IFMSA Policy Document
Open Science

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Policy Commission

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Policy Statement

Introduction

The modern-day practice of medicine worldwide is guided almost entirely by the principle of Evidence-based medicine (EBM). Science is a major driver for EBM, and Open Science seeks to make science available and transparent. Open Science, which is essentially a conglomerate of pillars including, but not limited to: Open Access, Open Data, Open Education, Open Reproducible Research and Open Review, has been proven to improve the educational experience, democratize access to research and education, accelerate research output, and improve the visibility and impact of scholarship. To allow improvement of medical care and for their continuing education, healthcare workers need to have unrestricted access to a broad-based repository of high-quality research irrespective of language, financial, and geographical barriers.

IFMSA position

The International Federation of Medical Students' Associations (IFMSA) firmly believes in the importance of openness across all published research outputs (including among others, all online research output, peer-review and non-peer-reviewed journal articles, conference papers, book chapters etc.) in order to bridge health inequities and advance health outcomes. We affirm the pressing need to increase the mobilisation of resources and the development of systems that ascertain open science practice amongst academia, researchers and students. Science is a collaborative process and openness is fundamental to knowledge advancement.

Call to action

1. IFMSA calls for **Governments** to:

- Develop and adopt multi-sectoral policies that adhere to principles of Open Science;
- Ensure that national funds are dedicated to research projects based on global and local health problems and under the premise of Open Science;
- Ensure the right to revise, remix, reuse, redistribute and retain materials and research output produced through public funds;
- Encourage and mobilise resources to support the development of local and national frameworks that encourage a transparent and open research society;
- Mobilise resources to support the development of Open Educational Resources;
- Facilitate enabling environments for use of Information and Communications Technologies (ICT) to support Open Science.

2. IFMSA calls for **Universities and medical schools** to:

- Adopt context-sensitive policies that ensure Open Science and demand their research outputs to be Open Access, Open Data and Open Reproducible Research;
- Accelerate efforts to promote open resources, technology and teaching practices in education through deployment of free and open-source software and providing the necessary training to staff and students;
- Support the use and creation of Open Educational Resources;
- Integrate principles of open science into research education in health professions curricula;
- Support initiatives within capacity building in Open Science amongst faculty staff, academia and students;
- Mobilise resources to the development and maintenance of university-based repositories.

3. IFMSA calls for **Researchers, Scientists and Academic Communities** to:

- Create and disseminate their research under the conditions of Open Science, including but not limited to: Open Access, Open Data, Open Educational Resources, Open Reproducible Research and Open Review;
- Publish in Open Access journals or deposit their full research output in available Open Access repositories;
- Advocate for Open Science within their scientific network and participate in Open Science movements in their regions.

4. IFMSA calls for **IFMSA National Member Organizations (NMO)** and **Students** to:

- Organize and promote peer-education events and awareness campaigns for Open Science;
- Advocate for Open Educational Resources from respective stakeholders to its members and share available resources;
- Advocate for Open Science policies locally within their respective universities and nationally with their government;
- Support, initiate and promote projects on Open Science including campaigns, workshops and conferences;
- Display licensing information on IFMSA produced documents and other materials, using Creative Commons licenses;
- Join or renew membership of the Right to Research Coalition, which states that no student should be denied access to the research they need.

5. IFMSA calls for **Non-governmental Organisations** to:

- Adapt policies to allocate research funding under the premise of Open Science, and to ensure the output is openly accessible;
- Invest and mobilise resources that support the transition toward Open Science;
- Advocate for Open Science as a foundation for advancement of science, healthcare and public good, namely: publishing in Open Access journals, depositing manuscripts in Open Access repositories, and ensuring underlying data is openly available where appropriate;
- Encourage youth engagement in the advancement of Open Science.

Position Paper

Background information:

Open Science is defined as the practice of science where: others can collaborate and contribute; research data, lab notes and other research processes are freely available; research and its underlying data and methods can be reused, redistributed and reproduced.[1] Open Science rose to the forefront of the scientific community with drafting of historical initiatives such as the Budapest Open Access Initiative of 2001 and the Panton Principles. The Open Society Institute convened a session in December 2001 in Budapest to craft a set of principles aimed at promoting open access to existing literature. Likewise, in July 2009 a group of scientists and open access advocates drafted a set of principles geared to award open science in publishing at the Panton Arms pub in Cambridge. The key roles of Open Science are to increase accessibility to information, promote research reproducibility and transparency and raise the overall impact of research. The current framework of production within the scientific community sees research papers largely hidden behind massive paywalls created by the publishing industry. This approach to research publishing is threatening the very institution it was designed to help and the restriction of access to research output has long been a sore point for the scientific community. [2]
The problem is grounded in the profiting of the publishing industry where tax money, originally used to fund research, is again used to access research outcomes by the scientific community. The essence of research in the modern era has been shifted to that of a business model entirely with the primary aim being to secure revenue streams. This approach undermines the scientific community since the driving force behind any research project has predominantly been to serve the public's interest.[2][3][4]
Open Science is a paradigm-shifting concept which aims to remove barriers to the access of information at all stages of research development. It is important to note that Open Science is not a singular entity but includes several domains: Open Access, Open Data, Open Education, Open Reproducible Research and Open Review which serve multiple purposes. [1]

Discussions

Open Access
According to the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, Open Access must grant "all users a free, irrevocable, worldwide, right of access to, and a license to copy, use, distribute, transmit and display the work publicly and to make and distribute derivative works, in any digital medium for any responsible purpose as well as the right to make small numbers of printed copies for their personal use." Furthermore, "a complete version of the work and all supplemental materials, including a copy of the permission as stated above, in an appropriate standard electronic format is deposited (and thus published) in at least one online repository using suitable technical standards".[5]

There are various ways to publish Open Access. The two most prominent ones are named the "Gold Route" and "Green Route". The Gold Route asks Scientists to pay an APC (article-processing charge) to grant immediate and full access towards the publication. The Green Route first asks readers for subscription or single download fees, but after a certain embargo period allows the Scientist to upload their own publication towards an online repository making it freely available. [6]

Oftentimes research is funded by the government and therefore financed through taxes. In a traditional subscription-based publishing system, research institutions and scientists have to pay to be able to read the previously published research and conduct their own research, potentially again spending tax money. In order to publish research, journals need income to cover operating costs. Traditionally, these costs have been covered through subscriptions or single download fees, paid by readers. With the start of the Open Access movement, some journals have shifted their operating costs from the reader towards the publishing Scientist, by charging an APC (article-processing charge). [7] Yet, shifting publication costs from the reader towards the researcher does not necessarily increase the cost of research. [8]

Costs for academic journal subscriptions can be tremendous and difficult to cover for universities and institutions. While publishers also have operating costs to cover, publishing prices are outgrowing inflation rates by far. [9] A study has shown that one academic publisher was able to increase profits by almost 6 times and had their profit margin at no point below 30%. It was observed that within Natural and Medical Sciences, the five biggest publishers accounted for 53% of all papers published in 2013, compared to only 20% in 1973. The academic publishing industry seems to have become an Oligopoly, which puts high pressure onto libraries and institutes. [10]

The cost of inaccessibility is specifically troubling to researchers and young professionals from low and middle-income countries and increases the gap in disparity. [11] While most open access policies are adopted in High-Income Countries (HIC), there is some evidence that Low-Income Countries (LIC) have the highest percentage of open access output. It is possible that the reason is that Scientists from Low and Middle-Income Countries (LMIC) have a higher motivation or understanding for the need to publish Open Access than their counterparts from High-Income Countries (HIC). [12] In another publication it has been shown that providing Low and Middle-Income Countries (LMIC) with Access to a few thousand journals increased publication output in participating countries by at least 29.6%. [13]

Even though Open Access has made great steps during the past years, in 2015 over 50% of all publications were hidden behind a paywall. [14] On the contrary, a pirating website for research articles, books and publications called Sci-hub, hosts over 50 million papers [15] and provides access to an average of 164,000 requests per day, clearly highlighting the global demand for open access. [16]

While highlighting the downsides of a paywall, we do also have to emphasize the benefits and opportunities of Open Access in general. Several studies have analyzed that Open Access publications are read and cited more frequently, according to Piwowar, Heather et al. they were cited 18% more than average. [14] Open Access can have significant benefits through evidence-based decision making and advancements for NGOs, health organizations and upcoming technologies. The Human Genome Project, which sequenced and mapped the human genome, was completed in 2003. Since then, the results and the knowledge gathered have generated 965 billion USD in economic output between 1988 and 2012 and created nearly 4 million jobs, showcasing the economic potential of Science and especially Science results that are publicly available. [8][17]

Open Data

Data open for anyone to use, re-use or redistribute. There are two dimensions of data openness: data must be legally open by placing it in the public domain or under liberal terms of use with minimal restrictions or technically open by publishing it in electronic formats. Data must also be publicly available and accessible on a public server, without password or firewall restrictions. [18] To make Open Data easier to find, most organizations create and manage Open Data catalogues. Organizations and governments use Open Data licences to clearly explain the conditions under which their data may be used. Many licences include both a summary version, intended to convey the most important concepts to all users and a detailed version that provides the complete legal foundation. Standard licences can offer several advantages over bespoke licences, including greater recognition among users, increased interoperability, and greater ease of compliance.

Anyone can release their data under an open licence for free use. Although we may think mostly about government and public sector bodies releasing public information such as budgets or maps, or researchers sharing their results data and publications, any organisation can open information (corporations, universities, NGOs, startups, charities, community groups and individuals).

Many individuals and organisations collect a broad range of different types of data in order to perform their tasks. Government is particularly significant in this respect, both because of the quantity and centrality of the data it collects, but also because most of that government data is public data by law, and therefore could be made open and available for others to use.

There are many areas where we can expect open data to be of value, and where examples of how it has been used already exist. Data repository is a place that holds data, makes it available to use, and organizes it logically. Data repositories may have specific requirements concerning subject or research domains. By 21st October 2019, there have been 1295 data repositories for Life Sciences, 1197 for natural sciences, 797 for social sciences and 405 for engineering science. 2281 data repositories opened while 120 were restricted and 15 closed. The United States, Germany, the United Kingdom, Canada and France counted for the top 5 of the highest number of data repositories with respectively 1048, 381, 282, 252 and 103 domains.[19]

There are also groups of people and organisations which can benefit from the availability of open data, including governments themselves. At the same time, it is impossible to predict precisely how and where value will be created in the future. The nature of innovation is that developments often come from unlikely places. In 2018, 27% of researchers furnished efforts to make their data available for public use and 40% of researchers took steps to manage their research data and/or archive it for potential re-use by themselves and/or others. Having access to other research data benefits or would benefit their own research for 74% of researchers. Sharing research data is important for doing research in their field for 69% of researchers. 66% of them are willing to allow others to access their research data.[19] Talking about transparency, citizens need to know what their government does by freely accessing data and information. Transparency should not only be about access, but also about sharing and reusing data. Data is a key resource activity to liberate social and commercial value. By opening up data, the government can help to drive the creation of innovative business and services. To improve the population's participation and engagement, citizens are only able to engage with their own governance sporadically. By opening up data, citizens are able to be directly informed and involved in decision-making. This is more than transparency, not just about knowing what is happening in the process of governance, but by also being able to contribute to it.[4]

Open data policies aim to stimulate and guide publication.[21] 56,6% of research funders have open data policies while only 27,6% enquired with the United Kingdom leading the countries list. By 2017, 21% of journals required open data policy.[19]There are many benefits to data sharing going from increasing collaboration number to more compliance to journal requirements. In 2016, 80% of researchers shared data with the peers working on the same subject. This led to 66% of more collaboration and encouraged 55% of researchers to make data available in 2016.[19]

Thirty open government advocates in Sevastopol wrote a set of open data principles which are: complete, primary, timely, accessible, machine processable, non-discriminatory, non-proprietary and license-free. Seven additional principles were also added: online, free, permanent, trusted, presumption of openness, documented, safe to open and designed with public input.[22]

Open Education

Open educational resources (OER) are educational materials free of charge that everyone could benefit from, defined specifically by the "5-Rs": users are free to Revise, Remix, Reuse, Redistribute and Retain .[23] Its concept embodies the sole purpose of education, which is sharing information; if an educator is not sharing, then education is not happening. In addition, OER promotes investment on the Internet thereby transforming it into a learning platform; this is even more true with the promotion of e-learning and distance learning.[24] Openness in education supports the delivery of more efficient, affordable and accessible education, thus releasing the article 26.1 of the Universal Declaration of Human Rights, which states that: "Everyone has the right to education".[25] Through these measures, OER empowers non-formal education by integrating Information and Communications Technologies (ICT) into the classroom; and even if it is for personal leisure, motivation or actual need, this movement enlarges the horizons of citizens and societies.[26] The phenomenon of Massive Open Online Courses (MOOC) which is an implementation of OER in higher education, rose to the surface. It became a technological and pedagogical player, offering added-value tools for learning and permitting new policies and ideas regarding the modalities for the accreditation of competencies.[27]

In addition, the fact of having OER provides researchers, instructors and faculty members to engage in quality improvement of the material shared; by applying the 5Rs, they are able to revise and remix then reuse a shared document, something that is impossible with licensed material.[28]
However, this issue of redistributing material is considered a barrier in the course of advocacy for openness since some people might consider it the other way around, and perceive it as derogatory to the shared material.[29]

A major problem limiting educational procedures is the very high prices of educational materials, according to the 2012 Paris OER declaration, the UNESCO "*encourages the open licensing of educational materials produced with public funds",* emphasizing on the point that the material is developed by the public taxes and should go back to the public. Open Education removes a huge barrier to education, the price of textbooks alongside paying for tuition, is very exhaustive for students and their supporters. Implementing OER is a problem solver; educational material can be printed, saved and redirected without having to pay for textbooks.

The movement of OER goes back to 2001 with the debuting with MIT Coursera founded by Andrew W. Mellon and Flora Hewlett; this is a website that includes more than 2400 digital courses, available for everyone and at a free cost.[30] This initiative was created in order to empower minds and improve curricula. Since then, OER has been a subject of high interest in several UNESCO meetings beginning with the 2007 Cape Town Declaration with further guidelines and policies regulating the usage of OER. As per the latest "Guidelines on the development of open educational resources policies" by UNESCO, OER falls under the 4th SDG that works on ensuring inclusive and equitable quality learning and promotes lifelong opportunities for all.[31]

Fortunately, we have OER that could help us overcome the educational crisis, and by all means prevent future ones considering that education is the key in order to proceed with society's improvement.

Open Reproducible Research
Reproducible research is a concept or idea that involves methods and approaches that enhance the integrity of research and also promote consistent expectations within the scientific community. Reproducible research ensures that the analysis portion of a research effort can be redone with equivalent results. A series of recent problems in published and funded research has led journals, methodologically knowledgeable scientists, and federal funding agency personnel towards proposals to increase the reproducibility of the research enterprise.[32]

Reproducible research is an idea that results should be independently replicable. Open Research is built upon and cited more frequently than work published in closed journals. Also, small details that are involved in the research results products and without accurate documentation researchers can forget how a particular outcome was reached. In addition, Open Research could satisfy and to lend one another the strength of that understanding. Furthermore, reproducibility permits the results verification and prevents fraud. Reproducibility also implies broadening the aspect of scientific know-how to anyone anywhere who has an Internet connection. Therefore, Open Reproducible research could strive for discipline that produces better science.[33]
However, there are legal impediments to Reproducibility of research, most importantly copyright law, this law acting against foundational scientific norms in two key ways. First, this law prevents copying work of research that could create barriers to the possibility of legally reproducing and verifying another scientist's results without obtaining permission. Second, copyright also establishes rights for the owner over the creation of derivative works which conversely to the scientific norm that scientists upheld: build on previous discoveries. All of these impediments could block the generation of new scientific discoveries.[33]

Data sharing through publicly accessible data could also greatly increase dissemination, meta-analysis, and understanding of research results, consequently, make research more

reproducible. In addition, data sharing could also aid confirmation or refutation of research through replication; it also allows for a better implementation of research findings, and increases transparency about the quality and integrity of research.[34]

A meta-research article by Wallach, J. D. Boyack, K. W., and Ionnidis, J. P. A., in 2018 stated that currently, according to an evaluation of 441 biomedical journal articles published between 2000 and 2014, the biomedical literature largely lacked transparency in important dimensions. The empirical evaluation of biomedical articles published between 2015 and 2017 suggest that there has been a progress to improve key indicators of reproducibility and transparency. However, even though numerous efforts that have been done to improve reproducibility have been adopted by researchers, journals, and funders, additional efforts will be necessary to continue to sensitize key stakeholders in the research enterprise of the importance of continuing to improve these indicators over time.[35]

Open Review

There are different stages in the process for the publication of quality articles.[36] Before research findings can be formally accepted, they must be evaluated and commented upon by other experts, who provide advice about the quality or validity of the work to journal editors and/or readers (whether via pre-publication peer-review, open peer-review or post-publication peer-review systems).[37] Peer Review indeed is the evaluation of work by one or more expert members as the producers of the work. Peer review methods are used to maintain quality standards, improve performance, and provide credibility.

Therefore we can state that peer-review is pivotal for the publishing system: encouraging the community to consciously (and conscientiously) uphold these principles should help to improve published papers, increase confidence in the reproducibility of the work and, ultimately, provide strategic benefits to authors and their institutions.[37]

In addition, the peer-review process is not infallible as it is carried out by individuals rather than at an institutional level. Peer review is slow, expensive, profligate of academic time, highly subjective, prone to bias, easily abused, poor at detecting gross defects, and almost useless for detecting fraud.[38]
One of the most significant problems generating most frictions, is that reviewers can safely dispense biased critiques, fully protected by the mask of anonymity. This has led to the articulation of various reviewer's oaths.

Open peer review (OPR) constitutes a concept offering various options starting from open identities of both reviewer and author, in order to improve the quality as it is theorised that reviewers will be more highly motivated and invest more care in their reviews if their names are attached to them. Furthermore, it resolves possible conflicts associated with editorial selection of reviewers (e.g. biases, closed-networks, elitism) and possibly improves the reliability of peer-review by increasing the number of reviewers. In the traditional peer-review, there is no contact with other reviewers, and authors usually have no opportunity to directly question or respond to reviewers' comments. By improving the communication and allowing an open discussion, the article itself can benefit in quality and completeness.
We can infer that Open peer-review is an umbrella term. It defines a number of overlapping ways that peer-review models can be adapted in line with the aims of Open Science, including making reviewer and author identities open, publishing review reports and enabling greater participation in the peer-review process.

The point of open peer-review isn't removing anonymity, though that's a/one part of it. Open peer-review is about transforming the peer-review process; it is about making peer-review a collaborative process between authors and reviewers; it is about constructive criticism, but with the goal of helping the authors to get published. More than all of that, it's about doing the right thing. The British Medical Journal gathered convincing evidence that open review did no damage to the quality of peer-reviews; yet still they insisted that they introduced open peer-review for 'ethical reasons', believing that removing anonymity would help bring an end to the worst abuses of peer-review (steal ideas and procrastinate), and transform the entire process from one of judgement to one of open, scientific discourse.[39]

The main argument against open peer-review is that junior reviewers will be reluctant to criticise the work of senior researchers for fear of reprisals. This fear is particularly acute for researchers whose livelihoods depend on winning grants. However, these arguments don't outweigh the ones for open review. Nevertheless, the hope is that a small move will contribute to a broader culture change so that junior researchers cease to fear reprisals from senior ones.[38]

Open Science and Healthcare

The British Medical Journal posted an online poll in January 2007 to determine the 15 greatest milestones that have shaped modern medicine. Evidence-based medicine ranked 7th out of 100 nominated medical discoveries.[40] Evidence-based medicine refers to the integration of best research evidence with clinical expertise and patient values.[41] The rate-limiting step for the practice of EBM is access to the available research.

Open Science has proven to be the pathway for brokering daily practice of EBM and the long-awaited panacea for the ailing healthcare industry. Open Science has the ability to positively impact the healthcare sector through each of its individual pillars ranging from the education of healthcare workers to the administration of healthcare itself. Through Open Access, research papers containing best practices in clinical medicine are now readily available to all physicians and allied healthcare workers, thereby largely improving patient outcomes. Open Education empowers faculty members with the right to reuse, remix and redistribute learning resources which is critical to the training of healthcare workers. Open Peer Review will remove the mask of anonymity that surrounds the process of article reviews thereby bringing greater transparency to the system of publishing articles. With the introduction of Open Review, relevance will once again be restored to negative research results - a fact often overlooked in the medical field. The concept of Open Reproducible Research requires that research results be replicable. This aims to curtail fraud within the scientific community as well as to increase the user's confidence in the information. Results that are reproducible are more likely to be built on which leads to accelerated research and increased publications.

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