What Does the Future Hold for Scientific Journals? Visual Abstracts and Other Tools for Communicating Research

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Abstract

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Journals fill several important roles within academic medicine, including building knowledge, validating quality of methods, and communicating research. This section provides an overview of these roles and highlights innovative approaches journals have taken to enhance dissemination of research. As journals move away from print formats and embrace web-based content, design-centered thinking will allow for engagement of a larger audience. Examples of recent efforts in this realm are provided, as well as simplified strategies for developing visual abstracts to improve dissemination via social media. Finally, we hone in on principles of learning and education which have driven these advances in multimedia-based communication in scientific research.

The traditionally stagnant field of scientific publishing is currently in the midst of a revolution driven by disruptive innovation. The rate at which science is evolving has been met with comparable acceleration in the methods used to review and distribute scientific material. The increased use of web-based content, electronic publishing, and open-access mediums has resulted in new opportunities for researchers and publishers alike. Through it all, journals have been established to build knowledge, communicate novel findings, validate research, and build scientific communities.[1] Although the process by which journals accomplish these goals is significantly different than before, these guiding principles remain true. In this section, we will discuss the evolution of scientific (in particular surgical) journals in the 21st century—highlighting current priorities and proposing future directions.

Evolving Role for Journals

An appreciation for the complex role journals play in academic medicine is necessary for one to understand the evolution that has taken place over the past decade. These fundamental responsibilities, described by Schaffner[1] more than 20 years ago, include (1) building a knowledge base, (2) communicating information, (3) validating research quality, (4) distributing rewards, and (5) building scientific communities (►**Fig. 1**). More than two decades since Schaffner's description, the principle functions of journals still hold true. Fortunately, the mechanism by which journals go about performing these functions has drastically changed as a result of technologic advances that have been made in such a short period of time.

Building the ever expanding knowledge base is considered one of the principle objectives of a journal. Maintaining this knowledge base has become more difficult as it has become quite clear that we are in the midst of an information boom. For example, a simple search on PubMed.gov today will reveal 119,062 results for "colon cancer," with nearly 58% (68,928) of work being published since 2000. These dramatic increases in data have corresponded to the popularity of open access journals.[2] Open access journals were innovated in the beginning of the 21st century, when the Public Library of Science (PLoS) and BioMed Central (BMC) implemented alternative strategies to fund their publication costs. By charging scientists "up-front" fees to have their work reviewed and potentially published, these journals
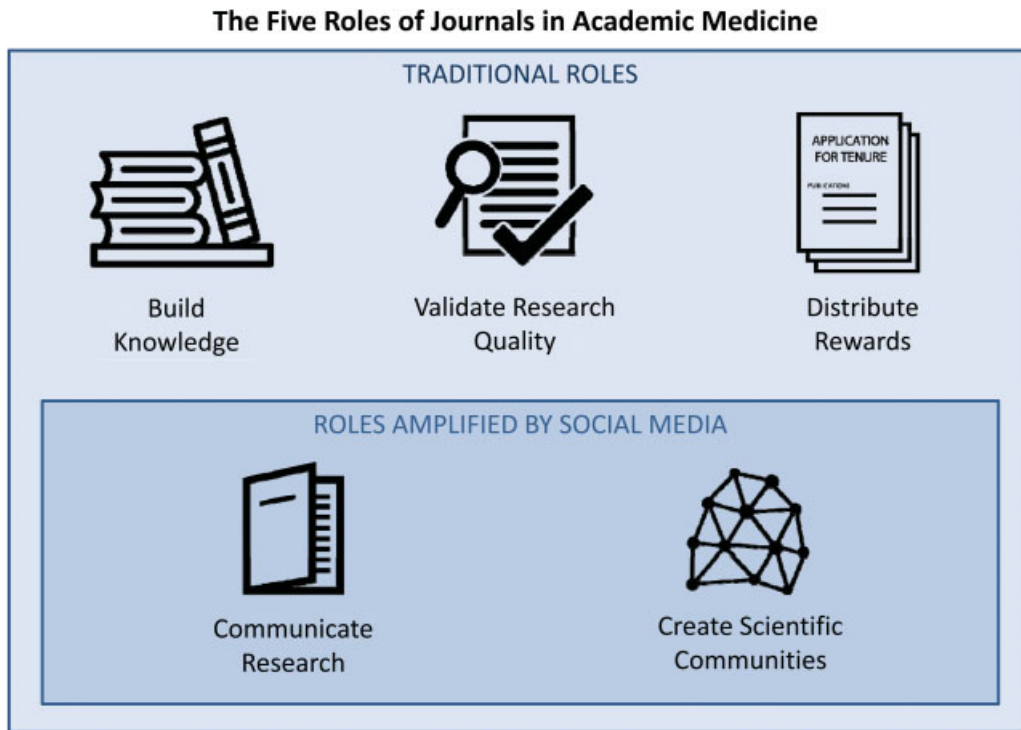
The Five Roles of Journals in Academic Medicine

TRADITIONAL ROLES

Build Knowledge

Validate Research Quality

Distribute Rewards

ROLES AMPLIFIED BY SOCIAL MEDIA

Communicate Research

Create Scientific Communities

Fig. 1 The five roles of journals in academic medicine: originally described by Schaffner[1] two decades ago. We believe these roles still hold true. The advent of social media has allowed for amplification of communication and development of broader communities.

were no longer dependent upon subscriptions to fund their enterprise. As a by-product, a major incentive posed to potential authors was that these journals could expand the readership from the limited number of individuals holding subscriptions for traditional journals to anyone with internet access. Proponents of open access publishing state that this method of publication upholds the basic principles of scientific sharing.[3] Additionally, many believe that publically funded projects should in fact be readily available for general consumption, review, and critique, rather than being hidden behind member firewalls. As such, it is not surprising that open access publications have dramatically increased in popularity—with nearly 10,000 such journals currently in the marketplace.[4] Many of these open access journals have online-only publications, which dramatically lowers production and distribution costs.

This leads to the next responsibility of journals: effectively communicating findings to the academic community and providing a mechanism for others to provide commentary. Traditionally, communication of content was rather restrictive and formalized. Readers would be able to access an article either through print or a licensed account. Questions, comments, and thoughts related to the article could be communicated to the journal through letters to editors. Once received, editors could selectively disseminate letters through publication, or ask experts in a field for their commentary on an article. These attempts at fostering communication were quite formalized and done in a delayed fashion. These communications may be missed and did not always receive the same degree of attention as the original publication due to the time delay.

Fortunately, communication between editors, authors, and readers has significantly improved over the past few years. Through social media and web-based content, we are better able to assess articles and get a better understanding of their significance. Metrics such as electronic article views or downloads can provide authors with a better assessment of the immediate impact of the work.[5] Finally, readers from all over the world are able to engage with one another through a variety of mediums to further discuss the implications of a study and determine the future studies that may be worth conducting. These communications have broken down the traditional hierarchy associated with academia.[6]

Validation of research standards is one of the most challenging responsibilities that journals must accept. The increasingly competitive nature of science has resulted in unintended consequences related to fraud and error. Articles are, by definition, reviewed by peers, who may have similar limitations in evaluating the quality of content, the details of the statistical analysis, or the sources cited. Just as surgeons have become more subspecialized in practice, research has become more subspecialized. Scientists are more frequently being asked to review work that is substantially different than their own interests and field of expertise and thus reviews have the potential to be based more on opinion than strict reliance on scientific principles. To counteract some of these biases and limitations, journals such as the *British Medical Journal* and *Nature* have experimented with novel approaches to review, including public commentary of electronic pre-prints through social media.[4,7]

Journals play a direct and indirect role in the distribution of rewards. In academics, the mantra "to publish or perish" underscores the direct rewards associated with favorable results in publication. Faculty members are constantly judged by the quantity and quality of their research. Publications as a first or senior author in high-impact journals are subsequently rewarded through a promotional system intricately tied to scientific accomplishment and merit. Funding for future work is similarly allocated based on prior success, supporting the notion that publication serves as the currency of academic promotion. The same pressures apply to journals themselves, who are always trying to increase citations, which is viewed as a surrogate marker for high-quality scientific knowledge.

Building communities for individuals with similar scientific interests is another responsibility for journals. In the past, these communities were quite cyclical in thoughts and goals. Like-minded individuals would seek out conferences in which topics of interest were discussed. These individuals would support and review each other's work to perpetuate the science in a nonblinded fashion. This science would be disseminated to others interested in the field and the process would repeat, thereby satisfying a self-fulfilling prophecy. With the advent of the internet, web-based interactions have taken these logical, homogenous communities and changed them drastically. With minimal required prerequisites, individuals can witness interactions between experts in real time or pose questions to leaders in a domain they have limited experience in.[8] As journals evolve, further embracing these methods will be crucial for science to be effectively disseminated and for readers to continue to have confidence in the content of journals.

While journals remain committed to all five responsibilities, we believe that growth and adoption of social media will allow journals to particularly excel in communicating research and creating scientific communities (►Fig. 1). We, therefore, dedicate the remainder of this article to explore those two further.

Communication of Research through Visual Abstracts

What Is a Visual Abstract?
In simple terms, a *visual abstract* is a visual representation of the key research findings of an article typically found in the abstract. The first visual abstract on social media was created in July of 2016 by the *Annals of Surgery*.[9] The purpose of a visual abstract is to efficiently communicate the key elements of the research article to a potential reader to help them decide if they want to pursue the article further. One might think of it as a "movie trailer" of research articles.

It is important to say what a visual abstract is not. A visual abstract is not a substitute for the written abstract and certainly not a substitute for reading the article. One should now draw conclusions from the visual abstract except to determine whether or not they want to continue on to reading the full article. It is impossible to include all the aspects of a complex article on a single slide, and therefore potential limitations or sources of bias which can be addressed in an article are not included in these brief teasers.

Components of a Visual Abstract
Since the inception, the authors have developed a standardized format, which has been adopted by several journals. Visual abstracts typically contain the following components which are summarized in ►Fig. 2:

Summary of key question being addressed: This typically reflects the title of the article, or the key objective of the study.

Summary of outcomes: This states the main finding or findings, typically the primary outcome of the study. Depending on the nature of the research, secondary outcomes may also be reported here.

Identification of author, citation: The citation should be very clear, including the author, journal name, and date. In addition, the full title may also be added if space permits, so
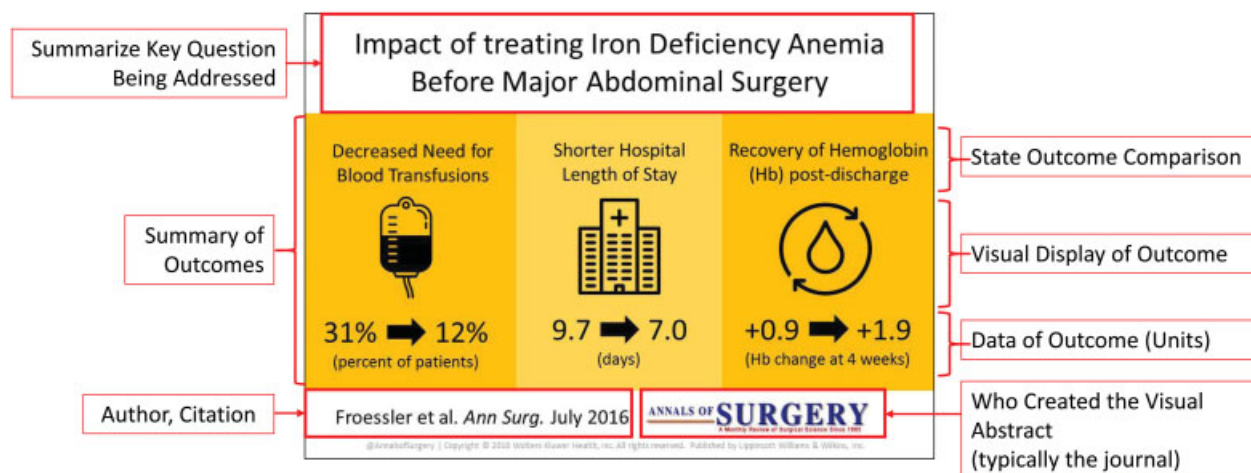

Fig. 2 Components of an effective visual abstract. (Modified and adapted with permission from Andrew M. Ibrahim and the *Annals of Surgery*.)

that readers can easily identify the source of the full manuscript for further information.

States outcomes comparison: A short phrase that clearly states the outcome with respect to groups being compared is important to ensure language is as close as possible to that which is directly in the article.

Visual display of outcome: Each outcome should be represented with an appropriate visual. This can be one of the more challenging aspects of creating a visual abstract, but what helps make it effective.

Data of outcome: Each stated outcome should be supported by the data from the article, including the numeric value and the units. When possible, absolute differences should be reported (e.g., 30-day mortality of 2 vs. 1%) as opposed to a relative difference (50% reduction in mortality.)

There are different formats for visual abstracts. By using the hashtag #VisualAbstract on social media, many of them can be found. In addition, a free, open source primer on how to create one is available online.[9]

How Are Visual Abstracts Used?

Visual abstracts have been adopted to serve several purposes. First, and most commonly, editorial boards are using visual abstract to highlight articles from the journal. To date, the authors of this section have spoken with more than 15 editorial boards who are pursuing some form of the visual abstract in their social media dissemination strategy. Second, many authors have been creating visual abstracts to help draw attention for journal club articles. Online journal clubs are becoming increasingly popular with visual abstracts being a succinct format to describe the content of the event. Third, presenters have incorporated visual abstracts into slides. Because the visual abstract contains the key elements of a study, it can be a very helpful way to guide a discussion about the work within a presentation.

Design Principles behind Creating an Effective Visual Abstract

The success of effectively using visuals to communicate research relies on embracing important design thinking principles. These principles are well known to people in fields of multimedia graphics and architecture, but more recently have been popularized by their wide adoption into business and consulting firms.[10,11] Here, we discuss five of the most relevant principles in creating a visual abstract.

Principle 1: Focus on the User Experience

Any design process always begins and ends with the user in mind. In this case of visual abstracts, the user is often a clinician and/or researcher who is on social media. Such a person is likely filtering through a lot of content quickly within a busy work day to find something of interest to read or share.

Principle 2: Clarity of Purpose

Effective communication is often simple. Although many of the research articles in surgery are complex and nuanced, the goal of a visual abstract is to simply inform what the article is about. By focusing on the purpose of the article—hopefully stated clearly in the manuscript!—a visual abstract has its best chance of engaging a potential reader.

Principle 3: Rapid Prototyping

Because there are infinite ways to communicate a message visually, it is worth testing several. Design thinking embraces the ideas of "rapidly prototyping" to encourage creativity. Most adopters of visual abstracts find that their first, second, or even fifth idea was not the final design, but were help forms of "trouble shooting."

Principle 4: Iterative Improvement

Much like surgical procedures, creating a visual abstract has a learning curve. Just as a surgeon does not perform an operation perfectly on the first attempt, those creating abstracts should focus on trying to iteratively improve their design. This can be facilitated significantly by seeking out feedback from peers not familiar with the content area of the research.

Principle 5: Thoughtful Restraint

Keeping in mind that the visual abstract is only a "preview" for the article and not a substitute, one should prioritize the key message over completeness. Adding too much information or detail to a visual abstract (while perhaps more "complete") can take away from the focus and make it less effective. This approach has been more controversial than some of the other components of a visual abstract, and thus this "simplified" approach has not been adopted by all journals. Some editorial boards believe that the omission of some methodology or other information could misrepresent the true meaning of the abstract (either by overemphasizing nonstatistically significant findings, not mentioning important limitations, or other problems). Thus each journal has taken its own approach, with variations on a common theme.

Challenges to Creating a Visual Abstract

There are several challenges to creating a visual abstract that deserve mention. They stem from the fact that most of us creating and consuming visual abstracts are more accustomed to other, more text-based forms, of engaging research. First, there is concern that a visual may be an over simplification of the actual research. For some study designs, this is inevitable and a potentially very real problem. This gets to the central core missions of a journal function, and how a visual abstract can be an extension of this purpose. It is important to remember that a visual abstract is not a substitute for the article, but instead serves as a "preview." Second, identifying appropriate visual designs can be challenging while abiding by copyright restrictions. This challenge can be mitigated by searching for copyright-free images online, or by subscribing to an image data bank (e.g., Shutterstock Noun Project) that provided copyright-free images, or by using copyrighted images owned by the journal publisher with permission. Third, it is possible that

the findings communicated in the visual abstract are presented in a way that is visually easier to grasp, but may be different from those stated in the original article. To prevent this from occurring, most journals have a policy that any visual abstract must be reviewed by at least one other editorial board member before it is disseminated. There is a potential conflict of interest with author-only created visual abstracts, which is why it is important to be reviewed by unbiased editorial members.

Finally, creating a visual abstract takes time. On average, a good visual abstract may take anywhere from 1 to 3 hours to create. This can be prohibitive to many busy surgeons and researchers who serve on editorial boards. Thus, they often need to recruit individuals to join their team (e.g., medical student, research fellow, designer) to help with the production. This has been done effectively by some anesthesia journals, which may have more resources to devote to these production and multimedia challenges.

Additional Dissemination Strategies Using Web-Based Content

In addition to visual abstracts, journals have also started to incorporate other innovative approaches that leverage social media help communicate their research.

E-Mail Distribution of Table of Contents

Many journals e-mail subscribers with a table of contents, with links to articles. This is typically done before the print journal is mailed out. Some journals also have a smart phone application or allow users to put an icon directly linking to the current table of contents page on their smartphone. Other journals have even considered discontinuing the print version entirely. In a digital age with a global marketplace, production costs are a barrier to wider dissemination of scientific material. Particularly when viewed as a cost per citation (a 1990 investigation[12] suggested that 55% of articles published between 1981 and 1985 received no citations at all in the 5 years following publication), this added expense can seem unjustified.

Video Abstracts

Similar to a visual abstract, some journals are now allowing authors to submit a video abstract, in which they summarize the major findings of the article. The *Journal of the American College of Surgeons* and the *Diseases of the Colon and Rectum* journal are among those that support this author-created feature.

Video Reviews

The *Journal of Pediatric Surgery* has established an innovative approach to disseminating information via video reviews of key articles. These videos, hosted by Dr. Todd Ponsky, feature 2-minute reviews of key journal articles. Residents, fellows, and faculty with no association with the presented work provide concise summaries of the main findings of the articles in question. Simple figures and "chalk talks" result in an immersive and natural experience for the viewer.

Videos discussing recent articles related to diagnostic approaches to appendectomy[13] or hospital outcomes following laparoscopic fundoplication[14] have been posted. Similar videos are being developed by Elsevier and are broadcasted on the publisher's YouTube Channel (https://www.youtube.com/user/Elsevierpublishing). These video abstracts are 5-minute videos developed by the author and meant to relay the main points of their manuscript in a simple and visually stimulating manner.

Podcasts

While visual and video abstracts are meant to serve as a snap shot of a manuscript, they lack a personable nature. When executed well, these multimedia supplements to a manuscript are intentionally refined. The message is delivered in a directed manner without the opportunity to ask questions. Though they serve the role of improve retention of information, they provide very little insights about the reasons for why a study was performed or opportunities to interact with the authors.

Given these limitations, journals such as the *Disease of the Colon and Rectum* have initiated programs geared toward not only highlighting important articles but also providing authors and guest discussants an opportunity to engage in conversations about the impetus and implications of certain studies. Hosted by section editor Dr. Kyle Cologne, these podcasts generally range between 20 and 30 minutes and feature an author from the article and a guest discussant/reviewer. Recent discussions have included conversations about preoperative immunonutrition[15] and classification of readmissions based on the day of rehospitalization.[16] Even more recently, the podcasts have been aligned with visual abstracts also created by the journal for an additive effect. An alternate approach has been taken by the *New England Journal of Medicine*, which has an editor summarize briefly the original research contained in each weekly edition of the journal (without additional commentary).

Why Are Journals Becoming More Visual?

Rationale for the Success of Multimedia in Science

Although these contemporary approaches to dissemination of research are considered to be novel, their success is likely related to well-defined mechanisms of learning that have previously been described in the cognitive theory of multimedia learning (CTML).[17] As we described earlier, the content available for any given field is growing at nearly an exponential rate. With such a large volume of data available for consumption, these unique endeavors have allowed readers to develop more meaningful learning experiences through multimedia. As one analyzes these supplemental resources, they soon realize that readers are being encouraged to engage multiple types of cognitive processing before ever reading the first line of a manuscript. These supplements serve to highlight and organize a selection of words or images to simplify the integration of verbal and pictorial models. As journals refine methods to engage readers, focus should be turned to maximizing the instructional design of

Table 1 Principles for instructional design of multimedia education[18]

Reduction of extraneous processing	Management of essential processing	Fostering generative processing
• Elimination of extraneous material	• Provide pre-training in names and characteristics of key concepts	• Present words and pictures rather than just words
• Highlight essential material	• Break lessons into learner-controlled segments	• Present words in conversational tone
• Place printed words near correspond-ing graphics	• Present words in spoken form	• Use human, rather than machine, voice

multimedia components, as proposed by Mayer.[18] Key components to improving instructional design include reduction of extraneous processing, management of essential processing, and fostering generative processing. Examples of evidence-based techniques to maximize these conditions and improve education are listed in ►**Table 1**. Gone are the days when academics had the luxury of sitting down to thumb through a variety of journals. The added pressures of clinical production, increased time spent with medical records, and the widespread use of smartphone technology have forced scientific journals to reconsider a variety of assumptions in how to distribute product.

Early Evidence for Academic Journals to Consider

Several publications have emerged that help describe the impact of social media on a journal's ability to disseminate their research. An early review of 1,599 primary research articles published between 2012 and 2014 in ecology science found that how often an article was disseminated on Twitter correlated with how often it was cited in the next 5 years.[19] A later review, this time of articles published in 2015 by *Transplantation* found that articles that were shared on Twitter were read *three times as often*.[20] While the authors conceded that there was some selection bias in which articles were chosen for Twitter, the effect size suggested it was more than simply selection. Not surprisingly, when Logghe et al[21] examined social media accounts on the internet, they found that nearly all major surgery and medicine journals created social media accounts to disseminate research.

To what extent the integration of visual tools, such as visual abstracts, will enhance a journals ability to communicate research is unclear. Recently, the *Annals of Surgery* completed a prospective case–control cross-over study of 44 primary research articles shared on Twitter both as a visual abstract and a text-only tweet.[22] Their early results, reported at the *12th Annual Academic Surgical Congress*, indicated that visual abstracts led to articles being shared eight times more often and read three more often than the same article being shared as a text-tweet alone.

How Journals Are Planning for Their Future

Journals are taking several approaches to facilitate the transition from text-only information to web-based visual content. These include *increasing social media presence,* *diversifying editorial boards*, and *engaging readers and authors.*

Nearly all journals have social media accounts in their name. Variability exists in how these accounts are utilized, but based on trends, it is anticipated that this mechanism of communication will continue to expand and become more refined. Given this expansion, editorial boards are creating a new position for social media editors who are dedicated to managing social media accounts and creating content to be shared. By embracing these novel approaches to information dissemination, there is no doubt that the diversity of those that read articles will increase, bringing together a more heterogeneous group of individuals who can help shape the future of science in a more impactful manner.

References

1 Schaffner AC. The future of scientific journals: lessons from the past. Information Technology and Libraries. 13.n4 (December 1994): 239(9). Academic OneFile. Gale. University of Washington. October 21, 2009. Available at https://faculty.washington.edu/jwj/lis520/schaffner.html. Accessed June 2017

2 Laakso M, Björk BC. Anatomy of open access publishing: a study of longitudinal development and internal structure. BMC Med 2012; 10:124

3 Finch J, Bell S, Bellingan L, et al; Working Group on Expanding Access to Published Research Findings. Accessibility, sustainability, excellence: how to expand access to research publications. Executive summary. Int Microbiol 2013;16(02):125–132

4 Smith R. Opening up BMJ peer review. BMJ 1999;318(7175):4–5

5 Scotti V. [Bibliometrics and web use: the birth of altmetrics]. Recenti Prog Med 2015;106(04):176–179

6 Cochran A, Kao LS, Gusani NJ, Suliburk JW, Nwomeh BC. Use of Twitter to document the 2013 Academic Surgical Congress. J Surg Res 2014;190(01):36–40

7 Mandavilli A. Peer review: trial by Twitter. Nature 2011; 469(7330):286–287

8 Turner PL. Stay connected and informed: start tweeting. Bull Am Coll Surg 2016;101(06):25–26

9 Ibrahim AM. A primer on how to create a visual abstract. 2016; December. Available at: 2016: www.SurgeryRedesign.com/resources. Accessed January 2, 2017

10 Brown T. Design thinking. Harv Bus Rev 2008;86(06):84–92, 141

11 Brown T. Design thinking. Harv Bus Rev September 2015:66–71

12 Hamilton DP. Publishing by—and for?—the numbers Science 1990;250(4986):1331–1332

13 Partain KN, Patel A, Travers C, et al. Secondary signs may improve the diagnostic accuracy of equivocal ultrasounds for suspected appendicitis in children. J Pediatr Surg 2016;51(10):1655–1660

14 Laje P, Blinman TA, Nance ML, Peranteau WH. Laparoscopic fundo-plication in neonates and young infants: failure rate and need for redo at a high-volume center. J Pediatr Surg 2017;52(02):257–259

15 Thornblade LW, Varghese TK Jr, Shi X, et al. Preoperative im-munonutrition and elective colorectal resection outcomes. Dis Colon Rectum 2017;60(01):68–75

16 Al-Mazrou AM, Suradkar K, Mauro CM, Kiran RP. Characterization of readmission by day of rehospitalization after colorectal sur-gery. Dis Colon Rectum 2017;60(02):202–212

17 Mayer RE. Applying the science of learning to medical education. Med Educ 2010;44(06):543–549

18 Mayer RE. Multimedia Learning. 2nd ed. New York, NY: Cam-bridge University Press; 2009

19 Peoples BK, Midway SR, Sackett D, Lynch A, Cooney PB. Twitter predicts citation rates of ecological research. PLoS One 2016; 11(11):e0166570

20 Baan CC, Dor FJ. The Transplantation Journal on Social Media: the @TransplantJrnl journey from impact factor to Klout Score. Transplantation 2017;101(01):8–10

21 Logghe HJ, Boeck MA, Atallah SB. Decoding Twitter: understand-ing the history, instruments, and techniques for success. Ann Surg 2016;264(06):904–908

22 Ibrahim AM, Lillemoe KD, Klingensmith ME, Dimick JB. Visual Abstracts to Disseminate Research on Social Media: A Prospective, Case-control Crossover Study. Ann Surg 2017. doi: 10.1097/SLA.0000000000002277