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Access to evidence-based care: a systematic review of trauma and surgical literature costs across resource settings

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ABSTRACT

Background Evidence-based medicine has become the foundation for surgeons around the world to provide the most effective surgical care. However, the article processing charges (APCs) and subscription fees for surgical journals may be a barrier, particularly for those in low-income and middle-income countries (LMICs).

Objectives The objective of this study was to define the current options for producers and consumers of surgical literature, inclusive of trauma, across resource settings.

Data sources The Web of Science Core Collection database.

Study appraisal and synthesis methods A complete list of journals publishing surgical content between 2019 and 2020 was compiled. The most frequently indexed journals were reviewed using the individual journal websites to extract the type of access (ie, open, closed, hybrid), impact factors, publication languages, APCs, subscription pricing, and any discounts listed.

Results The literature search revealed 4759 unique journals. The 500 most frequently indexed were reviewed. The mean APC for a fully open access surgical journal was US$1574 and for a hybrid surgical journal was US$3338. The average costs for a 1-year subscription in a hybrid surgical journal were US$434 and US$1878 for an individual and institution, respectively. When considering purchasing power parity, APCs and subscription costs ranged from 2 to 15 times more expensive in LMICs when compared with those in the USA.

Limitations Primary search term was in English only, and only peer-reviewed journal articles were reviewed.

Conclusions or implications of key findings Although initiatives exist to support peer-reviewed journals in LMICs, there is an exorbitant cost for authors in these countries, as well as those in high-income countries that are not affiliated with a large institution, to either publish in, or access, a majority of surgical journals. Efforts to lower the overall cost of publishing must be made to provide greater access to medical literature.

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Level of evidence Level IV.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Barriers exist for those in low-income and middle-income countries with regard to publication and consumption of potentially life-saving information.

WHAT THIS STUDY ADDS

⇒ This study found no correlation between journal ranking and article processing charges, but the relative cost tends to increase with decreasing country annual income level.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ If researchers and publishers prioritize a more equitable publishing ecosystem (one where everyone can participate without financial barriers), open access to medical literature can be an affordable and achievable reality for all.

INTRODUCTION

The practice of evidence-based medicine has become foundational for surgical education and for the provision of high-value, effective surgical care.[1 2] Although only 16% of the world's population lives in high-income countries (HICs), 86% of surgical content published on the Web of Science (WoS), a reportedly relatively comprehensive database, originates from these areas.[3–5] The over-representation of HICs on the WoS is partially due to barriers to publication and consumption of literature in low-income and middle-income countries (LMICs) due to language, training, and access to paywalled journals.[6–8]

During the last several decades, various efforts have been made to combat the disparities in access to healthcare information.[7] Historically, authors published "closed access," with individual readers or institutions paying a one-time or annual subscription fee to access the publications. An increasingly common practice is for closed access journals to make the article open after an embargo period, commonly 12 months.[9] Large international collaborations led to breakthrough initiatives, such as the Research4Life's Health InterNetwork Access to Research Initiative (HINARI) and the Pan American Health Organization's Biblioteca Regional De Medicina, which work to provide free access to a large number of paywalled journals for LMICs.[10 11] In the 2000s, these efforts were grouped under the conceptual title of "open access" (OA), established with a goal of improving access for the general public, specifically in LMICs.[12]

A number of OA models exist today, with the most common being "Green" OA and "Gold" OA.[13 14] In the Green OA model, authors publish

their work in an established journal but are permitted to self-archive on an OA repository, such as the Scientific Electronic Library Online (SciELO), usually after an embargo period of 6 to 9 months. Copyright is generally retained by the publisher with restrictions on how the work can be reused. A listing of international OA repositories can be found on the Directory of Open Access Repositories, which also encompasses archives supported by funding agencies such as the National Health Institute or the Wellcome Trust. In Gold OA, an article is made freely and permanently available to anyone, and copyright is retained by the author with most permission barriers removed, which allows for sharing and reuse. A large percentage of journals charge authors an article processing charge (APC) to publish Gold OA. Most journals now fall under a hybrid model in which authors are offered the choice of publishing OA in an otherwise subscription-based journal. The hybrid model was initially created to be transitional with the goal of pushing all journals to become OA. However, almost 30 years after its inception, the hybrid journal persists.[15]

APCs and subscription fees are often costly, particularly for those in LMICs.[16–19] When compared with the USA, APCs were shown to be 2.24 times more expensive (as defined by the World Bank's purchasing power parity (PPP)) in South Africa and 1.56 times more expensive in Brazil.[20] Furthermore, a comprehensive cross-sectional study of exclusively OA surgical journals found no correlation between the cost of publishing and the impact factor of the journal.[21]

Under-representation of LMIC-generated research leaves surgeons from LMICs reliant on the adaptation of clinical research performed elsewhere.[20] Further compounding the problem, most original research articles tend to focus on the priorities of HICs and often discuss treatments or advancements that are not relevant to problems faced by providers in LMICs.[22] Even when treatment appears nominally relevant, validation of the data in the local context is crucial. For instance, when a protocol shown to have a mortality benefit in sepsis in an HIC was applied to an LMIC high HIV-incidence population, it was associated with increased mortality.[23]

Despite several global initiatives, accessibility to consumption and publication of surgical literature is still beyond reach for many outside of large, HIC, well-resourced institutions such as universities and medical centers.[24] As of 2014, only 26% of published medical articles were publicly available through OA.[25] In 2017, in Nigeria (an LMIC), only 15 of the 463 institutions registered through HINARI had paid the new annual fee of US$1500 when the country was reclassified from a low-income country to a lower-middle-income country by the World Bank, and thus moved from HINARI free access to low-cost access.[26] In this systematic review, we aim to define the current options for producers and consumers of surgical literature across resource settings, identifying gaps in equitable access and potential next steps.

METHODS

In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, a protocol for this systematic review was drafted and registered (PROSPERO: CRD42021240227).[27] The Web of Science Core Collection database was chosen as the main database given its extensive results analysis including source titles and country of publication.[5] Additionally, the WoS was chosen due to its reported better end user experience and comprehensiveness compared with other databases.[5 28] To validate our results, we ran a similar search on Scopus with surgery as the subject area and confirmed that the first 100 titles sorted for relevance to result from Scopus were included in the WoS source results. Scopus was chosen for validation due to its comprehensive search abilities.[5] To further confirm the results' validity with regard to location of origin, an investigator reviewed a random sample of 50 of the 500 included journals from an internet protocol (IP) address outside the USA (Peru). Thus, we could ensure the search results were not specific to the location of the IP address conducting the search.

Using the WoS, we searched for all publications with the topic "Surgery" that were published between January 2019 and December 2020.[3] There were no language restrictions. Sources were restricted to scholarly/academic journals defined by the WoS as a periodical that includes original research articles written by researchers and experts in a particular academic discipline. A complete list of journal titles that resulted from this search was extracted and sorted based on the number of surgery-relevant articles published during the stated time period. The first 500 journals from this list were reviewed. Publications that were unrelated to humans (eg, veterinary surgery) were excluded.

Published content was defined as any article, review, meeting abstract, editorial material, early access paper, proceedings paper, letter, correction, news item, retraction, biographical item, reprint, data paper, or retracted publication that was peer-reviewed and citable. The WoS scope note on surgery includes resources on general surgical topics including the different surgical subspecialties (cardiovascular, neurosurgery, orthopedic, pediatric, trauma, or vascular), allied disciplines of surgery (surgical oncology, pathology, or radiology), and surgical techniques (arthroscopy, microscopy, or endoscopy). The WoS scope of the topic surgery is more comprehensive and inclusive when compared with a PubMed index search using "Surgery" as Medical Subject Heading (MeSH). The MeSH scope of surgery includes operative procedures on organs, regions, or tissues in the treatment of diseases, including tissue section by lasers, but specifically excludes transplantation or allied disciplines of surgery.

For each source title, the original journal website was used to extract the following information: the type of access (ie, open, closed, or hybrid), bibliometrics (ie, impact factor, CiteScore, h-index, SCImago Journal Rank), languages the journal was published in, cost for the author (including options for decreasing the cost), cost for the reader including the cheapest option (online, print, or both), and primary content of the journal (eg, surgical, medical, non-surgical subspecialty).

APCs for the least restrictive copyright license were listed when available. The highest priced APC was used for journals which base APCs on article type. When APCs were charged per PDF page, the price for a total of five pages was listed, as several journals set an article length limit of five pages. For both individual and institutional subscription prices, a subscription length of 1 year was selected. When applicable, the country of origin was chosen as a country other than the USA or one located in Europe. For several publishers, this meant selecting an "international" option or choosing a country from the World Bank's list of low-income countries. A majority of journals only offered costs in US dollars. To standardize our results, all costs not listed in US dollars on the journal's website were converted to US dollars using the Google-embedded currency conversion exchange calculator at the time of data collection.

PPP was used in an effort to compare the relative cost to authors and readers in countries outside of a high-income setting. According to the International Monetary Fund, the PPP exchange rate is the "rate at which the currency of one country

would have to be converted into that of another country to buy the same amount of goods and services in each country." The World Bank website (data.worldbank.org) was accessed on May 4, 2021, and the PPP index for private consumption (PPP conversion factor, private consumption in local currency units per international dollar) was collected for two low-income (Afghanistan and Ethiopia), lower-middle-income (Kenya and Nicaragua), upper-middle-income (Brazil and Peru), and high-income (Canada and UK) countries.[29] For each country, the mean APC for the creative commons attribution license (CC BY) for hybrid surgical journals was multiplied by the respective PPP, resulting in a monetary amount which approximates the "purchasing power" equivalent in US dollars.[30] The gross national income (GNI) per capita (current US dollars) was similarly obtained as another point of reference.

Options for decreasing the cost of APCs generally fell under a publisher's explicit fee waiver policy rather than a journal-specific policy. Six commercial publishers who publish the greatest number of fully OA or hybrid journals were selected and included Springer, Reed Elsevier, Wiley-Blackwell, Sage, Taylor & Francis, and Wolters Kluwer. Each publisher's website was searched for explicit fee waiver policies, whether the discount included publishing OA or in a hybrid journal, and the number of countries that met the policy criteria. In an effort to compare fee waivers from companies that rely solely on APCs for funding, three fully OA publishing companies were also reviewed and included the Multidisciplinary Digital Publishing Institute (MDPI), Public Library of Science (PLOS), and Frontiers.

Surgical journals were considered those journals that publish greater than 50% surgical content, inclusive of injury/trauma-focused journals. Medical journals were considered those that published original research across a broad spectrum of medical disciplines and subspecialties with less than 50% of the journal composed of surgical content. All other journals were classified as non-medical journals with less than 50% of the journal composed of surgical content (eg, engineering).

One author performed the initial search and determined the eligibility of sources for inclusion in the final analysis (MW). Two authors extracted the data (MW, HC). Data extraction was equally split, with cross-referencing used for journals that had discrepancies or where it was difficult to find the information needed. Discordance in categorization of abstracted elements between the two authors was resolved through discussion. Data were organized using an Excel (Microsoft, Redmond, USA) workbook. The study was conducted with the assistance of an advisory group composed of an expert in OA (AF), knowledge and research services (AF), as well as experts in surgical access to medical information (EH, LL) and systematic review methodology (LL). Pearson correlation coefficients were used to assess the relationship between journal factors and APCs.

RESULTS

As outlined in figure 1, a total of 146 448 articles resulted from our WoS database search, which corresponded to 4759 journals that published surgical content from 2019 to 2020. The first journal on our list published 2345 articles during our time period, which equated to 1.6% of the total articles, whereas the 500th journal published 62 articles or 0.04% of the total articles. A total of three veterinary journals were excluded from our list, leaving 497 journals for review. Of these, 189 (38%) were surgical journals, 293 (59%) were medical journals, and 15 (3%) were non-medical, non-surgical journals. Only 6% of the total journals reviewed offered publications in a language other than English. Validation of results from an IP address outside of the USA revealed concordance of results for 48 of 50 sampled journals, with the two discrepant journals having multiple links indicating different, and higher, prices when searched from outside the USA. Most hybrid journals offered two OA options, Green OA versus Gold OA. The Green OA option allows authors to publish an OA article after an embargo period; however, we did not obtain granular data specific to journal participation, the

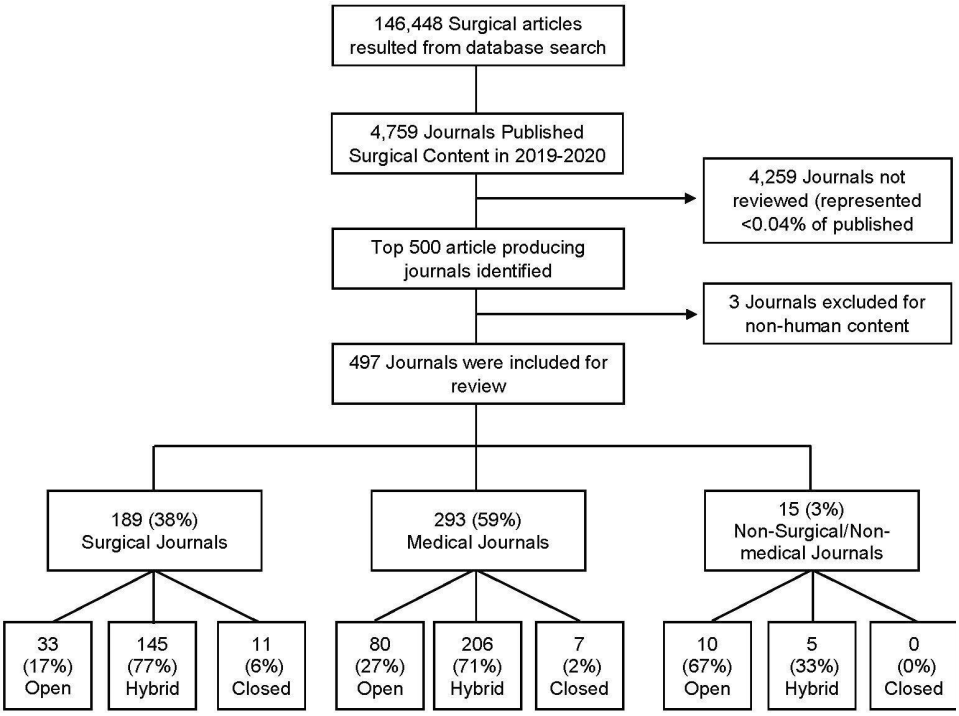

Figure 1 PRISMA flow diagram of studies for inclusion. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Table 1 Unadjusted cost of publishing in or subscribing to journals that publish surgical research

Journal type	Surgical journals (n=189)			Medical journals (n=293)			Other* (n=15)		
Access category†, number of journals (% of type)	Open, 33 (17)	Hybrid, 145 (78)	Closed, 11 (5)	Open, 80 (27)	Hybrid, 206 (70)	Closed, 7 (3)	Open, 10 (67)	Hybrid, 5 (33)	Closed, 0
Article processing charge‡ (US$), mean (SD)	1574 (984)	3338 (645)	No charge	2182 (801)	3407 (778)	No charge	1785 (531)	3064 (641)	N/A
Annual individual subscription cost (US$), mean (SD)	No charge	434 (276)	303 (161)	No charge	460 (357)	263 (114)	No charge	79 (0)	N/A
Annual institutional subscription cost (US$), mean (SD)	No charge	1878 (1317)	656 (N/A)	No charge	2411 (1814)	610 (0)	No charge	8181 (7408)	N/A
Journals offering discounts to authors, n (% of category)	22 (67)	55 (38)	N/A	61 (76)	77 (37)	1 (14)	7 (70)	3 (60)	N/A
Journals participating in HINARI, n (% of category)	N/A	122 (84)	4 (36)	N/A	185 (90)	2 (29)	N/A	5 (100)	N/A

US$ is unadjusted US dollars as of May 2022.
*"Other" journals had <50% surgery or medicine (eg, engineering); journal type is defined by a focus of >50% surgical content.
†Open: publications made immediately and openly available. Hybrid: author may choose open (with or without embargo period) vs. closed access. Closed: publications available for purchase/subscription only.
‡Article processing charge for the most restrictive (ie, cheapest) author license: creative commons attribution license.
HINARI, Health InterNetwork Access to Research Initiative; n, number; N/A, not applicable.

length of embargo periods, or how often authors are choosing the Green OA option.

For surgical journals, the mean APC for fully OA was US$1574 (SD US$984) and for hybrid US$3338 (SD US$645). When compared with surgical journals, the mean APC for publishing in medical journals was slightly higher at US$2182 (SD US$801) for fully OA and US$3407 (SD US$778) for a hybrid journal. Using PPP, table 1 compares the average APC and subscription costs of hybrid surgical journals across different resource settings. The mean adjusted APC was grossly inversely related to country annual income level. People from HIC pay consistently less, relatively, than people from upper-middle, who pay less than people from lower-middle-income countries. For example, the relative cost of an APC for an author from Nicaragua is 16 times that for an author from the UK (table 2).[30]

Sixty-seven percent of OA surgical journals and 76% of OA medical journals offered APC discounts. Thirty-eight percent of hybrid surgical journals and 37% of hybrid medical journals offered APC discounts. The amount discounted was different based on journal and publisher. Five of the six commercial publishers reviewed had explicit fee waivers and offered APC discounts based on socioeconomic status. Among the fully OA publishing companies, PLOS has a Global Participation Initiative in which authors from Research4Life's group 1 countries (low-income countries) are eligible for a 100% APC discount, whereas those from group 2 countries (lower-middle-income countries) are eligible for an APC reduction to US$500. The MDPI and Frontiers do not have explicit fee waiver policies but allow authors to apply for discounts which are made on a case-by-case basis and left up to the publisher's discretion (table 3).

The average cost for a 1-year subscription in a hybrid surgical journal for an individual was US$434 (SD US$276) and for an institution US$1878 (SD US$1317). The average cost for a 1-year subscription in a hybrid medical journal for an individual was US$460 (SD US$357) and for an institution US$2411 (SD US$1814). Most journals in both categories did not advertise discounts on APCs to consumers based on socioeconomic status. However, 84% of the hybrid surgical journals and 90% of the hybrid medical journals participated in the Research4Life's HINARI program. The average costs for a 1-year subscription in a closed surgical journal for an individual was US$303 (SD US$161) and for an institution US$656 (SD US$0). The average cost for a 1-year subscription in a closed medical journal for an individual was US$263 (SD US$114) and for an institution US$610 (SD US$0). Of the 18 closed journals, 7 (39%) participated in Research4Life's HINARI program and 1 (6%) offered a discount for residents.

Table 2 Adjusted cost (in US dollars), using purchasing power parity*, of publishing in or subscribing to hybrid surgical journals: example of countries from each World Bank income level classification

World Bank income classification†	Low		Lower-middle		Upper-middle		High	
	Afghanistan	Ethiopia	Kenya	Nicaragua	Brazil	Peru	Canada	UK
Average adjusted cost to publish (APC), US$	60 428‡	34 921‡	138 267	37 856	7592	5871	4049	2429
Average adjusted annual individual subscription cost, US$	8006	4626	18 318	5015	1006	778	536	322
Average adjusted annual institutional subscription cost, US$	40 799	23 577	93 352	25 559	5126	3964	2734	1640

*Purchasing power parity index per World Bank – currency conversion to reflect ability to purchase the same amount of goods and services.
†Low-income GNI <= $1,035; Lower-middle income GNI $1,036 to $4,045; Upper-middle income GNI $4,046 to $12,535.
‡The majority of 'big six' publishers offer full APC waivers for LICs.
APC, article processing charge; GNI, gross national index; LICs, low-income countries.

Table 3 The "big six" publishers' APC waiver policies and percentage of countries meeting the criteria based on World Bank classification (ie, low-income, lower-middle-income, upper-middle-income)

	Springer			Reed Elsevier			Wiley-Blackwell		
	LICs (%)	LMICs (%)	UMICs (%)	LICs (%)	LMICs (%)	UMICs (%)	LICs (%)	LMICs (%)	UMICs (%)
Full APC waiver	93	0	0	100	64	20	100	64	20
50% APC waiver	0	88	0	0	30	48	0	30	48
No APC waiver	7	12	100	0	6	32	0	0	32
	Sage			Taylor & Francis			Wolters Kluwer		
	LICs (%)	LMICs (%)	UMICs (%)	LICs (%)	LMICs (%)	UMICs (%)	LICs (%)	LMICs (%)	UMICs (%)
Full APC waiver	100	64	20	100	0	0	N/A	N/A	N/A
50% APC waiver	0	30	48	0	100	0	N/A	N/A	N/A
No APC waiver	0	6	32	0	0	100	100	100	100

LIC as classified by the World Bank with a gross national income of US$1035 or less. LMIC as classified by the World Bank with a gross national income of US$1036–US$4045. UMIC as classified by the World Bank with a gross national income of US$4046–US$12 535.
Green indicates higher percentage of countries meeting criterion for waivers, red fewer, with gradations in between.
APC, article processing charge; LIC, low-income country; LMIC, lower-middle-income country; N/A, not available; UMIC, upper-middle-income country.

The mean journal impact factor was 2.4 (range 0.1–30.2) for OA, 3.9 (range 0.1–60.4) for hybrid, and 5.6 (range 0.3–74.7) for closed journals. The correlation between journal impact factor and mean APC was poor (r=0.18) (table 4).

DISCUSSION

This systematic review describes the current options globally for producers and consumers of surgical literature, including the average APCs and subscription costs of journals based on access type, as well as discounts based on the socioeconomic status of the country of origin. Our results are similar to those found in studies looking more broadly at all medical journals, as well as more specifically at subspecialty medical journals (eg, emergency medicine, critical care medicine).[20 31] Furthermore, the results highlight other areas in need of improvement, such as discount options for both APCs and subscription costs, a lack of centrally indexed publications offered in languages other than English, and no correlation between journal ranking and APCs. The last element is particularly concerning. If we consider journal ranking to be a proxy for quality, then value (ie, quality divided by cost) is largely erratic in the market-place. Not only does quality not correlate with cost, but the relative cost (compared with GNI per capita) increases with decreasing country annual income level. When one considers the cost of publishing and subscribing in terms of purchasing power, authors in Nicaragua, an example of a low-middle-income country, may spend 15 times as much when they pay an average hybrid APC than those in the UK, an example of HIC (calculated by dividing the average APC adjusted for Nicaraguan purchasing power with that of an APC adjusted for purchasing power in the UK). Another way of conceptualizing the gravity of this inequality is that the unadjusted average APC costs 1.7 times the gross national income (GNI) per capita in Nicaragua compared with 7.9% of the GNI in the UK.

With high-priced APCs, funding becomes a critical problem for authors in LMICs. A survey of authors publishing in an OA journal found that around 80% of health sciences researchers used grants or institutional discretionary funds to cover APCs. When comparing sources of funding based on an author's country gross national product (GNP), authors from low GNP countries were more likely to cover APCs with personal funds compared with those from higher GNP countries.[32] A study looking specifically at global health research found a similar trend, with results suggesting authors from higher-ranking institutions have more resources to pay for publishing.[33] Likely in part due to these costs and lack of funding, authors from LMIC are more likely to publish in the traditional sense, in a closed journal.[33]

Many journals and publishers offer an APC fee waiver or discount policy to offset the high costs. However, the criteria to obtain the waiver differ by journal and are often vague or difficult to discern. Similar to our review, one study found that around 70% of publishers had an explicit fee waiver policy for fully OA journals for authors from LMICs, but this waiver did not apply to authors wishing to publish OA in a hybrid journal, limiting publication options for LMIC authors.[34] A study from India highlighted the barriers authors face as the country does not fall under the category of low-income or lower-middle-income country and most Indian institutes do not pay for publication.[35] This may be due to the "middle-income trap," a described phenomenon where economically fast-growing countries transition out of a low-income country or LMIC status but other socio or political restraints or limited resources stagnate

Table 4 Journal rankings based on access and journal type

	Access type			Journal type		
	Open	Hybrid	Closed	Surgical	Medical	Non-surgical/non-medical
Total journals, n (%)	123 (25)	356 (72)	18 (3)	189 (38)	293 (59)	15 (3)
Impact factor, mean (range)	2.4 (0.1–30.2)	3.9 (0.1–60.4)	5.6 (0.3–74.7)	2.2 (0.2–13.6)	4.5 (0.1–74.7)	3.3 (1.2–7.2)
CiteScore, mean (range)	2.7 (0.1–7.1)	5.1 (0.3–35.4)	1.7 (0.4–3.6)	2.8 (0.3–8.0)	5.2 (0.1–35.4)	4.5 (1.1–11.8)
SCImago Journal Rank, mean (range)	0.7 (0–2.4)	2.7 (0–390)	0.5 (0.2–1.3)	0.8 (0.1–2.5)	2.9 (0–390)	0.8 (0.4–1.9)
h-index, mean (range)	41 (1–129)	94 (0–494)	N/A	59 (1–235)	91 (1–494)	69 (2–155)

n, number; N/A, not available.

the progress to HIC status.[36] Limited research exists regarding the extent to which waivers are actually used, and our efforts to contact publishers to gain data for this review did not yield responses.

When focusing on the consumer aspect of surgical literature, approximately 25% of the total journals reviewed were fully OA. The percentage was lower when looking strictly at surgical journals, where fully OA accounted for 17%. In an effort to increase the amount of research published OA, Plan S was launched in 2018 by a consortium of research funding organizations, cOAlition S.[37 38] The APCs are covered by funders or institutions, not the individual author, as long as the article is published in a fully OA journal, a transformative hybrid journal, or is covered by a transformative arrangement. Furthermore, articles must be published under an open license, preferably CC BY, which allows the authors to retain the right to their publication.[39] Although several major European organizations have adopted Plan S, there has been notable opposition from researchers and publishers, and lack of adoption in many countries including the USA.[38] One opposition letter voices the concern that Plan S does not eliminate the "paywall" publication problem but rather shifts the burden from the consumer to the producer.[40] Few journals mentioned subscription discounts, but a vast majority (88%) participated in Research4Life's HINARI program. Although HINARI provides institutional access to healthcare information in 125 eligible countries, many healthcare professionals are completely unaware that HINARI exists, have difficulty acquiring or managing usernames and passwords, or work for institutions that remain ineligible.[41]

Publishing literature requires publisher resources to manage submissions, revisions, and ultimately production, yet it is difficult to know what a reasonable price is to cover the costs. Many major publishers acquire impressive profit margins, with articles produced by the academic and medical communities.[42] There is interest in creating a more accessible publishing ecosystem—one where everyone can participate without financial barriers. Within the APC system, where producers of literature pay for the cost of publishing, there are a few options to mitigate cost. For-profit journals tend to have higher APCs, so focusing on publishing in not-for-profit journals helps lower the cost of publishing to the producers. Alternatively, needs-based funding initiatives, such as HINARI, could be made more readily available to those outside of large HIC academic institutions.

In addition, other OA business models which do not rely on APCs are being created and tested. One option is for costs to be completely covered by revenue generated from advertisements on published article web pages. Alternatively, the "Subscribe to Open" model is gaining promising traction by leveraging subscription revenue to flip articles to OA, and libraries are eager to support. The PLOS has been an innovator in the quest to eliminate the reliance on APCs through the creation of their Community Action Plan. Eliminating the reliance on faulty metrics, such as impact factor or publication counts, for evaluation of science and promotion of researchers can remove the need to publish in certain journals, especially those that come at the highest cost. Finally, authors and librarians can demand price and/or cost transparency from publishers to help better understand the true cost of publishing. OA to medical literature can be an affordable and achievable reality for all if researchers and publishers prioritize it.

This review has several limitations. First, and most importantly, the language used for the search term was English. A survey of surgeons from countries with a diverse set of income classes found that language was a barrier to the use of evidence-based medicine in non-English-speaking countries.[8] Although English continues to be the dominant language in healthcare literature, only 66 countries currently list English as an official language.[43] There are efforts underway to increase the number of articles from non-English speakers such as SciELO and professional societies that offer article preparation.[44] Delineating the volume and quality of primarily non-English resources was beyond the scope of this systematic review. Also, this review focuses specifically on obtaining medical information through peer-reviewed journal articles; however, there are other ways of obtaining healthcare information, such as point-of-care peer-reviewed options (eg, UpToDate, ClinicalKey), non-peer-reviewed options, and medical textbooks.

CONCLUSION

Of the 500 surgical literature journals reviewed, most (72%) were hybrid journals, whereas 25% were OA and 3% were closed access. The publishers' response to the global public access movement appears to be to shift from primarily closed to primarily hybrid journals. However, for authors outside of HICs, the associated costs often put them in the position of choosing to publish in a journal they can afford to publish in, but not read, or one they can afford to read, but not to publish in. Further, the cost of publishing appeared to be divorced from the relative quality of a journal as measured by bibliometrics such as impact factor. As it stands, the basic economic principle of value (quality divided by cost) is chaotically represented in this market-place. Despite the OA movement and initiatives such as Plan S and HINARI, around 84% of the world's population is being treated by surgeons in LMICs who are lacking adequate access to surgical journals. Further, not only do those providers not have adequate access to information, the information they can access is largely generated by, and for, a high-income context. Although the paywall publication problem may never be eliminated, a better balance needs to be found between costs for producers and consumers and publisher profit margin. The problem does not exist solely in LMICs where initiatives are focused, but extends to include all of those that are outside of large academic institutions. The cost and access barriers in the current publishing paradigm exacerbate inequity and critically slow the dissemination of potentially life-saving information.

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