KNOWLEDGE IS GOOD, ACCESSIBLE KNOWLEDGE IS BETTER: APPLYING OPEN SCIENCE PRACTICES TO HEALTH SERVICES RESEARCH

Meeting Report

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SUMMARY

Open science refers to a broad set of principles and practices designed to increase the transparency and accessibility of research data, methods, and findings to advance knowledge. Interest in open science practices, particularly open access publishing, is growing across funders, institutions, and academic disciplines, including health services research (HSR). Through the **Paradigm Project,** an initiative to foster innovation in the field, AcademyHealth convened a May 2021 meeting to examine how aspects of open science might enhance HSR capabilities to produce high-quality, timely, and relevant evidence to inform policy and practice. Over two afternoons, health services researchers and others with expertise in open science issues explored the following topics:

- What open science practices are particularly suited to HSR and how conducive is the HSR culture to open science?
- What are the benefits, drawbacks, and feasibility of using preprints and other alternatives to traditional publication of research findings in peer-reviewed academic journals?
- How does open access to research findings facilitate translation, dissemination, and impact?
- What role do incentives and funding play in the acceptance and credibility of open access research in HSR?

Potential advantages of open science include greater availability and accessibility of publicly funded research; more extensive and diverse peer review of findings; greater reproducibility and transparency of scientific works; and greater research impact.[1] Key open science tenets include open data, open research materials, open code, preregistration of research protocols, open access to research findings, and open educational resources. Despite growing interest in open science practices, challenges exist, including less flexibility for researchers to pursue exploratory analysis beyond their initial hypothesis; additional time and costs for researchers to archive and document data and code and other research outputs; and a lack of incentives that encourage researchers to adopt open science practices.[2]

To support individual researchers in exploring how open science practices can increase the quality, relevance, timeliness, and impact of their work, meeting participants identified a range of possible next steps for the field and AcademyHealth, including:

- Developing a common open science terminology for HSR to ensure mutual understanding of key principles and terms and developing a "suite of practices" for researchers and institutions to consider for adoption.

- Creating an AcademyHealth interest group focused on open science and open access policies and practices, including issues of diversity, equity, and inclusion.

- Developing training to help researchers avoid predatory journals and identify high-quality open access journals that charge fees and how to budget for the fees.

- Examining how the federal Evidence Act could help make data more available and less costly to health services researchers, such as establishing a national all-payers claims database.

- Designing training to help researchers learn how to identify and tailor takeaway messages for specific audiences, including policymakers, practitioners, communities, and other researchers.

This report summarizes the May open science meeting. Because the session was off the record, the report conveys general content without attributing comments to specific participants. The report's goal is to familiarize health services researchers with common open science practices and issues, especially open access publishing, rather than provide an in-depth review of the topic.

OPEN SCIENCE ASPIRATION: COLLABORATIVE INQUIRY TO ADVANCE KNOWLEDGE

Defying simple definition, open science is as much a state of mind for researchers as a range of practices designed to encourage open and collaborative inquiry and advance scholarship and knowledge. Spawned by reproducibility scandals in psychology research in the 2010s[3] and accelerated by ever-expanding digital communication and collaboration capabilities, open science—in one form or another—is here to stay, meeting participants agreed.

Open science advocates believe letting more sun shine on the inner workings of studies, including data and methods, and making findings widely and freely available will enable researchers to more efficiently and effectively replicate and build on each other's work. The ultimate goal of open science, according to a presenter, is to eliminate all the "bad reasons" that replication studies fail, such as opaque data and methodologies, and instead generate "[g]ood conversations, fruitful conversations—when an original finding and replication finding don't align or disagree with one another…because there was something to be discovered, there was some important factor that wasn't addressed or wasn't known about…those so-called hidden moderators or important variables."

THE OPEN SCIENCE 'BUFFET'—EAT AS MUCH OR AS LITTLE AS YOU LIKE

To zero in on aspects of open science most relevant to HSR, participants took a quick and unscientific poll. The results indicated that free/equitable access to scientific knowledge (68%) and quicker access to research findings (60%) eclipsed concerns about selective nonreporting and replicability of findings (see Figure 1 for full poll results).

A sampler of open science practices and concerns. Some open science practices may resonate more strongly than others with health services researchers, depending on levels of concern within the field about replicability of research findings. For example, preregistration of research studies, a requirement for clinical trials and increasingly common in mainstream science, may not be as much of a priority in HSR, which tends toward exploratory rather than hypothesis-driven research. "The majority of HSR is not really hypothesis testing," a participant said. "There are studies, where there is one main hypothesis or two, but a lot actually emerges during the study, and I would argue that approximately two-thirds of HSR is exploratory…so replicability doesn't really apply to the HSR field to the same extent." Another participant, however, stressed that HSR is not immune from needing replicability reality checks to ensure accurate findings.

Additionally, researchers may worry about being "scooped" if they preregister study protocols or having publication opportunities limited if exploratory findings fall outside the registered study design. Several participants familiar with preregistration, however, said the process typically only requires documentation of change in study focus and does not prevent publication of exploratory findings. The one area in HSR where routine use of preregistration reportedly has become common practice is among researchers conducting systematic reviews.

Figure 1. Open Science and HSR Priorities and Challenges

Free/equitable access to scientific knowledge (paywalls/gatekeeping)
68%

Quicker access to research findings
60%

Better research syntheses and secondary analyses
20%

Selective non-reporting
20%

Access to code and/or data
12%

Replicability
12%

Identifying studies and linking their products (e.g., all the papers on the same study)
8%

Better reporting in manuscripts
4%

Computational errors
0%

Source: Informal poll of AcademyHealth Open Science meeting participants, May 2021.

Given the array of open science practices, several participants underscored that embracing—even fully understanding—open science practices can at first be a bit overwhelming, with one saying, "My take-home message on that is not to be overwhelmed—don't try to take the whole buffet at once—take one item at a time." Moreover, some health services researchers likely are already practicing aspects of open science—for example, by making working papers and other gray literature freely available on websites or taking part in data collaboratives. "I think some of us are doing some of these things, but using different words for them," a researcher participant said.

HSR CULTURE CLASH?

Another challenge in advancing open science principles and practices within HSR is the very nature of the field, which spans multiple disciplines with varying academic cultures, practices, and expectations. As one participant said, "We have multiple cultures—we have a medical culture, we have a social science culture, we have a policy analysis culture. We even have sort of a health care delivery and management culture, and all of them have different standards for research. In the management culture, it's, 'Is the information actionable, even if it might not meet the standards of the top peer-reviewed journal.'" Moreover, another participant observed "that we are a community of researchers who are actually quite resistant to change…. We're also a community that doesn't dialogue very well…the culture of the disciplines that we're talking about here don't embrace change and are not very open to dialogue, both of which seem to me to be essential for open science."

Along with squaring cultural differences across the field, HSR faces tensions among academic researchers and applied, or embedded, researchers in health systems and industry, with the two facing different incentives but sometimes competing for funding, especially from government sources. Typically, academic researchers focus on publishing in peer-reviewed journals in their quest for promotion and tenure. In contrast, applied researchers embedded in health systems, for example, typically focus on real-world health care delivery problems—often dealing with "dirty data" that might not pass peer-review muster and embracing null findings as guideposts to

quality improvement rather than disappointing results unlikely to be published in a peer-reviewed journal. Nonetheless, to compete for external funding, embedded health system researchers are expected to publish in the same peer-reviewed journals as their academic colleagues.[4]

OPEN SCIENCE AND THE 'BLACK BOX' OF PEER REVIEW

Dating to the 17th century,[5] peer review—or subjecting one's "scholarly work, research or ideas to the scrutiny of others who are experts in the same field"[6]—is meant to enhance research and methodological rigor, quality, and credibility. The peer review process also anchors academic promotion and tenure policies as well as journal publication decisions and public and private funding awards, making the role of peer review a central issue in open science and the entire HSR ecosystem. Peer review can take many forms—for example, single- or double-anonymized review, open review, a hybrid of the two, and more—leading to characterizations of the peer review process as a "black box."[7]

Open science advocates believe such practices as using preprints—or posting research findings online before they are peer reviewed and inviting other researchers to comment—can improve the peer review process both through greater transparency and a larger and more diverse pool of reviewers. At its best, peer review arguably can winnow out studies with questionable data, methodologies, and findings before publication, but not always given the growing number of peer-reviewed article retractions in recent years.[8]

Several participants pronounced the current peer review system "broken," with one saying the status quo too often perpetuates bias and elitism rather than rigor and relevant new knowledge. "I think this is about bullying, and I think it is about power, and power is about bias and a whole bunch of other things that are very bad for science," a participant said. "I've heard stories, and I've experienced some of it myself, with people using the bully pulpit of peer review—both for funding and for publication, both of which are the currency that people need to advance their careers—as weapons to use against people…and the reasons are often trivial and completely arcane…but we put up with it."

Nonetheless, the general sense among participants was to improve traditional peer review practices, especially by focusing on greater diversity and equity, rather than casting peer review aside. "I think peer review in general makes things better, and the truth is we're using ever more complicated methods, and…just throwing things out there without having people who have the sophisticated analytic expertise to actually vet the methods looking at it first—I think that potentially would be problematic," a participant observed. Citing a "mentorship gap in peer review," one early career researcher also bemoaned the dearth of resources and support to build skills to be a good peer reviewer.

DISSEMINATION AVENUES OTHER THAN PEER-REVIEWED JOURNALS

As the HSR field strives for greater timeliness, relevance, and impact on policy and practice, the slow nature of the journal publication process and peer review emphasis on methodological rigor over policy and practice relevance can work at cross purposes with those aspirations. "Peer review assumes a certain level of quality at least, but relevance and utility not so much," a participant observed.

Preprints. One way to get new and potentially important findings out quickly and draw wider input is to use preprints—or sharing research papers online before or concurrent with journal submission—to solicit open peer review as a paper moves toward formal publication. Different preprint models exist across disciplines. For example, ASAPbio (Accelerating Science and Publication in biology) is a scientist-driven nonprofit working to foster open and innovative communication in the life sciences by promoting the use of preprints for research dissemination and transparent peer review and feedback on all research outputs.[9]

About 70 percent of preprints in the life sciences are ultimately published in journals, according to a participant, who pointed to **MedRxiv** as likely being the most relevant preprint server for health services researchers. Rather than an alternative to journal publication, the participant said preprints "complement the journal process, and they are extremely compatible with that process, because they accomplish this dissemination function, while that paper is still undergoing a closed review process that may only involve a few individuals…. I think there's been many examples of papers, where perhaps larger and more open scrutiny, could have perhaps improved or caught errors in the paper prior to its formal publication."

The COVID-19 pandemic has spurred use of preprints as a way to quickly disseminate early but important findings with immediate real-world impact while casting a wide net for peer feedback. At the same time, pandemic-induced urgency to publish also led to several notable article retractions from prominent journals and removal of at least one preprint after other researchers questioned the findings, according to published reports.[10] By then, however, "conclusions without scientific support" circulated through news and other media channels in some cases.[11]

Preprints also are gaining currency with some funders—notably, the National Institutes of Health (NIH) "encourages investigators to use interim research products, such as preprints, to speed the dissemination and enhance the rigor of their work" and allows preprints to be cited in NIH applications, proposals, and reports.[12] Other funders, however, have been less eager to embrace preprints when awarding grants. For example, the Australian Research Council, a federal funding agency, recently reversed a decision to ban citation of preprints in funding applications after protests from researchers and the academic community.[13]

Less clear is the extent to which academic institutions use or value preprints in recruitment, promotion, and tenure decisions. Specific to HSR, one participant pointed to a lack of robust discussion of HSR papers, saying that even when discussions are open and available, they are rarely used.

Working papers. While not exactly preprints, National Bureau of Economic Research (NBER) working papers are an avenue used by the economics field as an "escape valve" to get findings out quickly and circumvent the discipline's "broken" peer review process, as one participant said, adding, "I've heard editors at the top journals…say the problem is not that 'I don't have enough good submissions; it's that none of my reviewers will recommend to accept the papers'…. It's a demonstration of ingenuity as a reviewer to just bad mouth papers no matter how good they are, so I think NEBR working papers are the only way things get out in a timely way."

And while NBER working papers are widely cited and used in the policy sphere, they are not peer reviewed—a fact that several participants noted they don't believe is widely understood by policy-makers and others. "Not only don't they know that it's not peer reviewed, the final version that does go through peer review often has nontrivial differences from the working paper version, and people continue to cite the original working paper with the incorrect or non-finalized results," a participant said. So, while there are timeliness and access advantages to NBER working papers, the participant cautioned against "emulating" the practice. Moreover, only NBER-affiliated scholars can publish working papers, and replicating such an oversight structure for other fields could be challenging.

Nonacademic HSR. Participants also discussed the role of nonacademic research conducted by consultants, nonprofits, think tanks, and universities, particularly on behalf of state governments and foundations. For example, many nonacademic studies and technical assistance of health reform models and demonstrations ultimately are funded by the states or the federal government.

"Nobody would disagree that there's a lot of really excellent work being published that's not in the traditional academic space, so how do we think about that?" a participant asked. "But on the flip side, there are plenty of questionable research practices in the nonacademic research space, so how do we address that question."

In keeping with open science principles, greater transparency and access to nonacademic HSR findings could help avoid duplication of effort and encourage collaboration and compilation of shared and open data. One area cited as ripe for such innovation is Medicaid, where multiple payment reform and quality improvement initiatives occur across states, according to a participant.

OPEN ACCESS AND COMPETING AND SOMETIMES PREDATORY PUBLISHING MODELS

Getting HSR findings out from behind paywalls struck a positive chord among participants, prompting one to ask: "Why aren't we more involved in HSR in this whole evolution of the open access movement, and shouldn't we be?" Another participant pointed to a recent commentary, titled "The truth is paywalled but the lies are free," which spells out the potential perils of keeping high-quality, vetted journalism and academic journals behind paywalls while massive amounts of free dis- and misinformation spread like wildfires across the public square of social media.[14]

Open access to research seems straightforward at first, but the tangled web of scientific publishing, competing business models, peer review, and who pays for what and when are difficult to unsnarl. "I think, in some ways, these things are interconnected—the issues around openness of peer review, open access, and other things, and in some ways, they are completely separable, so that you can say let's deal with an open access question that has nothing to do with how you do or don't manage peer review, but ultimately, there will be ripple effects, and it will matter," a researcher and journal editor observed.

Competing payment models. Historically, academic journals have relied on individual and institutional subscriptions or per-article fees—paywalls—to access content. Newer open access academic journals instead rely on author-paid article processing charges, known as APCs, to provide free online access to articles.

"We basically have two models of publication right now," a participant said. "So, one is—I'll just call it the *New England Journal* or the *JAMA* model, which is that individual subscribers and institutions pay a bunch of money to an organization and that's how they make their money. And they can be not-for-profit or for-profit, but they're going to act the same way, and that pays for them to hire editors and to publish and all that sort of stuff. And that's sort of the more traditional model, but now we have this new open access model that makes everything openly available as another financial model, which is that you have to pay a lot of money to get your papers published."

Both models have implications for researchers at academic institutions without the resources to pay either burgeoning costs of subscription-based journals or steep APCs to get their findings published, raising issues about diversity, equity, and inclusion and their importance to generating relevant and actionable research findings.

Scientific publishing morphs from cottage industry to oligopoly. Starting in the late-1990s, the mostly cottage industry of nonprofit print academic journals published by individual disciplines and learned societies found itself on the wrong side of the digital divide. Many journals were bought by a handful of mega, for-profit scientific publishers with more sophisticated digital platforms and varying degrees of editorial and peer review. By one 2015 estimate, five companies published more than half of all research papers in the natural and medical sciences in 2013, up from 20 percent in 1973.[15]

Getting articles "through the mill of peer review and then keeping your publisher happy on top of it, which in the open access world means bringing in article processing charges and publishing as much as you can—they're very enthusiastic about that—but this is not necessarily the best science," a participant with editorial experience said. "So, there's a real set of issues here that are perverse incentives and very problematic issues that are frankly not being discussed or don't work."

Predatory for-profit journals. While the push for open access journals stemmed from a desire to democratize information and advance knowledge, one unfortunate unintended consequence was an explosion of predatory journals willing to publish virtually anything—sans peer review and other quality checks—for a fee.[16] Incentives facing academic researchers to publish or perish on the road to promotion and tenure also create a niche for predatory journals offering seemingly legitimate publication.
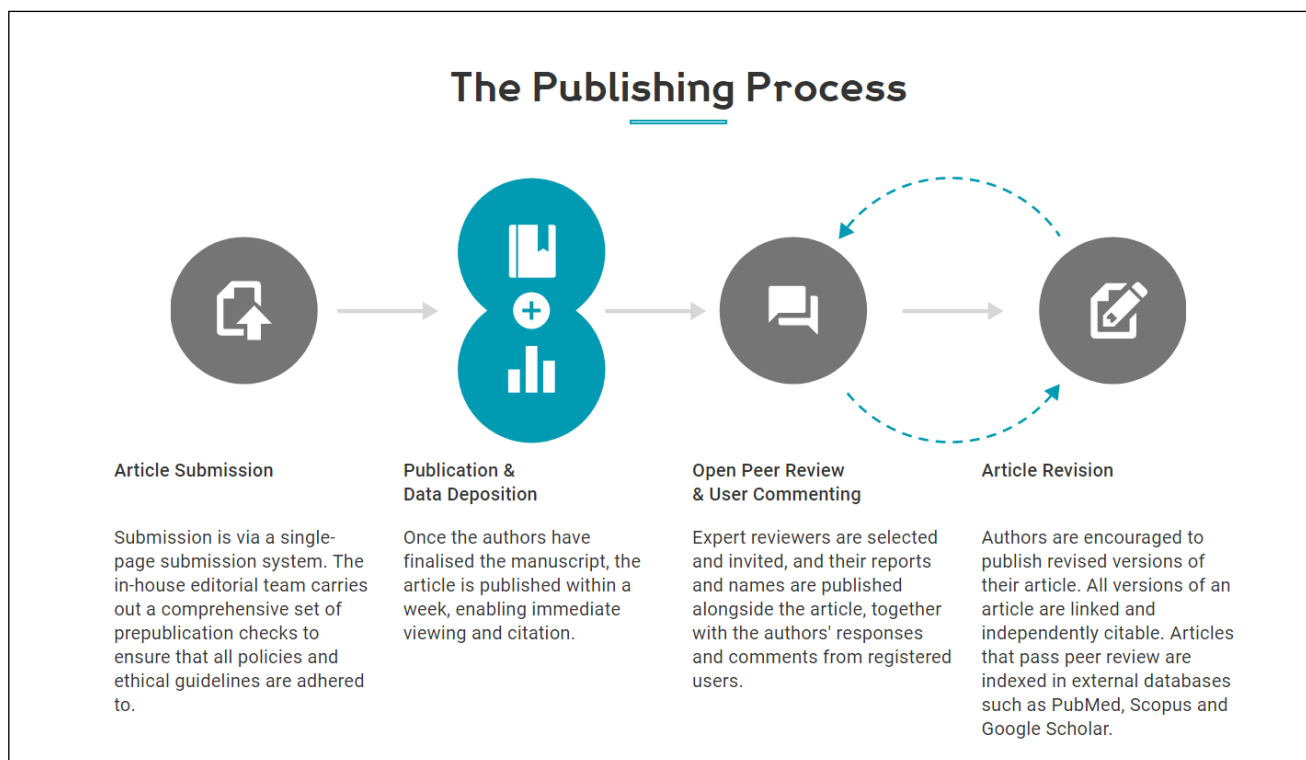
"I get like 10 emails a day—although I think they're getting mostly filtered out as spam now—from some for-profit publishing company who's inviting me to publish in their journal with 24-hour review times, and it's only going to cost me $5,000 or whatever, and at some point there's a line, but I don't actually think it's a clear line, I think it's a fuzzy line, and if we're going to go forward with some policy where everything has to be open access, we need to figure out how we're going to deal with the whole vast industry that we're going to multiply that's going to try to get at that trough," a participant said.

OPEN ACCESS AND THE HSR ECOSYSTEM

As the field explores open access as a way to increase the relevance, timeliness, quality, and impact of HSR, the surrounding ecosystem—public and private research funders, academia, and peer-reviewed journals—also must adapt and evolve.

Research funders. Given the large share of HSR funded by the federal government, particularly NIH, participants agreed that if the federal government required open access, "things would move." However, a previous effort to require open access to all NIH-funded research drew strong opposition from large scientific publishers, resulting in a compromise that all NIH-funded research must be open access 12 months after publication and available through *PubMed Central.*[17] Private research funders also are active in pushing for open access to research findings, with some like the London-based Wellcome Trust launching an open access journal to publish trust-funded research (see Figure 2 for a description of the Wellcome open research publishing process). Wellcome also is part of an international group of public and private funders committed to open access publication of their funded research.[18]

Figure 2. Wellcome Trust Open Research Publishing Process

The Publishing Process

Article Submission

Submission is via a single-page submission system. The in-house editorial team carries out a comprehensive set of prepublication checks to ensure that all policies and ethical guidelines are adhered to.

Publication & Data Deposition

Once the authors have finalised the manuscript, the article is published within a week, enabling immediate viewing and citation.

Open Peer Review & User Commenting

Expert reviewers are selected and invited, and their reports and names are published alongside the article, together with the authors' responses and comments from registered users.

Article Revision

Authors are encouraged to publish revised versions of their article. All versions of an article are linked and independently citable. Articles that pass peer review are indexed in external databases such as PubMed, Scopus and Google Scholar.

Source: Wellcome Open Research. Accessed at https://wellcomeopenresearch.org/about.

Major U.S. health-related foundations, including the Robert Wood Johnson Foundation and Bill and Melinda Gates Foundation, require that funded research be published in open access journals and will pay related journal APCs if certain requirements are met.[19]

Academic incentives. Realigning academic incentives away from counting a researcher's number of peer-reviewed journal articles toward conducting research with real-world impact also can encourage open science principles, including open access, designed to advance knowledge and solve societal problems. Noting that there is too much emphasis in tenure decisions, for example, on journal impact ratings, a participant said, "We need to think about where research is published, not because you're going to have a high impact factor, but because it's the audience you're trying to reach."

Similarly, academic recruitment, promotion, and tenure practices rarely acknowledge publications, such as blog posts, that may have greater reach than a peer-reviewed journal article. "I have one *Health Affairs* blog article, and I get more email about that article than anything else I've written in my entire academic career—people actually find it, but it doesn't count for academic promotion or anything because it's a blog," a participant said. At the same time, promotion and tenure policies are evolving, with some university promotion and tenure committees beginning to give serious attention to this kind of high-impact, high-reach work, another participant said.

Peer-reviewed journals. As funders adopt more stringent open access publishing requirements, subscription-based academic journals important to the HSR field, like *Health Affairs* and *Health Services Research*, will have to adapt to survive. Both are hybrid open access journals, meaning they continue to rely on subscription-based revenue but also offer online open access to articles for an additional charge—a practice discouraged by some funders. In some cases, journals are developing so-called overlay journals, or spinoffs from the flagship subscription-based journal, that publish open access articles.

BEYOND OPEN ACCESS: CURATING AND TRANSLATING FINDINGS FOR POLICY, PRACTICE, AND RESEARCH

While open access may be necessary, it is likely to be insufficient alone, in advancing HSR relevance, timeliness, quality, and impact. Simply opening the "floodgates" of research findings would lead to information overload with no trusted intermediary to sift through the good, the bad, and the ugly of research findings. "I think we have a big problem of excess volume of stuff that people are doing to get promoted in order to jump through hoops, checklists, whatever, and we have a serious problem of relevance, importance, and utility that we are not addressing," a participant said.

Similarly, another participant said, "Open access is a small piece of it—how do you break through with quality, and as a consumer on the policy side, how do you sift through everything to know what actually is not just relevant but is good and actionable."

Traditionally, journal editors have played a key role in separating the research wheat from the chaff, but primarily through the lens of white men.[20,21] A good first step for the field would be to prioritize making research more relevant and actionable through more transparent, diverse, and equitable editorial and peer review, with one participant saying, "Trusted intermediaries are there for some, but they are definitely not representative. So, how do we get to aggregators and trusted intermediaries who are more reflective of the diversity of voices and needs?"

To truly "democratize" relevant findings, the next step is to translate findings in ways that meet the specific needs of diverse audiences, including policymakers, practitioners, patients, communities, and other researchers. "Open access is going to be the future of publication in some way, shape, or form…. I think focusing on how we make that content…more accessible to people is something that we should think about," a participant said, adding that "knowledge synthesis" will become increasingly important—"that's where the value add is going to be coming from."

And effectively synthesizing evidence depends on understanding the needs of the targeted audience, with a participant saying, "We need to be very specific about the audience. I think synthesizing evidence for policymakers is very different from synthesizing evidence for researchers, so they can ask the next, better question…and decrease all that noise that's coming through our publication channels."

IMPLICATIONS

As the field continues to innovate and strives to improve the quality, timeliness, relevance and impact of research findings, aspects of open science, particularly open access publishing, may help improve dissemination and access to HSR findings by policymakers, practitioners, communities, and other stakeholders. At the same time, effective efforts to curate and translate research findings into accurate, accessible, and actionable information tailored to specific audiences likely will help increase take up of HSR findings in policy and practice.

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