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Article

Magnitude of Scholarly Communication Theories Used during the COVID-19 Pandemic: A Study

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Abstract: This study aimed to test the hypothesis that the use of theories in open access resources during the COVID-19 pandemic would be greater than in copyrighted resources. Using the Scopus database from August 18-28, 2023, the search terms "COVID-19," "Coronavirus," "SARS-CoV-2," and "2019-nCoV" retrieved 511,920 results, of which 17,487 were selected. After filtering, 8,254 studies were analyzed. These were categorized as "Both Theory and Model," "Only Theory," and "Only Model." Using MS Excel, the researchers sorted studies based on titles, abstracts, and keywords to assess the magnitude of theory and model use. The study found that theories and models were employed across various disciplines and indexed accordingly. Further analysis included term categories, year-wise distribution, and citation patterns in relation to access categories. The study recommended future research to explore the connection between theories/models and factors such as publication trends, geography, and funding. The study concluded that, journals should encourage authors to include theories/models used in their studies in titles, especially during health emergencies, to provide early insights into handling pandemics.

Keywords: COVID-19 pandemic; models; scholarly communications; theories; open access; copyrighted access

Introduction

Scholarly publishing in the wake of the COVID-19 pandemic has witnessed a remarkable increase and change in publication trend among researchers (Miller, 2020). According to Else, (2020), scientists from across different domains—*health and medicine, life science, physical sciences and engineering, social sciences and economics*—raced to share research on and about the COVID-19 through preprints to the extent journals adjusted their policies of review process especially in preferences of COVID-19 related research over non-COVID-19 research. This agrees with submission of Palayew et al., (2020) who have demonstrated that, following the declaration of the COVID-19 as public health emergency of international concern (PHEIC) by WHO; there was a fast-track publication of articles changing the median time to acceptance from 93 to or less than 7 days. This is true, as the duration of time from acceptance to publishing has drastically reduced for medical journals by 49% (Horbach, 2020). This arose due to the fact that, countries around the globe have tried to flatten the curve of the spread of the virus since it has affected almost every aspect of life—*economy, tourism, political affairs, arts, sports*—to mention but a few resulting in an increased volume of publications especially from biomedical sciences (Aviv-Reuven & Rosenfeld, 2021). There existed equilibrium with respect to many ecosystems, but the pandemic disrupted and tampered with the way they operate due to the health crisis. In this perspective, perhaps this has to do with the study captured by Materska, (2022, p6) cited in Adakawa, (2022) who noted that, there are many ecosystems that encompass "*information ecosystem, learning ecosystem, social ecosystem, socio-ecological ecosystem, cultural ecosystem, consumer ecosystem, searching ecosystem, innovation ecosystem, digital ecosystem, digital public services ecosystem, new media ecosystem, library ecosystem*". These ecosystems and others were affected and for them to regain their steadiness, communication scientific research is a necessity. To communicate scientific research effectively, researchers used theories and models to understand the behavior of animate and

inanimate objects surrounding the pandemic with the sole aim of restoring the ecosystems to near or back to normalcy.

For instance, many researchers have realized that, the COVID-19 pandemic has disrupted everyday life, ways of running businesses, altered economies, etc. thereby resulting in developing resilient strategies. In this direction, using news media reports employing NexisLexis database, Le and Phi, (2021) have noted how, at the beginning of the first phase of the pandemic, the media reported mostly about the negative impacts of the COVID-19. At the same time, the hotels were using pro-active (such as saving), reactive (surviving), and proactive (recovery and innovation, and learning and transformation) strategies to develop resilience (Le & Phi, 2021). At the onset of every pandemic, infection will continue to claim more lives if theories and models are not put to test to understand the pattern of progression, transmission of the disease and pattern of acceptance of vaccines developed to curtail the spread of the disease-causing organism. This is true, as at the beginning of the COVID-19 pandemic, there was a slow pattern of using theories necessitating employing practical solutions to solve pragmatic problems. This might be attributable to the publishing procedure taking months to reach the public/audience.

Background of the Study

Pandemics are a meaning-generating phenomenon that reciprocates reversibly for calming down the nerves, ensuring safety, security, wellbeing of lives thereby adjusting the economic activities and restoring the global health to sustainably agreed equilibrium. This is true, as the pandemic uses to place humans in cognitive dissonance owing to numerous happenings that involve disruptions of everyday life necessitating the urgency to regain equilibrium as a matter of course. Theories are important in generating such meanings using empirical data resulting from investigating different facets of the pandemics. That is, pandemics are about creating "*meanings at, on, about*" at least five (5) levels described as quintuple helix. These levels are patients-medical-workforce-stakeholders-researchers-technologies. At each level, there are varying descriptions of the pandemics from different perspective, which can be scientifically, environmentally, socially, culturally, etc. inclined. These divergent views give rise to various and sometime diffused perceptions that spontaneously form cloudy atmosphere with the resulting droplets of fragments of facts whose scientifically evidence-based pieces of information pervades and strives. That is why describing the COVID-19 pandemic to the contemporary generation that witnessed it seems inadequate and to the future generation might look like exaggeration. This dichotomy emanates from the fact that, no matter how an observer tries harder to capture all the details of a particular phenomenon using available evidence, there is always a room for leaving a large portion of it not intentionally but because of the angle one takes as contained in special relativity explained by Albert Einstein in 1920s.

The objective of this research is to find out the magnitude of scholarly communication theories used during the COVID-19 pandemic.

Methods

The study investigated magnitude of scholarly communication theories used during the COVID-19 pandemic. The researchers used Scopus database from 18-28 August 2023. The search strategy used was "COVID-19 OR Coronavirus OR Coronaviruses OR SARS-CoV-2 OR 2019-nCoV" during the four (4) year period from 2019-2023. The search revealed 511, 920 results. Out of this number, 17, 487 results were retrieved. After filtering and pruning the data, 8,254 results were used for the purpose of this study.

Findings

Table 1 shows the distribution of occurrence of theories in the title (Both Theory and Model). It is obvious from the table that, protection motivation theory occurred frequently than other theories 7(10.44776%) in the title followed by grounded theory 5(7.462687%), theory of planned behavior

5(7.462687%), integrated theory of planned behavior and norm activation model 3(4.477612%), and theory and practice 3(4.477612%).

Table 1. Distribution of Occurrences of Theories in Both Theory and Model Category in the Title.

Theory	No of occurrence	Percentage (%)
Adaptive structuration theory	1	1.492537
Burnout theory/model	1	1.492537
Classical test theory (CTT) and Item response theory (IRT)	1	1.492537
Connectivism theory approach	1	1.492537
Conservation of resources theory	1	1.492537
Conspiracy theory 5G	1	1.492537
Critical race theory	1	1.492537
Dempster-Shafer theory of evidence and grey relation analysis	1	1.492537
Dynamic capability theory	1	1.492537
Evolutionary theory of loneliness	1	1.492537
Extended theory of planned behavior	1	1.492537
Extended theory of value-identity-personal norm model	1	1.492537
Game theory	1	1.492537
Goal framing theory	1	1.492537
Graph theory	1	1.492537
Gratification theory	1	1.492537
Grounded theory	5	7.462687
Health belief model and theory of planned behavior	1	1.492537
Integrated theory of planned behavior and norm activation model	3	4.477612
Integrating the full spectrum of self-determination theory and self-efficacy into technology acceptance model	1	1.492537
Integration of pro-environmental behavior (PEPB) and service quality (SERVQUAL)	1	1.492537
Job demand-resources model and conservation of resources theory	1	1.492537
Kuznet curve theory	1	1.492537
Lattice field theory	1	1.492537
Life cycle theory	1	1.492537
Ogbu's cultural-ecological theory	1	1.492537
Online theory of change workshop	1	1.492537
Percolation theory	1	1.492537
Posthuman theory	1	1.492537
Practice to theory	1	1.492537
protection motivation theory	7	10.44776
Psychological capital theory	1	1.492537
Recognition theory	1	1.492537
Rhetorical arena theory and modality	1	1.492537
Self-determination theory (SDT)	2	2.985075
Serendipity-mindsponge-3D knowledge management theory	1	1.492537

Theory	No of occurrence	Percentage (%)
Situational crisis communication theory	1	1.492537
Sociolinguistic theory of survival	1	1.492537
Statistical theory of epidemics	1	1.492537
Supply chain viability theory	2	2.985075
Terror management theory	2	2.985075
Theory and practice	3	4.477612
Theory of Planned behavior	5	7.462687
Theory of traditional Chinese medicine	1	1.492537
Theory-informed formative evaluation	1	1.492537
Uncertainty theory	1	1.492537
	67	100

Table 2 shows the distribution of occurrences of theories in the “Only Theory” category in the title. In this table, conspiracy theories accounted for about 15% of the overall theories in this category followed by protective motivation theory 7(7%), and grounded theory 5(5%). In this perspective, it means that, during the COVID-19 pandemic, researchers inclined to investigate issues surrounding conspiracy theories as obstacles that restricted populace from using non-pharmaceutical interventions (NPIs), among others. It is important to mention in this juncture that, there are about 565 models used in the title to study COVID-19 related behaviors during the pandemic. The space is insufficient to contain all of them.

Table 2. Distribution of Occurrences of Theories in “Only Theory” Category in the Title.

Theory	No of Occurrence	Percentage (%)
Actor-network theoretical study	1	1
Adaptive structuration theory	1	1
Antisemitic conspiracy theories	1	1
Application of Theory Planned Behavior (TPB) and Health Belief Model (HBM)	1	1
Burnout theory and measurement	1	1
Classical Test Theory (CTT) and Item Response Theory (IRT) models	1	1
Combined theoretical and experimental study of nordihydroguaiaretic acid	1	1
Connectivism theory	1	1
Conservation of resources theory	1	1
Conspiracy theories	15	15
Critical race theory	1	1
Dempster–Shafer theory of evidence	1	1
Dynamic capability theory	1	1
Evolutionary theory of loneliness	1	1
Extended theory of planned behavior	1	1
Extended theory of value-identity-personal norm model	1	1
Foundational theoretical adsorption and quinolone docking study	1	1

Theory	No of Occurrence	Percentage (%)
Game theory	1	1
Goal Framing Theory	1	1
Graph theory	1	1
Gratification theory	1	1
Grounded theory	5	5
Health belief model and the theory of planned behavior model	1	1
Integrated theory of planned behavior and norm activation model	3	3
Integrating health behavior theories	1	1
Job Demands-Resources Model and Conservation of Resource Theory	1	1
Lattice field theory	1	1
Life cycle theory	1	1
Migration theory	1	1
Ogbu’s Cultural-Ecological Theory	1	1
Online theory of change	1	1
Percolation theory	1	1
Posthuman theory	1	1
Practice to theory	1	1
Pro-environmental planned behavior (PEPB) and service quality (SERVQUAL)	1	1
Protection Motivation Theory	7	7
Psychological capital theory	1	1
Reaction–diffusion epidemic model and theoretical analysis	1	1
Recognition theory	1	1
Rhetorical arena theory	1	1
Self-determination theory	3	3
Serendipity-mindsponge-3D knowledge management theory and conceptual framework	1	1
Situational crisis communication theory	1	1
Sociolinguistic theory of survival	1	1
Statistical theory of epidemics	1	1
Supply chain viability theory	2	2
Terror management theory	2	2
Theoretical analysis of CF-Fractional model	1	1
Theoretical aspects of fiscal federalism and COVID-19 crisis	1	1
Theoretical characterization of iron (III) and nickel (II) complexes	1	1
Theoretical Design of Functionalized Gold Nanoparticles	1	1
Theoretical Docking of Medicines With Two Proteins	1	1
Theoretical framework and model of ICT adoption and inclusion	1	1
Theoretical Investigation of 5-Fluorouracil and Tamoxifen Complex–Structural and Docking Simulation	1	1
Theoretical molecular properties of Anisidine-Isatin Schiff bases	1	1

Theory	No of Occurrence	Percentage (%)
Theories of COVID-19 risky behaviors	1	1
Theorizing parallelisms between COVID-19 restrictions and strands of otherness	1	1
Theorizing sociomateriality	1	1
Theory and practice	3	3
Theory of Kuznet curve	1	1
Theory of planned behavior	4	4
Theory of traditional Chinese medicine	1	1
Theory-informed formative evaluation	1	1
Three key theories of omicron	1	1
Uncertainty theory	1	1
	100	

Table 3 shows the distribution of terms in the title across OA and CA articles. A chi-square test of independence was conducted to examine the relationship between the access categories (Open Access vs. Copyrighted) and the term categories in the title (Both Theory and Model, Only Theory, and Only Model). The result is [$\chi^2= 21.97$; $df= 2$; $P\text{-Value}=0.0001$; $\alpha= 0.05$]. These results indicate a statistically significant association between the type of access categories and term categories in the title, suggesting that the distribution of open access and copyrighted titles differs significantly across the different categories of titles.

Table 3. Distribution of Terms in the Title across Open Access and Copyrighted Articles.

Term Category	Open Access	Copyrighted	
		(Title)	(Title)
Both Theory and Model	41	26	67
Only Theory	61	39	100
Only Model	447	119	566
Total	549	184	733

Table 4 shows the distribution of the combined term categories year-wise in the title across OA and CA articles. In this table, the Chi-square value for the years 2020 to 2023 is as follows [$\chi^2 = 39.23$; $p - value = 0.0001$; $df = 11$; $\alpha= 0.05$]. The p-value for the combined distribution for the year 2020-2023 in the title is far less than the significance level 0.05 suggesting a statistically significant difference between the observed and expected frequencies. This implies that the differences between the content type and access type is not by chance. Likewise, the Cramers V value is 0.232, which is a weak to moderate association. While the association is statistically significant, it is not particularly strong indicating that the term category has some influence on the access category.

Table 4. Distribution of Combined Term Categories Year-wise in the Title across Open Access and Copyrighted Articles.

Year	Content Type	Open Access	Copyrighted Access
2023	Both Theory and Model	15	14
2023	Only Theory	18	14
2023	Only Model	151	32
2022	Both Theory and Model	10	10

Year	Content Type	Open Access	Copyrighted Access
2022	Only Theory	18	14
2022	Only Model	93	29
2021	Both Theory and Model	6	3
2021	Only Theory	15	5
2021	Only Model	92	17
2020	Both Theory and Model	6	3
2020	Only Theory	10	6
2020	Only Model	109	40
	Total	543	187

Table 5 shows the combined distribution of combined term categories year-wise in the abstract across OA and CA articles. The result for the Chi-square for the distribution is as follows: [$\chi^2 = 149.41$; p – value = 0.0001; df = 11; $\alpha = 0.05$]. The p-value for the combined distribution is exceptionally low, suggesting a statistically significant difference between the observed and expected frequencies across all categories and years. This implies that the distribution of OA and CA across term categories is non-random. This shows the likelihood of authors to use the term categories in the abstract or the journal policies recommend or remain mute about that. In order to know the strength of the relationship, Cramer’s V test was run. It was found that, it equalled to 0.172 suggesting weak to moderate association between variables. While the χ^2 test indicated a statistically significant difference, the strength of the association between term categories and access categories is not especially strong. This suggests that, while the relationship is not strong, other factors such as journal policies, publication date trends, funding agencies, etc. might be responsible for the weak to moderate relationships.

Table 5. Distribution of Combined Term Categories Year-wise in the Abstract across Open Access and Copyrighted Articles.

Year	Term Category	Open Access	Copyrighted Access
2023	Both Theory and Model	193	94
2023	Only Theory	193	94
2023	Only Model	833	212
2022	Both Theory and Model	192	69
2022	Only Theory	191	70
2022	Only Model	693	171
2021	Both Theory and Model	113	36
2021	Only Theory	117	37
2021	Only Model	619	78
2020	Both Theory and Model	83	56
2020	Only Theory	93	56
2020	Only Model	593	138
	Total	3913	1119

Table 6 shows the combined distribution of term categories in the author keywords across OA and CA articles. The Chi-square test results for the combined distribution for the year 2020-2023 across the categories are given as [$\chi^2 = 29.36$; p – value = 0.0002; df = 11; $\alpha = 0.05$]. The p-value is

below the significance level 0.05, suggesting that there is a statistically significant difference between the observed and expected frequencies. This suggests a significant association between term categories and access categories. To understand the strength of the relationship, Cramer’s V test was conducted and the value of 0.194 was obtained. This value implies that, there is a weak association between the term category and access category. This means that, the term category does not have a significant influence on whether the access is OA or CA. That is, there no substantial and meaningful relationship between term categories and access categories, suggesting that, term categories can slightly determine whether the access category is OA or CA. This can serve as an evidence advising authors to include term categories within the author keywords section and can be associated with access categories alike. By implication, publishers and institutions can use this finding to fashion their OA policies. In addition, authors can use the term categories to enhance the accessibility, discoverability, and retrievability of their research outputs by using the term categories within the author keywords. Furthermore, there is evidence that, researchers can delve into understanding or exploring why certain term categories are strongly associated with OA or CA categories especially if they expand the spectrum of their studies to include such aspects as funding sources, journal policies, geographical locations of authors, among others. From another angle, funding bodies and institutions trying to increase OA content might need to consider including such term categories when developing policies. In this way, it implies that, the weak association suggests targeting term categories that could be an effective strategy for increasing overall OA publications.

Table 6. Distribution of the Combined Term Categories Year-wise in the Author Keywords across Open Access and Copyrighted Articles.

Year	Term Category	Open Access	Copyrighted Access
2023	Both Theory and Model	34	23
2023	Only Theory	35	23
2023	Only Model	113	37
2022	Both Theory and Model	37	17
2022	Only Theory	36	18
2022	Only Model	88	26
2021	Both Theory and Model	17	11
2021	Only Theory	17	11
2021	Only Model	61	9
2020	Both Theory and Model	15	13
2020	Only Theory	16	12
2020	Only Model	80	29
Total		549	229

Table 7 shows the distribution of combined term categories year-wise in the index keywords across OA and CA. The Chi-square test values are given as [$\chi^2 = 28.56$; p – value = 0.018; df = 15; $\alpha = 0.05$]. The p-value of 0.018 is less than the significance level 0.05 suggesting that there is a statistically significant difference between the observed and expected frequencies. This implies that, the distribution of OA and CA across different term categories and years is not due to chance. The implications of this finding are many and diverse. The fact that, the p-value is less than 0.05 significance level implies that, there is a statistically significant difference between term categories and access categories suggesting that, the tem category influences whether an article is OA or CA. In addition, from year-wise perspective, the association may vary across years suggesting that different years exhibit different patterns of association between term categories and access categories. What can be deduced from the implications of this finding are many. Firstly, during the early phase of the pandemic, many authors tend to publish in OA journals due to the funding opportunities. This might

have emanated from the decision taken by publishers and funders to make most research outputs public for containing the spread of the virus. On the other hand, for researchers investigating the publication trends, this finding is important in understanding factors (such as term categories) in influencing access categories. In terms of policy implications, institutions and funding agencies with goals of promoting OA might find this result interesting by focusing on term categories that are less likely to be made OA. To understand the strength of the relationship, Cramer’s V test value of 0.075 showed a weak association between variables in the dataset.

Table 7. Distribution of Combined Term Categories Year-wise in the Index (Database) Keywords across Open Access and Copyrighted Articles.

Year	Term Category	Open Access	Copyrighted Access
2023	Both Theory and Model	59	11
2023	Only Theory	59	12
2023	Only Model	211	41
2022	Both Theory and Model	35	6
2022	Only Theory	36	5
2022	Only Model	226	34
2021	Both Theory and Model	38	13
2021	Only Theory	37	13
2021	Only Model	270	26
2020	Both Theory and Model	64	13
2020	Only Theory	63	13
2020	Only Model	343	56
Total		1441	243

Table 8 shows the distribution of citation category in the title across OA and CA articles. The Chi-square test values are given as [$\chi^2 = 1638$; p – value = 0.0001; df = 10; $\alpha = 0.05$]. The p-value indicates a quite small value that is less than the significance level 0.05 suggesting a significant difference between the observed and expected frequencies. The p-value indicates a strong relationship between the range of citations and access categories i.e. whether article is OA or CA. The skewedness in distribution might be attributable to access restrictions, licensing agreements, or the nature of the content such that certain types of content might be OA at specific ranges but CA at others. Furthermore, understanding that certain categories could be OA or CA means that, institutions, libraries or publishers can make informed decisions about where to focus their efforts either increasing OA availability or managing CA items. A Cramer’s V test value of 0.805 shows a strong association between citation label and access categories. This implies that, the differences between these categories are substantial where knowing the citation label provides a strong indication of whether the content is likely to be OA or CA. This finding also confirms the significant association found in Chi-square.

Table 8. Distribution of Citation Category in the Title across Open Access and Copyrighted Articles.

Both Theory and Model in the Title			
Citation Category	Open Access	Copyrighted	Grand Total
0-24	104	181	285
25-49	90	113	203

50-74	72	50	122
75-99	76	0	76
100-124	107	0	107
125-149	285	0	285
150-174	333	0	333
175-199	0	177	177
200-224	220	0	220
300-324	308	0	308
400-424	413	0	413
Grand Total	2008	521	2529

These findings both confirm and challenge previous research. For example, Perianes-Rodríguez and Olmeda Gómez (2021) found that most European Research Council (ERC)-funded research is published in hybrid or non-OA journals (85%), which receive 50-60% of citations. This suggests that ERC-funded research is influential and that researchers with grants tend to avoid gold OA journals. Their study adds value by focusing on where ERC-funded researchers publish and why, complementing earlier studies that examined ERC's impact on areas such as gender, researcher mobility, and peer review (Perianes-Rodríguez & Olmeda Gómez, 2021). On the other hand, Bordons et al. (2023) examined the relationship between funding and OA in the Spanish National Research Council's publications across three disciplines: Biology & Biomedicine (BIOL), Humanities & Social Sciences (HSS), and Materials Science (MATE). They found that BIOL had the highest OA share (66%), and funded research generally had higher OA rates than unfunded work, especially in experimental fields. International first authors also increased OA chances in HSS. About 50% of Web of Science articles are OA (Martin-Martin et al., 2018, cited in Momeni et al., 2021), with German institutions showing significant OA growth from 2010-2018 (Hobert et al., 2020, cited in Momeni et al., 2021). Studies like Sotudeh et al. (2015) highlight the benefits of APC models, with OA outperforming Toll access, gaining 21.36% and 49.71% citation advantages in 2009 and 2008, respectively. Natural Sciences saw the greatest citation benefit (35.95%), while HSS had the lowest (3.14%). International OA journals attracted more attention across multiple countries than domestic ones (Fukuzawa, 2017).

Table 9 show the distribution of citation in the title (Only Theory) across OA and CA articles. The Chi-square test results are as follows: [$\chi^2 = 1558.36$; $p - \text{value} = 0.0001$; $df = 11$; $\alpha = 0.05$]. From the results, it is visible that, the p-value is less than the significance level 0.05 suggesting that there is a statistically significant difference between the observed and expected frequencies. This means that, there is a significant association between citation range and likelihood the access category been OA or CA. The Cramer's V test yielded 0.616 showing a moderate to strong association between the citation label and access categories, which implies that, the association is not random and highly associated with the citation ranges. This reinforces the Chi-square result of significantly meaningful association between the variables.

Table 9. Distribution of Citation in the Title (Only Theory) across Open Access and Copyrighted Articles.

Only Theory in the Title			
Citation Category	Open Access	Copyrighted	Grand Total
0-24	165	216	381
25-49	271	113	384
50-74	72	116	188

75-99	164	0	164
100-124	207	0	207
125-149	284	142	426
150-174	495	0	495
175-199	177	0	177
200-224	442	0	442
300-324	308	0	308
400-424	416	0	416
500-524	522	0	522
Grand Total	3523	587	4110

Table 10 shows the distribution of citation in the title (Only Model) across OA and CA articles. The Chi-square test results are [$\chi^2=12978.93$; p-value=0.0001; df= 35; $\alpha= 0.05$]. The p-value is extremely less than the significance level 0.05 suggesting a statistically significant difference between the observed and expected frequencies. This implies a strong association between citation ranges and access categories. Similarly, a Cramer’s V test values revealed 0.544 suggesting that, there is a moderate association between citation category and access category. Despite presence of significant association between these variables, it is not strong enough as many other factors such as access restrictions, licensing agreements, nature of the contents, among others might influence the distribution of citation across access categories.

Table 10. Distribution of Citation in the Title (Only Model) across Open Access and Copyrighted Articles.

Citation Category	Open Access	Copyrighted	Grand Total
0-24	1278	358	1636
25-49	571	133	704
50-74	771	51	822
75-99	353	97	450
100-124	324	0	324
125-149	705	0	705
150-174	1256	0	1256
175-199	197	176	373
200-224	835	0	835
225-249	243	240	483
250-274	538	0	538
275-299	1169	0	1169
300-324	1564	0	1564
325-349	1368	0	1368
350-374	2550	0	2550
375-399	1178	0	1178
400-424	1249	0	1249
425-449	860	0	860
450-474	1381	0	1381
475-499	2444	0	2444
500-524	505	0	505

525-549	1066	0	1066
575-599	585	0	585
600-624	1233	0	1233
625-649	646	0	646
675-699	2062	0	2062
700-724	1440	0	1440
775-799	788	0	788
800-824	813	0	813
875-899	882	0	882
925-949	945	0	945
1075-1099	1092	0	1092
1275-1299	1296	0	1296
1500-1524	3026	0	3026
1725-1749	3459	0	3459
2150-2174	2163	0	2163
Grand Total	42835	1055	43890

Table 11 shows the distribution of citation in the abstract (Both Theory and Model) across OA and CA articles. The Chi-square results are given as [$\chi^2=13069.63$; p-value=0.0001; df= 23; $\alpha= 0.05$]. From these results, it is obvious that, the p-value is extremely lower than the significance level 0.05 suggesting that, the null hypothesis is rejected. This means that, there is a strong relationship between the observed and expected frequencies. For Cramer’s V test value, 0.553 indicates a moderate to strong association between the citation ranges and access categories, suggesting that, the citation range has a significant impact on whether access category can be OA or CA articles. This Cramer’s V test value reinforces the Chi-square test value.

Table 11. Distribution of Citation in the Abstract (Both Model and Model Only) across Open Access and Copyrighted Articles.

Citation Category	Both Theory and Model in the Abstract		
	Open Access	Copyrighted	Grand Total
0-24	1549	1270	2819
25-49	1885	305	2190
50-74	1728	413	2141
75-99	663	92	755
100-124	531	234	765
125-149	1514	142	1656
150-174	1754	0	1754
175-199	1470	373	1843
200-224	1678	0	1678
225-249	701	226	927
250-274	511	259	770
275-299	574	0	574
300-324	1545	301	1846
325-349	2337	0	2337
350-374	2538	0	2538

Citation Category	Both Theory and Model in the Abstract		
	Open Access	Copyrighted	Grand Total
375-399	2698	768	3466
400-424	2060	0	2060
425-449	4358	0	4358
475-499	1950	983	2933
500-524	1537	0	1537
525-549	0	549	549
550-574	0	550	550
825-849	829	0	829
1875-1899	1886	0	1886
Grand Total	36296	6465	42761

Table 12 shows the distribution of citation in the abstract across OA and CA articles. The Chi-square results are [$\chi^2=7275.34$; p-value=0.0001; df= 13; $\alpha= 0.05$]. As it can be seen that, the p-value is extremely small far less than the significance level 0.05 suggesting that the null hypothesis is rejected. This means that, there is a significant association between citation ranges and access categories. A Cramer’s value of 0.398 implies that there is a moderate association between the citation category and access categories. Despite the significant association, it is not a strong one.

Table 12. Distribution of Citation in the Abstract (Only Theory) across Open Access and Copyrighted Articles.

Citation Category	Only Theory in the Abstract		
	Open Access	Copyrighted	Grand Total
0-49	3450	1559	5009
50-99	2334	562	2896
100-149	2045	376	2421
150-199	3224	373	3597
200-249	2379	226	2605
250-299	1085	259	1344
300-349	4566	301	4867
350-399	5979	1143	7122
400-449	7252	0	7252
450-499	1950	983	2933
500-549	2056	549	2605
550-599	0	550	550
800-849	829	0	829
1850-1899	1886	0	1886
Grand Total	39035	6881	45916

Table 13 shows the distribution of citation in the abstract across OA and CA articles. The results of the Chi-square test are given as [$\chi^2=44627.64$; p-value=0.0001; df= 29; $\alpha= 0.05$]. The p-value is far less than the significance level 0.05 suggesting the null hypothesis is rejected and that there is a strong relationship between the observed and expected frequencies. The Cramer’s V value of 0.320 indicates a moderate association between citation ranges and access categories. While there is a significant

relationship, the strength of the association is moderate implying that other factors such access restrictions, licensing agreement, etc. may influence the distribution.

Table 13. Distribution of Citation in the Abstract (Only Model) across Open Access and Copyrighted Articles.

Citation Category	Only Model in the Abstract		
	Open Access	Copyrighted	Grand Total
0-99	26625	4505	31130
100-199	28451	1454	29905
200-299	26062	964	27026
300-399	56571	1852	58423
400-499	51014	1642	52656
500-599	30836	0	30836
600-699	31567	0	31567
700-799	14129	0	14129
800-899	13359	0	13359
900-999	14995	0	14995
1000-1099	11558	1041	12599
1100-1199	9331	0	9331
1200-1299	5107	0	5107
1300-1399	4056	0	4056
1400-1499	5744	2832	8576
1500-1599	12391	0	12391
1600-1699	1652	0	1652
1700-1799	5215	0	5215
1800-1899	1886	0	1886
1900-1999	1966	0	1966
2000-2099	6179	0	6179
2300-2399	9312	0	9312
2400-2499	7293	0	7293
2500-2599	5119	0	5119
2600-2699	2692	0	2692
2800-2899	2829	0	2829
2900-2999	8933	0	8933
4500-4599	4504	0	4504
7600-7699	7664	0	7664
13400-13499	13475	0	13475
Grand Total	420515	14290	434805

Table 14 shows the distribution of citation in the author keywords across OA and CA articles. The results of the Chi-square are [$\chi^2=3417.59$; p-value=0.0001; df= 14; $\alpha= 0.05$]. The p-value is extremely less than the significance level of 0.05 suggesting that there is a statistically significant difference between the expected and observed frequencies and that the null hypothesis is rejected. A Cramer’s V test value revealed 0.721 suggesting a strong association between the citation ranges and access categories. This implies that, the citation range has a significant influence of determining whether the access categories could be OA or CA and it support the Chi-square test value of indicating strong relationship.

Table 14. Distribution of Citation in the Author Keywords (Both Theory and Model) across Open Access and Copyrighted Articles.

Citation Category	Both Theory and Model in the Author Keywords		
	Open Access	Copyrighted	Grand Total
0-24	391	273	664
25-49	425	195	620
50-74	379	51	430
75-99	249	92	341
100-124	207	0	207
125-149	277	0	277
150-174	648	0	648
175-199	353	197	550
200-224	435	0	435
225-249	0	226	226
275-299	585	0	585
325-349	339	0	339
350-374	358	0	358
375-399	0	378	378
500-524	522	0	522
Grand Total	5168	1412	6580

Table 15 shows the distribution of citation in the author keywords across OA and CA articles. The results of the Chi-square are [$\chi^2=3413.53$; p-value=0.0001; df= 14; $\alpha= 0.05$]. The p-value is far less than the significance level of 0.05 suggesting that, there is a statistically significant difference between the observed and expected frequencies. That is, the null hypothesis is rejected, which means that, citation range has impact on determining what access categories could be (i.e. either OA or CA). A Cramer’s V value of 0.720 shows a strong association between the citation categories and access categories indicating that, citation category has a significant impact on whether the content is likely to be OA or CA items. In addition, this value confirms the χ^2 result of strong association between citation categories and access categories.

Table 15. Distribution of Citation in the Author Keywords (Only Theory) across Open Access and Copyrighted Articles.

Only Theory in the Author Keywords			
Citation Category	Open Access	Copyrighted	Grand Total
0-24	399	265	664
25-49	425	195	620
50-74	379	51	430

75-99	249	92	341
100-124	207	0	207
125-149	277	0	277
150-174	648	0	648
175-199	353	197	550
200-224	435	0	435
225-249	0	226	226
275-299	585	0	585
325-349	339	0	339
350-374	358	0	358
375-399	0	378	378
500-524	522	0	522
Grand Total	5176	1404	6580

Discussions, Implications, and Insights for Hypothesis 1

To begin with, the current study is one the few studies desired during emergency especially of endemic, epidemic or pandemic nature where the confluence of uncertainty and confusion is eminent thus confounding to fill the atmosphere with doubts and the necessity for urgent solutions are extremely needed. This is true, as in the course of a health emergency, what the stakeholders in publishing/knowledge industry or health security sector need the most; is the presence of ingredients that can easily catalyze the application of knowledge to slow the phase at which the disease-organism travels and propagates. This is with a view to speeding up the period at which stakeholders can take important decision thereby making populace aware and adhere strictly to the guidelines, directing vaccine development, logistics delivery, boosting supply chain, lessening the spread of the viral/bacterial particles or any other disease-causing organisms, among others. When a pandemic erupts, many stakeholders perform their individualized and sometimes collective duties. From the knowledge industry, most of the findings above refer to them in one way or the other encompassing areas of journal polices, funding sources, geographic locations, publication venues, authors’ preferences, publication date trends, institutional policies, etc. For the health security sector, many roles are required that are reversibly shared with knowledge industry prior to reaching the populace for immediate compliance. One of the findings of this research is that, there is a pattern of increase in using theories/models from the beginning of the pandemic (2019-2020) to the post-pandemic period (2022-2023). This suggests that, if at the beginning of the pandemic, researchers focused on using theories/models, the pandemic would not have done more than it did to the population health and economy.

Bearing in mind that, research cannot solve all world’s problems, but extending a hand to attempt to contribute small fragments to the process of solving problems is a good thing. That is why this study attempts to look at a structure comprising five (5) key elements, namely patients—medical-workforce—stakeholders—researchers—technologies. These elements have roles to play during a pandemic. For instance, how the appearance of term categories such as theories or models in the title can affect its discoverability? To answer this question, it is a well-acknowledged fact that, many researchers while searching for documents/articles; the first interface they encounter is either the title or abstract. This means that, if the term category, for example theory, is not mentioned in especially title or abstract, the researchers may ignore important research output that could assist in providing a way forward to the ongoing research about the pandemic at the moment. In this way, stakeholders in health security sector should collaborate with knowledge industry in enumerating possible ways to suggest how authors should reconsider using these term categories in their write-ups to speed up the rate at which research can easily be discovered, understood, applied, etc. to solve a lingering health problem.

From the microscopic viewpoint the current research is trying to elucidate these quintuple points has to do with breaking down what the stakeholders, patients, medical-workforce, researchers, and technologies comprise. For stakeholders, they encompass health agencies (i.e. globally, internationally, regionally, nationally or locally), health providers (i.e. government- or private-owned hospitals, which include teaching or tertiary, cottage, general, specialist, specialized hospitals with their intensive care units). Healthcare or medical workforce comprises physicians (such as paediatricians, urologists, etc.), dentists, pharmacists, allied professionals (i.e. radiologists, physiotherapists, optometrists, medical laboratory scientists, basic clinical scientists, etc.), to mention but a few. Researchers are many but can be categorized into those working in dry laboratories, wet laboratories, social, economic, environmental, psychological, information, traditional and modern health surveillance researchers, among others. Technologies are still evolving in a rapidly increasing manner to supplement the activities embarked upon by all the above-mentioned categories and many more. Patients are those individuals from the population susceptible to diseases prevalent at the given time and can be categorized based on their demographic characteristics, which include but not limited to gender, occupation, education, status, age (children, young, elderly, etc.).

For instance, during a pandemic, taking pharmacists as an example, they require readily available information that has to do with drug discovery, drug evaluation, protease inhibitors, protein structure, viral non-structural protein, proteinase inhibitor, unclassified drugs, antimicrobial activity, computer-aided designs, crystal structure. The list is long and can contain enzyme activity, antiviral activity, complex formation, controlled study, drug efficacy, drug isolation, drug structure, drug targeting, high throughput screening, drug development, drug effect, molecular model, antiviral therapy, immunotherapy, vaccine, in vitro/in vivo studies, repetitive sequence, sequence analysis, sensitivity analysis, among others. At each level, certain important studies might be required that have to do with theories, or models or both to aid in speedy development of the desired anti-microbial agents. In addition, because the research of one component is needed by all other categories, research conducted by researchers, physicians, allied professionals, on or about patients can aid in a number of ways. In this way, the research outputs can contribute something that has to do with in relation with the disease at the time and African continental ancestry groups, Asian continental ancestry groups, European ancestry continental groups, Latin continental ancestry groups to understand the ethnically, ancestrally, environmentally, geographically diverse population. Furthermore, these researchers can come up with studies that have to do with genomic epidemiology study, virus antibody, immunization, immunogenicity, hospital admission, hospital mortality, mortality risk about middle-aged, elderly, children, adolescents, adults, prevalence of the infection, contact tracing, patient isolation, contact examination, immuno-compromised patients, population growth, population research, population risk, etc.

From the above, it is obvious that, making information readily available to the elements mentioned above is essentially important in understanding the disease and symptoms and possible ways forward to curtail the spread of the disease-causing organism. In this way, disease severity, binding affinity, disease transmission, infection control mechanisms, among others can best be understood. In addition, the symptoms can equip the elements of the structure with reliable information. For instance, does the patients have symptoms that have to do with coughing, diarrhoea, dysphagia, dysphonia, dyspnoea, face pain, fatigue, fever, headache, loss of appetite, nausea, vomiting, nose obstruction, otalgia, sore throat, thorax pain, etc. as in the case of COVID-19 patients. These symptoms of the disease can best be understood if the theories or models used in them are conspicuous to the researchers and stakeholders. The simplicity with which the diseases can be understood lies in the use of such term categories as elaborated by the current study.

Conclusions

During the COVID-19 pandemic, many researchers have employed the used of theories and models in their studies. Understanding whether term categories influence access categories (OA and CA) is important for decision-making, comprehending author preferences, journal policies, geographic locations, funding agencies, among others. There are instances where OA or CA is

frequent. Mostly, journals that employ models have more CA in lower ranges and OA journals have citations in non-skewed distribution. The paper concluded that, journals should encourage authors to include theories/models used in their studies in titles, especially during health emergencies, to provide early insights into handling pandemics.

References

- Adakawa, M.I. (2022). Relevance of Ranganathan's approaches in the contemporary information ecosystem: Towards enhancing their increased wavelength and penetration power. DOI: 10.13140/RG.2.2.31559.16808
- Aviv-Reuven, S., & Rosenfeld, A. (2021). Publication patterns' changes due to the COVID-19 pandemic: a longitudinal and short-term scientometric analysis. *Scientometrics*, 126, 6761–6784. <https://doi.org/10.1007/s11192-021-04059-x>
- Bordons, M., González-Albo, B., & Moreno-Solano, L. (2023). Improving our understanding of open access: How it relates to funding, internationality of research and scientific leadership. *Scientometrics*, 128, 4651–4676 <https://doi.org/10.1007/s11192-023-04726-1>
- Demeter, M., & Istratii, R. (2020). Scrutinising what open access journals mean for global inequalities. *Publishing Research Quarterly*, 36, 505–522. <https://doi.org/10.1007/s12109-020-09771-9>
- Else, H. (2020). How a torrent of COVID science changed research publishing — in seven charts. *Nature*, 588, 553. <https://www.nature.com/articles/d41586-020-03564-y>
- Fukuzawa, N. (2017). Characteristics of papers published in journals: an analysis of open access journals, country of publication, and languages used. *Scientometrics*, 112, 1007–1023. DOI 10.1007/s11192-017-2414-y
- Horbach, S.P.J.M. (2020). Pandemic publishing: Medical journals strongly speed up their publication process for COVID-19. *Quantitative Science Studies*, 1(3), 1056–1067. DOI: https://doi.org/10.1162/qss_a_00076
- Le, D., & Phi, G. (2021). Strategic responses of the hotel sector to COVID-19: Toward a refined pandemic crisis management framework. *International Journal of Hospitality Management*, 94, 1-6. DOI: <https://doi.org/10.1016/j.ijhm.2020.102808>
- Miller, R.C. (2020). Scientific communication: Scholarly publishing in the wake of COVID-19. *Int J Radiation Oncol Biol Phys*, 108(2), 491-495. DOI: <https://doi.org/10.1016/j.ijrobp.2020.06.048>
- Momeni, F., Mayr, P., Fraser, N., & Peters, I. (2021). What happens when a journal converts to open access? A bibliometric analysis. *Scientometrics*, 126, 9811–9827. DOI: <https://doi.org/10.1007/s11192-021-03972-5>
- Palayew, A., Norgaard, O., Safreed-Harmon, K., Andersen, T.H., Rasmussen, L.N., & Lazarus, J.V. (2020). Pandemic publishing poses a new COVID-19 challenge. *Nature Human Behaviour*, 4, 666–669. <https://www.nature.com/articles/s41562-020-0911-0>
- Perianes-Rodríguez, A., & Olmeda-Gómez, C. (2021). Effect of policies promoting open access in the scientific ecosystem: Case study of ERC grantee publication practice. *Scientometrics*, 126, 6825–6836. DOI: <https://doi.org/10.1007/s11192-021-03966-3>
- Sotudeh, H., Ghasempour, Z., & Yaghtin, M. (2015). The citation advantage of author-pays model: The case of Springer and Elsevier OA journals. *Scientometrics*, 104, 581–608. DOI: 10.1007/s11192-015-1607-5

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