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Zaid Almarzooq, MBBCh, Mathew Lopes, MD, Ajar Kochar, MD

PII: S0735-1097(20)34917-2

DOI: <https://doi.org/10.1016/j.jacc.2020.04.015>

Reference: JAC 27263

To appear in: *Journal of the American College of Cardiology*

Please cite this article as: Almarzooq Z, Lopes M, Kochar A, Virtual Learning during the COVID-19 Pandemic: A Disruptive Technology in Graduate Medical Education, *Journal of the American College of Cardiology* (2020), doi: <https://doi.org/10.1016/j.jacc.2020.04.015>.

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## **Virtual Learning during the COVID-19 Pandemic: A Disruptive Technology in Graduate Medical Education**

Zaid Almarzooq MBBCh<sup>1</sup>, Mathew Lopes MD<sup>1</sup>, and Ajar Kochar MD<sup>1</sup>

<sup>1</sup>Brigham and Women's Hospital, Harvard Medical School, Boston, MA, 02115

**Conflicts of interest:** None

**Acknowledgements:** The authors thank Dr. Donna Polk, Dr. Victor Nauffel, Dr. David Gross, Melissa Gayle, and the Brigham Education Institute for their unwavering support in both the design and implementation of this virtual learning platform.

**Corresponding author:**

Zaid Almarzooq MBBCh

Brigham and Women's Hospital Heart and Vascular Center  
and Harvard Medical School

75 Francis Street

Boston, MA, USA, 02115

Email: [zalmarzooq@bwh.harvard.edu](mailto:zalmarzooq@bwh.harvard.edu)

Twitter: @zaidalmarzooq

In these unprecedented times, the world has braced itself for the pandemic of COVID-19 caused by the novel virus SARS-CoV-2 (1). The US is seeing a surge in cases, and local authorities have taken aggressive measures to limit its spread through social distancing (2). US hospitals are expected to see an increase in patients with COVID-19 in the coming weeks to months.

Not only has this expanding threat lead to growing clinical and administrative demands on physicians, it has also dramatically impacted resident and fellow education. Given the CDC's recommendations to cancel large conferences and limit regular meeting sizes, our traditional model of person-to-person educational didactics, lectures, and chalk talks has been compromised (3). When considering the current state of graduate medical education, it comes as no surprise that the status quo is dominated by traditional didactic learning. This form of learning has now been challenged like no other time before, especially given the current public health measures being undertaken for the purpose of social distancing to mitigate the spread of COVID-19 (4). Consequently, the disruption of educational activities can have a negative impact on trainee wellness and their sense of community (5). In 2018, the American College of Cardiology Fellows-in-Training Section Leadership Council proposed three novel educational strategies: personalized learning, adaptive learning with real-world situations and feedback, and the flipped classroom (6). Using these strategies and to heed the call for social distancing, the Brigham and Women's Hospital Fellowship in Cardiovascular Medicine developed a virtual learning platform using Microsoft Teams (Microsoft Corporation, USA). In this article, we will describe the capabilities, implementation, and challenges of virtual learning for cardiology FITs and fellowship programs in the COVID-19 era and beyond.

Prior to the COVID-19 pandemic, many novel tools have been used in the education of trainees. For example, the group chat application, WhatsApp (Facebook, Menlo Park, California), was and continues to be used by many trainees for both sharing of medical knowledge and collaboration (7). Social media, such as Twitter, continues to be an important outlet for many physicians to both learn and disseminate information on a global scale (8). While these tools provide a useful virtual and social outlet for medical education, they often lack the depth and organization to reliably implement an educational curriculum.

In the COVID-19 era the need for innovative solutions to optimize educational endeavors has accelerated. Many programs have sought to improvise with new technologies such as Zoom (Zoom, San Jose, California) and Slack (Slack Technologies, San Francisco, CA)(9).

At our institution, a combination of Zoom and Microsoft Teams has facilitated continued fellowship educational activities. Prior to the COVID-19 pandemic, our primary didactic teaching was through a weekly block of conferences every Friday morning. This Friday morning block was protected for all general cardiology fellows regardless of their assigned rotation. This format has been a popular aspect of our fellowship for many years as it fosters a sense of community among the fellows despite rotating at multiple hospitals. Microsoft Teams, in particular, was utilized due to its easy interface, accessible outlets, collaborative platform, and its integrated, secure cloud systems used by our healthcare system. It has become a one-stop-shop for all our educational needs where, in a single application, one can share articles that are stored in our fellowship program cloud, work collaboratively on the same document, and conduct an engaging virtual conference (**Table 1**).

The week after our department released its policy on social distancing, our program implemented its virtual learning solution using the Microsoft Teams platform. The platform is

organized into teams and channels. In our case, the team was the cardiovascular fellowship and the channels were based on specific themes such as Friday Morning Conference, Chief Corner, and the various fellowship committees (**Figure 1**). We piloted the platform with the Program Director, chief fellows, and fellowship administrators. This was followed by an orientation for fellows via a virtual meeting on this platform. The orientation was easily coordinated by sending fellows an email link. Once they joined the meeting, we were able to share our screen and walk them through various features of the application. These features included secure messaging to individuals or teams, response to live polls and educational prompts, accessing the central fellowship knowledge repository, and streaming of live meetings with screen share and recording capabilities.

Once oriented, we proceeded with posting the Image of the Week challenge the day prior to the scheduled Friday morning conference; people were able to answer the polls ahead of time before the conference (Figure 1). This was not the case prior to using this platform, as it was usually presented and discussed at the time of the conference. We then had our first virtual fellow conference that was organized with our existing Friday morning conference structure. In this session, 20 fellows attended with a guest faculty member and the Program Director. The session was even more engaging than our usual session. We attribute this to the many features of the application that foster active learning such as polling of fellows during the talk, utilization of the chat box for ongoing discussions, and the easy sharing of articles. The session was recorded and stored on our work cloud for fellows to review at their own leisure.

We learned several lessons on the road to successful implementation of a virtual educational environment. First, ensure all potential users are oriented to the application. Second, ask the audience to place their microphones on mute unless they wish to speak to minimize

unintended interruptions. Importantly, we do not suggest this for small virtual meetings as it stagnates collaboration. Third, encourage participants to use video highlighting the speaker to allow for a more dynamic, engaging experience. Of note, this increased engagement with video can be coupled with the ability to blur the user's background to maintain privacy. Fourth, assign a moderator who can ask people for their opinions and also give people who have not had an opportunity to speak, a chance to do so. Finally, have someone designated for assisting others to trouble shoot as often this disrupts the flow of the conference (e.g. someone cannot see the PowerPoint slides and now can reach out, through the application, directly to that person for help).

With any new virtual initiative, technical issues are expected but can be managed as users become more familiar with the interface and local expertise emerges. That said, the primary challenge of this novel platform lies in the faculty's willingness to embrace this technology (10). Even in the post-COVID 19 era, we believe medical training programs will benefit tremendously from incorporating a similar virtual learning platform. A virtual learning platform provides a sustainable, high-quality educational infrastructure that fosters participation and collaboration. This may be especially valuable for trainees on maternity or paternity leave and can serve as an invaluable solution for physical separation.

Future applications will focus on measuring outcomes including fellow satisfaction, attendance, and clinical performance. In addition, the platform can be further utilized for board review purposes and for the mentoring of fellows by more senior clinicians; making them more available as a clinical and career resource. It is also important to acknowledge that this does not replace the need for procedural and experiential teaching but may complement existing virtual simulation platforms.

Amid the COVID-19 pandemic and the need for social distancing, this virtual learning platform has significantly reshaped and innovated how we teach and engage with our medical trainees. In addition, it has allowed us to continue to foster a sense of community that we hope can attenuate trainee burnout and promote wellness in a time when isolation has become a part of everyday life. Program specific virtual learning platforms have the potential to play an important and useful role in the learning of medical trainees.

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## Figure Legend

Figure 1: Microsoft Teams Application Layout on a Desktop Computer

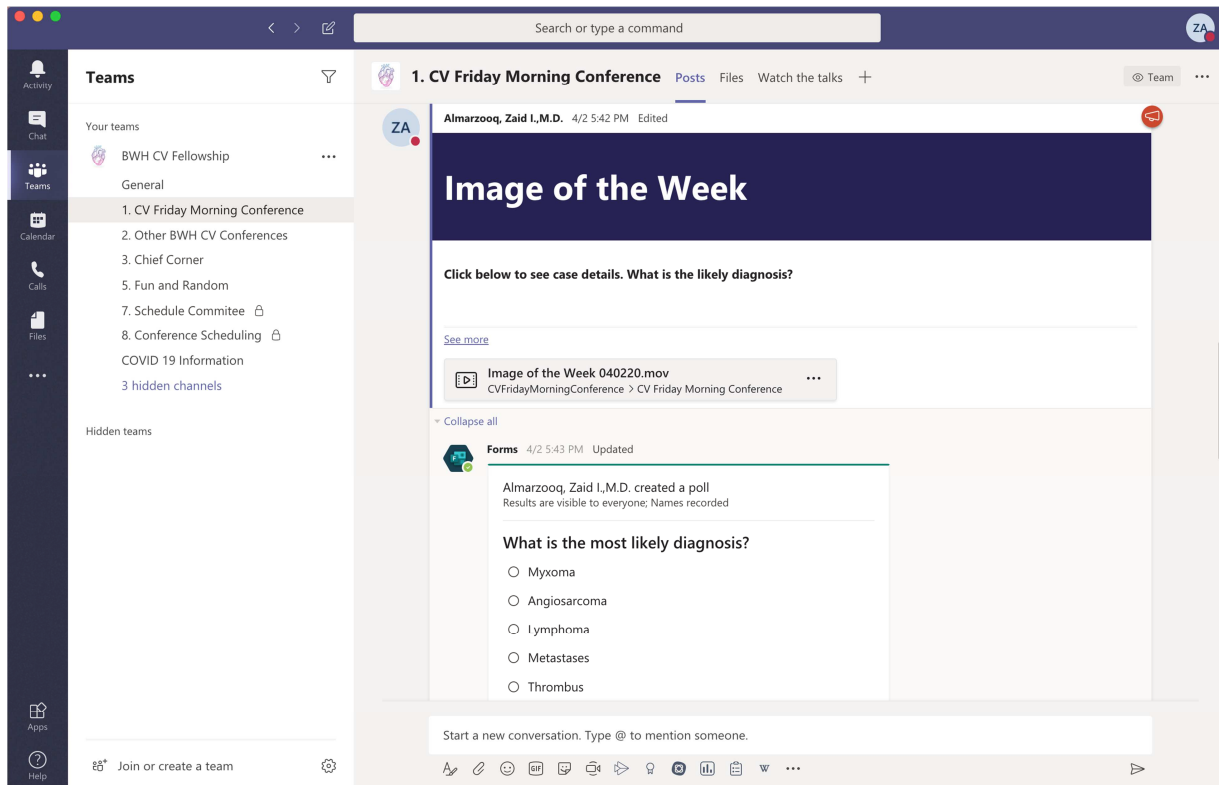


Table 1. Key Features of this Virtual Learning Platform

Integration	Collaboration	Education	Communication
<ul style="list-style-type: none"> <li>• Available as an application on desktops and phones, and on web browsers.</li> <li>• Multiple integrations available to the application.</li> </ul>	<ul style="list-style-type: none"> <li>• Share and edit documents and slides collaboratively.</li> <li>• Readily access fellowship administration and other colleagues.</li> </ul>	<ul style="list-style-type: none"> <li>• Poll audiences for better engagement and quicker feedback.</li> <li>• Stream and record conferences.</li> <li>• Easily share material including slides, articles, and figures.</li> </ul>	<ul style="list-style-type: none"> <li>• Virtual meetings.</li> <li>• Send program announcements that can be targeted (e.g. first year fellows only).</li> <li>• Reduce burden of emails.</li> </ul>