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Review

Online education in a hurry: Delivering pediatric graduate medical education during COVID-19

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ABSTRACT

In the setting of the coronavirus disease 2019 (COVID-19) pandemic, an emergency hospital-wide eWork policy was enacted at Boston Children’s Hospital on March 16, 2020. The number of clinicians on campus was restricted to only essential personnel, guidelines limited clinical care delivery to solely non-elective patients, and strict maximums were placed on the numbers of people allowed to congregate in the same physical space. With this abrupt transition to social distancing and electronic communication, the established approach to educating graduate medical trainees became obsolete overnight. Anticipating significant impact on trainee and faculty professional and personal lives, the importance of adaptive teaching strategies was evident. This document details one approach to redesigning the clinical learning system including a description of the learners and environment, the pedagogical principles that guided the approach, and technological tools used in implementation. Additionally, available literature pertinent to this topic is explored, assessment of the work to date is presented, and suggestions are provided regarding future directions related to online graduate medical education.

1. Introduction

Prior to March 2020, the Boston Children’s Hospital (BCH) Pediatric Cardiology Fellowship Program consisted of on-the-job clinical training in large interprofessional teams, scheduled in-person teaching conferences, and academic research. A total of thirty-seven trainees and more than seventy faculty were involved in the Department of Cardiology’s day-to-day care of patients and graduate medical education. At the start of the coronavirus disease (COVID-19) pandemic in the United States, many dedicated pediatric centers, including BCH, minimized elective appointments and procedures in order to mitigate spread of disease. As a consequence, our trainees and faculty were isolated with reduced clinical exposure and limited social connections.

Medical educators worldwide quickly recognized the potential for considerable impact on trainee and faculty learning, mental health, and professional relationships. Multiple months of limited clinical experience constitute a substantial component of the one to three years of sub-specialty education in pediatric cardiology. Online communication, learning, and collaboration became the primary way to maintain professional and personal connections with trainees, faculty, and larger medical communities. Under these unusual and dramatic circumstances, the BCH Fellowship Program sought to leverage technology to transform the established educational model. Our objectives were to implement a multi-faceted solution that would accommodate learners’ contexts and needs, meet the wide range of digital fluency present in faculty and trainees, create initiatives that could be deployed rapidly and fluidly, and adhere to established pedagogical principles and concepts.

2. Technological interventions and established support for these tools

Identifying learning and engagement goals early in the initiative
helped us focus on the use of technology as a solution to the challenges, as opposed to a gimmick or distractor. This approach is known to be important for learner and faculty buy-in, especially for those not already familiar with the tools [1], [2]. We, therefore, created learning goals and desired results as the first step in the process:

a. Provide high-yield synchronous and asynchronous learning opportunities that engage trainees and faculty using remote technology.
b. Create an online community that provides social support for one another by solidifying personal and professional relationships despite physical isolation.
c. Utilize and curate high-quality resources readily available to us (faculty and trainee expertise, pre-existing online resources, unstructured time) under extraordinary circumstances to create a learning tool that will be useful today and in the future.
d. Centralize currently available learning tools/resources from across the Cardiovascular Program.

e. Elicit real-time informal and formal feedback in order to modify and adjust the intervention to best meet the needs of our learners and educators.

2.1. Platform selection

Our fellowship program did not have an established Learning Management System. We needed an immediately functional platform with attributes of a successful educational technology tool including credible resources, easy access without temporal limitations, and a user-friendly interface [3]. BCH faculty and trainees were familiar with OPEN-Pediatrics (https://www.openpediatrics.org), a free, global, open-access, medical e-learning platform available to healthcare professionals and developed at the institution. In March 2020, OPEN-Pediatrics already contained established peer-reviewed educational resources relevant for pediatric cardiology fellows including video, PDF documents, interactive screen-based simulators, and a multi-media congenital heart disease library [4]. Taking into consideration our

Fig. 1. Home resource page for CVP private group, administrative view. Note embedded links to pre-existing transition to practice resources (TAKEHEART GROUP) and congenital heart disease library. Folders were created and labeled by the author, ST, to address the needs and resources of the department’s trainees and faculty.
pressing educational goals and the strengths inherent in OPEN-Pediatrics, we created a private group site dedicated to the BCH Cardiovascular Program on March 14th, 2020. It was released to the trainees and faculty on March 16th, 2020. By March 24, 2020, ninety-three faculty and trainee members had joined the group.

2.2. Curation of existing resources

In order to rapidly deploy the initiative, we used a combination of pre-existing content and real-time content creation. Anticipating rapid expansion in educational resources, we created clearly labeled folders assigned to topics such as “Electrophysiology” and “Cardiac Imaging” (Fig. 1), each with its own set of sub-folders for organization and ease of use. Task Force reports coordinated by the Society of Pediatric Cardiology Training Program Directors (SPCTPD) were included in each of the relevant sub-specialty folders to provide structure [5]. We identified Divisional educational champions across the Department of Cardiology to help populate folders in the sub-specialty topics with vetted, high quality content related to their area(s) of expertise (e.g. electrophysiology). Standards and guidelines for the care of patients with congenital or acquired heart disease were included. As the group site developed, it became increasingly easier to link resources which now number in the hundreds. For example, faculty teaching an imaging session on cardiac tumors could refer to the relevant pathology lecture and the surgical technique references already available on the BCH Cardiovascular Program group site.

2.3. Synchronous learning opportunities

Synchronous learning is defined as the education of a group of people that occurs simultaneously in real time. At the start of the pandemic, online conferences were immediately identified by global educators as an important solution for synchronous learning when learners could not be face-to-face. BCH had an established relationship with Zoom (https://zoom.us), however, many members of the Department were not familiar with its features. One of the Chief Fellows was tasked with creating a user-friendly document on how to host a Zoom meeting. This was circulated to the faculty and trainees on March 17, 2020.

Prior to the eWork policies, our Department hosted in-person teaching sessions one to two hours daily, Monday through Friday. The approach to these teaching sessions varied but included traditional lecture format and case-based learning. After a brief pause of a week, our core conference schedule was redeployed online, March 23, 2020. We added additional sessions at the request of the learners and interested faculty with a focus on important threshold concepts in the field of pediatric cardiology. Within several weeks, trainees had the option to attend two to three one-hour sessions per day and could choose amongst a variety of topics in the field of pediatric cardiology. Synchronous educational opportunities continued to increase in number throughout April and May, further complemented by national and international initiatives. Two to four hours of online pediatric cardiology content per day continues to be standard even though the Department has resumed much of its pre-COVID-19 activity. If local sessions do not contain patient health information, they are recorded and uploaded to the private OPENPediatrics group site for future viewing. Lecture references are linked with the recorded material for learners interested in additional content or reviewing sentinel literature.

2.4. Asynchronous learning opportunities

Asynchronous educational opportunities occur independently of a specific place or time and therefore offer increased flexibility. Learners may work independently or collaborate with others. This approach presents tremendous potential for active learning where the learner is compelled to engage with the subject material. Additionally, it allows the trainee control over when the learning will take place. With these pedagogical goals in mind, we created a voluntary team-based project that complemented the OPENPediatrics private group site and the Department’s expanded conference schedule. The design strategy of this project utilized active educational strategies to promote and reinforce learning. Acknowledging the online format, we also emphasized transparency of expectations and purpose, clear instructions, small groups of three to five trainees, monitoring and support of the initiative, and guidelines for online etiquette [6].

Each team consisted of individuals from a range of years in training. Mixing the years of experience presented opportunities for vertical learning and mentorship. Additionally, each team was assigned a faculty coach who had volunteered their time and expertise in support of the endeavor. Project components were as follows: 1. Complete the flow chart for a lesion chosen by the team (Fig. 2). 2. Identify three key references as “must read” articles for a learner interested in the designated lesion, and 3. Create three Accreditation Council for Graduate Medical Education-type board questions based on the lesion with answers and explanations. Four teams were created. All components of the project were completed for the following lesions chosen by respective team members: isolated atrial septal defects, pulmonary atresia with intact ventricular septum, total anomalous pulmonary venous connection, and tetralogy of Fallot with absent pulmonary valve. An example of a complete project can be found in Appendix 1. Faculty coaches reviewed all of the content for accuracy and provided feedback to the learners.

The first step of the project was to address the components of the lesion flow chart. In essence, this provided the scaffolding for a concept map of a specific congenital heart lesion over a patient’s lifespan. Each trainee was likely to have prior experience with some aspects of the map. The key component of the exercise was to elaborate on one’s own pre-existing mental model of the lesion by connecting new information in a more sophisticated web. Ideally, combining the varied components of the lesion map (e.g. pathophysiology, management strategies, outcomes) into a complete clinical picture using their own words helped trainees consolidate and solidify knowledge.

The second component of the project was to curate educational resources for the learners and their peers. Although original research and innovative work remain a substantial component of medical education, there is growing recognition of content curation as an important skill. “As curators of content, educators must be skilled in selecting content materials from existing educational materials, and building alliances across stakeholders, including faculty, specialties, professions, accrediting bodies, and professional and interprofessional societies [7].” Asking trainees to choose a limited number of essential references forced them to critically review the scope of the literature and identify references with the highest value for a stated purpose. This skill is an important tool in clinical practice as real-time electronic resources increasingly impact informed decision-making by clinicians and patients.

The third component of the project was to write three mock board exam questions with explanations for the answers. Questions were then used to populate Qstream (https://qstream.com), an online spaced learning platform. Although the learning theory supporting writing practice test questions appears valid, data from studies are mixed [8]. Using these mock questions in an online spaced learning game, however, employs the well-documented testing effect, or benefit of retrieval as a powerful learning tool [9,10]. Repeated recall over time strengthens memory and consolidates concepts. In addition to populating Qstream, we uploaded the learners’ questions into our private group on OPENPediatrics so that they may be used for additional independent learning in the future.

Information about the educational reasoning and pedagogical approach, available resources, and goal due dates were communicated to the trainees throughout the course of the project. Faculty coaches mentored content creation, guided the choice of key references, and reviewed the multiple-choice questions before submission. Our Department’s Chief Fellows ensured project completion and provided
ongoing community support and monitoring of etiquette. Project deadlines were kept somewhat flexible as hospital staffing models and the nationwide implications of the pandemic changed frequently.

3. Assessment

Five weeks into the initiative, a survey was sent to the trainees via SurveyMonkey (SurveyMonkey Inc., San Mateo, California, United States of America), a commonly utilized online survey platform familiar to the learners. The Instructional Design Evaluation Survey for Postgraduate Medical E-Learning was modified and used to assess learners’ experience of this online initiative [11]. Although the context was unusual and unique, assessing this initiative from a framework of quality student learning remained the priority. The survey attempted to measure student engagement, determine if the content delivery provided lasting significant learning, and whether the content and experience added value to the learners’ lives [12]. Survey participation was optional. Responses were anonymized and no survey responder identifying data were collected.

Our survey response rate was 70% (26/37). Respondents reported a high level of motivation for participating in online learning. The top three motivating factors were: “I feel continuing my education through online learning is important”, “I feel it is my professional responsibility to do this online learning”, and “Online learning provides a way to stay professionally connected to my peers and faculty mentors”. The most common barriers to participating in online learning were reported to be limitations on time due to clinical obligations, too many options for online learning, and distractions attributable to the COVID-19
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connectivity [13]. Throughout the COVID-19 pandemic, journals have
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innovative solutions to educational challenges [14 ],
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collaborative real-time solutions to the challenge. Previously accepted
approaches for many aspects of our existence were reimagined,
including the delivery of graduate medical education. The BCh
nous activities are not a new concept, they were not part of the BCH
Cardiology Fellowship curriculum prior to the pandemic. The extraor-
dinary circumstances offered our trainees unstructured time not typi-
cally available to them and therefore an opportunity for inventive
approaches to our training program.

Our local approach prioritized quality of content creation through
engagement of our learners and faculty. This required a substantial time
commitment across the Department. Rapid access to globally shared
high-quality education and medical content resources was an important
facet of our initiative. In a remarkably prescient document from 2010, a
global commission dedicated to health professional education cited
global threats, including infectious disease, as motivation to harness the
potential power of technology for distance learning and collaborative
connectivity [13]. Throughout the COVID-19 pandemic, journals have
expedited articles for online publication to disseminate high-quality,
innovative solutions to educational challenges [14–17]. Alternative
dissemination sources such as blogs, Twitter (San Francisco, California),
and crowd-sourced collaborative documents continue to be rich re-
sources for educators [18–22]. Sharing medical content was part of the
inspiration for the Free Open Access Medical (FOAM) educational
movement which started in 2012. It focuses on the practice of emer-
cency medicine, but its ethos is expanding to other specialties, especially
in light of the pandemic [23–25]. We linked outside initiatives such as
Heart University [26], the Congenital Heart Academy [27], and
SPCTPD’s Pediatric Cardiology National Educational Series [28] to our
OPENPediatrics site as additional resources for our learners and faculty.
Including flexibility in the design of online learning materials such that
unanticipated collaboration could be supported, was critical.

Pediatric trainees were a unique group given their limited role on the
frontline during this pandemic. Leveraging online learning to support
the educational and psychosocial needs of these physically isolated
learners was a priority. This experience may expand opportunities for
approaching graduate medical education in the future. As our medical
communities navigate a path back to a “new normal”, the blended
classroom model may continue to be a public health necessity. The
experience of the pandemic has demonstrated the potential power of
online learning to meet and sustain other educational challenges such as
low attendance at teaching sessions. High-quality online learning could
be one way to mitigate the educational impact of work hour restrictions
by allowing learners to participate from home. Perhaps most convinc-
ingly, the COVID-19 crisis profoundly demonstrated our interconnec-
tedness on this planet. Broad online sharing of expertise fostered
previously unimaginable collaboration within and between institutions
worldwide.

5. Limitations and challenges

This approach to transitioning graduate medical education from an
entirely face-to-face experience to completely online learning environ-
ment had challenges. Thankfully, all of our learners had reliable access
to the internet, and therefore digital equity was not a factor. Addition-
ally, none of our learners required assistive technologies to provide ac-
xess, but it is an important consideration for educators attempting to
design a similar kind of intervention.

Technological literacy and the generation gap between the learners
and the faculty was our biggest hurdle. In general, the age of current
trainees in graduate medicine qualifies them as “digital natives” and
generally fluent in technology. In 2020, a large number of educators in
academic medicine are “digital immigrants” with an enormous range of
technological literacy [29]. Many of the faculty participating in the
learning initiatives required substantial remote support from more
technologically fluent faculty and learners. In hindsight, a survey of our
faculty to assess technological literacy at the start of the initiative would
have been helpful.

Even for those comfortable with the technology tools, online teach-
ing and learning presents challenges to those not familiar with the
format. Teaching on a computer screen is a very different experience
than working with an overflowing lecture hall or intimate small group
session. Physical separation and limited face-to-face contact can lead to
feeling of disconnection and isolation by either the learner or the
educator or both. There is a risk of disengagement and the promotion of
superficial learning. Despite the need for rapid deployment of educa-
tional interventions, adherence to established concepts in adult learning
was prioritized. Important considerations included ensuring that
educational materials were relevant and meaningful to the learners’
professional work, information was applicable to everyday problems,
and learners were engaged with and feel connected to faculty and peers.
High levels of connectivity and collaboration in synchronous and
asynchronous activities were encouraged.

Online learning was a dynamic and expanding field prior to the
pandemic with virtual reality, augmented reality, and gaming viewed as
meaningful learning experiences which may engage our learners [30].
These approaches, however, require more established resources than
were available at the time of this intervention. Additional exploration of
these themes warrants further investigation and will be important to
better understand and improve future educational interventions.

Perhaps most importantly, our educational goals, no matter how
noble or grounded in theories of adult learning, were situated in the
context of a devastating and historic international crisis. This was an
incredibly challenging time for clinicians, professionally, and person-
ally. Openly acknowledging that all members of the department were
navigating multiple stressors was critical during this initiative.

6. Conclusion

Innovative, resourceful, and dynamic initiatives were required to
manage the challenges highlighted by the COVID-19 pandemic and will
be necessary to navigate the uncertainties of the future. Online learning
cannot replace the physical examination of patients and the power of
human touch. It is, however, an opportunity to deliver high quality
learner-centered education in non-traditional settings while simulta-
neously cultivating intrinsic motivation in our trainees and faculty. It is
clear that healthcare professionals yearn for lifelong learning, practice
development, and connection to their local and global communities.
Additional reflection and ongoing formal evaluation of new initiatives
will be essential to understand the implications of these types of
innovations.

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