



The rapid proliferation of solicited content online journals: a quest to disseminate knowledge?

Richard C. Becker¹ · Vlad Cotarlan¹ · Sakthi Sadayappan¹

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In quantum mechanics, the uncertainty principle is any of a variety of mathematical inequalities asserting a fundamental limit to the precision with which certain pairs of physical properties of a particle, known as complementary variables can be known simultaneously. Werner Heisenberg 1927

Introduction

The promotion of peer review in science and medicine, representing the bedrock of scholarly exchange dates back to March 6, 1665 with the Royal Societies establishment of the first peer reviewed scientific journal-*Philosophical Transactions*. Despite early critics, the founders to include the Society's first secretary, Henry Oldenberg, felt strongly that peer review (certainty) represented the best means to maintain scientific integrity in published materials. Well-known contributors to the *Journal* have since included Isaac Newton, Anton van Leeuwenhoek, Caroline Herschel, Benjamin Franklin, Michael Faraday, Charles Darwin, Alan Turing and Stephen Hawking. It is our position that this foundational tenet must not be forgotten and, in fact, should be emphasized more strongly in the current era of rapidly multiplying journals, including solicited content online journals that may lack thorough vetting of applied methodology, reproducibility and validated results. Indeed, that which cannot be measured has uncertain value. More concerning still are "pay-to-publish" solicited content online journals wherein the editor(s), editorial board, reviewers, review process, distribution and publishers may be completely unknown (*ipso facto* uncertain) to the contributors potentially allowing,

whether intentional or unintentional, misinformation to find its way into the annals of medicine where it could remain for perpetuity (*dubitationem hoste sublatus* sustained or eternal uncertainty).

Beyond its foundational core, peer review is a defining characteristic for inquiring minds established in a given field of study-a valued opportunity to instruct and guide scientists toward a higher ground of investigation, potentially advancing their individual maturation and chosen field in the process. Thus, the committed reviewer takes on the time-honored role of teacher, mentor, guide and protector of current and future generations of scholars.

As academicians, we are alarmed by students, trainees and early career investigators around the world being actively courted to follow a path of least resistance in an attempt to build ones curriculum vitae, obtain recognition or advance their scholarly ranking by publishing their work in solicited content online journals.

Knowledge and ability must be combined with ambition as well as with a sense of honesty and a severe conscience. Carl Remigius Fresenius 1847

Learning, knowledge acquisition and dissemination

Creative thinking emanates from a "need to know" worldview, innate sense of inquiry and an intense desire to transform virtual constructs into tangible forms. Is there sound proof that writing, to include scientific writing as a form of visual discourse represents the optimal medium for communication, incubating ideas and the emergence of new knowledge? [1].

Human learning

While reading, humans utilize visual cognition pathways to emphasize important information. New ideas often emerge during this neurologically complex sequence of rapid events.

✉ Richard C. Becker
BECKERRC@ucmail.uc.edu

¹ Division of Cardiovascular Health and Disease, Department of Internal Medicine, University of Cincinnati College of Medicine, Heart, Lung and Vascular Institute, Cincinnati, OH, USA

Internally focused attention is then coupled by a shift away from external tasks to a deep, internal train of thought. The ultimate goals, proposed from an evolutionary perspective are planning, memory retrieval, information bundling, segmented storage, command and generating form around new ideas [2]. In a separate area of the brain, written words can be adapted quickly to learn new words—collectively referred to as the *visual word form area* for visual processing [3]. In essence, what one reads is internalized and processed for future use. The coalescence of visual and linguistic information—the latter represented by one's inner voice or monologue that accompanies reading [4] creates an “experience” that is critical to the logical organization of words into language [5].

How can misinformation impact science?

By providing a mechanism to reach many individuals who are active in similar fields of study, scientific writing facilitates a collective knowledge that represents the foundation of advanced understanding. The reverse is true for misinformation. It has become increasingly clear that teams of scientists are a dominant source of knowledge as evidenced by high-impact research and established, high-quality journal citing's [6]. In addition, team science spans across university boundaries, sparking broad-based collaborations. In response, funding agencies, including The National Institutes of Health (NIH) have developed team science “tool kits” to enhance collaboration and knowledge dissemination [7]. The introduction of misinformation into this paradigm could have devastating, far-reaching and sustained impact—likened to a virus that infects even the most advanced computer programs; a domino of cascading falsehoods that rapidly proliferate forcing incremental advances off track; and thereby necessitating enormous time, effort and resources to regain clarity and find “true north”.

It is tempting for some (and potentially dangerous) to publish easily and often; to defend one's discoveries as transformational and beyond the grasp of traditional thought or being so novel that they are incapable of being understood by others (e.g. reviewers). This mind-set may well lead one away from scholarly interactions, academic pursuits and peer-reviewed processes employed in many scholarly venues toward a mysterious and non-time-tested culture. We believe that the core of true genius lies in methods and results that are reproducible and validated, respectively. To be clear, imagination is good, thinking creatively should be encouraged and developing novel hypotheses (to be tested) is the outgrowth of both; but science at its very core is a journey in search of truth.

All you have to do is write one true sentence. Write the truest sentence that you know. Ernest Hemingway

Disseminating knowledge: neither walls nor boundaries, but thoughtful processes

Knowledge is inherently meant to be readily accessible to all who seek it; to be widely disseminated; and to inform and to inspire. In science and medicine, a person should be free to explore and to imagine—even the unimaginable. We believe, however, that fact must always be separated from fiction or, at the very least, defined and stated as such for clarity and posterity. Thus, processes, standards and procedures must be in place to assure the quality and reproducibility of the information being spoken or read at that moment in time.

Standards, policies and procedures in scientific writing

The integrity of scientific writing in general and its integrity in particular are deeply rooted in standards, policies and procedures that collectively provide oversight for processes inherent to scholarly and enduring materials. Several examples that have effectively guided the medical and scientific communities for many years are summarized below:

The National Library of Medicine

The National Library of Medicine (NLM) was established “to assist the advancement of medical and related sciences and to aid the dissemination and exchange of scientific and other information important to the progress of medicine and to the public health...” (42 U.S.C. 286). It uses an NIH-chartered committee, the Literature Selection Technical Review Committee (LSTRC), to review and recommend biomedical and health-related life science journals for inclusion in MEDLINE®. (website accessed July 29, 2018). The Journals must first be suitable for the NLM collection and have subject material appropriate for MEDLINE before they are considered for review by the LSTRC. In addition, journals are not eligible for MEDLINE if they were reviewed for PubMed Central (PMC) and did not meet the scientific quality standard. A publisher or editor must submit an application for a journal to be considered for inclusion in MEDLINE.

Best practices for journals and LSTRC review

A journal should demonstrate quality of editorial work, including features that contribute to the objectivity, credibility, and quality of its content. These features may include:

- Information about the methods of selecting articles (especially on the explicit process of external peer review)
- Statements indicating adherence to ethical guidelines
- Evidence that authors have disclosed financial conflicts of interest.

Commercial sponsorship should not raise questions about the objectivity of the published material. Additional factors that are considered include the publisher and/or sponsoring organization's history and corporate structure, longevity, and record of performance defined as: quality of publications; experience in scholarly publishing; involvement with the scientific community; disclosure of and adherence to print and electronic publication standards; and promotion of editorial integrity and independence. Any journal applying to MEDLINE must have an ISSN (International Standard Serial Number) before submitting an application. A journal needs a separate ISSN for each publication format (such as one ISSN for the print version and a different ISSN for the electronic version).

Maintaining scientific integrity in publishing

Establishing and maintaining core practices in publishing are vital for writers, learners and in scholarly institutions. Several examples of existing committees designed specifically for this purpose are summarized below:

Committee on publication ethics

The Committee on Public Ethics (COPE) is a foundation for maintaining high standards and integrity in scientific writing. It has established definitions, processes, policies, procedures and core principles that guide both writers and publishers. These include: allegations of misconduct; authorship and contributors; complaints and appeals; conflicts of interest and competing interests; data and its reproducibility; ethical oversight; intellectual property; journal management; peer review processes and; post-publication discussions and corrections.

International committee of medical journal editors

The International Committee of Medical Journal Editors (ICMJE) is a group of general medical journal editors and representatives of selected related organizations working together to maintain the quality of medical science and its reporting. Its core values are based on annually reviewed and refined recommendations that pertain to the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals.

Council of scientific editors

The Council of Scientific Editors (CSE) was established in 1957 as the Conference of Biology Editors with funding and oversight from the National Science Foundation. In 2000, the Council of Biology Editors became the Council of Science Editors to reflect an expanded scope and undertaking to oversee and provide governance for securing adherence to high standards in scientific publishing (website accessed January 1, 2019). Guidance documents and foundational roadmaps address a wide-range of topics, general themes and pertinent operational themes. They can be summarized briefly as follows:

Editor roles and responsibilities:

- Editorial freedom
- Conflict of interest disclosure
- Editorial board participation
- Timeliness of the publication process
- Errata, retractions, and expressions of concern addressing authorship disputes considering appeals for reconsideration of rejected manuscripts
- Addressing allegations or findings of misconduct
- Preprint servers

Authorship and author responsibilities

- Authorship
- Contributor models
- Acknowledgments
- Order of authors
- Changes to the author byline

Reviewer roles and responsibilities

- Reviewer selection
- Ethical responsibilities of reviewers
- Examples of reviewer impropriety
- Using anonymous reviewers: critique of the process
- Acknowledging reviewers

Sponsor roles and responsibilities

- Publication planning
- Authorship
- Process control (content and journal selection)
- Disclosure of conflicts of interest
- Access to and provision of data
- Copyright
- Clinical trial registration and dissemination of findings

Relations between editors and publishers, sponsoring societies or journal owners

- Publication oversight committees

Description of research misconduct

- Mistreatment of research subjects
- Falsification and fabrication of data
- Piracy and plagiarism

Reporting suspect manuscripts

- Why might a manuscript be considered suspect?
- Who might notify a journal about a suspect manuscript?
- What steps should be taken when misconduct is suspected?
- Whom should a journal notify about a suspect manuscript?
- What to do if the submitting author's response is not satisfactory
- Who investigates allegations of misconduct?
- What information should be provided during investigations?
- Handling accusations from anonymous sources

Digital images and misconduct

- Guidelines for handling image data
- Procedure for handling guideline violations

Correcting the literature

- Processes and considerations
- Editor's list of correction considerations
- Editor's list of elements and operations for corrections
- Examples of errata, partial retractions, retractions, and expressions of concern
- Expressions of concern

National Information Standards Organization

The National Information Standards Organization, founded in 1939, is an industry-based, non-profit and non-governmental association accredited by the American National Standards Institute to identify, develop, maintain and publish voluntary, consensus-based standards for managing information (website accessed January 1, 2019). The NISO has published recommended Practices for the Presentation and Identification of E-Journals (PIE-J). Citations form the basis for this scholarly undertaking to include publications. In addition, researchers are provided carefully vetted content on an Open URL linking and other reference linking systems. The organization has emphasized two absolute requirements for maintaining the integrity of the process. First, published articles must be cited by the

title of the journal in which they originally appeared (this may differ the title the journal currently bears). Second, the correct ISSN must be used in order for link resolution to occur accurately.

The areas of focus currently include:

- Titles for different formats: Specifically, when a journal is available in print and online.
- Former titles: Information about and easy access to former titles (including ISSN of former titles and the dates that the journal was published under the former titles) is required on the new title's website to ensure acknowledgment, visibility, accessibility, and tracking.
- Citations: Citations need to be historically accurate; they need to cite the title and ISSN that the journal carried at the time when the article was originally published.
- ISSN: ISSN centers can assist and provide correct title sequences, dates, and the ISSNs that will enable and facilitate accurate linking, resolve questions and clarify many complex relationships.

The importance of information accessibility

The spirit of science and its careful conduct, analysis, peer-review, replication and dissemination is the foundation on which debate, advances and posterity is built. While hypotheses are made to be proven, disproven and re-visited as techniques and instrumentation evolve and new knowledge unfolds, the fundamental premise remains intact- the goal of scientific endeavors remains—that which is committed to the ages stays forever in its rightful place. The availability of information on the internet is a powerful tool that must be acknowledged and embraced by the scientific and lay communities alike. Indeed, knowledge is born to be shared openly. Similarly, research and scholarly discourse, conducted with rigor and thoughtful reflection, respectively, should not be restricted to a select few.

Open-access publishing represents one of many opportunities to benefit society on a global scale- a portal of entry for new ideas, data sharing and the enormous power of “the whole or collective being much greater than the sum of its individual parts”. One must continually reflect as the process moves forward, potentially doing so at light speed. Despite the inherent pressures and temptations of contemporary pace, we implore the reader and would-be scholar to ask— How will the utmost scientific rigor be maintained? Who will provide the much needed oversight? How will peer-review be maintained? What policies and procedures should be in place (and followed) to assure that scientific integrity remains the operative tenet of the published word?

Public access

The goal of sharing information through an open portal pertains to all who seek knowledge. An example of open public access is found within the NIH. The NIH Public Access Policy implements Division F Sect. 217 of PL 111-8 (Omnibus Appropriations Act, 2009). The law states:

The Director of the National Institutes of Health (“NIH”) shall require in the current fiscal year and thereafter that all investigators funded by the NIH submit or have submitted for them to the National Library of Medicine’s PubMed Central an electronic version of their final, peer-reviewed manuscripts upon acceptance for publication, to be made publicly available no later than 12 months after the official date of publication: Provided, that the NIH shall implement the public access policy in a manner consistent with copyright law (NIH website accessed January 1, 2019).

The Policy applies to any manuscript that:

- Is peer-reviewed;
- And, is accepted for publication in a journal on or after April 7, 2008;
- And, arises from:
 - Any direct funding from an NIH grant or cooperative agreement active in Fiscal Year 2008 or beyond, or;
- Any direct funding from an NIH contract signed on or after April 7, 2008, or;
- Any direct funding from the NIH Intramural Program, or;
- An NIH employee.
- Authors may submit final peer-reviewed manuscripts accepted before April 7, 2008 that arise from NIH funds, if they have the right or permission to do so.
- “Directly” funded means costs that can be identified specifically with a particular sponsored project, or that can be directly assigned to such activities relatively easily with a high degree of accuracy. When awardees list a publication in the progress report publication list of an RPPR or a renewal application, they are claiming that the publication directly arises from that award and the awardee is responsible for the public access compliance of the listed publications.
- For Institutional Training, Career Development, and Related Awards (T15, T32/TL1, T34/TL4, T35, T90, R25/RL5, R90/RL9, K12/KM1/KL2, D43, D71, DP7, U2R, U45): Trainee, scholar, and participant publications fall under the public access policy if the publication resulted from work conducted while the individual was supported by the award (i.e., receiving a stipend or salary from the award).

Distinguishing open-access, online and solicited online content

A journal can be available in print or electronic (online) forms (or both). Being available online does not automatically equate to open-access. An increasing number of online medical and scientific journals with proven track records of excellence are currently open-access and, in addition, they are made available to the scientific community through “share functions” offered by many, but not all, publishers. Institutional library sharing is also available. These mechanisms are designed to maintain scientific rigor while concomitantly opening a portal to knowledge-seekers.

Open-access is defined as information that is distributed online and free of cost (or other barriers to availability). Open-access can be applied to all forms of publishing, to include peer-reviewed and non-peer-reviewed academic journal articles, conference papers, theses, book chapters, and monographs [8]. However, open-access need not be limited to publications in journals, but also includes the online distribution of pre-print manuscripts, working papers, technical notes, patents, videos and podcasts, all of which researchers may choose to place on their personal home pages or are hosted in institutional repositories.

Traditionally, publishing costs were covered through individual, institutional or library subscriptions (often bundled), site licenses or pay-per-view charges. Open-access publishing is achieved through a variety of distribution mechanisms and business models [9]. These include the following:

- Self-archiving, open-access site: After acceptance by a journal, the author posts the same content the journal will be publishing to a website either controlled by the author, the institution that funded the work or a central open-access repository.
- Open-access journal: The publisher of the journal makes all articles and related content available free of charge on the journal’s website. There are several variations of this model:
 - Open-access journal funded by article processing charges paid by authors or research sponsor
 - Open-access journal funded by an academic institution, society, governing body or a government information center
 - Delayed open-access journals—provide open access after an embargo period, typically 6–12 months and occasionally longer
- Hybrid open-access journals are partially funded by subscriptions, and only provide open access for those

specific articles for which the authors (or research sponsor) pay a publication fee.

Each model has its proponents and potential merits. We understand that there are monetary costs for publishing, whether it be on printed pages or online. The fundamental questions offered by skeptics, however, boil down to quality, accountability, oversight and overarching objectives or perhaps even the mission(s) for online, open-access journals—particularly solicited content online journals.

Solicited content online publishing casts a broad net in hopes of attracting manuscripts. For example, in the month of December 2018, one of the authors of this editorial (RCB) received 250 online journal invitations to submit a manuscript. Of these, nearly one-in-four was completely outside of his primary and secondary areas of research and clinical experience, others were in entirely unrelated fields, including veterinary medicine, engineering, law, economics and astronomy. The invitations frequently did not contain information on the publisher, editor, reviewers or review process, requested a manuscript submission in 1–2 weeks, promised a response and publication within several days and did not offer information on publishing costs. When costs were openly stated, they ranged from \$300 to 1200 USD. Cancellation fees were up to \$350 USD. It was common to receive daily invitations from the same journal for a period of up to 5 days.

Several concerns have been raised by the scientific community at-large about the following potential shortcomings of solicited online content journals:

- Aggressive marketing
- Publication of false information
- Publication of results from non-IRB (Institution Review Board)-approved research
- Publication of non-IACUC (Institutional Animal Care and Use Committee) approved research
- Loss of public trust in science.

Maintaining the integrity of online, open-access journals

The entry of open-access journals need not signal the “death of scientific journals” [10], but rather the birth of widely accessible information placed in the hands of those who seek it. The accountability for high quality research, reviews, editorials and position papers remains with the author(s) and academic institutions in which they train, practice, teach or conduct research. Search Committees, Admissions Committees, Thesis Committees and Appointment, Promotion and Tenure Committees must be increasingly cognizant of potential trends in low-risk

publishing practices. In addition, a major challenge lies in the power of temptation for applicants competing for highly prized positions, those seeking promotions and the “publish or perish” mentality of academia. A case in point is illustrated by Nguyen and colleagues who reported 113 publications in solicited content surgery journals over a 3-month period at a cost of ~\$83,000 USD. The median journal impact factor was 0.13 and many did not have a publishing or citation index [11]. A majority of the authors, including some senior authors, admitted to not having success publishing in “traditional” journals.

Accountability within the publishing industry is vital to maintaining high quality, peer-reviewed and scholarly standards. This requires strict adherence to policies, practices, indexing and both data and code availability for reproducibility post-publication upon request [12]. A journal *integrity index* with independent oversight, has been suggested as a means to distinguish high quality from poor quality publishing [13]. There are several other options to improve transparency that include:

Directory of open access journals

DOAJ is a community-curated online directory that indexes and provides access to high quality, open-access, peer-reviewed journals. DOAJ is independent. All funding is via donations, 40% of which comes from sponsors and 60% from members and publisher members. All DOAJ services are free of charge, including index entry in DOAJ. All data is freely available.

DOAJ operates an education and outreach program across the globe, focusing on improving the quality of applications submitted. There are currently 12,431 journals, 9476 that are searchable at the article level and 3,621,478 articles (website accessed December 28, 2018).

Journal citation reports

The Journal Citation Reports (JCR) is an annual publication produced by Clarivate Analytics that provides information for scientists, researchers, libraries, publishers and academic institutions with a focus on natural sciences and social sciences (website accessed January 1, 2019). JCR is integrated with the Web of Science Core Collection. The value of a given journal is assessed through use of metrics, analytic tools and transparency of the data and publisher. There are several related products that include: *InCites* (an objective analysis of authors, programs and peers) and *Essential Science Indicators* (a database of emerging science, institutions, publications and reputable journals in specific fields of research).

PubMed

PubMed, established in 1996, is a free search engine accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics. The United States National Library of Medicine at the National Institutes of Health maintains the database as part of the Entrez system of information retrieval. Publishers whose journals are indexed in MEDLINE must submit citation and abstract data electronically for inclusion in PubMed. Electronic submissions ensure that citations and abstracts are available to the public more rapidly, assignment of medical subject heading (MeSH) terms will take place more quickly, and each citation can display a link to the publisher's web site for access to full-text. Publishers are also encouraged to submit full text for inclusion in PubMed Central (website accessed January 1, 2019).

The NLM uses an NIH-chartered committee, the Literature Selection Technical Review Committee (LSTRC), to review and recommend biomedical and health-related life science journals for inclusion in MEDLINE®. Journals must first be suitable for the NLM collection and have subject material appropriate for MEDLINE before they are considered for review by LSTRC. When reviewing an application, NLM scrutinizes materials for conformance with guidelines and best practices published by professional organizations, including recommendations for the conduct, reporting, editing, and publication of scholarly work in medical Journals from International Committee of Medical Journal Editors (ICMJE) and Principles of Transparency and Best Practice in Scholarly Publishing.

A journal currently indexed in MEDLINE, should it become an online only publication must comply with the MEDLINE Policy on Indexing Electronic Journals. The NLM offers assistance to the publisher of an electronic-only journal to ensure compliance with its policy to assure that the journal's citations can be found in MEDLINE/PubMed. If an electronic-only journal is not able to meet the policy requirements, the journal will no longer be indexed in MEDLINE prospectively.

Readers and authors—use good judgement

We have been vocal with our students, trainees and faculty about the potential pitfalls of solicited content online journals and provided a brief list of FAQs (frequently asked questions) to consider long before hitting the submit button:

- Is the author being contacted by a reputable publisher?
- Is the journal affiliated with known/reputable professional society?

- Is the journal fully indexed in PubMed? (not just scattered articles)
- Does the journal have an Impact Factor granted by Clarivate? (shown in PubsHub)
- Are there fully transparent good signs?: journal and publisher are members of Committee on Publication Ethics (COPE); International Association of Scientific, Technical, & Medical Publishers (STM); or the Open Access Scholarly Publishers Association (OASPA)
- Does the journal comply with COPE core practices?
- Are there contact details for the journal and its staff (email, postal address, working telephone number)? Reputable journals have a named editor and editorial board comprised of recognized scholars in the field.
- Are the fees associated with publishing clearly stated? Credible journals do not ask for a submission fee. Many legitimate open-access journals require a publication charge or APC, but this fee is levied only after acceptance and through a process separate from the editorial process.

The World Association of Medical Editors has proposed a more expansive list of criteria that should raise concern about a journal's or publisher's intentions and status in the academic community [14]. They also clarify characteristics that must be taken into consideration to avoid making assumptions about authenticity or the lack thereof. Indeed, transparency and objectivity are important on both sides of the equation—authors and publishers.

Institutional responsibilities

There are steps that all academic institutions must take to preserve the integrity of science and its dissemination. The research quality framework employed widely to include our institution emphasizes values, ethics and integrity.



It also underscores the importance of science and publishing as a continuum in academia. Prior to application of research to humans in a manner that directs diagnostic testing or therapy either in clinical studies or in commercialization, the findings must be reproducible (both internally and externally) based on additional documented data sets.

Documentation of internal reproducibility should extend in a readily traceable manner back to the fundamental source of the original data (*data provenance*). External reproducibility should be demonstrated in data external to those used to produce the original findings. Optimally, this could include a requirement that the data analysis is reproduced in an independent facility in addition to being replicated in second data sets.

Scientific studies must be conducted with adequate quantitative expertise, applied under proper standards to the design, conduct, analysis, and presentation of results. Governance and oversight of science with direct implications for patient care can no longer be seen as residing solely within the purview of any one laboratory. Given consideration of public investment, public trust, and direct impact on the well-being of patients, a chain of accountability extending beyond the individual laboratory to mentors and scientific leaders within the institution must be established.

Concluding thought

We believe strongly that shortcuts or lack of attention to the *checks* and *balances* in medicine, science and publications will be potentially damaging to their quest for truth and dissemination of knowledge. Responsibility and accountability lay with the primary, contributing and senior authors, institution(s) of origin, research funding agencies, societies representing and overseeing the field(s) of study, publishers, editors, editorial board members and the journals themselves that have a responsibility to uphold the highest ethic for the written word.

Nothing in life is to be feared, it is only to be understood. Marie Curie

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Compliance with ethical standards

Conflict of interest Dr. Sadayappan provides consulting and collaborative services to AstraZeneca, Merck and Amgen unrelated to the con-

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