For hundreds of years, medical journals have served as arbiters of the quality of medical research. But the traditional peer-reviewed publication model is fraying. The hierarchical gateway to publication, historically in the hands of experts, is at odds with the ubiquitous democratization of data and information in the 21st century. The impending revolution in the approach to evaluate and disseminate scientific findings is not an indictment of the talent, intentions, or products of editors and reviewers, but rather a response to a model that simply may have run its course given societal and technological change.

The *Circulation: Cardiovascular Quality and Outcomes* team has had the privilege to found and lead this publication. My thoughts about the state of publication derive from my experiences as an editor, an investigator, an avid reader of the medical literature, and a seeker of ways to improve health care. My observations are as much or more about my own journal as they are about others. As our group approaches the end of our terms, it seemed to be a good time to reflect on the medical journals.

Journals are facing fundamental challenges that can only be overcome through relentless innovation and a willingness to leave the security of an outdated model. There are at least 9 deficiencies in the current model that fuel the sense that journals as we have known them are approaching their final act.

### Too Slow

The publication process is a long one. The time from the initial submission of an article to its publication can be half a year or more. There are exceptions, and some papers are expedited, but that is not the typical experience. Despite efforts to streamline the process, obstacles remain in the timeliness of publication. Improvements such as online posting and digital transactions with reviewers and editors have reduced times, but it still takes many months even for papers that require only a single round of review. Moreover, many contributions are considered by multiple journals and most articles take a year or more to be publicly available. The idea that much of the medical literature lends itself to this leisurely timeline raises the issue that if new knowledge in medicine is not time sensitive, perhaps it is not important enough to be published. Other fields provide the opportunity for public posting of new publications and a public peer review process long before the print version. In the future, these types of delays in the transmission of new knowledge will likely not be acceptable.

### Too Expensive

From the perspective of authors, the expense of publishing is growing rapidly. Page charges, even from journals that produce profits, drain vital resources from the research enterprise. These funds often must derive from sources other than grants and can be an obstacle for many investigators. It is not uncommon for a publication to cost in the range of $3000 to $5000, particularly for open access. From the perspective of journals, even though their value derives from content provided by investigators and from reviewers who donate their time, costs of maintaining a model that requires a web presence and an infrastructure of editors and staff, along with sales personnel, are increasing. From the perspective of libraries and subscribers, the price of the journals can be prohibitive. For the public, timely access to articles in journals that do not have open access is also too expensive. In the future, medical knowledge will likely be considered a social good and cost barriers will not play their current role.

### Too Limited

The configuration of articles within most medical journals prohibits a comprehensive and in-depth approach to a scientific question. The format generally requires the investigators to chunk their work into contributions that fit within 3000 to 5000 words and no more than a handful of tables and images. Supplementary files are allowed, but a published article typically must be limited to executive summary length. Therefore, for substantive investigations, the published work represents only a fraction of the knowledge that was generated to address the research question. But more expansive presentation of findings can, in many cases, have value. In the future, investigators will have the capacity to fit the structure of the presentation of new data to the needs of the project; constraints on format, beyond those that improve readability, will be unnecessary.

### Too Unreliable

Peer review and the journal decision-making process occur without much external scrutiny and transparency. The way that journals select or eliminate contributions is rarely evaluated and routine metrics of success are absent. It is not unusual for similar-tier journals to arrive at different decisions about
the same article. Reviewers donate time, the quality of reviews is variable, and there is little accountability for performance. Moreover, biases can go unappreciated. The impact of articles published in high-profile venues may derive as much from the venue as from the quality of the science. In the future, there will be a growing interest in a more reliable and open process, one that can be subject to iterative improvement and public comment.

Too Focused on the Wrong Metrics
Journals vie for prestige, which brings them attention, authors, and revenue. The impact factor has gained an edge among all potential measures as a means of ranking journals. Many journals are internally and externally judged by their relative position on the impact factor list, which is issued annually to increasing fanfare. The drive toward simplified metrics that inadequately capture the performance of a journal can distort decisions about what to publish and encourage a culture of pandering to the citation rather than seeking to advance scientific knowledge and improve clinical practice. The flaws of the impact factor are well characterized, but its pre-eminence is unquestioned. In the future, the success of a vehicle to communicate scientific information will probably be gauged by much more than a narrow view of performance centered on frequency of citations.

Too Powerful
Except for a few scientific contributions with obvious and substantial importance for clinical practice, acceptance of a contribution involves discretionary decisions. Much like college admissions, editors face thousands of submissions that could qualify for acceptance, and they must make choices for limited spots. That discretion and the importance of publication, particularly among the journals with the greatest prestige, place the editors in a remarkably powerful position. Publication in such a journal can transform a career or influence millions of dollars or more in sales of a product. That concentration of power exerts substantial influence over perspectives and information that are disseminated broadly in the press, and that guide the public and policy makers. In the future, the scientific community may prefer that such influence is more broadly and openly distributed, rather than placed in the hands of the few.

Too Parochial
Journals tend to lack diversity in their editorial groups. This applies to sex and race/ethnicity, as well as national origin. Science knows no national boundaries yet journals seem to have national, and sometimes even regional, preferences with regard to their selection of submissions. Given the lack of transparency in the decision-making process, it is difficult to capture data to evaluate this perception, but it is commonly expressed that journals tend to favor contributions from their countries of origin. They may also prefer content that reflects the preferences and interests of their editors. In the future, the value of scientific knowledge will increasingly lie in its evaluation by the larger scientific community, uninfluenced by the imposition of favoritism—implicit or explicit—by a select group.

Too Static
The journal publication is currently a static product, presented as a singular contribution rather than as a living document. It can be corrected or retracted, but it is not interactive and has no capacity for iterative change spurred by input from the larger audience. Many scientific projects might be better presented as an interactive website with the opportunity for the community to probe the findings and provide feedback. Creative visualizations of data are often best presented in ways that allow images to be rotated and manipulated for better understanding. In the future, novel strategies for conveying knowledge and engaging readers will probably emerge, leaving behind the static presentation of results that offers limited options for interactive understanding.

Too Dependent on a Flawed Business Model
Journals have been a good business. For organizations and corporations, they have been cash cows. The model from the author’s perspective has been likened to a restaurant in which the customers cook the meal and then pay the bill. Despite the profits, page charges abound and reviewers are unpaid. The contributions in kind to journals are immense. The availability of editorial support that could improve the quality of the contributions is the exception rather than the norm. For those journals with hefty advertising revenues, there are issues—generally unexamined—surrounding conflict of interest. Journals rarely, if ever, expose their advertising revenue sources even as disclosure is mandatory for authors. Almost all journals separate their business and editorial functions, but every editor is aware of which articles are likely to produce revenue through reprints—and which companies support advertisements. In the future, there will likely be interest in business models that rely less on revenues that tax authors and reviewers and depend on support from industry.

Conclusions
We have arrived at the juncture where medicine and science need new vehicles for the dissemination of knowledge. These new approaches will enable us to separate the wheat from the chaff in order to better serve the public. The question for all of us in medical publishing—and for those who consume medical knowledge—is how that would best be accomplished in a new world that is flat, digital, and transparent.

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