

Washington University School of Medicine

Digital Commons@Becker

2020-Current year OA Pubs

Open Access Publications

7-1-2022

Online learning for infectious disease fellows-A needs assessment

Miguel A Chavez

Nathanial S Nolan

Emily Gleason

Saman Nematollahi

Emily Abdoler

See next page for additional authors

Follow this and additional works at: https://digitalcommons.wustl.edu/oa_4



Part of the [Medicine and Health Sciences Commons](#)

Authors

Miguel A Chavez, Nathaniel S Nolan, Emily Gleason, Saman Nematollahi, Emily Abdoler, and Gerome Escota

Online Learning for Infectious Disease Fellows—A Needs Assessment

Miguel A. Chavez,^{1,*} Nathaniel S. Nolan,^{1,*} Emily Gleason,² Saman Nematollahi,³ Emily Abdoler,⁴ and Gerome Escota⁵

¹Division of Infectious Diseases, Washington University in St. Louis School of Medicine, St. Louis, Missouri, USA, ²Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania, USA, ³Department of Medicine, University of Arizona College of Medicine, Tucson, Arizona, USA, ⁴Department of Medicine, University of Michigan, Ann Arbor, Michigan, USA, and ⁵Division of Infectious Diseases, Park Nicollet Clinic and Specialty Center, Minnesota, USA

Background. Online resources and social media have become increasingly ubiquitous in medical education. Little is known about the need for educational resources aimed at infectious disease (ID) fellows.

Methods. We conducted an educational needs assessment through a survey that aimed to describe ID fellows' current use of online and social media tools, assess the value of online learning, and identify the educational content preferred by ID fellows. We subsequently convened focus groups with ID fellows to explore how digital tools contribute to fellow learning.

Results. A total of 110 ID fellows responded to the survey. Over half were second-year fellows (61, 55%). Although many respondents were satisfied with the educational resources provided by their fellowship program (70, 64%), the majority were interested in an online collaborative educational resource (97, 88%). Twitter was the most popular social media platform for education and the most valued online resource for learning. Focus groups identified several themes regarding social media learning: broadened community, low barrier to learning, technology-enhanced learning, and limitations of current tools. Overall, the focus groups suggest that fellows value social media and online learning.

Conclusions. ID fellows are currently using online and social media resources, which they view as valuable educational tools. Fellowship programs should consider these resources as complementary to traditional teaching and as a means to augment ID fellow education.

Keywords. infectious disease fellows; medical education; online learning; social media; Twitter.

The exact prevalence of knowledge deficiency among infectious disease (ID) fellows is not known, but >30% of postresidency learners referred to a remediation program exhibited at least 1 deficit on medical knowledge or clinical reasoning [1]. To improve this knowledge deficit, learners have suggested integrating technology into education [2], and ID fellowship program directors have proposed web-based technology as a complement to traditional educational resources [3].

Social media platforms, such as Facebook, Twitter, and Instagram, have become ubiquitous parts of daily life. Designed primarily for casual social interaction, medical education innovators have leaned into these tools and leveraged them to create interactive learning platforms [4]. A simultaneous movement of

democratized medical learning, termed free open-access medical education (FOAMed), has also flourished in the online space [5]. FOAMed consists of crowdsourced educational products (blogs, videos, images, etc.) that are frequently distributed over social media platforms. As a result, several specialties have used FOAMed to create robust online communities that span social media platforms. For example, the field of nephrology has excelled in using a combination of Twitter, blogging, and podcasting to create interactive yet asynchronous events, simulated cases, and live journal clubs that deliver education to trainees and nephrologists [6], resulting in positive changes in their education [7].

There are already an increasing number of ID-oriented educators posting online educational content, particularly on Twitter [8]. However, little is known about how ID fellows use online and social media resources, the value given to these resources, and the interest in new content and topics. This study attempts to explore ID fellows' current use of extracurricular online and social media tools, identify needs for future educational interventions, and determine how to best integrate online resources into current program didactics.

METHODS

Survey Development

We created a survey following best practices for questionnaires in educational research [9]. The objectives of the survey

Received 17 March 2022; editorial decision 16 May 2022; accepted 19 May 2022; published online 23 May 2022

*Equal contribution

Correspondence: Miguel A. Chavez, MD MSc, Campus Box 8051, 4523 Clayton Avenue, St. Louis, MO 63110-1093 (m.chavezconcha@wustl.edu).

Open Forum Infectious Diseases®

© The Author(s) 2022. Published by Oxford University Press on behalf of Infectious Diseases Society of America. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs licence (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial reproduction and distribution of the work, in any medium, provided the original work is not altered or transformed in any way, and that the work is properly cited. For commercial re-use, please contact journals.permissions@oup.com
<https://doi.org/10.1093/ofid/ofac264>

included identifying the need for a fellow-led collaborative learning resource, assessing the value of online learning, exploring preferred content delivery methods, and describing the educational content preferred by ID fellows. The survey was then built using Research Electronic Data Capture (REDCap) [10]. The survey was piloted with 9 ID fellows to evaluate the wording, layout, and response options [11]. A final 11-question survey was generated (Supplementary Data 1).

All pediatric and adult ID fellows worldwide were considered eligible to participate. No incentive was offered for participation. The survey was first distributed during the IDWeek Fellows career breakout session on October 20, 2020, and then disseminated via Twitter (from the @ID_Fellows account) 2 days later. The survey was also sent to adult ID fellowship program directors in the United States via email for dissemination within their training programs. Reminders about the survey were distributed via Twitter and email. A total of 3 weeks were allotted to allow for additional respondents. We used descriptive data analysis to summarize all survey responses. Data analysis was performed using STATA software, version 11.1 (StataCorp, College Station, TX, USA).

Focus Groups

Using a sequential exploratory design, focus group questions were designed based on the survey results [12]. Questions were evaluated and revised after a pilot focus group. These pilot data were not included in the final analysis, but the feedback was used to create a final interview guide (Supplementary Data 2). Questions focused on the role that online media plays in learning, what positives and negatives exist when using online media for learning, and what characteristics are important in online educational resources.

Focus groups were convened in March 2021. ID fellows who had completed the prior survey and volunteered to participate were eligible. Participants were selected based on order of response and availability. Consent was obtained digitally before the focus group and again at the time of the focus group. No incentive was offered for participation. Focus groups were held on Zoom (Zoom Video Communications, Inc., San Jose, CA, USA) via an encrypted, HIPAA-compliant account hosted through the Washington University School of Medicine [13]. The focus group sessions were recorded and transcribed into de-identified text documents for analysis. Interview transcripts were coded using NVivo qualitative research software (NVivo 12, QSR International, Melbourne, Australia). Coding was performed by 2 authors (N.N., E.G.), who used an inductively developed, and jointly agreed upon, codebook. The 2 authors independently coded the transcripts and rectified coding discrepancies before performing a thematic analysis using a constructivist framework [14], with the overall goal of exploring how digital tools contribute to fellow learning and the gaps that remain in fellow education. The authors who conducted

the focus groups (M.C., N.N.) were ID fellows at an academic institution at the time of the interviews, active users of social media for medical education, and co-founders of the Infectious Diseases Fellows Network. The methods and data are reported based on established best practices [15]. The survey and focus group were evaluated by the Washington University Institutional Review Board and were determined to be exempt (IRB ID# 202009131).

Patient Consent

Our study did not include factors necessitating patient consent.

RESULTS

Survey

A total of 110 ID fellows completed the questionnaire. Most of the respondents were second-year fellows (61, 55%), followed by first years (26, 24%). No data were recorded regarding country of origin or characteristics of their fellowship program. Most respondents were satisfied or very satisfied with the educational resources provided by their fellowship program (70, 64%), although 13 (12%) were dissatisfied or very dissatisfied. The majority of respondents were interested in a fellow-led collaborative educational resource (97, 88%) (Table 1).

Among the current online resources for learning, medical journals and UpToDate were the most used. At least a third of ID fellows also used blogs, websites, podcasts, or Twitter for learning at least once a month, with Twitter being the most common (55%). YouTube and flashcards were rarely used for learning. Twitter was the most valued online resource for learning, followed by online websites. Facebook and Instagram were not viewed as valuable for learning (Table 2).

When queried about the benefits of social media learning, 79 respondents (72%) indicated that small amounts of digestible material and ease of accessibility from mobile devices were beneficial. This was followed by access to content experts (78, 71%) and the ability to share experiences between institutions (74, 67%). ID fellows noted that unclear expertise of social media content creators (81, 74%) and lack of peer review (70, 64%) were significant downsides to using social media for learning. When asked about resources they would most like to use if available, 85 fellows (77%) indicated that they would like access to board-style questions. Podcasts (61, 55%) and Twitter content in the form of linked posts (known as Tweotorials; 60, 55%) were also highly favored (Table 1).

Respondents were given several ID topics they most wanted to learn about (Supplementary Data 1). Fellows indicated interest in learning more about clinical reasoning (60%), tropical/travel medicine (51%), mycobacterial diseases (48%), and transplant ID (41%). Respondents suggested email (63%) and social media (50%) as preferred methods of delivery of educational material (Table 1).

Table 1. Characteristics and Responses of Infectious Disease Fellows (n = 110)

Question	No. (%)
Year of fellowship training	
First year	26 (24)
Second year	62 (56)
Third year	17 (15)
Fourth year	5 (5)
How satisfied are you with the educational resources provided by your program during fellowship?	
Very dissatisfied	4 (4)
Dissatisfied	9 (8)
Neither dissatisfied nor satisfied	22 (20)
Satisfied	49 (45)
Very satisfied	21 (19)
N/a	5 (5)
How interested would you be in collaborative educational resources made by fellows?	
Very disinterested	2 (2)
Disinterested	0 (0)
Neither disinterested nor interested	6 (5)
Interested	46 (42)
Very interested	51 (46)
N/a	5 (5)
Which of the following do you consider to be benefits of learning via social media? (option to select >1 response)	
Easily accessed by phone/mobile device	80 (73)
Digestible material offered in small bites	79 (72)
Access to content experts	78 (71)
Shared experience across institutions	74 (67)
Infographics	63 (57)
Links available to direct resources	60 (55)
The ability to have dialogue while learning	42 (40)
Other	1 (1)
Which of the following do you consider to be drawbacks of learning via social media? (option to select >1 response)	
Unclear expertise of people posting	81 (74)
Lack of peer review	70 (64)
Difficulty in saving and finding material	68 (62)
Overwhelming amount of content	60 (55)
Limitations in character count (loss of details)	39 (36)
Not considered credible resources	36 (33)
Other	3 (3)
If available, which of the following online-based resources are you most likely to use? (option to select up to 3 responses)	
Online board questions	85 (77)
Podcasts	61 (55)
Tweetutorials via Twitter	60 (55)
Online live case conferences	46 (42)
Online interactive simulated cases	44 (40)
Infographics	42 (38)
Online journal clubs and chats	39 (35)
Websites	33 (30)
Educational YouTube videos	27 (25)
Other	0 (0)
Which of the following topics would you be interested in learning more about? (option to select up to 3 responses)	
Clinical reasoning in infectious diseases	66 (60)
Tropical/travel medicine	56 (51)
Mycobacterial diseases	53 (48)
Infections in transplanted patients	47 (42)

Table 1. Continued

Question	No. (%)
Fungal infections	
Immunology	43 (40)
Antimicrobial stewardship,	39 (35)
Antimicrobial pharmacology	39 (35)
Complications of advanced HIV	35 (32)
Hospital epidemiology	29 (26)
HIV primary care	24 (22)
Vaccinations	22 (20)
Bone and joint infections	22 (20)
Management of substance use disorder	16 (14)
Infection control and prevention	16 (14)
Other	6 (5)
Via what platform would you prefer online-based content be delivered to you? (option to select >1 response)	
Via email	69 (63)
Via social media	55 (50)
Via live online conferences	43 (39)
Via phone-based messages	27 (25)
Other	2 (2)

Abbreviation: N/a, not available.

Focus Groups

Data collection stopped after 3 focus groups, with a total of 11 fellows (11/50, 22%). Interviews were transcribed and reviewed in real time. After transcribing the first 3 focus groups, authors reached information sufficiency for developing themes—thus, it was felt that further focus groups would not add meaningfully to the final analysis. Each focus group lasted 60–90 minutes. The average age of participants was 32.5 years, and most identified as male (n = 7, 64%). Six were first-year fellows (55%), 4 were second-year fellows (36%), and 1 had completed at least 2 years of fellowship (9%). All participants were training in academic institutions in the United States.

Common codes included the benefits of online learning, the negatives of online learning, comparing and contrasting online vs nononline learning strategies, and social media-based vs non-social media learning. Most participants were digital natives, defined as a person who was born or has grown up since the use of digital technology became common and so is familiar and comfortable with computers and the internet, and frequently used online and social media tools. A total of 4 themes were identified and are presented below and summarized in [Table 3](#).

Broadened Community

A theme identified in the transcripts was the value of augmenting fellows' learning community. Many fellows felt that the ability to engage in online learning with social media provided the opportunity to expand the pool of people from whom they could learn. For example, 1 fellow noted that engaging with people online “gives me a glimpse into what other institutions may have policies [on] or programs or approaches to certain

Table 2. Responses to Frequency and Value of Use of Learning Resources Among Infectious Disease Fellows (n = 110)

Question	Response, No. (%)					
	Very Seldom	Once a Month	Once a Week	Multiple Times a Week	Daily	N/a
How frequently do you use the following tools for learning?						
UpToDate	1 (1)	4 (4)	10 (10)	40 (36)	55 (50)	0 (0)
Journals	3 (3)	8 (7)	32 (29)	55 (50)	12 (11)	0 (0)
Websites	47 (43)	17 (16)	26 (24)	12 (11)	2 (2)	6 (6)
NEJM ID Journal Watch/ACP JournalWise	31 (28)	34 (31)	25 (22)	14 (13)	4 (4)	2 (2)
Blogs	44 (40)	25 (23)	24 (22)	11 (10)	2 (2)	4 (4)
YouTube videos	62 (56)	22 (20)	6 (5)	3 (3)	1 (1)	16 (15)
Podcasts	43 (39)	20 (18)	20 (18)	18 (16)	2 (2)	7 (7)
Textbooks	21 (20)	28 (25)	29 (26)	26 (23)	5 (5)	1 (1)
Twitter	19 (17)	15 (14)	21 (19)	22 (20)	18 (16)	15 (14)
Online journal clubs and chats	36 (33)	32 (29)	15 (14)	6 (5)	0 (0)	14 (13)
Flashcards	62 (56)	5 (5)	8 (7)	1 (1)	0 (0)	34 (31)
How much do you value each of the following resources for learning?	Almost No Value	Little Value	Some Value	Quite a bit of value	A great amount of value	-
Twitter	18 (16)	9 (8)	22 (20)	41 (37)	20 (18)	-
YouTube	18 (16)	32 (29)	42 (38)	15 (14)	3 (3)	-
Facebook	62 (56)	31 (28)	14 (13)	1 (1)	2 (2)	-
Instagram	58 (53)	33 (30)	11 (10)	7 (6)	0	-
Websites	11 (10)	7 (6)	37 (34)	40 (36)	15 (14)	-

Abbreviations: ACP, American College of Physicians; ID, infectious disease; NA, not applicable; NEJM, *New England Journal of Medicine*.

areas that may be something I've not considered before and then also lets me see cases that I may not see very often." Given that much of infectious diseases is regional, being able

to share experiences across regions was seen as beneficial. The same fellow went on to say, "You know, I don't live in an area where there's coccidiomycosis, so if someone presents

Table 3. Quotes From Infectious Disease Fellows on the Online Focus Groups

Theme	Representative Quotes
Community	"I think the interactivity in and of itself is a little bit of a good thing.... It's nice to have some education larger than just your particular program or your particular hospital or even region.... You're seeing different perspectives, how different institutions may think about things differently...and there's a little bit of an inherent good in us being a bit more connected." "If I'm on Twitter, I'm looking more for that conversation than just rote facts about X, Y, and Z. So, like when I see Twitter strength is, say, having like a journal club where someone might—and there are a number of virtual journal clubs—where someone might lay out, you know, this is an article, people can discuss things like that as opposed to when I'm reading Mandell, I'm just absorbing information."
Low barrier to learning	"I feel like it's [Twitter is] kind of giving me little nuggets of knowledge that have come up later." "Accessibility is the biggest thing.... Just the quick accessibility of your phone makes it a lot easier." "It's also helpful in material I wouldn't necessarily have looked up just because it would not have come up in my practice."
Technology-enhanced learning	"In a short amount of time, you can read a lot of information and try to screen out things that you are more interested to read about in that moment and make a list of what you want to read later." "I just did not have time to read the literature, and I felt like it [Twitter] was a really...succinct, accessible way to get information. You know, you have to check your sources, but if you have sources you feel like are making sense and are trustworthy and give you good links to literature that then you review and, you know, pans out, what they're summarizing makes sense. I felt like it was very useful for that." "It keeps me up to date on what the most relevant literature is, or at least for the people that I follow."
Limitations of available tools	"At the end, if you end up just [listening to] a certain podcast or reading a certain blog every time, you're going to be biased with those points of view and not others. So, I think that you have to kind of try to keep it objective even if even though it may go with your ideas, you should, you know, open it up a little bit more and understand that that's only an opinion." "I think of it as a little bit less focused in a way, because when I'm looking something up, I have a direct question, I'm trying to answer, right? Whereas when I'm listening to [a podcast] or am on [Twitter], it's sort of whatever authors choose to go over is what I learn. Which is not a criticism, it's just different."

a case on that, I get to see a little bit of that, which I think is nice. It does serve as a little bit of a forced board review.”

Participants frequently cited the ability to have access to expertise and experience beyond their institution. The opportunity to read literature appraisals by experts was noted multiple times, specifically citing the benefits of online journal clubs (Table 3). ID fellows noted that social media provided access to content experts doing research in the field.

Low Barrier to Learning

ID fellows frequently mentioned the difficulty of learning while serving on a busy consult service. One participant stated, “I don’t find that I have the time to go to those resources, like Twitter and the internet. I just go to see my patients and learn from whatever my attendings want me to do different.” One participant shared, “After two very busy weeks on service...I had texted to my cofellows that grand rounds hits differently when you’re not holding the pager and waiting for it to go off and interrupt you.” Fellows described having little time for intentional reading and learning—they reported that their learning occurs through the patients they see, with most plans created with their attendings. Many expressed a desire to do deeper reading but lacked the time to do literature searches or read textbooks. However, the ubiquitous nature of internet-enabled devices, including ones that are portable, was cited as a way to promote on-the-go learning. These devices improve the learner’s ability to access online resources and, when coupled with digestible learning points, were seen as improving the capability of busy learners to study. Many fellows reported using spare moments to quickly check Twitter or other online social media sources for new articles, questions, or learning pearls. Podcasts were also frequently highlighted, with fellows noting the ability to listen to educational material while doing other things, like driving or exercising. The introduction of asynchronous online lectures from IDWeek and the Conference on Retroviruses and Opportunistic Infections was seen as a strong benefit for fellows who could not dedicate the time to watch the conference in 1 setting.

Technology-Enhanced Learning

Online and social media learning was felt to have significant value for learners who used it. The concise nature of tweets and other online posts enables quick discrimination of relevant information. One fellow shared, “In a short amount of time, you can read a lot of information and try to screen out things that you are more interested to read about in that moment and make a list of what you want to read later.” Fellows specifically cited the benefits of social media and rapid information dissemination during the beginning of the coronavirus disease 2019 (COVID-19) global public health crisis.

Value was also found in the ability to have expert help in the discrimination of important and relevant information. Fellows

often noted that the studies that more senior ID physicians were sharing and commenting on allowed them to discern which literature was worth more attention. It was mentioned multiple times that social media allowed fellows to stay up to date with newer literature while also finding references to key studies from years past.

Limitations of Available Tools

Despite the many benefits of social media and online learning, there were significant limitations reported. Uncertainty in the source of the online information and lack of peer review were seen as limitations, with fellows sometimes concerned about receiving incorrect or biased information. Interestingly, on certain social media platforms, ID fellows analyzed the elements of social media platforms such as who was sharing content or the quality of comments as a form of informal peer review. Fellows frequently noted that if well-known figures shared information and there was not significant dissent, it was likely trustworthy.

Online material was seen as less focused than the use of more traditional education methods, such as referencing a textbook. For example, learners noted that they often received learning on whatever was posted to social media, blogs, or specific podcasts rather than being able to determine their own questions and conducting a literature review.

DISCUSSION

ID fellows are utilizing online educational resources available outside their fellowship programs. In our survey, at least a third of fellows were not satisfied with the educational resources provided by their programs, and at least a third were already regularly using online resources such as blogs, websites, podcasts, and Twitter to supplement learning. We found that fellows value currently available online and social media tools, with >50% interested in using online board review questions, podcasts, or Twitter educational content, if available. These educational resources have many potential benefits identified by the focus group participants. For example, social media posts provide simple and bite-sized learning, in contrast to the large amount of information contained in other resources such as textbooks or review articles. Additionally, concise clinical pearls were seen as low barrier and easily accessed/reviewed, even while on a busy clinical service. Fellows frequently cited the benefits of rapid dissemination of new data, which has played a critical role in allowing many to stay abreast of evolving COVID-19 data [16]. Furthermore, online learning also allowed broadening of their learning community, in which fellows cited the value of accessing an ever-enlarging pool of peers and teachers. In fact, several participants specifically mentioned the ability to gain insight and perspectives from clinical experts, such as during an online journal club. It is likely that many of these

premade digital tools and social media posts present a reduced cognitive load [17], facilitating learning even when trainees have their attention divided across multiple clinical tasks.

These tools are not without limitations, and these were acknowledged by fellows. A disadvantage of online and social media content is that the peer review process achieved with articles published in journals is missing. However, this may be somewhat offset by the informal community review, which may help adjudicate erroneous information, assuming experts see the content. Another mentioned limitation was the lack of focus and organization of much of the information posted through social media platforms. Often what is shared is not organized in a specific manner and may not serve as an easily retrievable resource. Furthermore, fellows brought up the difficulty of using tools meant for social engagement in a purely learning capacity, given that there are frequent distractions built into these systems, such as ads, news alerts, and off-topic posts.

Our findings demonstrate the significant potential of social media and other online resources in ID fellow education. There are already many initiatives to improve education within the ID community using these online tools. For example, an online ID journal club (@IDJClub) has been created with monthly chats using Twitter as an online platform [18]. Clinical microbiologists are also sharing content (images and pearls) on Twitter of their daily encounters using #micro-rounds to disseminate knowledge. Likewise, a group of ID fellows, including 3 of the authors, has launched the Infectious Diseases Fellows Network, which has been creating educational content for ID fellows through a website and on Twitter (@ID_fellows) with faculty oversight. Similarly, a repository of board-style questions has been created on Twitter by many fellowship programs (@WuidQ [7], @MayoClinicINFD, @IUIDfellowship), and recently a fellow-driven initiative has curated board-style questions via a gamification phone app as preparation for the ID boards (@IDfellowscup) [19]. Finally, the Febrile Podcast has also been well received among ID fellows.

Our results also suggest the potential benefit of providing a roadmap for ID societies and affiliated journals, fellowship programs, and individual educators on how best to use online and social media resources to improve fellows' education. Thus, we have the following recommendations. First, educational leaders locally and nationally should acknowledge online learning as a useful complement to fellowship program curricula and not as a replacement of fellowship education [3]. Likewise, they could consider expanding their educational presence on online resources or social media. Such efforts may help with specialty brand recognition, attracting candidates into ID and their own programs [20]. Second, educators should recognize the educational theories that online learning leverages such as self-directed learning, critical reflection, repetition, and social

learning theory, among others [21], and consider adopting digital learning into their educational curricula [22]. Similarly, affiliated journals could utilize social media to increase readership and disseminate research among fellows who often look to social media for digestible content.

Third, ID societies and fellowship programs should consider offering guidance for fellows on the use of online resources to gain ID knowledge and build a community of learners. For example, the Infectious Diseases Society of America (IDSA) has already effectively developed an antimicrobial stewardship program for ID fellows that includes web-based electronic platforms [23] and could easily include other online and social media resources. The IDSA could also promote and/or incentivize other educational workgroups that are developing content and resources using digital tools and social media to improve education among ID fellows. ID societies could also provide a vetted list of FOAMed material and social media accounts with trusted, verified, and expert knowledge and which meet the needs and standards of learners and fellowship programs, allowing for self-directed learning and efficient use of fellows' time. This will allow programs to leverage online educational resources to fill in for topics that their programs may be lacking, such as mycobacterial diseases, travel and tropical medicine, or infections in transplanted patients, about which fellows frequently expressed interest in learning more. Nevertheless, fellows should be allowed to have the opportunity to explore educational content strategically and critically, participate and engage in online discussions, and create content of their own. Likewise, ID societies can provide opportunities and resources for educators to learn how to effectively use online and social media tools for teaching, recognizing this as educational scholarship. Finally, fellowship programs should consider giving allotted didactic time to digital learning, taking advantage of its shorter and more digestible content, which will help balance the time between service and education commonly quoted by fellows as a barrier to learning.

There are some limitations to this study. Most notably, we had a limited response rate (<39% based on the total number of matched fellows in 2019 and 2020). Though efforts were made to increase the response rate including using the program director's email lists and reminders on social media, this approach may have biased response among those users who preferentially use online and social media resources. Similarly, because all focus group participants were recruited via the survey, there is a risk that this population was also biased. However, to the best of our knowledge, this is the largest survey and qualitative study of ID fellows with a focus on online educational resources. Finally, this survey was done during the COVID-19 pandemic, which may have influenced the response to some of our questions, as we know fellows have been overwhelmed by inpatient work, keeping up with the current literature, and the psychological effects of the pandemic overall.

CONCLUSIONS

We found that ID fellows are already using online and social media resources, which are viewed as valuable resources that complement their education during their training. Continued improvement of the fellowship curriculum with complementary online and social media resources should be considered to improve ID education among our trainees.

Acknowledgments

Financial support. This work was produced without external funding.

Potential conflicts of interest. All authors: no reported conflicts. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

References

- Guerrasio J, Garrity MJ, Aagaard EM. Learner deficits and academic outcomes of medical students, residents, fellows, and attending physicians referred to a remediation program, 2006–2012. *Acad Med* **2014**; 89:352–8.
- Roberts DH, Newman LR, Schwartzstein RM. Twelve tips for facilitating millennials' learning. *Med Teach* **2012**; 34:274–8.
- Melia MT, Paez A, Reid G, et al. The struggling infectious diseases fellow: remediation challenges and opportunities. *Open Forum Infect Dis* **2020**; 7(3):ofaa058.
- Sterling M, Leung P, Wright D, Bishop TF. The use of social media in graduate medical education: a systematic review. *Acad Med* **2017**; 92:1043–56.
- 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:e76–7.
- Colbert GB, Topf J, Jhaveri KD, et al. The social media revolution in nephrology education. *Kidney Int Rep* **2018**; 3:519–29.
- Farouk S, Sparks MA. Renal fellow network: past and future. *Clin J Am Soc Nephrol* **2018**; 13:1915–7.
- Escota GV, George I, Abdoler E. **1948.** Impact of @WuidQ, a Free Open-Access Medical Education Twitter resource, on infectious disease learning and teaching. *Open Forum Infect Dis* **2019**; 6(Suppl_2):S57–8.
- Artino ARJ, La Rochelle JS, Dezee KJ, Gehlbach H. Developing questionnaires for educational research: AMEE Guide No. 87. *Med Teach* **2014**; 36:463–74.
- Harris PA, Taylor R, Minor BL, et al. The REDCap Consortium: building an international community of software platform partners. *J Biomed Inform* **2019**; 95:103208.
- Willis GB, Artino AR Jr. What do our respondents think we're asking? Using cognitive interviewing to improve medical education surveys. *J Grad Med Educ* **2013**; 5:353–6.
- Kajamaa A, Mattick K, de la Croix A. How to ... do mixed-methods research. *Clin Teach* **2020**; 17:267–71.
- Santhosh L, Rojas JC, Lyons PG. Zooming into focus groups: strategies for qualitative research in the era of social distancing. *ATS Sch* **2021**; 2:176–84.
- Kiger ME, Varpio L. Thematic analysis of qualitative data: AMEE Guide No. 131. *Med Teach* **2020**; 42:846–54.
- Tong A, Sainsbury P, Craig J. Consolidated Criteria for Reporting Qualitative Research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care* **2007**; 19:349–57.
- Coleman CG, Law KL, Spicer JO. #EducationInTheTimeOfCOVID: leveraging social media to teach during the COVID-19 pandemic pandemonium. *Med Educ* **2020**; 54:852–3.
- Young JQ, Van Merriënboer J, Durning S, Ten Cate O. Cognitive load theory: implications for medical education: AMEE Guide No. 86. *Med Teach* **2014**; 36:371–84.
- Schwartz IS, Woc-Colburn L, McCarty TP, et al. 135. Impact of #idclub, a synchronous Twitter journal club, as a novel infectious disease education platform. *Open Forum Infect Dis* **2020**; 7(Suppl 1):S197–8.
- Herrera LN, Nolan N, Chavez MA, et al. 966. ID fellows cup: leveraging gamification and social media to enhance clinical infectious diseases education. *Open Forum Infect Dis* **2021**; 8(Suppl 1):S575–6.
- Lanjewar S, Filipiak R, Osman F, et al. Factors associated with infectious disease fellowship fill rate: an analysis of 2019, 2020 and 2021 match cycles [published online ahead of print, 2021 Nov 12]. *J Infect Dis* **2021**
- Taylor DCM, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. *Med Teach* **2013**; 35:e1561–72.
- Masters K, Ellaway RH, Topps D, et al. Mobile technologies in medical education: AMEE Guide No. 105. *Med Teach* **2016**; 38:537–49.
- Spicer JO, Armstrong WS, Schwartz BS, et al. Evaluation of the Infectious Diseases Society of America's core antimicrobial stewardship curriculum for infectious diseases fellows. *Clin Infect Dis* **2022**; 74:965–72.