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Review article

Open Access: Concepts, findings, and recommendations for stakeholders in dentistry

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ABSTRACT

Objectives: Open Access (OA) to the scientific literature, a recent revolution in scientific communication, is now required by an increasing number of funders and institutions. The aims of this narrative review are to raise awareness of OA-related concepts and recent research findings among stakeholders in dentistry and to help them make better use of OA and relevant resources.
Data sources: Published journal articles and relevant online materials.
Study selection/results: OA-related definitions and research findings, the approaches to OA, as well as its motivating factors, benefits, 'citation advantage', and mandate policies are introduced. Moreover, the phenomenon of predatory publishing and the status quo of OA in dentistry are discussed. Recommendations are made for stakeholders to avoid and address the hazards of predatory publishing, and for dental researchers to make their work OA in an appropriate manner.
Conclusions/clinical significance: Knowledge about concepts on OA, associated resources and research findings are important for researchers and other users of dental research to make full, appropriate use of OA, and help reduce the avoidable waste caused by inaccessible research. We need more studies into the use and development of OA in dentistry. In addition, joint efforts are required to eliminate the threat of predatory publishing to the dental profession.

1. Introduction

During the past 25 years, developments in information technology, especially the advent of the World Wide Web, have led to a two-phase revolution of scientific communication – firstly electronic publishing, and then Open Access (OA) to the scientific literature [1]. With the emergence of an increasing number of open repositories, mandate policies and OA journals, OA is rapidly changing the way researchers disseminate study findings and users (e.g. clinicians, policy-makers) identify/retrieve research evidence. Although the importance of OA has been pointed out in several dental journal editorials [2–6], to our knowledge, OA-related concepts, recent research findings, as well as potential implications have not been reviewed and introduced in a comprehensive way for stakeholders in dentistry. The aims of this narrative review are, therefore, to improve the awareness and knowledge of dental researchers, clinicians, students, educators and policy-makers about OA, and to help them make better use of relevant resources and achieve better performances in this "era of Open Access" [7].

2. What is Open Access?

In 2002, the Budapest Open Access Initiative (BOAI) [8], a major international initiative on OA, first used the term "Open Access" and articulated its first public definition [9]:

> *"By 'open access' to this literature (peer-reviewed research and unreviewed preprints), we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself."*

One year later, two further OA statements were released: the Bethesda Statement on Open Access Publishing [10] and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities [11]. As the definitions used in these two statements were similar to that in the BOAI, they were often referred to as the BBB (Budapest-Bethesda-Berlin) definitions of OA.

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However, these definitions, although comprehensive and well articulated, did not distinguish two different components of OA – the "removal of price barriers" and the "removal of permission barriers". Therefore, Peter Suber [12], a leading OA expert and proponent, proposed the use of "gratis OA" to indicate free online access (removal of price barriers), and "libre OA" to indicate free online access plus additional re-use rights (removal of price and some/all permission barriers).

3. The "two roads" to OA

The 2002 BOAI initiative first proposed two complementary strategies to achieve OA: (I) self-archiving and (II) open-access journals [8]. Ten years later, BOAI reaffirmed the effectiveness of these two strategies, but renamed them to take into account changes that had occurred during the past decade: (I) OA through repositories (also called the "Green OA") and (II) OA through journals (the "Gold OA") [9].

3.1. The "Green road" to OA

Green OA was initially defined as authors' self-archiving of their articles in open repositories [8]. However, with the recent development of Internet and OA mandates, articles can now be archived on authors' personal websites, or in open repositories by institutions/publishers on the authors' behalf. For instance, many publishers have been uploading articles funded by the National Institutes of Health (NIH) to the PubMed Central (PMC) on behalf of authors [13]. Therefore, a more general definition of Green OA as used by Björk et al. [14] may be more appropriate:

> *"All freely accessible copies of articles, including different versions of said articles, which exist on other web locations than the original publisher's website."*

The locations of self-archived articles can generally be categorised into subject-based repositories (e.g. the PMC), institutional repositories (IRs) and other websites (e.g. personal websites/academic social networks, departmental websites, industrial websites). Among these, subject repositories and institutional repositories are usually better locations for self-archiving, because they are maintained by professional librarians, with relevant resources and technologies to ensure the visibility and persistence of archived articles [14]. One example of such mechanisms to improve the visibility of Green OA copies is the OAIster database, a combined catalogue harvesting data from all OAI (Open Archives Initiative) compliant repositories/libraries, which as of 2017 includes over 50 million records [15]. The *Open*DOAR (Directory of Open Access Repositories; www.opendoar.org) and ROAR (Registry of Open Access Repositories; roar.eprints.org) are two websites providing information about existing open repositories. According to the *Open*DOAR, there has been a substantial increase in the number of registered open repositories worldwide, from 902 in 2007 to 3311 in 2016 [16].

To protect their subscription revenue, publishers of subscription-based journals usually only allow authors to self-archive certain versions of their articles, after a set embargo period. Based on articles' content and formats, they are usually categorised into three distinct versions:

- Publisher's version (after copy-editing; also known as the "published article" or "exact copy");
- Author's postprint manuscript (before copy-editing but after peer-review; also referred to as "accepted manuscript"); and
- Author's preprint manuscript (before peer-review; also known as "submitted manuscript").

SHERPA/RoMEO (Securing a Hybrid Environment for Research Preservation and Access/Rights Metadata for Open Archiving; www.sherpa.ac.uk/romeo) is a database of the self-archiving policies of journals and publishers. As of April 2017, 80% of all 2362 publishers included in this database allow some form of self-archiving [17]. Miguel et al. [18] studied journals registered in Scopus as of April 2010, and found that 57% of journals in "medicine" and 52% of those in "areas related to medicine" were subscription journals that did not allow any form of self-archiving. However, in another 2010 analysis by output volume [19], the self-archiving of preprints and postprints was allowed in 79% and 78%, respectively, of articles published in subscription-based health sciences journals. As a result, at least about 80% of all research articles published in health sciences journals could be made OA through the Green route alone.

However, the self-archiving of potentially inappropriate versions of articles (versions not allowed by the publishers) has been noticed in previous studies on OA across scientific fields [1] and more specifically in the field of dentistry [20]. In a 2017 study, Jamali [21] found that among subscription-based articles (not published in Gold OA) self-archived on the ResearchGate, about 50% did not comply with publishers' policy and therefore infringed the copyright, of which 98% were due to the self-archiving of the publisher's version PDFs. Researchers need to be more familiar with publisher's copyright and self-archiving policies and relevant resources (e.g. the SHERPA/RoMEO website) before making their articles Green OA.

3.2. The "Gold road" to OA

The Gold OA, sometimes also referred to as "publisher-provided OA", is broadly defined as making articles OA through journals or publishers. It can be further subdivided to three types according to the OA policy of journals: "Direct OA", "Hybrid OA" and "Delayed OA" [22].

- "Direct OA" refers to publishing in full immediate OA journals (OAJs), which make all their articles freely available online upon publication (e.g. *PLoS One*, *BMC Oral Health*). To cover costs related to editorial workflow, a growing proportion of OAJs require authors (or their funders/institutions) to pay an "article processing charge (APC)" [23]. In 2010, the average value of such APCs was about 1100 USD for OAJs in biomedicine [24]; among authors who published in OAJs in the fields of health sciences, biology and life sciences, an estimated 80% had their APCs covered by funders or institutions, 8% used their own funds, 8% had their APCs waived, and the rest paid the APCs through other means [25]. According to Laakso et al. [22], the number and volume of OAJs have been growing rapidly. Between 2000 and 2009, the average annual growth rate was 18% for number of journals and 30% for the number of published articles; in 2009, an estimated 7.7% of all peer-reviewed articles were published in OAJs. The DOAJ (Directory of Open Access Journals; www.doaj.org) is a major index of legitimate OAJs. As of April 2017, a total of 9358 OAJs are listed in this database, which include 899 medical journals and 93 dental journals [26].
- "Hybrid OA" means those subscription journals that allow authors to make their individual articles OA by paying an optional fee, while keeping the rest of the journals' content available to subscribers only (e.g. *Journal of Dentistry*, *Oral Diseases*, *Clinical Oral Investigations*). After Springer first initiated its "Open Choice" Hybrid OA model (APC: 3000 USD) in 2004 [27], many major publishers followed suit. Based on a study of the five largest publishers, Laakso and Björk [28] found that the number of Hybrid OA articles published by these publishers increased substantially from 666 in 2007 to 13994 in 2013; among all articles published in dental journals that had at least one Hybrid OA article in 2013, an estimated 3.7% were published using Hybrid OA. Interestingly, although Hybrid OA journals usually have higher APCs than full OAJs, recent studies of authors' APC payment behaviour have indicated a current preference among authors for Hybrid OA journals over OAJs [29,30].