Building Up While Shutting Down: An Academic Health System Educational Response to the COVID-19 Pandemic

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Abstract

The disruptive influence of the novel Coronavirus Disease 2019 (COVID-19) pandemic was felt worldwide, shutting down global activities and with it standard medical educational processes of face-to-face classroom sessions and clinical clerkship education. In the midst of suspending our face-to-face educational events to support safety for students, faculty, patients, and the community, we recognized the urgent need to build and implement online medical education coursework focused on the COVID-19 pandemic. In this innovative educational experience, we created a comprehensive approach to learning about the COVID-19 pandemic, including not only basic science and clinical knowledge, but also incorporating information in health system science, public health, and health equity. This study examined that perspective of third and fourth year medical students enrolled in a rapidly created two-week online COVID-19 Pandemic course. A course evaluation was completed by 266 of 347 students enrolled in the course. The evaluation included 10 Likert-scale items and 3 open response items. Results indicated an appreciation of basic science and clinical content of the course and serve to inform quality improvement for future iterations of the course or other institutions seeking to develop or improve COVID-19 coursework.

Keywords: COVID-19 pandemic course; virtual learning; curriculum planning; evaluation

Introduction

The disruptive influence of the novel Coronavirus Disease 2019 (COVID-19) pandemic was felt worldwide, shutting down activities across the globe and effectively eliminating the traditional educational operations. The impact on medical education was striking, as face-to-face classroom and clinical clerkship activities were rapidly suspended for the safety of students, faculty, patients, and the community. For the third and fourth year medical students who will
quickly become the next wave of physicians providing care during this health crisis, there was an urgent need to build virtual medical education coursework related to the COVID-19 pandemic.

Recent articles describe a need to both prioritize student safety and wellness while offering opportunities for education and participation with appropriate safety protocols that minimize risk (Ahmed et al., 2020; Ashokka et al., 2020; Miller et al., 2020; Wang et al., 2020; Woywodt, et al., 2020). Documented COVID-19 responses in medical education include using rapidly created student response teams (Soled et al., 2020) and moving to virtual coursework to comply with social distancing guidelines (Fernandez-Altuna et al., 2020; Rose et al., 2020; Singh et al., 2020). Medical student commentary and interviews indicate that students are interested in being prepared to help in clinical settings with broad education related to COVID-19, including clinical care, communication skills, mental health care, crisis management, and public health (Tabari et al., 2020; Theoret and Ming, 2020).

In response to the COVID-19 pandemic, a growing number of medical schools have made changes in medical education. The American Association of Medical Colleges (AAMC) Response Dashboard indicated that at least 61% of medical schools reported developing a COVID-19 course in order to address student needs (AAMC, 2020). Though one study assessed students’ perceptions of on an online learning platform created to allow virtual learning during the COVID-19 pandemic (Singh et al., 2020), to our knowledge, this is the first reported description and corresponding evaluation of the educational content of a COVID-19 pandemic course in a medical school setting. While many medical schools have implemented COVID-19 coursework, there is a need to research the perceived quality of such course materials from the students’ perspectives.

The primary objective of this study was to assess whether the COVID-19 course materials were perceived as useful to students. A secondary objective was to use the evaluation data for course improvement. The course material would be used again within a month by second year (M2) medical students who would shortly enter the clinical clerkship phase of their medical education to treat patients potentially exposed to COVID-19.

Methods

The COVID-19 Pandemic online course was developed over a period of two week period for initial use by third year (M3) and fourth year (M4) medical students immediately after these students were removed from their clinical clerkship rotations. Traditional clerkships were suspended the second week of March and this course began the fourth week of March. Course evaluations were sent electronically to all enrolled students (n=347) at the completion of the course. The course evaluation process was completely anonymous and voluntary. Course evaluations included Likert-scale rating items and open response questions.

Setting: The College of Medicine (COM) at the University of Arkansas for Medical Sciences (UAMS) offers a four-year M.D. degree. The COM, a Liaison Committee on Medical Education (LCME) accredited public institution, is the only M.D.-granting medical school in Arkansas, a mid-sized largely rural Southern state. Our mission is to educate and train physicians who will serve the medical needs of our state. This study was reviewed by the Institutional Review Board for ethics and deemed exempt.

COVID-19 Pandemic Education: It was immediately apparent that our M3 and M4 students who had been abruptly removed from their clinical clerkships and other face-to-face classes needed rapid education on the COVID-19 virus in a virtual, self-directed learning format.

Students: All M3 and M4 students (n=347) were enrolled in the course within 2 weeks of being removed from their
clinical clerkship rotations due to safety concerns.

**Faculty Resources**: The course included substantial contributions from faculty with varying backgrounds and expertise. Clinical M.D. faculty from the specialty areas of Cardiology, Infectious Disease, Internal Medicine, Pathology, Pediatrics, Psychiatry, and Pulmonary Critical Care participated. Basic Science Ed. D. and Ph.D. faculty in the special areas of Education, Ethics, Diversity, Immunology, Microbiology, Psychology, Public Health, and Pulmonary Physiology participated. In addition to COM faculty, we invited contributions from the Arkansas Department of Health, the Vice Mayor of the City of Little Rock, the Executive Director of the Arkansas Minority Health Commission, and several local non-profit leaders.

**Course Design**: The entirely online course was designed to offer M3 and M4 students 2 weeks of immediately applicable education related to the COVID-19 pandemic. Course materials were designed for students to complete approximately 3 learning events and associated study per day. The learning events included a variety of media including faculty recorded lectures, narrated PowerPoint slides, educational videos, reading materials, and select live sessions using the video conferencing platform Zoom.

It was a priority for faculty that student received well-rounded education that addressed not only the medical implications of COVID-19, but also elucidated the broad impact of this public health crisis beyond clinical care. We designed the course to address four major areas of learning: basic science and pathophysiology, clinical care, health system science, and health equity. "Fireside Chats" were moderated, live sessions using the video conferencing platform Zoom. The course began with a live session to acknowledge the emotional impact of the rapidly evolving COVID-19 pandemic and student stress management. This was moderated by course co-directors and representatives from faculty wellness. The course was concluded with a "Lessons for the Future" wrap up session (Table 1).

### Table 1. COVID-19 Pandemic Course Outline

| Lecture Title | Lecture Theme | Modality: | Learning Objectives |
|---------------|---------------|-----------|-------------------|
| Course introduction | Synchronous/Recorded | • Live event to re-orient students after in-person classes were suspended due to COVID-19  
• Discuss course goals and expectations, stress and time management, etc. |
| Biology of coronaviruses | Basic Science & Pathophysiology | Asynchronous | • Understand the classification and nomenclature of coronaviruses  
• Appreciate the origin of SARS CoV2  
• Understand coronaviruses structure  
• Describe the coronavirus replication cycle |
| Topic                                | Subject                     | Delivery Method | Objectives                                                                                                                                 |
|-------------------------------------|-----------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Normal Pulmonary Function           | Basic Science & Pathophysiology | Asynchronous    | • Review steps in the movement of $O_2$ from atmospheric air to alveoli to arterial blood to tissue  
• Define arterial hypoxemia and distinguish it from tissue hypoxia  
• List the causes of tissue hypoxia and arterial hypoxemia; recognize which of these cause elevated Alveolar-arterial (A-a) $PO_2$ gradient  
• Be able to calculate the Alveolar-arterial $PO_2$ gradient and recognize when the A-a gradient is elevated  
• Describe the use of the ratio $PaO_2/FIO_2$ as an index of gas exchange |
| COVID-19 Pathogenesis               | Basic Science & Pathophysiology | Asynchronous    | • Consider disease statistics  
• Think about the spectrum of symptoms and their timing  
• Discuss basics of pathogenesis in the lung  
• Highlight risk factors for severe disease  
• Compare SARS-CoV-2 and other emergent coronaviruses |
| Epidemiology of COVID-19            | Basic Science & Pathophysiology | Asynchronous    | • Gain basic knowledge of the conditions needed for pandemic spread  
• Appreciate the similarities and differences between spread of SARS and SARS-COV-2  
• Understand the impact of flattening the curve of case incidence on healthcare management  
• Understand the impact of $R_0$, $S$, and secondary attack rates on disease progression |
| COVID-19 Transmission and Control   | Basic Science & Pathophysiology & Clinical Care | Asynchronous    | • Define how SARS-CoV2 is transmitted  
• Understand the potential role of asymptomatic carriers in spreading SARS-CoV2  
• Appreciate measures used to control SARS-CoV2 transmission |
| COVID-19 Treatments                 | Basic Science & Pathophysiology | Asynchronous    | • Appreciate supportive care measures for treating COVID-19  
• Understand the current status of pharmacologic treatments for COVID-19 |
| Immune responses to COVID-19        | Basic Science & Pathophysiology | Asynchronous    | • Acquire working knowledge of the course of an immune response in mild and severe COVID-19 infections  
• Understand the potential benefits and limitations of plasma therapy  
• Understand the impact and benefits of widespread COVID-19 antibody screening  
• Understand the challenges involved in achieving herd immunity while minimizing morbidity and mortality |
| Course Title                                           | Module Type | Study Mode  | Goals                                                                 |
|-------------------------------------------------------|-------------|-------------|----------------------------------------------------------------------|
| Coronavirus vaccines                                   | Basic Science & Pathophysiology | Asynchronous | • Understand vaccines against veterinary coronaviruses            |
|                                                       |             |             | • Understand the current state of vaccine development against SARS-CoV1, MERS, and SARS-CoV2 |
|                                                       |             |             | • Appreciate the development and approval process for vaccines      |
| Health Disparities and COVID-19                       | Health Equity | Asynchronous | • Evaluate the role of population health management in public health emergencies |
|                                                       |             |             | • Define vulnerable populations during a pandemic                   |
|                                                       |             |             | • Recognize the impact of social determinants of health for patients and communities facing a public health crisis |
| Fireside Chat: COVID-19 & Racial Disparities           | Health Equity | Synchronous/Recorded | • Live, interactive forum to discuss how the COVID-19 pandemic |
| Exam 1                                                | Week 1 Content | Asynchronous | • Approximately 3 questions per learning event                     |
| Ethics & the COVID-19 Pandemic                        | Health System Science | Asynchronous | • Explain the shift to public health ethics and some major ethical issues that arise during a pandemic. |
|                                                       |             |             | • Analyze the ethical dimensions of triage protocols.              |
|                                                       |             |             | • Describe sources of moral distress during the COVID-19 pandemic, and assess methods for alleviating moral distress. |
| COVID-19 Case presentation                            | Clinical Care | Asynchronous | • Understand signs and symptoms associated with COVID-19           |
|                                                       |             |             | • Understand the effect of treatment on COVID-19 disease progression |
| COVID-19 Screening                                    | Clinical Care | Asynchronous | • Understand the reasons for testing an individual for SARS-CoV2  |
|                                                       |             |             | • Describe how specimens are collected for SARS-CoV2 testing      |
|                                                       |             |             | • Appreciate the different laboratory tests used for SARS-CoV2     |
|                                                       |             |             | • Understand what a "positive" test result means                  |
|                                                       |             |             | • Describe what to do with a positive test?                       |
| COVID-19 Overview                                    | Clinical Care | Asynchronous | • Overview of COVID19 to date with epidemiology, treatment data/trials, and clinical progression |
| Severe COVID-19 Complications – An ICU Primer         | Clinical Care | Asynchronous | • Recognize the mechanism of critical illness in COVID-19          |
|                                                       |             |             | • Understand the basic pathophysiology of ARDS                    |
|                                                       |             |             | • Review the management of severe ARDS                            |
|                                                       |             |             | • Review other supportive measures                                |
| Infection Control | Clinical Care | Asynchronous | • Understand the measures taken in the clinic to prevent SARS-CoV2 spread  
• Explain the containment/isolation procedures for COVID-19 patients  
• Understand what PPE is required for treating COVID-19 patients  
• Know how to don & doff PPE |
| Social media and the COVID-19 Pandemic | Health Equity | Asynchronous | • Appreciate how false and misleading reports contribute to confusion during the COVID-19 pandemic  
• Understand how social media influences public perception of the medical establishment  
• Understand how to separate public and private social media presence |
| Public Health Emergencies and Response | Health System Science | Asynchronous | • Appreciate how the Arkansas Department of Health (ADH) responded to the COVID-19 pandemic  
• Understand the role of ADH in future efforts to track and manage SARS-CoV2 spread in Arkansas |
| Pre-TSD: COVID19 and Mental Health | Health System Science | Asynchronous | • Increase understanding of the psychosocial impacts of pandemics on healthcare workers and patients.  
• Introduce skills to support personal wellbeing for the duration of the COVID-19 outbreak and after.  
• Introduce skills to support trauma-informed care of patients. |
| Fireside Chat: Clinical wrap-up | Clinical Care | Synchronous/Recorded | • Live event to allow students to ask questions about COVID-19 clinical care |
| COVID19: UAMS’ Response to a Population Health Emergency | Health System Science | Asynchronous | • Review population health concepts related to "vulnerable populations"  
• Introduce "Population Health Emergencies" related to COVID19 pandemic  
• Discuss UAMS’ response to COVID19 Population Health Emergencies through case examples:  
  ○ Quarantined employees and students  
  ○ Homelessness and patient discharge  
  ○ Undocumented, Spanish-speaking population in Arkansas |
| Fireside Chat: COVID19 and Vulnerable Populations | Health Equity | Synchronous/Recorded | • Live event to help students:  
  ○ Evaluate the role of population health management in public health emergencies  
  ○ Define vulnerable populations during a pandemic  
  ○ Recognize the impact of social determinants of health for patients and communities facing a public health crisis |
Lessons for the Future

| Asynchronous | • Course wrap-up and important questions about COVID-19 going forward  
| • Discussion of how response to COVID-19 can aid preparation for future pandemics  

| Exam 2 | Week 2 Content | Asynchronous | • Approximately 3 questions per learning event  

**Asynchronous/Synchronous-Recorded Learning Events:** To allow students maximum flexibility to complete course assignments, given unexpected disruptions to study time, space, and methods, the course was designed with mixed asynchronous and synchronous-recorded learning events. Asynchronous events allowed students to complete the learning event when convenient, considering other educational, personal, and family responsibilities. The faculty also recognized that many students may feel isolated due to rapidly enacted social distancing requirements and thus scheduled synchronous-recorded leaning events via the video conferencing software Zoom. This allowed faculty-student interaction through both the live video and the typed chat feature during the learning event. These synchronous, interactive events were also recorded and posted to the online learning management software for all students to view at another time, if more convenient.

**Exams:** Two scheduled online exams included approximately 3 questions per learning event. Students were allowed flexibility to complete each exam in their own testing location. Each exam was available for student to initiate within a 2.5 day period following the week of learning events. The time available for each test was calculated by 90 seconds per question which mirrors the average length of time allotted per question for the United States Medical Licensure Exam (USMLE) Step 1. After submitting their answers, students were allotted an additional 5 minutes to review incorrect answers, and read answer rationales. No test security monitoring software was used, though students were reminded of the college honor code prohibiting consulting with others or other resources during the exam. It was also anticipated that a short amount of time allotted per question would reduce the likelihood of cheating.

**Course Evaluation Instrument:** The 13-item course evaluation was sent to students electronically and included 10 questions that asked students to rate each item using a 5-point Likert-scale of Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, and Strongly Agree, and 3 open-ended questions that prompted students to write about course strengths, opportunities for improvement, and additional comments. The course evaluation was anonymous and voluntary.

**Results/Analysis**

A total of 266 students completed the course evaluation of 347 students enrolled in the course, giving a response rate of 76.7%.

**Quantitative:** Data indicate that the majority of students ranked all course evaluation prompts with responses of "Strongly Agree" and "Agree" combined (Table 2). The items that students ranked the highest in combined ratings of "Strongly Agree" and "Agree" were "How well do think this course prepared you to understand the scientific background of the COVID-19 pandemic" (94.23%), "Testing: Material on exams was related to material covered either in class or in course assignments; students were treated equitably" (90.97%), and "How well do you think the course prepared you with knowledge of appropriate protocols for use of Personal Protective Equipment" (89.96%). The items that students ranked the lowest in combined rating of "Strongly Agree" and "Agree" were "How well do you think this course prepared you to manage patients with COVID-19?" (80.76%), "How well do you think this course prepared you to understand the social determinants of health that contribute to public health crises?" (84.11%), and "Clarity: Goals and educational objectives of course were clear, faculty expectations of students were
clear, grading policy was clearly explained." (86.84%)

| Table 2. Student Course Evaluation Responses (n=266) |
|-----------------------------------------------|
| **Question** | 1-Strongly Disagree | 2-Disagree | 3-Neither Agree Nor Disagree | 4-Agree | 5-Strongly Agree | Mean | StDev |
|---------------|----------------------|------------|--------------------------------|--------|-----------------|------|-------|
| Organization: Course was well organized, material was presented in a logical sequence, instructional time was used effectively, important points were emphasized. | 0.38% | 1.50% | 10.15% | 46.24% | 41.73% | 4.27 | 0.73 |
| Clarity: Goals and educational objectives of course were clear, faculty expectations of students were clear, grading policy was clearly explained. | 0.38% | 1.13% | 11.65% | 40.60% | 46.24% | 4.31 | 0.75 |
| Testing: Material on exams was related to material covered either in class or in course assignments; students were treated equitably. | 0.38% | 1.13% | 7.52% | 37.59% | 53.38% | 4.42 | 0.71 |
| Materials: Syllabi/course outline was well prepared, relevant to the course and understandable. | 0.38% | 1.50% | 9.77% | 40.98% | 47.37% | 4.33 | 0.75 |
| Content: Course content facilitated student ability to achieve course goals and objectives and was relevant to career preparation. | 0.75% | 1.50% | 8.27% | 39.47% | 50% | 4.36 | 0.76 |
| Overall: The quality of this course is outstanding. | 0.75% | 1.88% | 10.53% | 42.11% | 44.74% | 4.28 | 0.79 |
| How well do you think this course prepared you to understand the scientific background of the COVID-19 pandemic? | 0.38% | 0.38% | 5.00% | 40.77% | 53.46% | 4.47 | 0.65 |
How well do you think this course prepared you to manage patients with COVID-19?

| Percentage | Rating |
|------------|--------|
| 1.15%      | 4.04   |
| 5.00%      | 0.86   |
| 13.08%     | 4.25   |
| 50.38%     | 0.84   |
| 30.38%     | 4.36   |
| 4.04       | 0.74   |

How well do you think this course prepared you to understand the social determinants of health that contribute to public health crises?

| Percentage | Rating |
|------------|--------|
| 1.55%      | 1.16   |
| 1.16%      | 13.18  |
| 13.18%     | 39.15  |
| 39.15%     | 44.96  |
| 44.96%     | 4.25   |
| 4.25       | 0.84   |

How well do you think the course material prepared you with knowledge of appropriate protocols for use of Personal Protective Equipment?

| Percentage | Rating |
|------------|--------|
| 1.16%      | 4.36   |
| 0.00%      | 0.74   |
| 8.88%      | 4.36   |
| 42.08%     | 0.74   |
| 42.08%     | 4.36   |
| 47.88%     | 0.74   |
| 47.88%     | 4.36   |

**Qualitative:** Data were sourced from three open-ended questions included in the course evaluations.

1. Describe some of the strengths of the course in your opinion.
2. Describe possible areas of improvement for the course in your opinion.
3. Enter any additional comments in the space provided.

Themes that emerged from the wide range of comments included (1) an appreciation of timely course development to allow relevant continuity of medical education during the pandemic, (2) an appreciation of COVID-19 specific basic science educational content to provide vital knowledge for medical students during the pandemic, and (3) constructive comments that called for more course learning events that covered clinical applications. Student comments included, "Very informative material and helped me feel more knowledgeable about the virus and confident in being able to intelligently discuss the pandemic and share information," and, "I would have loved a few more lectures on the specifics of actually managing a COVID patient, i.e. ventilator settings, working through a few vignettes, etc. Overall, thank you for organizing such a wonderful course so quickly."

**Discussion**

It was challenging to create a course on evolving content as knowledge, expectations, protocols, and daily routines were also changing for all. Nonetheless, we realized that the charge to create timely, relevant medical educational content was imperative. To the best of our knowledge, this is the first published survey of medical students’ evaluation of a rapidly created COVID-19 Pandemic course that sought to balance salient basic science, clinical, ethical, wellness, public health, and health equity topics surrounding the COVID-19 Pandemic.

As expected, quantitative rating and qualitative comment themes aligned in regard to strengths and opportunities for the course in future iterations. Students recognized the monumental effort involved to create and curate educational content in such a short amount of time. Additionally, students appreciated the inclusion of high yield basic science information, and lectures related to the scientific underpinnings of the COVID-19 pandemic received the highest evaluations in ratings and in comments.

Also expected, student feedback indicated that the greatest potential area for course improvement was related to clinical application of knowledge, specifically case presentation, case management, and personal safety. It is
important to note that students enrolled in the course were in their third and fourth years of medical school and had been abruptly removed from their clinical clerkship rotations for their and others’ safety. These students felt a great amount of concern and fear as they were quickly going to be reintroduced to the clinical environment and any COVID-19 related knowledge would be immediately relevant.

Addressing the clinical concerns posed two distinct challenges. First, course content required clinician input and was difficult to develop quickly given the two-week development time frame and many clinician educators were largely unavailable due to patient treatment responsibilities. Second, the clinical implications for treatment and management of COVID-19 patients were rapidly changing from day-to-day during the early phase of this pandemic and keeping abreast of clinically appropriate information while simultaneously building a curriculum proved challenging. The planning processes for future iterations of the course for future groups of students will incorporate these findings and will have the benefit of clinical treatment experiences at the initial stages of this noel COVID-19 pandemic.

One unexpected finding was not related to the results of the student responses in the course evaluation. Faculty review of student results on Exam 1 and Exam 2 seemed to indicate individual effort, i.e., that the students were not collaborating with others or using outside materials during the testing. Exam 1 percentage correct scores ranged from a low of 79% to high of 100%. Exam 2 percentage correct scores ranged from a low of 84% to a high of 100%. This may have resulted from the brief average time allotted for the exam questions, the result of social distancing, or intrinsic motivation to test one’s knowledge related to such an important societal medical concern.

A limitation of this study is that this course evaluation was a one-time survey of students in a single institution faced with unprecedented and rapidly evolving circumstances of the COVID-19 pandemic. It is possible that perceived needs may change over time. Nevertheless, the findings of this study provide valuable insight to schools who want to initiate or improve their COVID-19 pandemic education. This evaluation will be used to make future improvements to our COVID-19 education for medical students and other students across health care programs at our university, as well as continuing education for physicians and other health care workers across our state.

**Conclusion**

Building up educational content for medical students while in the midst of shutting down traditional educational processes at our academic health system proved a formidable challenge; but one of vital importance for those medical students who will shortly become practicing physicians in a world forever changed by the COVID-19 pandemic.

Several findings of the study would be helpful for other schools as they plan the development or improvement of coursework that covers the COVID-19 pandemic. Education related to the virology and epidemiology of the COVID-19 virus is likely to be well accepted. However, medical students are acutely aware of the need for thorough clinical education related to COVID-19, specifically in the areas of diagnosis, management, safety protocols, and personal protective equipment. In addition, addressing the larger context of health equity, physician mental health, and community response beyond the clinical environment offers an important opportunity to prepare well rounded future physicians.

Clinician input is essential to COVID-19 education, but clinical physician time is stretched thin during a pandemic, making it less likely that clinicians will have the ability to set aside time to leave clinical service in order to prepare separate educational content on short notice for medical students. Medical education programs may need to explore novel options that allow students to learn from clinical experiences without adding additional time and effort to practicing clinicians. One such option may a “Day in the Life” type video recording that maintains patient anonymity.
but allows medical students to be virtually present for the clinical experience. A recording could then be edited by clinical educators working with educational technology experts to develop instructional material that could be organized by topic and include imbedded learning objectives and associated assignments for students.

**Take Home Messages**

- COVID-19 medical education should seek to balance basic science content, clinical applications as well as public health and health equity considerations.
- Student feedback indicates that practical clinical knowledge and applications for managing patients with COVID-19 is valued.
- Innovative educational content should prioritize designing virtual clinical content that seamlessly integrates into practicing clinicians' regular clinical responsibilities.

**Notes On Contributors**

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Appendices

None.

Declarations

The author has declared that there are no conflicts of interest.

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