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Readers beware! Predatory journals are infiltrating citation databases.

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Declaration: Both authors declare that they have read all cited references and checked the legitimacy of the cited source

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Publishing in predatory journals has been described as a “waste of people, animals and money” (Moher et al. 2017). Because predatory journals were assumed not to be indexed in well-known academic search engines and citation databases, it was assumed that their publications would rarely be cited by other scholars or be applied in practice. But publications in these scientifically questionable journals have already infiltrated citation databases such as PubMed and Scopus (Manca et al. 2017a, b; Cortegiani et al. 2019). Many initiatives aimed at combating predatory journals have focused on reducing submissions by warning researchers not to publish in them. With citation databases already infected, researchers, academic institutions, journals, publishers and research funders will need additional strategies to prevent the further spread of predatory publications.

Researchers and authors should now all be aware of the term ‘predatory journal’, but might not know how they work. Publishers of predatory journals are businesses that reap profits by ignoring scientific integrity (Pai and Franco 2016). They exploit the online open access model of publication, which aims to make research findings freely available to all and to allow authors to retain copyright of their work. Predatory publishers operate large numbers of online ‘journals’ that offer to publish articles in return for a fee, but do not conduct the kind of peer review, or offer the editorial services, expected from legitimate journal publishers (Frandsen 2019). Indeed, many of their practices are fraudulent. In April 2019, the predatory publisher OMICS Group, was fined USD50 million for deceptive business practices including falsely claiming peer review, listing scientists as journal editors without their knowledge, using fake impact factors and unauthorised use of logos implying that journals were indexed in the US National Institutes of Health PubMedCentral and Medline (Timmer 2019).

There are potentially serious consequences of scientifically questionable publications being indexed in well-known citation databases. Manuscripts in predatory journals that do not undergo rigorous quality control are more likely than those published in legitimate journals to have inadequate standards of reporting of methods, results and of approval from research ethics committees (Moher et al. 2017). Researchers might base their research activities on poor-quality, unethical, or even fabricated findings and cite these in their own publications, thereby further disseminating untrustworthy evidence. Industry-funded studies that promote products such as e-cigarettes can be published rapidly and without scrutiny in predatory journals and be claimed as authoritative peer-reviewed research (Ault 2019). In public health, where practitioners and policy makers rely on valid empirical evidence published in scholarly journals, these publications distort the evidence base and could influence policies and practices, potentially causing harm to the population.

The integrity and usefulness of citation databases such as PubMed and Scopus, on which we rely as sources of trustworthy research, are now being called in question. Citation databases are contaminated

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with publications of questionable quality originating from so-called predatory journals. Manca and colleagues investigated the bibliometric characteristics of potential predatory journals, listed in the so-called [Beall's list of potential, possible, or probable predatory journals](#), in the fields of rehabilitation and neurosciences. They found that seven of 59 rehabilitation journals (Manca et al. 2017a) and 14 of 87 neurosciences and neurology (Manca et al. 2017b) were also indexed in PubMed. In critical care medicine, Cortegiani and colleagues found two journals indexed in Beall's list that were also indexed in Scopus (Cortegiani et al. 2019). The claims of authority and objectivity of citation databases rest on their promise to index only journals that fulfill editorial standards and conduct rigorous peer review (Chavarro et al. 2018). Many universities and funding organisations consider inclusion of a journal title in databases such as PubMed and Scopus as a proxy of quality and integrity when they assess the publications included in scholars' records of scientific achievement. Scholars themselves use these databases to search for work related to their own research activities (Dadkhah et al. 2017). If researchers cite articles in scientifically questionable journals, their reputation could risk as much damage as if they appear as authors in such publications.

What can editors, reviewers and authors do on top of deleting junk mail 'greetings of the day' and sycophantic, or bullying, invitations? Editors should institute measures to reduce the risk of citations from predatory publications appearing in their own journals. They can start by alerting their associate editors, reviewers and authors to the need to check reference lists and cited literature carefully. All need to develop the skills to identify potentially predatory journals. This is not easy but online resources such as Think Check Submit (www.thinkchecksubmit.org) and databases like the Directory of Open Access Journals (www.doaj.org) can help. There are also blacklists of potentially predatory journals, including [Beall's list of potential, possible, or probable predatory journals](#), but these can be difficult to keep up to date (Strinzel et al. 2019). Authors should not publish in, or cite articles published in, predatory journals, even if an individual study appears credible. Our advice for authors is always to read a full publication, assess its scientific rigour and check that it comes from a reputable source before citing it, rather than copying uncritically from another article. Above all, we should ensure that the science that we do, that we publish and that we cite fulfils the highest standards of scientific integrity.

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