



COVID-19 and open science: analysis of evidence and trends to delivery and share information

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Abstract:

The current situation of the SARS-CoV-2 virus pandemic responsible for Covid-19 highlights the development and implementation of multiple theoretical and empirical actions of an informative nature in which delivery and sharing data and scholarly outputs are in the focus of global attention.

The opening of the research outputs is articulated so that the FAIR principles of location, accessibility, interoperability and reuse allow informational resources financed with public funds to be delivery and shared for the resolution of the current social phenomenon and to give continuity to educational and cultural activities political, scholarly, among others.

The health crisis and the sharing of advances and research outputs in open access on various platforms crystallize the transition to open science, and a paradigm shift is articulated in which science is literally by and for society.

This document is made based on the exploratory analysis of literature whose content is about open access, open science and Covid-19. After the analysis of the information, the interpretation and recommendations on the subject of study are made from the perspective of the library field and information studies.

The aim of this document is to address the paradigm shift posed by open access and the transition to open research; as well as analyze the trends that the phenomenon of covid-19 manifests to delivery, share, exchange, make transparent and formalize the opening of research for the benefit of societies.

The organization of this document consists of two sections, and they are the following: first, the evidence of open access, open science and covid-19 is analyzed based on data and actions of organizations and educational and research institutions to share information; second, the main trends for opening and sharing information are studied, such as open data, preprints and the formalization of this action.

Keywords: Open science; Open access; Covid-19; Scholarly Communication; Open data.

Introduction

The SARS-CoV-2 virus pandemic responsible for COVID-19 raises the development and implementation of multiple political, educational and informational actions in which the open sharing and delivery of scholarly data and knowledge are in the focus of global attention. Further, the situation of COVID-19 raises known problems on scholarly communication, such as the crisis of subscriptions, costs for editorial processing, flexibility of mandates and fundamentals of access to information, among other issues.

The health crisis and the daily availability of research advances in open access on various platforms crystallize the transition to open science so that the openness to research data with FAIR principles will be literally useful to solve the current phenomenon, and in this way, justify that the advances and research outputs are for social benefits.

This document is articulated to propose the usefulness of access and open science to treat COVID-19 based on the evidence that shows the various actions implemented for access to informational goods financed with public funds.

The aim of this document is that, based on the evidence, support the paradigm shift faced by open access and its transition to open science; as well as analyzing some trends that the phenomenon of COVID-19 manifests for the openness of the research.

1. Open science and COVID-19: evidence for the paradigm shift

The evolution of scholarly communication in a changing world such as the current one requires channels and media for the distribution, circulation, availability and open and transparent visibility of research advances financed with public funds, which is represented by the open science movement.

The main principles of open science are to implement and expand the actions of access, collaboration, reproducibility, visibility and management without barriers and limitations to communicate and share data, publications and research outputs financed with public funds through various platforms.

Some theoretical background to support open science are the following:

- In 2002 and 2003, the main declarations known as the three B's of open access were proclaimed so that scholarly literature financed with public funds is available and visible without barriers.
- Bartling, S. and Friesike, S. (2014) proposed the beginning of the second scientific revolution, which is articulated with the opening of research outputs with the support of technological tools.
- UNESCO in 2019, formulated the “IX Declaration of the World Science Forum” (UNESCO, 2019) and proposed that science be considered a global public good, and for this, it supports open science and new models of visibility and access to data and research outputs.

- In 2021, UNESCO published the “Draft recommendation on open science” (UNESCO, 2021), which sets out the concept, values, principles and seven main areas of action to promote the development and implementation of open science.

Open science is constituted as a paradigm shift in the way science is done, which is based on opening all the phases of the research process, ranging from design to publication. (Abadal, 2020)

To date, the following definitions of the object of study are used:

- “Open science is defined as an inclusive construct that combines diverse movements and practices with the aim of making scientific knowledge openly available, accessible and reusable for all, to increase scientific collaborations and the exchange of information for the benefit of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to social actors beyond the traditional science community. It includes all scientific disciplines and aspects of academic practices, including applied sciences, natural and social sciences and humanities, and is based on the following key pillars: open access to scientific knowledge, open scientific infrastructures, open science communication, open participation of social actors and open dialogue with other knowledge systems.” (UNESCO, 2021)

Open science works on a set of factors, such as the following: (FOSTER, 2019)

Open Science factors		
Globalization	Open evaluation	Open access
Economy	Open policies	Citizen science
Infrastructure	Open licenses	

The background and definition exposed show the main elements that constitute open science, and also, allow us to identify that this movement requires a deep analysis of the factors, actors, actions and trend to make data and research outputs and scholarly publications available, visible and share freely.

- *Evidences of actions on open science and COVID-19*

Derived from the impact of COVID-19 on all social structures, we have witnessed that multiple universities, publishers, organizations and international funders have opened the contents stored through their platforms without barriers and / or limits. Some evidences of open science actions that different international organizations and institutions have carried out in relation to the COVID-19 crisis are the following:

The National Genomics Data Center of China and scientists from Fudan University, Shanghai, who were commissioned to study the first cases of the COVID-19 outbreak in Wuhan, China, deposited the test kit in the GenBank open access repository diagnosis of the DNA of the new coronavirus; which allowed researchers around the world to begin their analysis to develop diagnoses, decipher the virus and find a treatment or vaccine; (EOSC, 2020) further, this action allowed the researchers to be free to analyze and share the data. (Cohen, 2020)

The before evidence allows us to define that the COVID-19 pandemic is a phenomenon that crystallizes the principles and opportunities involved in the opening of data with advances and research outputs through various communication channels for its location, access and usability, as well as provides us significant elements to support the paradigm shift on the central functions and legitimation of free access and transparency to content financed with public funds.

UNESCO (2020) in a virtual meeting to analyze COVID-19 determined to intensify international scientific cooperation through national research systems to mitigate and prevent global crises. He also noted the importance of improving knowledge sharing through open science. He also highlighted that trade barriers and logistical obstacles need to be modified to allow science to respond to the current pandemic. Finally, he urged the actors of scholarly communication to look up ways for free access to research data, educational resources and research infrastructures.

This UNESCO call in relation to the social effects of COVID-19 advocates that science be literally more and more open, because as Burgelman (2020) indicates this phenomenon "shows as evidence the social and scientific impact" of multiple empirical actions implemented by various international organizations to find a response to the pandemic.

Other relevant evidences are the requests that the World Health Organization, (WHO) the White House (Finley, 2020), Wellcome Trust (2016), and other organizations made to their institutions, consortia and publishers for the opening of advances and research outputs on this gene, in order to provide information resources to scientists studying a treatment or vaccine (IFLA, 2020) as well as to encourage society to have access to current and transparent information.

Furthermore, SPARC Europe (2020) has noted that "The real-time exchange of research publications, software and data to combat COVID-19 has shown in recent weeks that it is unprecedented." Despite the actions of good intention with which research institutions and international publishers have opened resources on the problem of the pandemic, SPARC Europe emphasizes being careful with the temporality of free access to content, due that "... the editors have responded responsibly unlocking material that is normally behind paywalls, making it accessible to all as they did during the Zika, SARS and Ebola crises. However, this is a temporary measure for the current health emergency; and ... once the editors determine that the crisis period has passed, the paywalls will return". (SPARC Europe, 2020).

Based in the before mentioned, Larivière, Shu, and Sugimoto (2020) "reported that more than half of the articles published on Coronavirus remain closed despite efforts to unblock publications. Furthermore, they underscore the need to access more research beyond a limited subset for COVID-19 as biomedical research is interdisciplinary in nature. This approach potentially blinds the investigation of other work that could be vital. "

According to Lew (2020), this evidence in relation to the COVID-19 pandemic reactivates various global scholarly debates, such as: the subscription crisis, payments for editorial processing, among other phenomena that affect the scholarly communication. Also, this set of evidence allows us to emphasize that the empirical actions for the opening of content on COVID-19 (Torres, 2020) need to be documented, analyzed and verified; therefore, it is feasible to suggest that once the health pandemic is over, it find to ensure that openness is relative in other fields of knowledge, such as the humanities and social sciences.

Also, the evidence of actions presented is articulated to justify the trend for open science organizations, institutions and actors to collaborate to "... provide an infrastructure and a publication system that is prepared for the biggest crises that we still have to face. We can expect continued closed access to research for many, unless more sponsors and governments call for a systematic shift to open up the research they fund, immediately after publication, as requested by COalition S for Publications, and by numerous countries and national funders in Europe for research data." (SPARC Europe, 2020)

Given the statements of different parties involved in global public health, it can be emphasized that open science actors "We need to eliminate barriers such as high prices for OA publication and embargoes; We need open licenses, more shared FAIR research data, and a sustainable open scientific infrastructure to support our efforts in the future. " (SPARC Europe, 2020)

This type of evidence allows us to suggest that never before have societies had such a need for access and openness to information, in order to support the development of informed societies to make relevant decisions, because today more than in other times and social difficulties intensifies the need to develop and implement systems that reduce and eradicate barriers to free access to information goods financed with public funds, among other issues.

Based on the before analyzed, it can be argued that open access and open science in the COVID-19 crisis is in transit to the implementation of collaborative actions for democratic access, delivery and sharing of data and research outputs. Therefore, it is essential to analyze some trends for the access, delivery and sharing of information, such as open data, preprints and the formalization of the opening.

2. Trends on the openness of science

The time of the COVID-19 pandemic crisis has revealed some trends regarding the implementation of actions to open, sharing, and reuse data and research outputs for the continuity of social, educational, and political activities, among others, which focus on open data, preprints and the formalization of the opening, and which are exposed below:

- *Open research data*

Studies on open research data are an emerging field of open science that mark a before and after for the actions of free access, useful and decision-making.

According to the current framework, Ayris (2020) appoint that "Traditionally, publishers did not publish or preserve research data, they were only interested in publications. Now, research data and publications are at least as important. Data is not only good for science. They are also good at driving the kind of innovation needed to solve some of the biggest problems facing the world today. The coronavirus outbreak is a perfect example of how open data can help address a major global problem."

A relevant reference on the significance of the data in the institutional framework is the Sorbonne Declaration, (SCIELO, 2020) and in which nine university networks "... undertook to develop adequate reward systems for academics who made their data open and accessible. It was an important milestone in advancing the cause of research data management for the world of open science. "

Other relevant evidence on open data and the COVID-19 crisis is the European Open Science Cloud, which provides the infrastructure for the reproducibility, openness, collaboration and reuse of publicly funded research data.

The specialized literature refers that the success of the research data will be based on the implementation of the FAIR principles (findable, accessible, interoperable and reusable), since these "... mean that researchers have easy access to experimentation others, thus avoiding the need for costly duplications. They also allow research groups to examine research methodology, test results produced by others, and detect misuse, even fraudulent use, of data." (Ayris, 2020)

Further, in the emerging studies on research data, it is pertinent to consider developing and defining "metadata to describe the data as a common data dictionary (a set of definitions that allows understanding the data variables)", (Ayris, 2020) in function of identifying, recording and organizing attributes with standards and establishing relationships of research data, harmonized with FAIR principles.

According with the treatment of research data, another current of study is the development and implementation of open science platforms, so that organizations and institutions "... have to create institutional research data repositories in which the data can be cured and stored for the long term, with the premise of being as "open as possible, as closed as necessary"; and in turn, this trend requires the training of human resources for data processing" (Ayris, 2020)

- *Preprints for the opening of science*

The literature raises that the production of platforms for the availability of research data is lower in relation to those of publications; Therefore, according to the evidences of the current health pandemic, *preprints* can be considered resources closely linked to the principles of open science, since they promote free access, the transparency of open evaluations, the immediate availability of manuscripts before or formal publication, the use of persistent identifiers, citation, real-time discussion between colleagues, (Kubota, 2020) among other factors.

The COVID-19 crisis has provided evidence to studies on scholarly communication to verify the premise of moving from repositories of publications to repositories of research data, since as Lew (2020) indicates it has “induced the development, implementation and utility of *preprints* platforms for the democratization of the scientific process”

In this regard, *preprint* platforms have a relevant role for the research cycle, since they support the sharing of data with FAIR principles (Burgelman, 2020) for the common good, as well as contribute to complement the complexities of the system of traditional publication, such as delays to publish, subjective evaluations, costs for subscriptions, payments for publishing, payments for editorial processing, among others.

The COVID-19 pandemic has promoted the implementation of *preprints* platforms (Kubota, 2020) for the availability, exchange of data and research outputs to address this phenomenon, such as the following: [bioRxiv](#), [medRxiv](#), [SocArXiv](#), the systems [COVID-19 SARS CoV-2](#), [Nextstrain](#), [The Humman Coronavirues Data Initiative](#), [COVID-19 Open Source Dashboard](#), [Wikiproject COVID-19](#), [COVID Tracking Project](#).

Based on these initiatives, it can be defined that some of the benefits that *preprint* platforms provide to scholarly communication are: storage and preservation; legitimation of information with qualitative values; provide qualitative indicators for scholarly-administrative evaluations; they promote the use of scholarly production in open access for incentives, recognition and professional development, among other aspects.

Furthermore, SPARC Europe (2020) points out that one of the benefits of *preprint* platforms is that they “ensure that the platforms will be open after the pandemic”. However, the development and use of these resources reveals issues to be debated, such as the legitimacy and veracity of the information they store, (Kubota, 2020) the technological improvement of the platforms, changes in practices and business models, changes in sociocultural thought, (IFLA, 2020) scholarly evaluation processes, plagiarism vulnerability, free review, among other topics.

Undoubtedly, the actions and trends of open science derived from the COVID-19 pandemic are directly articulated to the development and implementation of an open and transparent scholarly communication system that is maintained during and after the current health crisis. Therefore, to achieve this trend, it is pertinent to analyze, harmonize and formalize open science actions.

- *Harmonize and formalize open science*

Burgelman (2020) points out that before the pandemic, informational resources were closed and / or limited for their access and use with embargoes and / or subject to subscription; and during the COVID-19 crisis it has been witnessed that various organizations, institutions and publishers around the world have modified their actions to open data and publications financed with public funds; which have promoted reducing access costs, enhancing

distribution, increasing access, expanding the circulation of research outputs, among other benefits.

Harmonizing and formalizing open science actions is based on the cases of the OSTP (2020), the WHO, UNESCO, the Sorbonne Declaration and the Cloud of Europe, among others; since, based on this evidence, it is exposed how governments, organizations and institutions, through their normative and legal frameworks, support the formalization of the implementation of the actions of opening to the advances and research outputs that have been partially or completely financed with public funds.

To harmonize and formalize open science, it is necessary to articulate strategies that influence the updating and/or adaptation of the actions of opening science and free access in the public, scientific, educational and information policies of each country. Also, it is necessary that the actors involved in free access make a call for policy makers to strengthen the idea that open science is an action that supports the main challenges of the future, (Burgelman, 2020) because the 'good intention' with which the actions to open science have been implemented to date need to be strengthened and formalized with normative elements to share and exchange without barriers and limitations research data and outputs financed with public funds.

Another element to consider for harmonize and formalize the actions to open science is the economic factor, since according to More (2020), economic factors and scholarly openness need to be analyzed since if they are not addressed now, after the pandemic, such factors may be conditioning factors for a return to payment models and limitations for access to information.

In the economic approach related to the openness of science, the research outputs have the particularity of being partially or completely financed with public economic resources. Therefore, it is essential to deepen the study and research to define what it covers, what criteria are applied, how to interpret the financing and what data and publications are developed with public resources, in order to give conceptual and pragmatic clarity to the openness of science.

A justification for the previous raises has as a reference what was indicated by the WIPO (2016) which mentions that research and education organizations that produce scholarly products partially or totally financed with public funds have the faculty to make explicit in their regulations that part of the ownership of the moral and patrimonial rights of what is produced corresponds to the institutions in which it was developed.

Another feasible argument about public financing is that the producers of data and publications with an employment relationship in an scholarly and / or research institution receive public funds in the form of salary remuneration for the their functions; therefore, this fact allows us to state that the products developed are by labor law subject to being available in open access, if the institution makes the decision.

Due open science is made up of the collaboration of various factors, a central element of this movement is the implementation of open licenses that harmonized with national and international legal norms with the aim of guiding free access actions of the availability, interoperability and reuse of different types of research data and scholarly publications funded with public funds on open access platform, as well as to define and implement

feasible criteria and standards within the framework of legality that formalize the openness of science.

The "UNESCO Recommendation on Open Science" (UNESCO 2021) it is emphasized that this movement exists thanks to the results available in the public domain and open licenses, as well as it transforms the limits of intellectual property, and promotes the implementation of Creative Commons Licenses, which are alternative permits that harmonize with the rights on recognition, distribution and communication for the opening, exchange and access to demonstrations financed with public funds.

Some of the benefits of implementing open licenses for scholarly products financed with public funds will be to expand the use of third-party works; support the circulation of information to support the solution of social phenomena; reduce subscriptions for access to resources made with public funds; eradicate long embargo periods, eliminate costs for editorial processing, among other matters; because with base on the suspension of barriers, limitations and extension of exceptions, as well as with the collective flexibility of the guarantees for free access to informational goods, the theoretical and empirical postulates that have been raised for a couple of decades are confirmed on the relevance, impact and global benefit that opening to such information resources contributes.

In this sense, we can define that science actions open to data and publications require the implementation of CC licenses, since they are compatible with economic rights of dissemination and communication, as well as moral copyright, guarantee access and fair use of information produced with public funds for education and research purposes, and for the global scope and implementation of these guarantees.

Finally, in order to eradicate a return to the situation of barriers and limitations for the access and use of resources financed with public funds when the COVID-19 pandemic over, it is raise that the harmonization and formalization of open science needs to articulate the factor economic with international regulations and guarantees.

Final considerations

The COVID-19 crisis has presented the evidence for the paradigm shift and relevance that open science has, both to address current problems and to give continuity to educational, cultural, scientific, political, economic activities and functions, among others, through the implementation of open and transparent practices to the data and research outputs financed with public funds.

Research data in the framework of open science are products that in the current social situation provide evidence of their usefulness; however, it is concluded that it is essential to define concepts, typology and attributes of research data, define metadata schemas for open platforms in order to record and organize them with FAIR principles.

According with the trend to implement transparent scholarly communication systems, it can be concluded that *preprint* platforms are positioned as an alternative option to meet this condition; however, it will be critical to monitor your progress and results as your goals match your practices.

The act of good intention that various organizations, institutions and institutions have carried out for the opening of research outputs, does not have elements that guarantee that said action will remain when the pandemic is overcome; therefore, it is concluded that to guarantee that the development and implementation of open science actions is maintained, it is pertinent to harmonize and formalize open science with legal regulations in order to ensure its continuity and encourage higher educational institutions and centers of research make decisions about the management, usufruct, access and reuse of the informational assets that their community develops, either partially or totally with public funds; and make transparent the investment of public resources in research projects to crystallize the benefits derived from science to society.

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