

# Coping With COVID-19

## Emerging Medical Student Clinical Pathology Education in the Pacific Northwest in the Face of a Global Pandemic

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### ABSTRACT

**Objectives:** *The first coronavirus disease 2019 (COVID-19) case in the United States was reported in Washington State. The pandemic caused drastic disruptions to medical institutions, including medical education. The Department of Laboratory Medicine at the University of Washington responded by rapidly implementing substantial changes to medical student clerkships.*

**Methods:** *In real time, we converted one ongoing case- and didactic-based course, LabM 685, to remote learning.*

**Results:** *Fifteen of 17 scheduled sessions proceeded as planned, including two sessions for student presentations. Two didactics were canceled as the functions of the teleconferencing platform were not sufficient to proceed. One grand rounds speaker canceled due to COVID-19 precautions. Elements of an immersive clinical laboratory clerkship, LabM 680, were repurposed to accommodate 40 medical students per class via remote learning, highlighting clinical laboratory activities that continue throughout the outbreak. A new remote clerkship, MedSci 585C, was developed incorporating distance learning and guided small-group sessions. This coincided with parallel efforts to make resident and fellow service work, conferences, and didactics available remotely to comply with social distancing.*

**Conclusions:** *The changes in medical education described reflect the dynamic interplay of current events affecting the world of clinical pathology. Throughout this, technology—while with some limitations—has provided the platform for innovative learning.*

### Key Points

- The COVID-19 pandemic response has led to enormous medical and popular interest in laboratory diagnostic tests as the issues pertaining to them have vital repercussions for society.
- COVID-19 quickly forced universal adoption of technology such as teleconferencing to facilitate education, and these tools have provided both solutions and new challenges.
- The changes in medical education necessitated by the global pandemic reflect the dynamic interplay of current events affecting the world of clinical pathology and vice versa.

The first novel coronavirus disease 2019 (COVID-19) case was reported in the United States in the state of Washington on January 21, 2020, approximately 2 and a half months following the initial reports of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Wuhan, China.<sup>1</sup> Washington State became an early focus of the outbreak in the United States and initially held the distinction of most confirmed positive cases and highest mortality in the country.<sup>2,4</sup> The University of Washington (UW) School of Medicine (SOM) is headquartered in Seattle and serves students in five states, including Washington, Wyoming, Alaska, Montana, and Idaho (WWAMI) with regional sites in each state. The UW SOM was immediately on high alert given the number of flights arriving daily from Asia to the West Coast and the recent return of several undergraduate students from Wuhan.<sup>5</sup> The number of confirmed COVID-19–positive cases increased rapidly, resulting in significant disruption to daily activities at medical institutions, affecting all activities including medical student education, with the primary focus

on maintaining optimal patient care while protecting the well-being of the workforce and trainees.<sup>6</sup> In March 2020, as cases of COVID-19 increased throughout the state, the SOM halted all clinical clerkships and advised students to return to their home states. A parallel gubernatorial proclamation required all classes and meetings at the university to be held remotely, prohibiting in-person classroom instruction.<sup>7</sup> Simultaneously, the US federal government declared the pandemic a national emergency.<sup>8</sup> These developments required the rapid implementation of significant changes to medical education in clinical pathology at our institution.

The Department of Laboratory Medicine routinely offers two 2-week clerkships for medical students: Laboratory Medicine 685: “Laboratory Case Studies for Clinical Diagnosis” (LabM 685) and Laboratory Medicine 680: “Clinical Laboratory Testing—Methods and Interpretation” (LabM 680). LabM 685 is a case-based course offered once per academic year (AY) using lectures and guided discussion to teach senior medical students the efficient selection and rational interpretation of laboratory tests. LabM 685 pedagogy relies on classroom discussions, laboratory shadowing, and student presentations. Enrollment is an average of 11 students per AY. Two days prior to the start of LabM 685, the viral genome analysis from two regional patients diagnosed with COVID-19 suggested 6 weeks of cryptic transmission in the local community, a finding broadcast through social media<sup>9</sup> and that set the tone for the session.

LabM 680 is a 2-week, modular clinical laboratory experience offered throughout the AY in which one to three students participate at an introductory level in division-specific and interdisciplinary conferences, didactics, and a weekly review of calls handled by the laboratory medicine residents (“call rounds”) and tour clinical laboratories at the university-based medical center and the general trauma hospital. Division-specific activities include sign-out of coagulation and hemoglobinopathy testing, identification of alloantibodies, review of transfusion reactions, and other clinical consultation encountered in resident service work. In addition, three interdisciplinary conferences occur weekly between clinical microbiology faculty and infectious diseases clinical services (“plate rounds”). Both courses are graded with a pass or fail format. The clerkships are not available simultaneously because each clerkship draws from the same pool of instructors.

Medical student instruction in laboratory medicine is distinct from other specialties in part because while critical patient care activities are performed,

relatively little direct patient contact takes place. This feature greatly facilitates the transition to remote learning. However, being provider-facing means clinical laboratory activities are often less recognizable to nonpathologists as patient care. Nonpathologists are often unaware of the regulatory environment in which clinical laboratories operate, a topic that has been a source of increased discussion recently in the context of developing diagnostic testing for SARS-CoV-2.<sup>10</sup> These features make medical education in laboratory medicine a valuable resource, especially during the COVID-19 pandemic, which serves as a unique real-time case study highlighting multiple central aspects of laboratory medicine for learners at all levels.

## Materials and Methods

### Incorporating Clinical Laboratory COVID-19 Pandemic Responses in Course-Based Learning

SARS-CoV-2 remained a key topic of discussion throughout the course. Specific questions from or interests expressed by students prompted additional discussions and supplemental reading/journal articles related to both the new pathogen and vaccine development in other outbreak situations (ie, Ebola, severe acute respiratory syndrome virus, Zika virus). Impromptu and extemporaneous discussions or modifications were made to existing scheduled lectures to incorporate SARS-CoV-2 biology, epidemiology, and laboratory responses. The rapidly changing SOM policies for medical students and employee health guidelines were also discussed with students.

### Remote Learning Tools

The Zoom teleconferencing platform (Zoom Video Communications) was used to conduct all remote learning. The professional version of the teleconferencing application was made available for university students, faculty, and staff on March 4, 2020, including a Health Insurance Portability and Accountability Act (HIPAA)-compliant version for Protected Health Information (PHI). Support for the application was available through administrative staff and course directors. The new online-only course, Medical Science 585C: “Clinical Laboratory Testing Distance Learning—Methods and Interpretation” (MedSci 585C), relied on the cloud-based Canvas Learning Management System (Canvas GFX) for distribution of course materials and submission of assignments. The Zoom “breakout room” feature was used for small-group discussions in MedSci 585C.

## Changes to Educational Structure

Changes to course structures made due to COVID-19 are summarized in **Table 1**. Briefly, the second week of LabM 685 was conducted online. Scheduled sessions of LabM 680 (March to June 2020) were canceled by the UW SOM along with all in-person medical student rotations. LabM 680 was replaced with MedSci 585C, which provided most regularly scheduled LabM 680 curricula in an online format. In addition, we identified previously recorded and upcoming lectures that could be recorded, as well as the clinical services with remote-access capabilities for trainees, and created supplemental activities not typically part of LabM 680, such as guided discussions, self-study resources, and reflective writing assignments. After assessing capacity, we planned to accommodate up to 40 students. To maintain low trainee/faculty ratios, we also planned twice-weekly small-group discussions facilitated by at least one faculty plus a second faculty or senior fellow. No changes were made to an additional clerkship with rare enrollment, LabM 600, which covered individualized independent study or research projects with a faculty mentor. No students were enrolled at the time, and this course likely would have been canceled under SOM policy.

## Course Evaluations

No changes were made to previously planned LabM 685 feedback collection through an anonymous survey and discussion between course directors and students. For MedSci 585C, student feedback was gathered through (1) a final wrap-up session with the whole class, (2) an assigned reflection piece, and (3) a course survey. The final wrap-up session invited students to provide verbal feedback and

closing remarks. The reflection piece, due at the end of the course, was a one- to two-page reply to the following prompt: “Describe three key aspects of lab medicine you’ve learned and how they apply to the Covid-19 pandemic.” The anonymous course survey contained quantitative and free-text elements for students to give feedback on small groups, lectures, and the overall course (**Supplemental Table 1**; all supplemental materials can be found at *American Journal of Clinical Pathology* online). Survey questions were designed to assess aspects of the course such as interactivity, clinical casework integration, achievement of course objectives, and overall impression. Students graded the course on a scale of 1 to 5, with 5 indicating the strongest level of agreement or most positive assessment.

## Results

### Real-Time Modifications to Course-Based Learning

When the Centers for Disease Control and Prevention began issuing guidance to curb the spread of COVID-19, 11 students were enrolled in course-based learning via LabM 685 **Table 2**. Adjustments to LabM 685 (**Table 1**) were implemented in both week 1 and week 2, with significant structural changes in week 2 **Table 3**. The most significant alteration implemented in week 1 was the real-time incorporation of the COVID-19 pandemic as an overarching theme or case study to highlight the role of laboratory medicine. Course directors led either impromptu or rapidly prepared discussions focused on multiple aspects of the growing pandemic. These covered a diverse array of topics, including clinical features of

**Table 1**  
Summary of Courses Before and During the COVID-19 Pandemic

Characteristic	Prepandemic	During Pandemic Rotations
Course name	LabM 685 LabM 680	LabM 685 MedSci 585C
Brief description	LabM 685—In-person lecture format, case-based overview of laboratory medicine for graduating students; offered once, 2-week block in spring quarter LabM 680—In-person immersive experience in laboratory medicine; rotate through multiple laboratory areas; participate in clinical conferences, rounds, and sign-out; consecutive 2-week blocks for most of academic year; maximum 2-3 students per block	LabM 685 (during pandemic)—second week of course changed to online format (Zoom) MedSci 585C—Online format (Zoom); mixed format of lectures, participation in clinical conferences, rounds, and sign-out; offered twice, 2-week blocks in spring quarter; maximum 40 students per block
“Pros”	Restricted to MS-3 and MS-4 In-person format Many direct faculty interactions Participate in laboratory clinical activities Opportunity for time at the bench	Included MS-2, MS-3, and MS-4 Maintain social distance Fewer faculty interactions but more in-depth Some participation in laboratory clinical activities Participate from wide geographic range, rural areas Increased scalability/enrollment
“Cons”	Unable to maintain social distance Limited scalability/enrollment Required to be on site	Loss of in-person connection Accessibility challenges, especially for rural areas New technical skills (eg, Zoom presentations)

MS-, medical student year.

**Table 2**  
Number of Enrolled Students by Course<sup>a</sup>

Course	Students per Academic Year, No.				Average No.	4-Year Total No.
	AY2016	AY2017	AY2018	AY2019		
LabM 600	0	0	1	1	1	2
LabM 680	13	13	22	25 <sup>b</sup>	18	73
LabM 685	11	16	4	11	11	42
MedSci 585C	NA	NA	NA	28	14	28
Total	24	29	27	64		

AY, academic year; NA, not applicable.

<sup>a</sup>LabM 600: “Independent Study or Research”; LabM 680: “Clinical Laboratory Testing—Methods and Interpretation”; LabM 685: “Laboratory Case Studies for Clinical Diagnosis”; MedSci 585C: “Clinical Laboratory Testing Distance Learning—Methods and Interpretation.”

<sup>b</sup>Thirty-four students were registered for LabM 680, but nine were dropped from the rotation due to COVID-19.

COVID-19, understanding outbreak dynamics through representative graphs, specific infection control precautions in clinical laboratories, molecular epidemiology from viral genome sequence data, and sharing emerging data and reports. Other discussions covered SARS-CoV-2 test development and regulatory requirements for clinical laboratories. These discussions were facilitated by the start of clinical testing for SARS-CoV-2 by the clinical virology laboratory<sup>11</sup> on the first day of LabM 685. One clinical-hematopathology conference was canceled. During week 1, the faculty and administrative staff responsible for the course anticipated and planned to convert to remote-only instruction using the university teleconferencing platform. In-person instruction was suspended at the midpoint of the course in concordance with university official policy.<sup>12</sup>

Week 2 of LabM 685 was conducted entirely online. Two of the scheduled presentations were canceled as they were formatted to be given as “chalk talks.” The “white-board” feature of the teleconferencing platform did not meet the needs of the two presenters, and the lectures could not be rewritten as slide-based presentations in the time available. In addition, one grand rounds presentation was canceled by the invited speaker, an expert in tropical medicine, who declined to travel given the risks of SARS-CoV-2 transmission. All other pedagogic activities proceeded, including the student presentations, which were conducted in two sessions at the end of the course. The success of these changes informed modifications to the upcoming LabM 680 course.

### Transformation of Clinical Experience in Laboratory Medicine

Before the next section of LabM 680 began, the SOM canceled all upcoming clerkships to allow a window of opportunity for the development and implementation

**Table 3**  
Real-Time Adaptations of LabM 685

Educational Activity	Scheduled Sessions, No. (Week of Course)	Completed Sessions, No.	Significant Modifications
Faculty presentations	15 (week 1)	15	Week 1: Clinical virology faculty canceled due to outbreak demands
	15 (week 2)	13	Week 2: Two chalk talks canceled
Student presentations	2 (week 2)	2	All 11 students presented
Laboratory tours	2 (week 1)	2	General laboratory tour truncated due to laboratory staff concerns
Laboratory medicine	1 (week 1)	1	
Grand rounds	1 (week 2)	0	Week 2: Speaker canceled
Hematopathology clinical conference, optional	1 (week 2)	0	Canceled, not by LabM 685 faculty
Call rounds, optional	1 (week 1)	1	Special session on COVID-19; one-third of LabM 685 students attended

of alternate educational plans. The course directors and clerkship administrator for LabM 680 collaborated to develop a new course, MedSci 585C, based on LabM 680 activities but conducted as remote learning. Many activities in which LabM 680 students participated were concurrently being transitioned online to allow residents and fellows to work remotely. These included clinical microbiology–infectious diseases plate rounds, resident didactics, call rounds, and coagulation/hemoglobinopathy testing sign-out. The course directors effectively leveraged these parallel changes in clinical activity and resident education to provide medical students remote access to these activities, which had been components of LabM 680 **Table 4**. The online format allowed a greater capacity of up to 40 students with the first course scheduled to begin late April. Small-group sessions and flipped classroom teaching sessions were incorporated. The new course, MedSci 585C, provided third- and fourth-year medical students an opportunity to develop their diagnostic and patient management skills through directed distance learning in the hospital-based clinical laboratory.

### Student Evaluations

Fourteen students completed each session of the new course, MedSci 585C. In the first session, five of 14

Table 4

## Comparison of LabM 680 to MedSci 585C

Educational Parameter	LabM 680	MedSci 585C
Maximum enrollment, No.	3	40
Learning environment	In-person	Remote
Welcome lecture	NA	Remote
Small group sections	NA	10 students each
Microbiology bench rounds	2×/week	NA
Microbiology plate rounds	2×/week, in-person	2×/week, remotely
Coagulation sign-out	2×/week, in-person	2×/week, remotely
Transfusion Education	2×/week, in-person	3×/week, remotely
Student presentation	1/rotation, in-person	1/rotation, remotely
Call rounds	1×/week, in-person	1×/week, remotely
Resident and clinical chemistry didactics	3×/week, in-person	3×/week, remotely
Supplemental readings	Discretion of service	Added several
Guided discussion questions	—	Added several
Final written reflection	—	Added

NA, not applicable.

students were located in states outside of Washington (one in Alaska, two in Idaho, one in Iowa, and one in Wyoming) and four of 14 students in the second session (one in Alaska, one in Idaho, two in Wyoming). Three additional students in the second session were more than a 3-hour drive from Seattle. As a required assignment, all students completed the reflection piece. Students most frequently commented on phases of testing ( $n = 10$ ), test utilization ( $n = 10$ ), regulatory agencies ( $n = 8$ ), and the experience of teaching reverse lectures ( $n = 3$ ). All students completed the course evaluation survey in the first session, and 11 of 14 students completed the course evaluation in the second session. Average rating of the course overall for each session was 4.45 and 4.57 out of 5 (Table 5), corresponding to good to excellent (Supplemental Table 1). The response to “this course helped me appreciate the significance of the subject matter” was consistently in the top two highest scores (4.7 of 5). For both sessions, the lowest average score to a targeted question was in response to whether there was adequate protected study time (Table 5). In response to whether the class length was appropriate for the subject matter, 16 respondents answered it was “just right,” five “too short,” and four “too long.” Critical remarks about the course most frequently included teleconferencing fatigue ( $n = 4$ ) and the density of complex subject matter in sign-out and conferences ( $n = 7$ ), with the majority of these comments directed toward the first session. Only free text or verbal feedback on the adaptation to LabM 685 was available.

## Discussion

During the COVID-19 pandemic, the clinical laboratory response has been dynamic. As new developments

Table 5

## Student Evaluation of Course

Assessment Statement	Session 1 Score <sup>a</sup>	Session 2 Score <sup>a</sup>
This course helped me appreciate the significance of the subject matter.	4.79	4.73
The course was supported by adequate digital resources.	4.64	4.45
There was adequate protected study time.	4.57	4.36
Clinical case work was integrated into the course.	4.64	4.45
The components of the course, such as class activities, assessments, and assignments, were consistent with the course goals.	4.64	4.55
The course used a variety of instructional methods to reach the course objectives (eg, group discussions, student presentations).	4.79	4.45
I felt comfortable asking questions.	4.57	4.82
Did this course meet the course objectives?	4.71	4.64
Overall course rating	4.57	4.45

<sup>a</sup>Highest score of 5.

have arisen on a global and national scale, these disruptions to the community at large have greatly affected academic practice.<sup>6,13,14</sup> Other groups in dermatology,<sup>15</sup> surgery,<sup>16,17</sup> nursing,<sup>18</sup> and anatomic pathology<sup>19,20</sup> have reported on rapid and drastic changes in medical education and ways to proceed. In laboratory medicine, most divisions—except for therapeutic apheresis—conduct clinical service work without direct patient contact. In compliance with COVID-19 distancing measures, laboratory medicine service work, sign-out, and didactics have shifted to a predominately remote-access paradigm for trainees and faculty alike. This represents a unique opportunity for medical students to participate in similar

activities with additional guidance to interpret the clinical experience. Therefore, the course structure involved elements of direct sign-out observation, in addition to both guided and independent study. Additional activities involve small-group sessions, journal article reading, and live or prerecorded didactics.

The lack of a vaccine against SARS-CoV-2 has placed diagnostic tests for the virus at the leading edge of the pandemic response. The result has been enormous medical and popular interest in laboratory diagnostics with the recognition that issues pertaining to the laboratory have vital repercussions for society. This was apparent from the student response during LabM 685. We have leveraged this interest by creating a remote course, MedSci 585C, so future clinicians have a better understanding of the laboratory's role. As in the pre-COVID rotation, the goal was to provide exposure to multiple laboratories and the breadth of testing performed at our institution. Special focus included how the clinical laboratories have mobilized in response to an urgent pandemic and whether this response is generalizable or unique to this institution. More quotidian goals included introducing students to common activities of the laboratory; exploring concepts of preclinical variables, including labeling/patient identification and patient safety in the clinical laboratory; and encouraging consultation with laboratorian/pathologist colleagues in future clinical practice.

The change of the course from a two- to four-student rotation conducted in person to a potentially 40-student rotation conducted entirely online necessitated changes in structure to preserve interactivity, engagement, and participation in sign-out. To facilitate discussions, we structured portions of the clerkship as small groups of up to 10 students co-led by laboratory medicine faculty and fellows who meet twice a week for an hour. The first two sessions consisted of guided discussion and question-and-answer sessions, while the last two sessions consist of flipped classroom teaching sessions moderated by small-group instructors (Table 4). The benefits of small-group and reverse teaching methods in the classroom in promoting interaction and collaboration have been reported on previously,<sup>21-23</sup> and students commented positively on their experience in evaluations. For the first spring quarter that this clerkship was offered, 28 students rotated through the clerkship. This brings the total students rotating through UW laboratory medicine clerkships in AY2019 to 64 students—roughly double the number of students who normally would have been exposed to laboratory medicine (Table 2). Together with the distance learning clerkship offered by our anatomic pathology colleagues, pathology accounted for two of 13 courses offered to third- and fourth-year medical students at this institution during COVID-19.

The changes in the clerkship increased the visibility of and access to laboratory medicine education, including nine (32%) medical students who were out of state. However, serving students in different regions revealed two unanticipated challenges: accommodating a 3-hour span of time zones and coping with limited or disrupted internet access, particularly in rural areas. To meet these needs, we minimized activities at the extremes of the workday and encouraged early submission of student presentations when weather threatened to disrupt infrastructure, with the option to have students narrate their presentations by phone. Additional trade-offs between traditional and online format are presented in Table 1.

Technology such as teleconferencing, didactic recording, and learning management software was already partially used in the SOM, but the global pandemic quickly forced universal adoption of these tools to facilitate education in this period of social distancing.<sup>6,18,24</sup> An unprecedented amount of online resources, media, and readings have been made available through both online commercial modules purchased by the university and free online learning materials.<sup>19,20,25,26</sup> Stored content has the main advantage of flexibility—students and trainees can access high-quality content at any time—but lacks the immersion of a real case and an experienced mentor to navigate the clinical thinking around each case. Hence, a curriculum that would bring students into the environment of clinical pathology, combined with small-group activities to navigate cases and increase learning engagement, was used.

We identified two additional challenges unique to the remote format: teleconferencing fatigue and HIPAA compliance. Students in the first session reported teleconferencing fatigue on days with back-to-back conferences. This was partially mitigated in the second session by increasing the number of breaks between live sessions and reliance on several previously recorded lectures that were viewable at any time. Concerns over the security of teleconferencing applications are not unique to this setting,<sup>27</sup> but because teleconferencing was used extensively for didactics and sign-out of clinical cases that could involve sensitive PHI, HIPAA compliance was critical. This required that teleconferencing applications could (1) ensure the confidentiality of electronic PHI, (2) protect against reasonably anticipated threats to such information, (3) protect against reasonably anticipated nonpermitted uses or disclosures of such information, and (4) ensure compliance by its workforce.<sup>28,29</sup> We relied on the HIPAA-compliant accounts made available by our institution, required students include their role in their screen name (eg, “medical student,” “MS-4”), and encouraged teleconference hosts of PHI-sensitive meetings to require a passcode for access as recommended.<sup>28</sup>

Our efforts reflect one of several ways in which medical educators have adapted to COVID-19. On the basis of this experience and the positive student feedback (Table 5), we will continue to offer a remote learning course for up to 24 medical students per session—including students in quarantine, those at WWAMI/rural sites, and visiting students—for the rest of calendar year 2020. Even though our SOM is returning to in-person clerkships with some limitations in the summer and fall of 2020, this remote learning approach has the benefits of providing in-depth instruction in laboratory medicine, exposing students to the critical role of the clinical laboratory in response to emerging infections, and affords flexibility for educators to respond to the continuing pandemic. We note that other solutions have been employed for medical and nursing students. These have ranged from graduating senior medical students early<sup>30,31</sup> to training medical students to perform critical public health activities, particularly contact tracing, conducting telehealth visits, and staffing COVID-19 call centers.<sup>32-34</sup> We encourage such innovative solutions and believe that our approach to rapidly adapt to distance learning dovetails with engaging medical students in a variety of alternative learning activities. The changes in medical education afford a new opportunity for medical student exposure to pathology and laboratory medicine. As the United States faces a prolonged first wave of COVID-19 infections, such changes in medical education appear to reflect a new normal and may require further evolution.

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