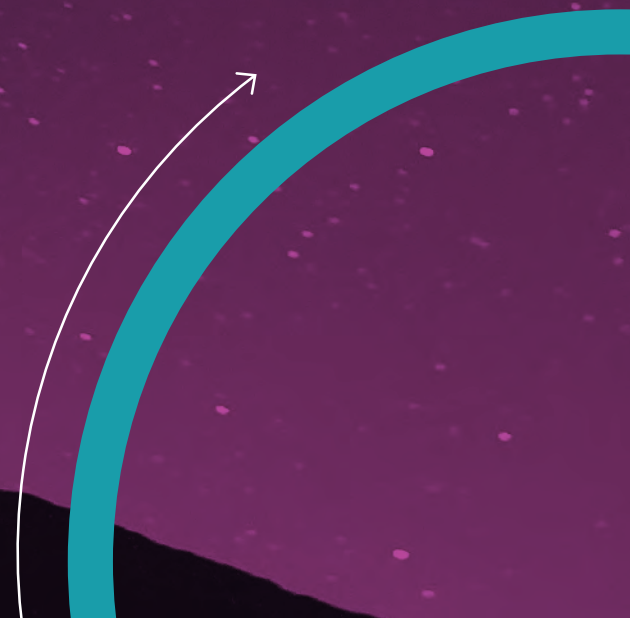


WILEY

Scholarly publishing in the digital era

Expert views on the future of research
communication, content access, and learning



The publishing industry has witnessed dynamic growth over the years and continues to transform itself based on evolving needs. Tracing the evolution of scholarly publishing highlights the primary drivers of change and enables a deeper understanding of some of the current trends that could shape its future.

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1. Introduction

Over the past few decades, the scholarly publishing industry—an integral aspect of scientific research and development—has evolved considerably due to various drivers of change, such as digitization, which brought the promise of increased efficiency; the realization that publishing workflows needed refinements to increase speed and transparency; and mass movements focused on increasing the accessibility of research.^{1,2,3} In this paper, we explore how the publishing process has evolved across three broad areas—editorial systems, digital technology, and information seeking and learning patterns of healthcare practitioners (HCPs), patients, and readers—as well as how the pharma-publisher relationship has evolved over the years. We also share the views of industry experts to speculate future trends and phenomena based on some current trends, focusing on biomedical and pharmaceutical research and publishing.

2. The evolution of editorial systems

The hallmark of scholarly publishing is its assurance of quality based on a robust system of scientific research, content creation, and editorial selection and evaluation, all of which serve to aid the production and publication of valuable and reliable scientific output. In this segment, we look at the evolution of scholarly content and journal publication processes.

2.1. Evolution of content

2.1.1. Transformations in scholarly output over the years

If we were to trace the evolution of scholarly publishing, it would be clear that the scholarly publishing landscape has undergone complex transformation since its origin in 1665, including the nature of the published article itself. Post World War II, the recognition of the importance of research for human development and the consequent increase in funding for research has led to an unprecedented growth in global scholarly output.^{4,5} To elaborate, in 2014, there were 28,100 peer reviewed English-language journals publishing 2.5 million articles annually. In 2015, the STM (scientific, technical, and medical) information market was valued at \$25.2 billion, of which the medical segment alone accounted for a whopping \$13 billion.¹ Additionally, increasing submissions from emerging markets like China—now the number 1 contributor to global scholarly output^{6,7}—have put an unprecedented strain on the scholarly publishing system.

Accordingly, the phenomenally high volumes of submissions that journals need to process have led to high journal rejection rates that can vary from 60% to 70% and even cross 90%.⁸



>28,100
journals

60-90%
rejection rate

>2.5 million
papers

2014 data
Source: STM publishing report¹

2.1.2. Positive developments in journal publishing

These upward trends have introduced several changes in the scholarly publishing landscape:

- More specialized content is now generated and made available across a variety of biomedical and pharmaceutical fields: today, there are multidisciplinary mega journals publishing a range of research topics as well as super-specialty niche journals that focus on specific areas of research.
- Over the years, digitization has influenced every aspect of the scholarly publishing process and driven several critical trends, including impact measurement, data management, and information discovery.
- As the different stakeholders in the scholarly communications industry (researchers, authors, funders, publishers, pharmaceutical companies, etc.) began to recognize the need to harmonize their functions, their synergy in the publishing ecosystem increased.⁹ A direct outcome of this synergy has been the rise in global collaboration,¹⁰ and the institution of publishing-related societies (such as The Society for Scholarly Publishing¹¹) and conferences (such as the Peer Review Congress¹²) that bring various stakeholders together.
- Publishers have also begun to show greater interest in reaching out to their audiences and engaging them through efforts such as author education, support through the editorial workflow, etc.
- With the growing influence of biomedical research in shaping critical healthcare policies and treatment outcomes, most countries have introduced policies and guidelines to ensure that best and ethical practices are followed while conducting and reporting research on human or animal subjects. These include ensuring that clinical trials are registered, trial data are available, and negative results are appropriately reported.¹³

2.1.3. Challenges introduced by the growth of scholarly publishing

The burgeoning volumes of research output have also introduced a unique set of challenges. In addition to problems of scale that have placed a lot of pressure on journal workflows, the most critical challenge is the publish-or-perish culture that has prompted some researchers to take short cuts and resort to unethical practices.¹⁴ These unethical practices have had major implications on scientific development and led to published studies being retracted. The publication process itself has come under scrutiny for its lack of transparency.¹⁵

Another challenge is that the growth of research output has been accompanied by an emphasis on greater accessibility to published content and the data behind it, which led to the open access movement. In the backdrop of open access, inadequate understanding of copyright policies has in some cases led to illegal sharing of journal publications.¹⁶

2.1.4. Nevertheless, the future looks promising!

According to Chris Graf, Director, Research Integrity and Publication Ethics at Wiley, "It feels like the winds of change are blowing. And we're getting somewhere. There are many positive things happening right now, all of which enable the outside world to look at a piece of research from different directions and assess its credibility. The future lies in ensuring the integrity of the publishing process through embracing transparency without breaching confidentiality. Pharma has adapted to the need for transparency—pharma companies are obliged to register clinical trials and post their results, despite time constraints. In the future, standards for human and animal research will become compatible globally. Also, regulations will be supplemented with ethical guides or playbooks, which will demonstrate good practices that everyone involved in research and its publication can adopt."

The future lies in ensuring the integrity of the publishing process through embracing transparency without breaching confidentiality.

- Chris Graf

2.2. Evolution of the publication process

2.2.1. The peer review story

Peer review did not enter the publishing space as a formal process until the 20th century,¹⁷ when increasing field specializations led journal editors to feel the need to seek expert opinions. Peer review helps maintain the quality of published research and enables researchers to learn from the opinions and critical evaluation of experts. Over the years, the system came to be considered the gold standard for ensuring high-quality research output. In fact, several journals now “closely track and advertise their low acceptance rates, equating these with rigorous review.”⁴

2.2.2. Challenges and developments in peer review

A few major challenges in the peer review system that have been identified and discussed in the industry are the inability of journal editors to source and retain reviewers, lack of recognition for peer review, inconsistencies in peer review evaluations, the absence of formal training or onboarding for new reviewers, and a general lack of trust in the traditional blinded review process because of its lack of transparency.^{18,19,20} Over the years, various developments have served to address these problems. For example, platforms like Publons²¹ emerged that enable reviewers to showcase their work, and many journals now proactively recognize their reviewers. To address the onboarding problem, some publishers and organizations have begun to offer peer review training to groom reviewers.^{22,23,24} Additionally, newer forms of peer review—such as open, post-publication, collaborative, and patient-led peer review—are being adopted in an attempt to deal with the issue of trust in peer review.²⁵

2.2.3. Will traditional peer review cease to exist?

“The quick answer is, no,” says Deborah Wyatt, Vice President, Asia-Pacific Society Publishing at Wiley. “If you look at the underlying reason for peer review it’s to validate quality. The need for validation is now stronger than ever due to the proliferation of published research. Authors worldwide are under pressure to publish their research in peer-reviewed journals so authors are driving demand for greater efficiencies and speed in peer review. Cascading peer review is one solution because it saves authors the time spent in looking for new publications. Machine learning and artificial intelligence might also play a role in reviewer selection in the next decade as journal editors and publishers push for further process efficiencies to keep up with demand.” Graf believes that “we are headed towards increased transparency in peer review where optionally and with permission we publish communications between authors, journal editors, and peer reviewers alongside research articles to help readers understand how peer review works.”

Richard Donnelly, Professor in Medicine at the University of Nottingham and Editor-in-Chief of Diabetes, Obesity, and Metabolism, has slightly different views. He believes that authors would benefit from “more transparency on the background of reviewers, without the reviewer’s identity being revealed. Knowing the expertise and origin (country) of the different reviewers might be beneficial for authors to understand the outcome. However, the move to transparency in peer review is not straightforward for several reasons: Firstly, reviewers are currently not comfortable providing direct feedback to authors. Second, in collaborative peer review, reviewers knowing each other’s identities might encourage them to engage in mutual discussions about the manuscripts, through which they might influence each other’s opinion. While the collaborative process will prove beneficial, it could also be problematic because currently peer reviewers are carefully selected based on different areas of expertise (i.e., subject matter expertise, methodology expertise, etc.). So although transparency in several aspects of peer review could point the way forward, a move to total transparency might not be entirely beneficial.”

“If you look at the underlying reason for peer review it’s to validate quality. The need for validation is now stronger than ever due to the proliferation of published research.”

- Deborah Wyatt

Another type of evolution that Donnelly would like to see in the future is “a standardized rating system of manuscripts for the different reviewers to complete, based on quality, originality, and impact.”

Another type of evolution that Donnelly would like to see in the future is “a standardized rating system of manuscripts for the different reviewers to complete, based on quality, originality, and impact. I do think that developing a more quantitative scoring system to be used by reviewers and feeding back these aggregated scores to authors would be helpful. At present most peer review is based on free text comments and global assessments. Currently, there are no universally defined guidelines or criteria that reviewers work with, and the editor is required to make the final call. So depending on the editor, a manuscript may or may not be accepted as everyone has different quality thresholds, which in some journals leads to irregularities in the quality of published articles.”



3. The impact of digital advancements on scholarly publishing

3.1. Digitization and its potential

Technology has played a major role in enhancing the research and publication landscape—by 2008, 96% of all STM journals were accessible electronically along with circulating print editions.¹ Over the years, digitization has seeped into almost every aspect of biomedical research and publishing, speeding up the publication process, allowing content to be disseminated in various formats that best suit the reader’s needs, and improving content access. As Graf puts it, “Machines augment humans; they have the potential to help researchers express their work in the best possible way, and to help peer reviewers and journal editors to do their job more quickly and more effectively.”

3.1.1. Focus on user engagement, new content formats, and smart technology

Digitization brought with it new ways for researchers, authors, funders, publishers, and pharmaceutical companies to demonstrate the impact of research in influencing policy or practice and increasing user/reader engagement.^{26,27,28} Martine Docking, Vice President, Global Corporate Sales at Wiley states that, “Clinical research has always informed medical policy and practice. However the advent of digitization has created more avenues for both propagating and measuring that impact—as demonstrated by the rise of altmetrics.” In the biomedical and pharma publishing landscape, journal supplements and re-prints emerged as two major content types for specialized communication and increased outreach. In addition, pharma companies have begun to create a planned, multichannel marketing approach to give their HCPs the content they need in the format they prefer.^{29,30} There is also an increased focus on technology-based innovations such as artificial intelligence (which helps data analysis and drug discovery),³¹ virtual reality (which has introduced the learning-by-seeing approach),³² and online forums such as SERMO³³ (which increase a sense of community and build trust in the healthcare system). Using the power of digital, pharma companies and other stakeholders in the industry have also begun to explore alternative and more engaging content formats such as plain-language summaries, video abstracts, infographics, podcasts, and posters.

The advent of digitization has created more avenues for both propagating and measuring that impact

- Martine Docking

3.1.2. How will the scholarly community embrace the digital future?

Interestingly, almost every expert we spoke to had strong views about how technology will influence future developments. For example, discussing the new modalities of content, Chris Elliot, General and Developmental Physician, and Editorial Board Member of the *Journal of Paediatrics and Child Health*, says, “These alternative modes of communication will only add to publishing rather than revolutionizing the fundamental role of publishing. I think academic articles are necessary and vital records of reproducible scientific experiments and I don’t think they will or should be supplanted, but communication about and arising from these articles definitely should be enhanced.”

Donald Samulack, President, US Operations at Editage, predicts that “Re-prints, although reducing in importance, will continue to be important for pharma, while journal supplements will continue to evolve and integrate alternative multimedia content formats in order to stay relevant and continue to meet unmet needs in specific research areas. Moreover, technology will play an important role in helping us manage data better through data mining solutions. Tools will be developed to assign unique fingerprint-like identifiers for datasets, which will help detect fraudulent practices with data usage.”

Amitabh Dash, Senior Regional Medical Lead, Asia Region, Neurology Business Group, at Eisai Singapore Pte. Ltd., is of the view that “Infographics, video summaries, podcasts, and online forums will soon dominate the biomedical communication sphere, because they help convey accurate scientific information in an easy-to-absorb way and are thus a great solution to increase HCP engagement.”

“I’m looking forward to future developments in the amplification of critical research findings,” predicts Wyatt. “Tools that help ‘tell the story’ of published research and create multimedia content for different audiences. The future will no doubt bring further changes to the way we measure research impact. Universities, funders, and Learned Societies will continue to emphasize the need for tools to improve metrics for published research. Public scrutiny of research expenditure will continue, so it will be essential to measure ‘impact’ beyond just the research community and focus on metrics like patient outcomes, evidence-based policy change, or public awareness around particular issues.”

According to Docking, “Understanding how, when, and by whom the research outcomes are used has driven the need to fully understand the patient’s and physician’s journey and deliver appropriate multichannel marketing and education. This will intensify as digital technologies become pervasive across all aspects of healthcare—from pre-launch discovery and the process of informing that discovery, through clinical research and clinical trial recruitment, to post-launch personalized care and services beyond the pill, and real world evidence informing treatment protocols.”

3.2. The emergence of content access, discoverability, and sharing

Due to the increased ease of access and communication offered by digital, over the years, the focus has shifted from passive one-sided scientific communication to outreach and engagement, and the first step to increasing outreach is to make relevant content easily discoverable. Content discoverability is now key to creating impact and is supported by digital-led innovations such as artificial intelligence, search engine optimization, and digital object identifiers.

3.2.1. Social media at the forefront of change

Social media, which began as a way to share information and build a personal network, has become a vehicle for content dissemination and outreach. It also provides endless possibilities of innovation for outreach, engagement, and impact.^{35,36} According to Stacy Konkiel, Director of Research and Education, Altmetric, social media is a great equalizer: “Everyday people can now directly message scientists, journal editors, and luminaries in a field to share how research affects their lives...those normally marginalized in the production and consumption of science are now given more of an opportunity for involvement, thanks to social media.”

The scholarly record is evolving into a corpus of material vastly different from its previous print-based version. While in the past the scholarly record was largely defined by the formally published monographic and journal literature, its boundaries are now both expanding and blurring, driven by changes in research practices, as well as changing perceptions of the long-term value of certain forms of scholarly materials.

Source: The evolving scholarly record³⁴

3.2.2. How social is the future?

“The rise of social media over the past decade—and related cultural expectations about the ability to create and engage with online content—is arguably one of the biggest drivers of change in how research is consumed. For example, scientists are often no longer content with just reading a paper; they want the ability to re-run its code to analyze its data. Or, they may have opinions on the paper that they want to share, so they might blog or tweet their thoughts.”

-Konkiel

Konkiel has additional expectations from social media: “I believe there is a very positive role for social media engagement to play in building a sense of community and increasing awareness of a journal’s brand, especially in healthcare and biomedicine. Journals often have the attention of a wide swathe of researchers, practitioners, professional societies, and sometimes even patients in a field. By organizing community-building events (Twitter chats, Facebook Live Q&As, Reddit Ask Me Anythings, virtual conferences, etc.), journals can position themselves as leading vital conversations in healthcare-related topics. This in turn can build valuable brand awareness which is useful for finding new readers and authors.”

Elliot feels in that “in the coming years, we will increasingly see peer-to-peer groups providing encouragement, support, and feedback on social media. Peer-to-peer, patient-to-patient, and HCP-to-patient communication channels have all grown significantly and will continue to do so. Informal and formal communities have emerged around health topics, services and geographic areas. From an HCP perspective, seeing the way our research is accessed and discussed by patient groups is incredibly interesting. They can sometimes provide real-world context to our research.”

According to Elliot, “each stakeholder in publishing can benefit from using social media: Authors can use and enjoy social media to promote and discuss their articles. Social media can also inform research, help in patient recruitment, and then enable research promotion and distribution post-publication. There’s still the rigorous scientific work to be done in the midst of all this, which doesn’t change. Social media will also allow casual engagement around particular topics of interest among patients. It will help journals and healthcare providers to attract a wide audience including the general public, allied health professionals, patients and parents as well as other medical groups.” But Elliot clarifies that “As well as opportunities there is also risk—social media teams are at risk of making errors, mis-quoting and mis-interpreting research, and so we need content-level experts moderating everything. The wider audience and public nature of social media also increases scrutiny on the intersection between online discussions about research and patient rights and confidentiality.”

3.3. The evolution of performance and impact metrics

3.3.1. The Impact Factor—challenges, and alternatives

One of the biggest advantages introduced by the digital age is the ability to measure and analyze the performance of publications. The introduction of the impact factor (IF) by Eugene Garfield in 1955 led to the widespread use of citation metrics, whereby greater citation rates indicated better quality. Over time, the IF has become the gold standard for measuring and demonstrating “research quality and impact in promotion, tenure, and funding proceedings”³⁷ and “authors tend to equate journal impact with the ‘impact factor.’”³⁸

However, gradually, academics realized that the IF has some limitations and should not be the sole indicator of the performance of publications.^{37,39} This led to the introduction of other author- or article-level metrics such as the Immediacy index, g-index, h-index, Eigenfactor, and Source Normalized Impact Per Paper (SNIP). In recent years, the use of alternative impact indicators (or altmetrics)—which enable the analysis of how published content is being discovered, accessed, cited, or shared online—is being encouraged in conjunction with citation-based measures.^{37,40}

Authors tend to equate journal impact with the “impact factor,” which is a journal-level metric and may not always reflect the amount of attention an individual article receives.

Source: Wiley blogpost - Maximize your study’s visibility by choosing the right journal³⁸

3.3.2. Expert views on the future of metrics

Konkiel believes that metrics have a lot of promise and that we may never “fully do away with traditional metrics like citations or the journal impact factor, nor should we. They definitely will remain useful to the publishing industry. We may start to use traditional metrics—and also altmetrics—in more nuanced and creative ways. For example, improvements in machine learning may make it possible to better scale content analysis for citations, which would in turn provide accurate metrics for whether a study has been able to be replicated—which in turn can help editors monitor the literature for possible retractions. Or, we might use certain types of altmetrics to monitor discussions amongst scientists to track the emergence of new disciplines, well before these fields manifest in the citation record of the peer reviewed literature, in order to create new journals, data repositories, etc., that can meet the needs of the researchers.”

4. Changes in learning patterns and trends

HCPs are becoming increasingly digital native today

63%

of HCPs use desktops, smartphones, and tablets

70

of HCPs look for information online

Source: The new rules of HCP engagement: 5 Strategies to consider in an evolving pharma landscape⁴⁴

4.1. HCPs' information seeking behavior and content needs

A critical driver of content sharing and discoverability in biomedical publishing is the way in which HCPs seek, access, and absorb content. Recent studies have shown that HCPs rely on online sources for staying updated about their field and that more than 75% patients expect to use digital services in the future.^{41,42,43} Therefore, publishers, healthcare information providers, and pharmaceutical companies use digital platforms to engage HCPs and patients with information that they can easily access and apply in their practice.

Continuing medical education (CME) is another area where HCPs seek relevant information to upgrade their skills or meet accreditation requirements. CME aims to provide HCPs with “balanced, disease-oriented, and patient-centered education” because that is the only way HCPs can translate innovations into practice and help improve healthcare outcomes.⁴⁵ Over the years, the CME landscape has undergone several changes, some of which include exhaustive peer reviews and evidence-based analyses of CME material before it can be used by HCPs.

4.1.1. The future of content for HCPs

Principal of WentzMiller Global Services, LLC., and founder of both the Alliance for Continuing Education of Healthcare Professionals and the Global Alliance for Medical Education, believes that “pharmaceutical companies, where not limited by accrediting or government regulations, need to work closely with medical education providers to share their inputs on needs of physician learners as developed in research, without compromising the integrity of CME content. What I see lacking in peer reviews of medical editorial content today is that it is primarily one or more specialists reviewing the work of another. Peer reviewers should include the recipients of the education, the audience. Expert reviewers can assess the accuracy of evidence but not necessarily its relevance to the practicing physician; that requires a panel of HCP reviewers.” Miller adds, “In order for CME to be effective it has to enable blended learning, learner interaction, and repetition, where more than one medium or platform is used to impart CME, thus helping integrate alternative content formats and engaging the learner in applying content to patient care. Also, going forward, HCPs will prefer shorter snippets of relevant information that help them learn faster and retain and apply what they have learnt better.”

According to Dash, the future of CME will be heavily invested in technology. “CME providers and pharmaceutical companies will start using intelligence powered by digital technology to maximize CME impact—for example, geo-tagging technology will help them identify peak traffic hours in the evening when HCPs commute back home and are more likely to devote time to learning through mobile apps specially created to support CME.”

4.2. Where does the patient fit in?

Patients play an important role in pharma-related content discovery and healthcare practice because they are at the receiving end of all that is being studied, debated, and written about. Over the years, more and more people are talking about engaging patients in research, publication, and practice, for example, by getting them on board as co-authors or peer reviewers for a study, seeking their feedback on specific treatments, or empowering them by providing them with access to medical records. As a result, the role of the patient has changed from passive to involved, interested, and engaged.

Patient involvement, however, introduces its own set of challenges.^{46,47} Given the present proliferation of digital avenues of information, patients are more active when it comes to seeking and understanding medical information. The challenge here is to ensure that the content they access is reliable. Another challenge is the need for onboarding or orientation when involving patients in research or publication. But perhaps the most critical challenge is the lack of evidence-based data on the impact of patient engagement, which makes it difficult to drive engagement activities.

4.2.1. How will the HCP-pharma-patient relationship evolve?

Acknowledging the challenges involved in patient engagement, Karen Woolley, Global Lead, Patient Partnerships, at Envision Pharma Group, states that “The evidence base for patient involvement in publications is lagging behind other areas and must be strengthened (See Figure 1). The irony is that when the evidence goes public in a PUBLICATION, the PUBLIC have rarely been involved. This has to change! Too many people don’t consider patients as key contributors to publications—too many people say ‘but patients can’t meet ICMJE authorship criteria...’ Well, patients have already proven they CAN do just that—they ARE authoring peer-reviewed publications! They are experts living with disease and their unique insights can enhance the real-world relevance of publications.”

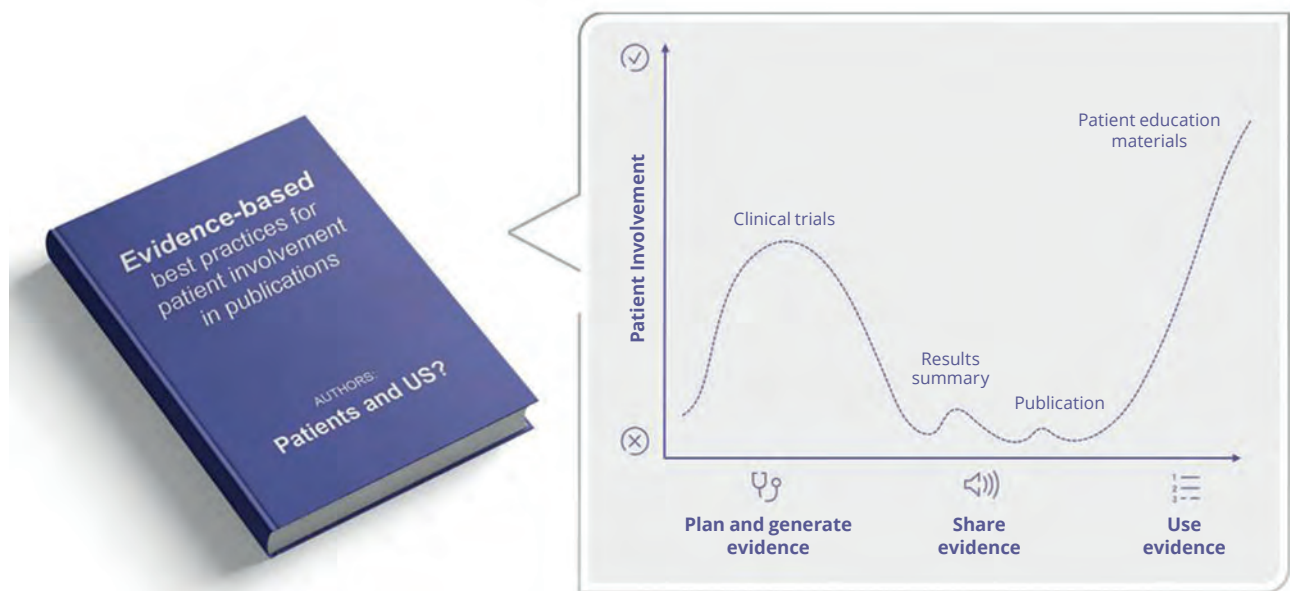


Figure 1: Evidence-based practice for patient involvement – Schematic presented at the Envision Patient Forum, London, January 2018, shared by Karen Woolley. (© Envision Pharma Group)

Woolley asserts that “The best way forward is for HCPs and patients to be true partners where both are informed, both learn from each other and shared decision-making can take place. There has to be an increased focus on patients’ priorities and responsible sharing of the latest research with patients—so they can be informed partners. International industry codes of conduct DO allow us to share research findings with patients and that is what many patients are demanding. We and others have also recognized the need to conduct more studies—with patients—on the impact of patient involvement in publications. We need evidence-based guidance to help ensure we maximize the benefits and minimize the harms of patient involvement. To help patients find and use current, credible and relevant evidence, we also need to involve patients—patients can help us co-create lay summaries, videos, or infographics. Many patients are also active on social media—they can be ‘evidence ambassadors’ helping to raise awareness of robust evidence and reduce the risk that evidence will be misunderstood. Ideally, we’ll see online platforms hosting lay summaries of medical/clinical research with links to the original publications. It would be great if patients could post comments too—a different open access approach that builds in post-publication patient peer review.”

“We’re at the tipping point. Patients are not ‘just another stakeholder’—they are our unifying stakeholder. Shouldn’t we all be on ‘Team Patient’? Don’t we all want what’s best for the patient? I don’t think there’s ever been a more exciting, important, or rewarding time to be in the medical affairs and medical communications space, and it’s because of patients.”

-Woolley

5. Where is the pharma-publisher relationship headed?

Pharmaceutical companies and publishers are top-level stakeholders in the biomedical and pharmaceutical research, publishing, and content sharing space. Both have vested interest in and are responsible for the publication of high-quality research. Over the years, their relationship has evolved in response to the dynamic changes in research and publishing. Here’s what the experts we talked to think about where this relationship is headed in the future

Wyatt: “Pharma companies and publishers should continue supporting best practices, robust approaches to peer review and clinical trial registration, and ethical publishing. We must work together and react quickly and appropriately when ethical issues come to light. There is ongoing potential for us to work together to create effective digital learning solutions, improve patient involvement, and use peer-reviewed research to solve urgent global health challenges.”

Samulack: “The next wave in publishing and research communication through alternative content formats is to encourage and train researchers to be science advocates in front of the public and policymakers. The pharma community absolutely needs to pick this up because they have a huge stake in influencing and ensuring that the public respects the science in their studies, and that their patient advocacy groups and their patients themselves trust the science. Publishers and pharma need to work together to ensure that trust in the science exists and to push researchers to be more engaged with the public and policymakers in order to make sure the science stands up above the pseudoscience. The way to do this is to encourage and train not just certain researchers but all researchers to be science advocates to the public and to policymakers. The three Ps of communication will gain predominance: peer-to-peer, peer-to-public, and peer-to-policymaker.”



6. Summing up—What will the future of publishing look like?

The only constant in the publishing process has been its evolution and change, of which we have had ample evidence over the years. Our conversations with industry experts revealed a few common themes and trends that have the potential to shape the future of the biomedical research and publishing space.

- **Technology will lead the way:** The future will be dominated by technology and digitization, both of which will be used to introduce critical innovations. For example:
 - Technology will help revolutionize biomedical publishing by disseminating information in a way that allows users to discern and extract the information they want without having to digest the entire volume of information available on digital platforms. This will drive intelligent information-sharing and high-quality research.
 - It will also help provide solutions to manage and use data more efficiently as well as trigger innovations that will help monitor data and detect fraudulent practices with data usage.
- **Information snippets will determine content discoverability:** The proliferation of content available on digital platforms and the shared pharma-publisher need to drive content discoverability will necessitate the extraction and presentation of key content from published studies in formats that can be easily absorbed and appreciated by all kinds of users. Thus, a manuscript will be broken down into a single-source piece of information. Easily discoverable research findings are likely to lead to more citations, give researchers and publishers a competitive edge, and influence critical policy-level changes.
- **Big data and data mining will open up new roads:** It is safe to predict that data, big data in particular, will play an important role in several aspects of medical publishing, pharma strategy, and healthcare systems across the globe. Publishers, pharmaceutical companies, and healthcare providers will start using the data they collect to improve their knowledge about unmet needs in healthcare, gaps in existing literature, patient needs and behavior, HCP learning requirements, peer review trends, etc. Once the data has been mined, it will be used to provide intelligent solutions for some of the most pressing challenges in research, publishing, and healthcare.
- **Communication among peers, public, and policymakers will gain importance:** The “three Ps of communication” in biomedical and pharmaceutical research and publishing will gain importance, that is, the awareness that researchers need to talk not only peer-to-peer but also peer-to-public and peer-to-policymaker. Researchers will be coached to get out of their shell and speak to the public and policymakers to overcome the fake news rhetoric and the science deniers’ rhetoric, with a view to promoting reliable science.
- **Alternative communication formats will be widely adopted:** Owing to their high engagement value, alternative formats of scientific communication, via multimedia and social channels, will play a key role in driving policy-level changes in healthcare and research as well as help reinstate trust in science.
- **Researcher education will gain importance:** Given the rapid growth of predatory publishers and ethical issues in publishing, researcher training in these areas will emerge as an urgent need so that they can steer clear of predatory publishers as well as follow best ethical practices when publishing.
- **Science will become more open:** Open science will influence the biomedical publishing and healthcare space by canvassing for easy access to medical literature and information for academic and non-academic audiences alike.
- **Peer review will be more efficient and reliable:** Training and onboarding efforts of publishers and organizations will help address the reviewer scarcity problem. Patient peer reviews will find their way into the scholarly publishing and CME evaluation workflows.
- **Everybody will be on “team patient”:** There will be an increased focus on improving patient involvement (through tools like social media platforms and online discussion forums). Patients will become our partners in healthcare research and communication.

It is clear that the evolution of the scholarly publishing industry has been fraught with unexpected twists and turns, and while there may be miles to go before scholarly publishing overcomes all its challenges, the industry is poised to surge ahead into a promising future!

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