapid Spread of Severe Acute Respiratory Syndrome Coronavirus 2    | Steven Sanche      | Community-dynamics in a specific area                                                      | Emerging Infectious Diseases | Estimation via cases, modeling | 3                 | 8705 | 68              |
| #41            | Reviving the US CDC                                                                        | No authors         | Community-broader evaluation of the situation in a specific area                          | The Lancet               | Comment, editorial       | 4                 | 8496 | NC              |
| #42            | Observational Study of Hydroxychloroquine in Hospitalized Patients with Covid-19           | Joshua Geleri      | Treatment-hydroxychloroquine                                                              | New England Journal of Medicine | Observation of treatment effects | 3                 | 8478 | 36              |
| #43            | A Trial of Lopinavir-Ritonavir in Adults Hospitalized with Severe Covid-19                 | Bin Cao            | Treatment-ritonavir                                                                       | New England Journal of Medicine | RCT                      | 1                 | 8436 | 528             |
| #44            | Coronavirus: the first three months as it happened                                         | No authors         | Community-broader evaluation of the situation in a specific area                          | Nature                   | News                    | 4                 | 8211 | 1               |
| #45            | Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis | Derek K Chu        | Transmission-protective equipment                                                          | The Lancet               | Metaanalysis             | 1                 | 8203 | NC              |
| #46            | Do us a favor                                                                             | H. Holden Thorp    | Other-social evaluation                                                                  | Science                  | Comment, editorial       | 1                 | 8102 | 1               |
| #47            | Breakthrough: Chloroquine phosphate has shown apparent efficacy in the treatment of COVID-19 associated pneumonia in clinical studies | Jianjun Gao        | Treatment-hydroxychloroquine                                                              | Bioscience Trends        | Comment, letter          | 4                 | 8033 | 363             |
| #48            | Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing | C Jason Wang       | Community-broader evaluation of the situation in a specific area (approach evaluation)   | JAMA                     | Comment, viewpoint       | 4                 | 8018 | 109             |
| #49            | The airborne lifetime of small speech droplets and their potential importance in SARS-CoV-2 transmission | Valentyn tadnytskyi | Transmission-airborne                                                                      | Proceedings of The National Academy of Sciences of The USA | Estimation via cases | 3 | 7862 | 3 |
| #50            | COVID-19: Attacks the 1-Beta Chain of Hemoglobin and Captures the Porphyrin to Inhibit Human Heme Metabolism | Wenzhong Liu       | Prognosis- outcomes in specific body systems                                             | Chemrxiv                 | Lab study, physiologic   | 4                 | 7851 | NC              |
| #51            | Turbulent Gas Clouds and Respiratory Pathogen Emissions                                    | Lydia Bourouiba    | Transmission-protective equipment                                                          | JAMA                     | Comment, insight         | 4                 | 7804 | 63              |
| Rank Of Article | Title Of The Publication                                                                 | First Author       | Main Subject Of The Article               | Where Published | Type Of The Publication | Level Of Evidence | AAS   | Dimensions-Badge |
|-----------------|------------------------------------------------------------------------------------------|--------------------|------------------------------------------|-----------------|-------------------------|-------------------|-------|------------------|
| #52             | Lack of Reinfection in Rhesus Macaques Infected with SARS-CoV-2                          | Linlin Bao         | Other-reinfection prevention             | Biorxiv         | Lab study, animal experiment | 4               | 7787 | 47               |
| #53             | SARS-CoV-2 RNA concentrations in primary municipal sewage sludge as a leading indicator of COVID-19 outbreak dynamics | Jordan Peccia      | Community-outbreak dynamics             | Medrxiv         | Correlational study      | 3               | 7712 | NC               |
| #54             | The race for coronavirus vaccines: a graphical guide                                      | Ewen Callaway      | Prophylaxis                              | Nature          | News                    | 4               | 7501 | 4                |
| #55             | Efficacy of hydroxychloroquine in patients with COVID-19: results of a randomized clinical trial | Zhaowei Chen       | Treatment-hydroxychloroquine            | Medrxiv         | RCT (randomized controlled trial) | 1               | 7430 | 90               |
| #56             | Epidemiology of COVID-19 Among Children in China                                          | Yuanyuan Dong      | Community-broader evaluation of the situation in a specific group | Pediatrics      | A descriptive evaluation of total cases of an area | 3               | 7410 | 252              |
| #57             | Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing | Luca Ferretti      | Transmission-case                        | Science         | Estimation via cases, modeling | 3               | 7364 | 97               |
| #58             | Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro | Manli Wang         | Treatment-remdesivir-hydroxychloroquine  | Cell Research   | Lab study, cell culture  | 4               | 7286 | 740              |
| #59             | On the origin and continuing evolution of SARS-CoV-2                                      | Xiaolu Tang        | Genetic                                  | National Science Review | Lab study, genetic       | 4               | 7234 | 140              |
| #60             | Coronavirus Disease Outbreak in Call Center, South Korea                                  | Shin Young Park    | Transmission-case                        | Emerging Infectious Diseases | Descriptive, cross-sectional | 3               | 7114 | 3                |
| #61             | Spike mutation pipeline reveals the emergence of a more transmissible form of SARS-CoV-2 | Bette Korber       | Genetic                                  | Biorxiv         | Lab study, genetic       | 4               | 7111 | 23               |
| #62             | An outbreak of severe Kawasaki-like disease at the Italian epicenter of the SARS-CoV-2 epidemic: an observational cohort study | Lucio Verdon       | Community-specific groups dynamics       | The Lancet      | Retrospective cohort     | 2               | 7110 | 11               |
| #63             | Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area | Safiya Richardson  | Community-broader evaluation of the situation in a specific area | JAMA            | Descriptive, cross-sectional | 3               | 7088 | 193              |
| #64             | Phylogenetic network analysis of SARS-CoV-2 genomes                                       | Peter Forster      | Genetic                                  | Proceedings of The National Academy of Sciences of The USA | Lab study, genetic     | 4               | 7007 | 58               |
| #65             | The UK’s public health response to COVID-19                                              | Gabriel Scally     | Community-broader evaluation of the situation in a specific area | BMJ Open        | Comment, editorial       | 4               | 6984 | 3                |
| Rank Of Article | Title Of The Publication | First Author | Main Subject Of The Article | Where Published | Type Of The Publication | Level Of Evidence | AAS | Dimensions-Badge |
|-----------------|---------------------------|--------------|-----------------------------|----------------|--------------------------|------------------|-----|-----------------|
| #66             | Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection | Lei Fang     | Prognosis-risky situations for catching the disease | The Lancet Respiratory Medicine | Comment, letter | 4    | 6924            | 298 |
| #67             | Full-length title: Early treatment of COVID-19 patients with hydroxychloroquine and azithromycin: A retrospective analysis of 1061 cases in Marseille, France | Matthieu Million | Treatment-hydroxychloroquine azithromycin | Travel Medicine and Infectious Disease | Retrospective analysis of treatment effects | 3    | 6829            | 6   |
| #68             | Public Health Responses to COVID-19 Outbreaks on Cruise Ships - Worldwide, February-March 2020 | Leah F Moriarty | Community-broader evaluation of the situation in a specific area (cruise ships) | Morbidity and Mortality Weekly Report (MMWR) | A descriptive evaluation of total cases of a specific area | 3    | 6812            | 31  |
| #69             | Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia | Rui Wang     | Transmission | New England Journal of Medicine | Case series | 3    | 6790            | 1800 |
| #70             | Coronavirus cases have dropped sharply in South Korea. What’s the secret to its success? | Dennis Normile | Community-broader evaluation of the situation in a specific area (approach evaluation) | Science | News | 4    | 6742            | 20  |
| #71             | A study on infectivity of asymptomatic SARS-CoV-2 carriers | Ming Gao     | Transmission | Respiratory Medicine | Descriptive, cross-sectional | 3    | 6694            | NC  |
| #72             | Effectiveness of Surgical and Cotton Masks in Blocking SARS-CoV-2: A Controlled Comparison in 4 Patients (RETRACTED later on) | Seongman Bae | Prevention-personal protective equipment | Annals of Internal Medicine | Intervention study, comparison | 3    | 6572            | 14  |
| #73             | Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China | Dawei Wang   | Clinical characteristics in a specific area and people | JAMA | A descriptive evaluation of total cases of an area | 3    | 6469            | 2200 |
| #74             | Safety, tolerability, and immunogenicity of a recombinant adenovirus type-5 vectored COVID-19 vaccine: a dose-escalation, open-label, nonrandomized, first-in-human trial | Feng-Cai Zhu | Prophylaxis | The Lancet | A nonrandomized clinical trial, phase1 | 2    | 6381            | 2   |
| #75             | Remdesivir for the Treatment of COVID-19 — Preliminary Report | John H Beigel | Treatment-remdesivir | New England Journal of Medicine | RCT, preliminary results | 2    | 6373            | 6   |
| #76             | Virological assessment of hospitalized patients with COVID-2019 | Roman Wölfel | Laboratory characteristics of a specific area and people | Nature | Case series, virologic evaluation | 3    | 6358            | 289 |
| #77             | The pandemic and the female academic | Alessandra Minello | Social-female academic | Nature | News | 4    | 6125            | 2   |
| #78             | Responding to COVID-19 — A Once-in-a-Century Pandemic? | Bill Gates | Social-evaluation of situation | New England Journal of Medicine | Comment | 4    | 6122            | 77  |
| Rank Of Article | Title Of The Publication                                                                 | First Author            | Main Subject Of The Article                                                                 | Where Published                                      | Type Of The Publication               | Level Of Evidence | AAS | Dimensions-Badge |
|-----------------|----------------------------------------------------------------------------------------|-------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------|------------------|-----|------------------|
| #79             | Correlation between universal BCG vaccination policy and reduced morbidity and mortality for COVID-19: an epidemiological study | Aaron Miller            | Prognosis; prophylaxis with BCG                                                            | Medrxiv                                              | Correlational study                    | 3                | 6118 | 51               |
| #80             | Visualizing Speech-Generated Oral Fluid Droplets with Laser Light Scattering           | Philip Antinrud         | Transmission-dynamics                                                                       | New England Journal of Medicine                      | Comment                              | 4                | 6081 | 20               |
| #81             | Wuhan seafood market may not be source of novel virus spreading globally                | Jon Cohen               | Social-global spread origin                                                                 | Science                                              | Comment                              | 4                | 6049 | 12               |
| #82             | SARS-CoV-2 was already spreading in France in late December 2019                       | Antoine Deslandes       | Community-broader evaluation of the situation in a specific area and time                    | International Journal of Antimicrobial Agents        | A descriptive study, short communication | 4                | 6045 | NC               |
| #83             | Ten Weeks to Crush the Curve                                                           | Harvey V Fineberg       | Social-community-broader evaluation of the situation in a specific area and time            | New England Journal of Medicine                      | Comment, editorial                    | 4                | 6014 | 7                |
| #84             | The psychological impact of quarantine and how to reduce it: rapid review of the evidence | Samantha K Brooks       | Community-remote effects-psychological                                                        | The Lancet                                           | Comment, editorial                    | 4                | 5885 | 303              |
| #85             | COVID-19 and Italy: what next?                                                          | Andrea Remuzzi          | Community-broader evaluation of the situation in a specific area and time                    | The Lancet                                           | Review                               | 4                | 5798 | 242              |
| #86             | COVID-19 outbreak on the Diamond Princess cruise ship: estimating the epidemic potential and effectiveness of public health countermeasures | Joacim Rocklov          | Community-broader evaluation of the situation in a specific area (cruise ship)             | Journal of Travel Medicine                           | A descriptive evaluation of total cases of an area | 3                | 5712 | 48               |
| #87             | Considering BCG vaccination to reduce the impact of COVID-19                            | Nigel Curtis            | Prophylaxis with BCG                                                                       | The Lancet                                           | Comment, letter                      | 4                | 5601 | 4                |
| #88             | COVID-19: four-fifths of cases are asymptomatic, China figures indicate                 | Michael Day             | Community-broader evaluation of the situation in a specific area and time                    | British Medical Journal (BMJ)                       | Comment, news                        | 4                | 5583 | 43               |
| #89             | High COVID-19 Attack Rate Among Attendees at Events at a Church - Arkansas, March 2020 | Allison Jame            | Community-broader evaluation of the situation in a specific area and time; transmission-asymptomatic cases | Morbidity and Mortality Weekly Report (MMWR)        | A descriptive evaluation of total cases of an area | 3                | 5543 | 1                |
| #90             | No Evidence of Rapid Antiviral Clearance or Clinical Benefit with the Combination of Hydroxychloroquine and Azithromycin in Patients with Severe COVID-19 Infection | Jean Michel Molina      | Treatment-azitromycin clearance                                                             | Medicine & Maladies Infectieuses                    | A clinical trial, letter             | 3                | 5540 | 74               |
| #91             | Spread of SARS-CoV-2 in the Icelandic Population                                        | Daniel F Gudbjartsson   | Community-broader evaluation of the situation in a specific area and time                    | New England Journal of Medicine                      | A descriptive evaluation of total cases of an area | 3                | 5538 | 66               |
| Rank Of Article | Title Of The Publication                                                                 | First Author          | Main Subject Of The Article | Where Published            | Type Of The Publication | Level Of Evidence | AAS | Dimensions-Badge |
|-----------------|-----------------------------------------------------------------------------------------|-----------------------|------------------------------|----------------------------|-------------------------|-------------------|-----|------------------|
| 92              | Cross-species transmission of the newly identified coronavirus 2019-nCoV                  | Wei Ji                | Genetic                      | Journal of Medical Virology | Estimation via phylogenetics | 4                 | 5532 | 159              |
| 93              | Cluster of Coronavirus Disease Associated with Fitness Dance Classes, South Korea        | Sukbin Jang           | Community-broader evaluation of the situation in a specific group (fitness dance class) | Emerging Infectious Diseases | A descriptive evaluation of total cases of an area | 3                 | 5355 | 1                |
| 94              | How will country-based mitigation measures influence the course of the COVID-19 epidemic? | Roy M Anderson        | OTHER-country-based measures different effects | The Lancet                     | Estimation via cases, modeling | 4                 | 5332 | 182              |
| 95              | Association of Treatment With Hydroxychloroquine or Azithromycin With In-Hospital Mortality in Patients With COVID-19 in New York State | Eli S. Rosenberg     | Treatment-adverse effects-mortality increase | JAMA                        | Retrospective cohort study | 2                 | 5310 | 13               |
| 96              | SARS-CoV-2 Infection in Children                                                        | Xiaoxia Lu            | Community-broader evaluation of the situation in a specific group (children) | New England Journal of Medicine | Comment, letter | 4                 | 5285 | 179              |
| 97              | Estimates of the severity of coronavirus disease 2019: a model-based analysis           | Robert Verity         | Prognosis-severity estimates, bias | The Lancet Infectious Diseases | Estimation via cases, modeling | 3                 | 5255 | 202              |
| 98              | A serological assay to detect SARS-CoV-2 seroconversion in humans                       | Fatima Amanat         | Laboratory-seroconversion     | Medrxiv                       | Methodologic study, serological assay development | 3                 | 5246 | 33               |
| 99              | SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients                | Lirong Zou            | Transmission-virus load       | New England Journal of Medicine | Descriptive study, letter | 3                 | 5199 | 576              |
| 100             | Asymptomatic Transmission, the Achilles’ Heel of Current Strategies to Control COVID-19 | Monica Gandhi         | Transmission-via asymptomatic person | New England Journal of Medicine | Comment, editorial | 4                 | 5178 | 38               |

RCT: Randomized controlled trial; NC: Not calculated by the Altmetric Explorer.
### Appendix 2. Some descriptive values about specific electronic sources that give citations to top-100 COVID-19 publications in concern (long top-10 version)

| The specific electronic source that gives citations to top-100 COVID-19 articles in concern | Number of citations given in this specific electronic source (top-10) | Ranking number of publication based on AAS | Mean value of citations of top-100 COVID-19 articles in concern (on this specific electronic source) | Min-Max values of citations of COVID-19 articles in concern |
|---|---|---|---|---|
| Tweeters & tweets | 154442 | #1 | 14781,77±17971,95 | 0-154442 |
| | 73357 | #2 | | |
| | 63684 | #10 | | |
| | 41695 | #3 | | |
| | 39639 | #13 | | |
| | 31006 | #8 | | |
| | 30101 | #5 | | |
| | 27601 | #6 | | |
| | 25090 | #11 | | |
| | 24425 | #28 | | |
| Mendeley downloads & Mendeley saves | 3442 | #73 | 113,06±467,24 | 0-3442 |
| | 2581 | #21 | | |
| | 1065 | #16 | | |
| | 981 | #35 | | |
| | 826 | #3 | | |
| | 796 | #13 | | |
| | 466 | #48 | | |
| | 376 | #20 | | |
| | 278 | #63 | | |
| | 269 | #51 | | |
| News outlets | 933 | #4 | 238,41±166,55 | 4-933 |
| | 626 | #1 | | |
| | 604 | #37 | | |
| | 595 | #2 | | |
| | 574 | #87 | | |
| | 555 | #6 | | |
| | 545 | #15 | | |
| | 543 | #22 | | |
| | 516 | #14 | | |
| | 460 | #21 | | |
| Facebook pages & Facebook posts | 132 | #2 | 25,48±21,68 | 0-135 |
| | 102 | #54 | | |
| | 91 | #44 | | |
| | 84 | #4 | | |
| | 60 | #17 | | |
| | 58 | #71 | | |
| | 55 | #9 | | |
| | 55 | #21 | | |
| | 53 | #66 | | |
| | 52 | #14 | | |
| The specific electronic source that gives citations to top-100 COVID-19 articles in concern | Number of citations given in this specific electronic source (top-10) | Ranking number of publication based on AAS | Mean value of citations of top-100 COVID-19 articles in concern (on this specific electronic source) | Min-Max values of citations of COVID-19 articles in concern |
|---|---|---|---|---|
| Blogs & Blog posts | 117 | #1 | 25.48±19.62 | 0-117 |
| Reddit(ors) & Reddit threads | 33 | #17 | 10.64±8.52 | 0-33 |
| Policy source & Policy documents | 7992 | #83 | 2.18±1.47 | 1-6 |
| Videos & video uploaders | 17 | #32 | 2.26±3.24 | 0-17 |
| The specific electronic source that gives citations to top-100 COVID-19 articles in concern | Number of citations given in this specific electronic source (top-10) | Ranking number of publication based on AAS | Mean value of citations of top-100 COVID-19 articles in concern (on this specific electronic source) | Min-Max values of citations of COVID-19 articles in concern |
|---|---|---|---|---|
| Wikipedia pages & Wikipedia references | 12 | #69 | | |
| | 11 | #14 | | |
| | 10 | #31 | | |
| | 9 | #81 | | |
| | 8 | #2 | | |
| | 8 | #94 | | |
| | 7 | #51 | | |
| | 6 | #43 | | |
| | 6 | #58 | | |
| | 6 | #70 | | |
| Q&A thread | 3 | #17 | | |
| | 2 | #1 | | |
| | 2 | #14 | | |
| | 1 | #2 | | |
| | 1 | #4 | | |
| | 1 | #37 | | |
| | 1 | #31 | | |
| | 1 | #59 | | |
| | 1 | #38 | | |
| | 1 | #51 | | |
| F1000 reviews | 1 | #17 | | |
| | 1 | #14 | | |
| | 1 | #59 | | |
| | 1 | #38 | | |
| | 1 | #31 | | |
| | 1 | #37 | | |
| | 1 | #40 | | |
| | 1 | #6 | | |
| | 1 | #49 | | |
| | 1 | #7 | | |
* This study does not require Ethics Committee Approval.

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