

A Short History of Free Open Access Medical Education

The Past, Present, and Future

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ABSTRACT

Free Open Access Medical education (FOAM) has taken the emergency medicine and critical care worlds by storm in the past decade. This article represents one perspective on the stages of transition for FOAM from its humble beginnings as a grassroots movement to the more recent multiauthor blogs that are described in the peer-reviewed literature. In this article, the authors describe the following four distinct waves of people within the movement, with each wave creating a new stage in the evolution of the FOAM community: Creation by the Founders, Adoption by the Enthusiasts, Structure and Formalization by the Structuralists, and Engagement and Activity by the End Users. The authors contextualize some of the phenomena that have been observed within this field and highlight challenges for the field moving forward.

Keywords:

social media; Free Open Access Medical education (FOAM); online education; medical education

Education has always been an inextricable part of medicine. In the beginning, Galen and Hippocrates gathered their apprentices for instruction. As medical sciences became more prominent, journal clubs were introduced by Sir William Osler (1). The printing

press scaled works by great teachers and scientists, allowing the ascension of work by Gray, Marino, Goldfrank, Rosen, and Tintinalli. However, medical schools and professors curated and controlled access to medical knowledge. Those who became physicians would make pilgrimages to learn

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from great teachers in the classrooms and clinical spaces, as this was the only path toward apprenticeship in medicine.

With the exponential growth of information technology in the 21st century, the creation of the internet irrevocably changed the way we access information (2). Wireless connectivity and smartphone technologies further extended the accessibility of the online environment (3). No longer were teachers and supervisors the primary access point for information; learners now had instantaneous access to much of the world's knowledge (3). Physicians who trained in the 1970s and 1980s describe reading paper journals and memorizing their results in the library stacks after hours. These anecdotes contrast with modern stories of experienced faculty being fact-checked by students as they teach (4). In keeping with this shift, trainees are no longer taught to be walking encyclopedias. Instead, they curate and translate high-quality evidence, problem solving to change the data into actionable diagnostic or management plans. Today's educators help trainees learn to safely navigate, appraise, and curate this content so that what they put into practice has been appropriately vetted.

The open educational resources (OERs) movement arose with the goal of making education accessible to all (5, 6). The Free Open Access Medical education (FOAM) movement is the medical education community's response to the larger OER movement (7, 8). What began with a few innovators in English-language nations seeking to experiment with creating their own OERs has grown into a highly networked learning environment that interweaves learners, teachers, scientists, and practitioners in a swirling web of content production and consumption. Today, teachers are no longer the

exclusive arbiters of content, trainees are leading the development of their own content (9). FOAM is a constellation of OERs that are usually published initially via other media (blogs for in-depth articles, podcasts for discussions and tacit knowledge, and infographics for distillation of key components) (2) before being connected and disseminated via open platforms such as Twitter (10–12). Originating from English-speaking nations predominantly, this movement eventually included participants from all over the world.

The world of critical care medicine has contributed to this community since its inception (13). Discussions between articulate and intelligent individuals from different backgrounds break down silos between professions and disciplines. Such interactions allow researchers, educators, and learners access to outside perspectives, including regional or professional practice variation that would otherwise not have been considered. On Twitter, for example, intensivists, cardiologists, paramedics, nurses, and emergency physicians vigorously debate the latest resuscitation guidelines from their unique perspectives. At the same time, social media amplifies charismatic personalities, leading some to criticize the rise of celebrity educators (14).

The Internet provides great opportunities but can also be a liability at times (15). This unprecedented access to information has allowed educators to engage in online discussions and publish their own resources, scientists to monitor and interact with the end users of their work, and clinicians to engage in discourse to critique and enhance science (16). However, the commercialization of the Internet has led to decreased access to high-quality information. Publishers often seek to make a profit from their readership by putting

up paywalls to high-quality medical education resources, the cost of which are becoming increasingly unaffordable to many consumers (17). At the same time, publisher interest in profit and disruptive technologies make it easy to publish and disseminate opinions and hyperbolic claims, driving traffic to poor-quality resources (and therefore increasing revenue) (18).

Since the originators of FOAM began to experiment more than a decade ago, this movement has become increasingly structured. Although it began as a hobby, akin to start-ups created in garages and basements, FOAM has found its way into the academic mainstream (e.g., it has entered into curricular use and may be included in promotion and tenure processes) as its use by trainees (19–21) and teachers alike (22–28) increases. Similarly, there has been a substantial increase in publications about social media and digital scholarship (2). Recent scholarship has shown that FOAM is a rapidly evolving field that is outpacing previous educational innovations (2). In this article, we archive the rapid evolution of FOAM, elucidating its journey from a disruptive innovation to its current place in medical education.

THE WAVES OF FOAM EVOLUTION

The influence of these new media has diffused through academic medicine and medical education. FOAM is now poised to reach new states of production and formalization. But this did not occur overnight. Inspired by the ubiquitous framework used by feminist researchers to describe the sociology of feminism (29), we identified four distinct waves of people within the movement, with each wave bringing change to the FOAM community. Here, we present our reflections on these waves and how they have affected the movement.

The First Wave: Creation by the Founders

The first wave of individuals founded FOAM. They saw the potential of the internet for improving medical education. Overcoming high technological barriers to entry, the founders began creating FOAM before it had a name. The work of the founders was published primarily on their individual websites or podcasts. There were few publications recognizing or describing the growing impact of FOAM or other online educational resources until 2014 (7). Key FOAM sites that emerged during this time included *Life in the Fast Lane*, *Academic Life in Emergency Medicine*, and the *EMCrit Podcast*.

The general academic community, led by established academicians and medical leaders, gave this work little to no scholarly credit. Many in mainstream academia were generally unaware of the potential power of these new media. Founders pushed to establish the legitimacy of their work with a rapid succession of scholarly papers highlighting the merits of social media-based resources for teaching and learning (2). Still, the growing impact of FOAM was not acknowledged in many academic circles. The FOAM community primarily integrated with the rest of the medical community at conferences, where they would speak broadly about social media, addressing misconceptions and skepticism regarding its use and describing how it could be used as a tool for medical education.

The end of the era precipitated by this wave is probably best defined by the formalization of the term FOAM (with the associated hashtag #FOAMed) at the 2012 International Federation of Emergency Medicine conference in Ireland (30). The rise of the next stage was facilitated by the interaction of the online community of practice at large

international conferences, such as the International Conference on Emergency Medicine and the Social Media and Critical Care conference.

The Second Wave: Adoption by the Enthusiasts

The second wave of individuals entering the FOAM movement consisted of the early adopters and enthusiasts who saw the merits of the work of the FOAM founders. Key players sought to join established FOAM providers or started their own blogs and/or podcasts, often with mentorship from the founders. The enthusiasm of this group launched dozens of podcasts and websites affiliated with the greater open access movement (8) (and eventually the #FOAMed hashtag when it arose in 2012). The unbridled passion that this group of early adopters displayed brought attention to these resources, resulting in three main phenomena: the creation of an attention economy, a digital opinion leader phenomenon, and the emergence of a community of FOAM practitioners.

The creation of an attention economy

Similar to other fields, the abundance of OERs resulted in the development of an *attention economy* (i.e., there is now a “market” for attention) (31). The creation of dozens of blogs and podcasts aimed at educating clinicians led to a veritable explosion of easily accessible online educational content, and consumers picked their favorites (8). Content creators aimed to disseminate their work broadly, and though few within this wave sought to monetize their content, creators sought to reach as many consumers as possible by making their work stand out. The drive for engagement and content consumption led to more sophisticated mechanisms of dissemination. Blogs and podcasts created online brand extensions to bring readers

and listeners to their content, with most FOAM outlets creating their own social media accounts (e.g., Twitter, Facebook, and Instagram). New engagement strategies such as infographics and visual abstracts entered the field (32, 33).

A digital opinion leader phenomenon

Although local physician groups had opinion leaders (34), the followership of these online resources created platforms for individuals to become thought leaders within clinical medicine worldwide. This phenomenon gave previously unknown individuals a time and place to state their opinions; however, some accused those who established a following of being “celebrities” (or “Science Kardashians”) (35, 36) and not true clinical educators with well-thought-out positions (14). Through social media, clinicians began engaging with researchers who previously could not hear them (16). Translational teachers arose to fill the space between investigators and their clinician audiences (16). New digital scholars emerged, upending the traditional publishing paradigm and creating novel ways to disseminate information (16).

The emergence of a community of FOAM practitioners

The emergence of a community of practice for FOAM began with this wave. Although FOAM has been described as a rhizomatic learning network (37), the practitioners within this wave sought to support one another and formed a community of practice (10, 38). Discourse between practitioners within the FOAM community led to discussions around the practice of FOAM creation and to the increased adoption of these resources by educators, who incorporated FOAM into their curriculae (39, 40).

The Third Wave: Structure and Formalization by the Structuralists

The third wave was the “structuralists,” those who strove to increase the organization of FOAM from the processes of creation to the legitimization of dissemination. In this stage, structures were created that began to make FOAM more sustainable, such as the formalization of a FOAM organization (41–43) and the curation of content (44). Other structural phenomenon generated by this wave included “reverse-publication” (i.e., publishing about already widely disseminated online resources or programs in peer-reviewed journals) (41, 45–50), research and analysis of FOAM itself (2, 33, 44), and critical appraisal of FOAM resources (51–55). An example of this is a recent publication by the members of the American Thoracic Society (ATS) describing their Best of ATS Video Lecture Series (49). Initiatives to translate FOAM resources to other languages have also sprung up, hoping to spread the impact of these resources via organized translation efforts (56).

The structuralists included members from the first two stages and external members who joined from more traditional arenas. Collaborations between traditional scholarly institutions and new media outlets began to arise, such as the PulmCCM.org resource (57), which began as a single-author blog in 2012 and expanded into a multiauthor media outlet partnered with the traditional publication *MedPage Today*. Perhaps sensing that these disruptive innovations would come to change traditional publishing, journal editors began to pay attention to the new formats of scholarly discourse (58, 59). Multiple journals adopted the practice of adding social media editors to their editorial teams (60), and we began to see joint endeavors

between the new online educational groups and other established organizations within the field (e.g., national bodies) (44, 48).

Structuralists brought with them the signs, symbols, and practices of modern academia; through these, they sought to create credibility for FOAM. To this end, they brokered alliances with academic entities such as journals and physician societies. ATS has its own Twitter journal club (12, 61) and a Thoracic Surgery Social Media Network to bring thoracic surgery scholarship to Twitter (62). The American College of Chest Physicians has also developed a tweet chat (#pulmcc) (50). Online journal clubs helped to highlight and foster open discussion around key papers, which ultimately resulted in the production of journal articles about these online proceedings (48).

As the number of FOAM resources increased, it became important to assist end users with obtaining and curating the content. Methods to do this included developing more structured categorization on producers’ websites and larger scale curation (44, 51–53, 55). The structure and assessment of FOAM also increased through the incorporation of peer review (46, 47) and editorial processes (42, 43, 47), development of formal curricula (39, 40), and creation of tools to assess FOAM quality (53–55, 63). Unfortunately, the imposition of this structure created tension between structuralists and the FOAM content producers, who felt structure impinged on their autonomy (64).

Finally, this era marked the acknowledgment that FOAM deserved academic recognition as either another form of scholarship (65, 66) or less of a departure from historical scholarship than previously thought (65). Tools were developed for presenting social media

work to promotion and tenure committees (66–68), and FOAM was reverse published into traditional print journals, converting previously unrewarded work into academic currency. Though the overarching goal of FOAM is knowledge translation and dissemination, academia is slowly recognizing that to ensure sustainability of high-quality open access educational materials, academia will need to develop a model to support content producers (e.g., pay, promote, or reward these individuals).

The Fourth Wave: Engagement and Activity by the End Users

The fourth stage features the entry of the largest wave: *The End Users*. Changes in structure and increasing acknowledgment of FOAM have allowed for the easy participation and contribution of the general population of healthcare professionals. This group contains a mix of learners who have “grown up” with social media and faculty with a wide range of social media experience (69, 70).

Social media provides a natural progression of the discussions that occur during patient care (e.g., ward rounds), with its unique allowance for direct, almost real-time discussion with content creators worldwide (16, 71). The needs of end users have largely molded FOAM into what it has become, as their followership is what gives the resources their influence. By listening, commenting, and integrating FOAM into daily learning and practice (72), end users transform the learning environment (73). With the engagement of this wave, FOAM has expanded into a powerful platform for real-time clinical decision support, community building, message amplification, research and knowledge dissemination to healthcare professionals and patients, and learning,

with many learners considering this the most influential part of their “curriculum” (19, 71).

As the popular adage goes, “with great power comes great responsibility.” The power of FOAM has created many tensions. FOAM now consists of an overwhelming amount of easy-to-access content that is not of uniform quality. Critical appraisal is required, and the consumer is largely responsible for conducting it. The Box contains some questions that trainees can ask themselves when reading FOAM. Educators should consider that, although core content is slowly becoming more represented (74), many resources do not incorporate background foundational knowledge and may not be appropriate for junior trainees. This critical appraisal may be difficult, and because many learners use FOAM as their primary source of learning, there is concern that they are learning the views of those they “follow” rather than the primary literature (14, 39).

FOAM also provides real-time collaboration and publishing, significantly decreasing knowledge translation time. However, there may be hazards that end users should bear in mind. The Box clarifies key questions that trainees should consider for reading any resources (whether it be a textbook or a FOAM blog post). Fortunately, social media and FOAM resources permit both rapid detection and correction of errors as well as transparent communication between consumers and creators that could counter these potential issues (75, 76).

Lastly, many users grew up using social media and have little hesitancy regarding what they post given their previous “unconstrained use.” This could result in problems related to breaches of patient privacy and impact on future prospects (77, 78). Professional social media codes

Key questions to ask yourself when reading secondary resources and FOAM

Before applying information from any secondary resource, including FOAM, clinician readers must always consider:

- What if something is published with incorrect information (75, 76)?
- What if the early studies don't match the later, follow-up studies? What if something fails replication?
- Has standard of care changed incorrectly (16)?
- What if I misinterpret what was actually said (23)?

Questions that many trainees must begin to ask as they use FOAM include:

- Is this at the right level for me (24)?
- Is this just opinion or well-grounded in scientific evidence (54, 83)?
- Has it been peer reviewed (43)?
- How does it score or rank compared with other resources (using the Approved Instructional Resources [AIR] Score [54], Medical Education Translational Resources: Impact and Quality [METRIQ] scores [53], or Social Media Index [51, 55])?
- Is this person credible (84)?
- What are the credentials, experience, and/or expertise of the author(s)? Do they display these credentials in a way that is visible and transparent (84)?
- Are these their own words? (Caution: cross-posting or reblogging is a common practice).
- Do they have any conflicts of interest (85)?

of conduct, stories of consequences, and modeling of appropriate behavior may help prevent missteps (79). Formalization of social media usage within formal professional school curricula, the role-modeling of those within the field, and an active community of practice with teachers seeking to help trainees apprentice within online spaces will allow the FOAM movement to be sustained as more individuals enter the field.

DISCUSSION

As FOAM resources continue to increase in influence, it is important to remember where they came from. We have provided an overview of their evolution that spans their growing utilization over decades.

Notably, this description is far from precise; in fact, it is meant as a conceptual overview of the social movement around FOAM. The waves were labeled with the goal of facilitating understanding of FOAM's development; however, there is

substantial overlap (*see* Figure 1), with up to three waves coinciding over the same years, as various perspectives and stakeholders contributed to the online community of practice. This figure is a representation of how we, the authors, have viewed the emergence of different waves within the movement. It does have similarities with the Roger's diffusion of innovation framework (80). However, we have focused on describing the social movement surrounding FOAM rather than the innovation itself. The sociological underpinnings, therefore, warrant a different conceptualization that goes beyond the technology itself. The sociomateriality (81) of FOAM and the sociology of the people supporting this movement have resulted in an interesting innovation and provided insights into how we organize volunteerism and academia in the 21st century. This perspectives piece is our attempt to describe this emerging social phenomenon for the archives.

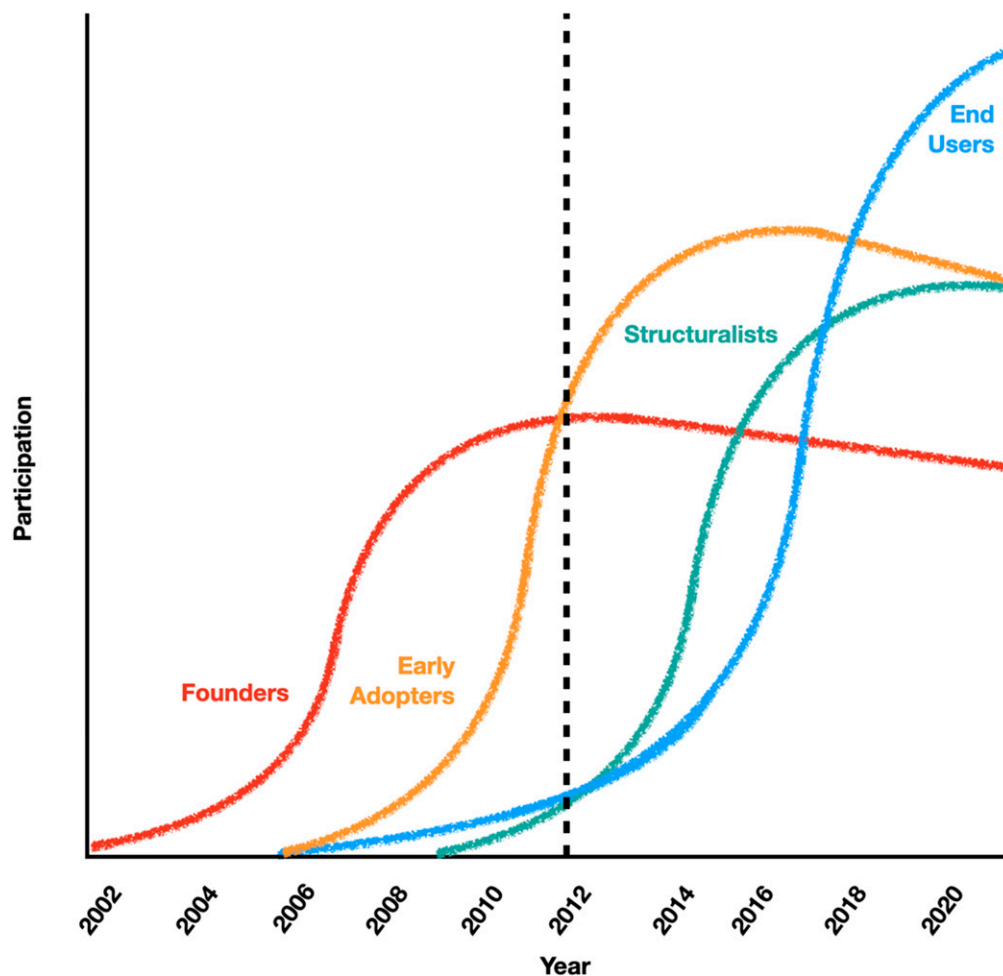


Figure 1. The overlapping stages of the development of Free Open Access Medical education.

Lastly, we anticipate that our description of FOAM's development and evolution may be controversial and that some members of the community may not endorse the descriptions of each wave. Given the huge variability in the global community of practice, such disagreement is inevitable. It is also biased by our perspective as English-language providers and may not form a comprehensive view of how all parts of the world have engaged in this movement. The description that has been outlined by our team was developed by a blend of FOAM community members, one of whom entered the community as an Enthusiast but identifies most strongly as a Structuralist, and others

whom have come in as Structuralists and End Users. Several members of our authorship team have been formally engaged in building the literature base for the use of these resources. Ultimately, we believe that this description will provide helpful context for future researchers investigating the development of the field. We hope that as our global communities become more intercalated and interconnected that we move toward a greater sharing of information that breaks down traditional barriers such as paywalls, language barriers, and disciplinary differences. The FOAM movement has a great potential to continue disrupting the traditional hierarchies within medicine,

Table 1. Names, hallmark features, years, and manifestations of each stage of Free Open Access Medical education development

Era	Wave	Hallmark Features	Year	Manifestation
Foundation of the FOAM community	The Founders	Innovators and early adopters begin experimenting in the space	Early 2000s–2012	<ul style="list-style-type: none"> • Creation of free online resources
Adoption by the Enthusiasts	The Enthusiasts	Early majority sees the success of early adopters and begin to use the resources and engage in exchange of ideas in a community of practice	2010–2015	<ul style="list-style-type: none"> • Popularization of FOAM resources • Development of an online community of practice on social media and at international conferences
Structure and Formalization	The Structuralists	<p>Late majority begins utilizing the resources and contributing via submissions to established resources</p> <p>Translating innovative practices back into mainstream structures</p> <p>Merging of new ways of doing into more traditional and time-honored processes</p>	2014–present	<ul style="list-style-type: none"> • Reverse publication of FOAM artifacts (blogs and podcasts) and FOAM educational innovation work in traditional journals • Recognition of FOAM as scholarship and increasing perceptions of importance for scholarly endeavors (Social Media Journal editors) • Development of editorial processes and teams, quality assurance processes, acceptance of submissions • Development of critical appraisal tools • Consolidation of resources
Fulsome engagement and activity by all	The Participants	<p>Increasing acceptance of the utilization of these resources by the broader medical community</p> <p>The resources are well established in the literature, with studies moving beyond descriptions to investigate their optimal development and utilization</p>	Since the beginning, but a much more accessible entry for end users exists since 2015 with the opening of submission processes for various blogs	<ul style="list-style-type: none"> • Integration of social media into residency training programs • Increasingly open editorial and submission processes • Founding of fellowship or faculty development programs focused on online education to allow for participants to engage in rapid upskilling (CanadiEM digital fellowship, ALiEM Faculty Incubator)

Definition of abbreviation: ALiEM = Academic Life in Emergency Medicine; FOAM = Free Open Access Medical education.

and we look forward to seeing this come to pass.

Next Steps

Where do we go from here? FOAM has evolved so quickly; the possibilities seem

endless. Here are some questions that will be worth pondering in the next while within this field:

1. Will FOAM become sustainable? As it transitions from an innovation into part of the establishment, increasing attention will need to be given to its fiscal

sustainability. Though there are currently no costs to learners, the costs covered by content producers can be significant.

2. As best practices are increasingly recognized, how will they influence the production processes and overall quality of FOAM resources? For example, conflict of interest declarations are still quite rare within the FOAM world, but they are recognized as key aspects of quality (77).
3. How will the relationship between researchers, journals, industry, and FOAM content producers evolve? Increasingly, major studies are taking developing FOAM or collaborating with FOAM producers as part of their knowledge translation efforts. Similar trends are occurring with journals and websites (e.g., PulmCCM and American College of Chest Physicians) (50).
4. How will we encourage cross-language sharing of resources? How will

we connect a global community of practitioners (whether they be critical care or emergency medicine) to join together to take on new global challenges by the free and open access sharing of useful educational resources and combat misinformation (82)?

Conclusions

The short history of FOAM suggests that it is transitioning from a hobby for the few to a mainstream academic avenue with its own best practices and its own scholarship. It has evolved quickly in the past two decades, and the full potential of participatory FOAM has not yet been reached.

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REFERENCES

1. Linzer M. The journal club and medical education: over one hundred years of unrecorded history. *Postgrad Med J* 1987;63:475–478.
2. Chan TM, Dzara K, Dimeo SP, Bhalerao A, Maggio LA. Social media in knowledge translation and education for physicians and trainees: a scoping review. *Perspect Med Educ* 2020;9:20–30.
3. Patocka C, Lin M, Voros J, Chan T. Point-of-care resource use in the emergency department: a developmental model. *AEM Educ Train* 2018;2:221–228.
4. Ragan ED, Jennings SR, Massey JD, Doolittle PE. Unregulated use of laptops over time in large lecture classes. *Comput Educ* 2014;78:78–86.
5. Pearce N, Weller M, Scanlon E, Kinsley S. Digital scholarship considered: how new technologies could transform academic work. *Education* 2011;16:1.
6. Veletsianos G, Kimmons R. Assumptions and challenges of open scholarship. *Int Rev Res Open Distance Learn* 2012;13:166–189.
7. Nickson CP, Cadogan MD. Free Open Access Medical education (FOAM) for the emergency physician. *Emerg Med Australas* 2014;26:76–83.
8. Cadogan M, Thoma B, Chan TM, Lin M. Free Open Access Meducation (FOAM): the rise of emergency medicine and critical care blogs and podcasts (2002-2013). *Emerg Med J* 2014;31:e76–e77.
9. Milne K, Thoma B, Bond C, Purdy E, Yiu S, Targonsky E, et al. CanFOAMed: Canadians can do FOAM too. *Emerg Med J* 2014;31:351.
10. Roland D, Spurr J, Cabrera D. Preliminary evidence for the emergence of a health care online community of practice: using a netnographic framework for twitter hashtag analytics. *J Med Internet Res* 2017;19:e252.

11. Choo EK, Ranney ML, Chan TM, Trueger NS, Walsh AE, Tegtmeier K, *et al.* Twitter as a tool for communication and knowledge exchange in academic medicine: a guide for skeptics and novices. *Med Teach* 2015;37:411–416.
12. Carroll CL, Dangayach NS, Khan R, Carlos WG, Harwayne-Gidansky I, Grewal HS, *et al.*; Social Media Collaboration of Critical Care Practitioners and Researchers (SoMe-CCCPR). Lessons learned from web- and social media-based educational initiatives by pulmonary, critical care, and sleep societies. *Chest* 2019;155:671–679.
13. Barnes SS, Kaul V, Kudchadkar SR. Social media engagement and the critical care medicine community. *J Intensive Care Med* 2018;34:885066618769599.
14. Cameron P, Carley S, Weingart S, Atkinson P. CJEM Debate Series: #SocialMedia: social media has created emergency medicine celebrities who now influence practice more than published evidence. *CJEM* 2017;19:471–474.
15. Gerds AT, Chan T. Social media in hematology in 2017: dystopia, utopia, or somewhere in-between? *Curr Hematol Malig Rep* 2017;12:582–591.
16. Chan T, Trueger NS, Roland D, Thoma B. Evidence-based medicine in the era of social media: scholarly engagement through participation and online interaction. *CJEM* 2018;20:3–8.
17. Sample I. Harvard University says it can't afford journal publishers' prices. The Guardian; 2012 [published 2012 Apr 24; accessed 2018 Sep 7]. Available from: <http://www.theguardian.com/science/2012/apr/24/harvard-university-journal-publishers-prices>.
18. Bolton DM, Yaxley J. Fake news and clickbait: natural enemies of evidence-based medicine. *BJU Int* 2017;119:8–9.
19. Purdy E, Thoma B, Bednarczyk J, Migneault D, Sherbino J. The use of free online educational resources by Canadian emergency medicine residents and program directors. *CJEM* 2015;17:101–106.
20. Mallin M, Schlein S, Doctor S, Stroud S, Dawson M, Fix M. A survey of the current utilization of asynchronous education among emergency medicine residents in the United States. *Acad Med* 2014;89:598–601.
21. Thurtle N, Banks C, Cox M, Pain T, Furyk J. Free Open Access Medical education resource knowledge and utilisation amongst Emergency Medicine trainees: a survey in four countries. *Afr J Emerg Med* 2016;6:12–17.
22. Stuntz R, Clontz R. An evaluation of emergency medicine core content covered by Free Open Access Medical education resources. *Ann Emerg Med* 2016;67:649–653, e2.
23. Chan TM, Stukus D, Leppink J, Duque L, Bigam BL, Mehta N, *et al.* Social media and the 21st-century scholar: how you can harness social media to amplify your career. *J Am Coll Radiol* 2018;15:142–148.
24. Lin M, Joshi N, Grock A, Swaminathan A, Morley EJ, Branzetti J, *et al.* Approved instructional resources series: a national initiative to identify quality emergency medicine blog and podcast content for resident education. *J Grad Med Educ* 2016;8:219–225.
25. Galiatsatos P, Porto-Carreiro F, Hayashi J, Zakaria S, Christmas C. The use of social media to supplement resident medical education: the SMART-ME initiative. *Med Educ Online* 2016;21:29332.
26. Thoma B, Joshi N, Trueger NS, Chan TM, Lin M. Five strategies to effectively use online resources in emergency medicine. *Ann Emerg Med* 2014;64:392–395.
27. Cameron CB, Nair V, Varma M, Adams M, Jhaveri KD, Sparks MA. Does academic blogging enhance promotion and tenure? A survey of US and Canadian medicine and pediatric department chairs. *JMIR Med Educ* 2016;2:e10.

28. Kirkup G. Academic blogging: academic practice and academic identity. *Lond Rev Educ* 2010;8:75–84.
29. Wrye HK. The fourth wave of feminism: psychoanalytic perspectives introductory remarks. *Stud Genl Sex* 2009;10:185–189.
30. Cadogan M. Mike Cadogan on FOAM at ICEM2012. Ireland: Vimeo; 2012.
31. Davenport TH, Beck JC. The attention Economy: understanding the new currency of business. Cambridge, MA: Harvard Business School Press; 2001.
32. 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;266:e46–e48.
33. Huang S, Martin LJ, Yeh CH, Chin A, Murray H, Sanderson WB, *et al*. The effect of an infographic promotion on research dissemination and readership: a randomized controlled trial. *CJEM* 2018;20:826–833.
34. Carpenter CR, Sherbino J. How does an “opinion leader” influence my practice? *CJEM* 2010;12:431–434.
35. Hall N. The Kardashian index: a measure of discrepant social media profile for scientists. *Genome Biol* 2014;15:424.
36. Khan MS, Shahadat A, Khan SU, Ahmed S, Doukky R, Michos ED, *et al*. The kardashian index of cardiologists: celebrities or experts? *JACC Case Rep* 2020;2:330–332.
37. Reardon M, Sanzogni L, Poropat A. Towards a rhizomatic method for knowledge management. *Int J knowledge* 2006;5:159–168.
38. Lave J, Wenger EC. Situated learning: legitimate peripheral participation. Cambridge, UK: Cambridge University Press; 1991.
39. Scott KR, Hsu CH, Johnson NJ, Mamtani M, Conlon LW, DeRoos FJ. Integration of social media in emergency medicine residency curriculum. *Ann Emerg Med* 2014;64:396–404.
40. Shappell E, Chan TM, Thoma B, Trueger NS, Stuntz B, Cooney R, *et al*. Crowdsourced curriculum development for online medical education. *Cureus* 2017;9:e1925.
41. Carley S, Beardsell I, May N, Crowe L, Baombe J, Grayson A, *et al*. Social-media-enabled learning in emergency medicine: a case study of the growth, engagement and impact of a Free Open Access Medical education blog. *Postgrad Med J* 2018;94:92–96.
42. Ting DK, Thoma B, Luckett-Gatopoulos S, Thomas A, Syed S, Bravo M, *et al*. CanadiEM: accessing a virtual community of practice to create a Canadian national medical education institution. *AEM Educ Train* 2018;3:86–91.
43. Azim A, Beck-Esmay J, Chan TM. Editorial processes in Free Open Access Medical educational (FOAM) resources. *AEM Educ Train* 2018;2:204–212.
44. Grock A, Bhalerao A, Chan TM, Thoma B, Trueger NS. Systematic Online Academic Resource (SOAR) review: renal and genitourinary. *AEM Educ Train* 2019;3:375–386.
45. Chan TM, Thoma B, Lin M. Creating, curating, and sharing online faculty development resources: the medical education in cases series experience. *Acad Med* 2015;90:785–789.
46. Thoma B, Chan T, Desouza N, Lin M. Implementing peer review at an emergency medicine blog: bridging the gap between educators and clinical experts. *CJEM* 2015;17:188–191.
47. Sidalak D, Purdy E, Luckett-Gatopoulos S, Murray H, Thoma B, Chan TM. Coached peer review: developing the next generation of authors. *Acad Med* 2017;92:201–204.

48. Lin M, Joshi N, Hayes BD, Chan TM. Accelerating knowledge translation: reflections from the online ALiEM-annals global emergency medicine journal club experience. *Ann Emerg Med* 2017;69:469–474.
49. Seam N, Richards JB, Kritek PA, Khemasuwan D, McCallister JW, Santhosh L, *et al.* Design and implementation of a peer-reviewed medical education video competition: the best of American Thoracic Society video lecture series. *J Grad Med Educ* 2019;11:592–596.
50. Carroll CL, Bruno K, Ramachandran P. Building community through a #pulmcc twitter chat to advocate for pulmonary, critical care, and sleep. *Chest* 2017;152:402–409.
51. Thoma B, Sanders JL, Lin M, Paterson QS, Steeg J, Chan TM. The social media index: measuring the impact of emergency medicine and critical care websites. *West J Emerg Med* 2015;16:242–249.
52. Thoma B, Sebok-Syer SS, Colmers-Gray I, Sherbino J, Ankel F, Trueger NS, *et al.*; METRIQ Study Collaborators. Quality evaluation scores are no more reliable than gestalt in evaluating the quality of emergency medicine blogs: a METRIQ study. *Teach Learn Med* 2018;30:294–302.
53. Chan TM, Thoma B, Krishnan K, Lin M, Carpenter CR, Astin M, *et al.* Derivation of two critical appraisal scores for trainees to evaluate online educational resources: a METRIQ study. *West J Emerg Med* 2016;17:574–584.
54. Chan TM, Grock A, Paddock M, Kulasegaram K, Yarris LM, Lin M. Examining reliability and validity of an online score (ALiEM AIR) for rating Free Open Access Medical education resources. *Ann Emerg Med* 2016;68:729–735.
55. Thoma B, Chan TM, Kapur P, Sifford D, Siemens M, Paddock M, *et al.*; METRIQ Study Collaborators. The social media index as an indicator of quality for emergency medicine blogs: a METRIQ study. *Ann Emerg Med* 2018;72:696–702.
56. ISAEM. #FOMAed Project: International Student Association of Emergency Medicine;2020 [accessed 2020 Apr 8]. Available from: <http://isaem.net/foamed-project/>.
57. Grock A, Paolo W. Free Open Access Medical education: a critical appraisal of techniques for quality assessment and content discovery. *Clin Exp Emerg Med* 2016;3:183–185.
58. Thoma B, Mohindra R, Artz JD, Chan TM. CJEM and the changing landscape of medical education and knowledge translation. *CJEM* 2015;17:184–187.
59. Adler JR, Chan TM, Blain JB, Thoma B, Atkinson P. #OpenAccess: free online, open-access crowdsourced-reviewed publishing is the future: traditional peer-reviewed journals are on the way out. *CJEM* 2019;21:11–14.
60. Lopez M, Chan TM, Thoma B, Arora VM, Trueger NS. The social media editor at medical journals: responsibilities, goals, barriers, and facilitators. *Acad Med* 2019;94:701–707.
61. Admon AJ, Kaul V, Cribbs SK, Guzman E, Jimenez O, Richards JB. Twelve tips for developing and implementing a medical education Twitter chat. *Med Teach* 2019;0:1–7.
62. Antonoff MB. Thoracic surgery social media network: bringing thoracic surgery scholarship to twitter. *Ann Thorac Surg* 2015;100:383–384.
63. Thoma B, Camorlinga P, Chan TM, Hall AK, Murnaghan A, Sherbino J. A writer's guide to education scholarship: quantitative methodologies for medical education research (part 1). *CJEM* 2018;20:125–131.
64. Carley S. The Social Media Index (SMi): can & should we measure #FOAMed? St. Emlyn's website [accessed 2020 May 5]. Available from: <https://www.stemlynblog.org/the-social-media-index-smi-is-it-flawed/>.

65. Roland D, Brazil V. Top 10 ways to reconcile social media and ‘traditional’ education in emergency care. *Emerg Med J* 2015;32:819–822.
66. Sherbino J, Arora VM, Van Melle E, Rogers R, Frank JR, Holmboe ES. Criteria for social media-based scholarship in health professions education. *Postgrad Med J* 2015;91:551–555.
67. Cabrera D, Vartabedian BS, Spinner RJ, Jordan BL, Aase LA, Timimi FK. More than likes and tweets: creating social media portfolios for academic promotion and tenure. *J Grad Med Educ* 2017;9:421–425.
68. Cabrera D, Roy D, Chisolm MS. Social media scholarship and alternative metrics for academic promotion and tenure. *J Am Coll Radiol* 2018;15:135–141.
69. Berk J, Trivedi SP, Watto M, Williams P, Centor R. Medical education podcasts: where we are and questions unanswered. *J Gen Intern Med* [online ahead of print] 2 Jan 2020; DOI: 10.1007/s11606-019-05606-2.
70. Riddell J, Robins L, Brown A, Sherbino J, Lin M, Ilgen JS. Independent and interwoven: a qualitative exploration of residents’ experiences with educational podcasts. *Acad Med* 2020;95:89–96.
71. Carley S, Laing S. How can emergency physicians harness the power of new technologies in clinical practice and education? *Emerg Med J* 2018;35:156–158.
72. Khadpe J, Singh M, Repanshek Z, Brumfield E, Guirgis F, Kalynych C, *et al.* Barriers to utilizing social media platforms in emergency medicine residency programs. *Cureus* 2019;11:e5856.
73. Thoma B, Turnquist A, Zaver F, Hall AK, Chan TM. Communication, learning and assessment: exploring the dimensions of the digital learning environment. *Med Teach* 2019;41:385–390.
74. Chan TM, Bhalerao A, Thoma B, Trueger NS, Grock A. Thinking critically about appraising FOAM. *AEM Educ Train* 2019;3:398–402.
75. Carley S. #FOAMed errors: does the opportunity for speedy resolution outweigh the risk of rapid dissemination? *Emerg Med J* 2019;36:452.
76. Edwards S, Roland D. Learning from mistakes on social media. *Emerg Med J* 2019;36:453–455.
77. Cheston CC, Flickinger TE, Chisolm MS. Social media use in medical education: a systematic review. *Acad Med* 2013;88:893–901.
78. Chretien KC, Tuck MG, Simon M, Singh LO, Kind T. A digital ethnography of medical students who use twitter for professional development. *J Gen Intern Med* 2015;30:1673–1680.
79. Dimitri D, Gubert A, Miller AB, Thoma B, Chan T. A quantitative study on anonymity and professionalism within an online Free Open Access Medical education community. *Cureus* 2016;8:e788.
80. Rogers EM. *Diffusion of innovations*. 4th ed. New York, NY: The Free Press; A Division of Simon & Schuster Inc.; 1995.
81. Goldszmidt M. When I say ... sociomateriality. *Med Educ* 2017;51:465–466.
82. Rochweg B, Parke R, Murthy S, Fernando SM, Leigh JP, Marshall J, *et al.* Misinformation during the coronavirus. *Crit Care Explor* 2020;2:e0098.
83. Campbell L, Evans Y, Pumper M, Moreno MA. Social media use by physicians: a qualitative study of the new frontier of medicine. *BMC Med Inform Decis Mak* 2016;16:91.
84. Lin M, Thoma B, Trueger NS, Ankel F, Sherbino J, Chan T. Quality indicators for blogs and podcasts used in medical education: modified Delphi consensus recommendations by an international cohort of health professions educators. *Postgrad Med J* 2015;91:546–550.
85. Niforatos JD, Lin L, Narang J, James A, Singletary A, Rose E, *et al.* Financial conflicts of interest among emergency medicine contributors on Free Open Access Medical education (FOAMed). *Acad Emerg Med* 2019;26:814–817.