Impact of COVID-19 on Medical Education: Perspectives From Students

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Abstract

This article provides an overview of issues facing medical students in such key areas as communication, preclinical and clinical education, increased isolation, disruption to time-based curricula, inequities in virtual learning, racial trauma, medical student activism, increased conversations surrounding race and racism, LGBTQIA+ students, dual-degree students, and the virtual residency cycle. This article described challenges navigated by medical students during the COVID-19 pandemic, as well as triumphs resulting from the disruption, and actionable recommendations in key areas. While the pandemic presented new challenges for medical students, it also uncovered or exacerbated longstanding problems. The intent is for medical schools and institutions to utilize these recommendations to create learning environments that do not depend on medical student resilience. The main takeaways for medical schools are to: (1) maintain an individualized and learner-centered ethos while remaining dynamic, flexible, and ready to embrace both immediate and incremental change; (2) maintain open lines of communication; (3) implement policies and practices that support students’ academic, physical, and mental well-being; (4) engage and support students who bear historically disadvantaged identities on the basis of race, ethnicity, sexual orientation, gender, or disability; and (5) support creative and collaborative partnerships between medical institutions and students to ensure the ongoing evolution of medical education to meet the needs of learners and patients.
Medical education navigated unique challenges and an unprecedented rate of change in response to the novel coronavirus (COVID-19) pandemic. This article outlines the experience of United States medical students as they traversed the pandemic, a tumultuous sociopolitical climate, numerous devastating natural disasters, and uncharted territory in their education. Although the authors have represented medical students by serving as national leaders and engaging with students across the medical continuum, we by no means reflect the full diversity of student voices, and therefore have drawn upon the literature as well as anecdotal conversations with peers and professional colleagues to supplement the arguments and conclusions.

One critical component that we wish to emphasize is the recognition of the inherent resilience and grit of medical students who took authority over their own education and were a large part of, and sometimes the sole innovators of, interventions that preserved medical education during the pandemic. While transforming medical education, students also responded to the nation’s collective trauma by mobilizing as social activists, public health leaders, and critical support volunteers for frontline workers, all while taking care of their own families and communities.

This paper provides an overview of issues facing medical students in such key areas as communication, preclinical and clinical education, increased isolation, disruption to time-based curricula, inequities in virtual learning, racial trauma, medical student activism, increased conversations surrounding race and racism, LGBTQIA+ students, dual-degree students, and the virtual residency cycle. The sections illuminate students’ perspectives on how COVID-19 impacted medical education, delineate the continued challenges facing medical education, and provide specific recommendations to leverage lessons learned.
Issues Facing Medical Students

Communication

The rapidly changing COVID-19 landscape highlighted the need for timely, transparent, and accurate communication. The pandemic also intensified sociopolitical conflicts, which impacted students' well-being and ability to perform academically. To help understand the implications of COVID-19 and sociopolitical events on medical education (see Figure 1), students looked to their institution’s administrators for guidance and frequent communication more than ever before, some requesting town halls as a forum to transparently discuss immediate concerns. The authors' home institutions increased their frequency of town hall meetings to weekly or biweekly, sent daily listserv notifications, and increased their social media activity.

Recommendations for effective communication

The power of timely, empathetic statements followed by regular, transparent communication from university leadership alongside student representatives regarding an event impacting students should never be underestimated. The principles espoused by the Centers for Disease Control and Prevention's (CDC’s) Crisis Emergency Risk Communication (CERC) program (time-sensitivity, accuracy, honesty, empathy, active-orientation approach, and respectfulness)\(^1\) enabled schools to improve university-student communication and should be used for future health, social, and political crises. Another effective communication strategy was utilization of medical student government leaders as intermediaries, which helped streamline communications relevant to specific cohorts.\(^2\) Anecdotally, generalized communication from university presidents or administrators directed to an entire student body was less helpful, as students expressed a disconnect between updates necessary for undergraduates and those specific for each medical school class. Therefore, we recommend partnering with medical student leaders, having frequent
and regular town halls, and communicating using the CDC’s CERC guidelines when communicating during future crises.

**Preclinical education**

Prior to the pandemic, some schools required daily in-person activities, making it difficult to tailor education to an individual’s needs or to take time off for illness, outside commitments, or life events. Virtual learning provided some immediate improvements to medical education, including the ability to access educational materials at students’ convenience and increased flexibility. However, working from home full-time blurred the boundaries between work and life, resulting in students working through illness or personal issues, such as caregiving for a loved one. Furthermore, increased use of online curricula challenged the instruction and assessment of clinical medicine skills including physical exam, patient encounters, and laboratory dissections.

The importance of establishing peer and professional relationships was emphasized when opportunities for networking, research, and professional development diminished during exclusively virtual premedical education. In conversations and online forums, students wondered if their education sufficiently prepared them for rotations. Given the perceived decrease in educational quality and lack of physical access to university resources, students also questioned tuition prices. The cost of a completely virtual medical education has become less relevant now that schools have re-opened. However, we feel that tuition and medical education debt remain critical topics that require ongoing examination.
**Recommendations for preclinical education**

We recommend that, post-pandemic, medical education maintain both flexibility and accessibility to educational resources by continuing to record all learning activities so that students can access them 24/7. Other recommendations include working to obtain discounted proprietary study materials and removing attendance requirements that limited access to PowerPoint presentations or lectures. Learning communities such as the House Advisory Systems have proven effective at forming support communities and bolstering networking in a wholly virtual space.\(^6\)\(^,\)\(^7\)

**Increased isolation and need for support services**

The long-term impacts of educational changes faced by preclinical students have yet to be determined, but preliminary surveys show preclinical students were significantly more likely to report higher symptoms of burnout during the pandemic.\(^5\)\(^,\)\(^8\) Students from marginalized communities hit hardest by COVID-19 were sometimes unable to attend funerals or care for sick relatives due to travel restrictions. Students were not immune to the trauma and hardships the rest of the world was experiencing, and many students continued to support their families despite their medical school workloads.

Although the need for mental health and support services was higher than ever, students were physically isolated and had decreased access to support.\(^3\) Students beginning medical school in fall 2020 never met their entire class in person or oriented to their new locations since mass gatherings were prohibited and businesses were closed. Without being able to visit support communities back home, students’ lack of peer interaction and inability to develop or sustain local support systems was exceptionally detrimental. Mental health services were more difficult to access due to counseling centers exceeding their capacities. With universities physically
closed, opportunities to de-stress at the gym or interface with support services, such as student affairs offices and offices of diversity and inclusion, were limited or eliminated entirely.

**Recommendations to address increased isolation and need for support services**

One of the most urgent recommendations is to decrease the extent of isolation preclinical students are facing, formally check on students’ mental health, and increase access to mental health and support resources. Since this report was first drafted, in-person learning has resumed. However, should the need to go entirely virtual occur again, virtual group clinical opportunities and study sessions are recommended, as they reduced isolation and provided opportunities for meaningful interaction with peers.

**Clinical education**

When clinical rotations were abruptly paused in March of 2020, virtual clinical experiences emerged, including virtual rotations,\(^5\) virtual rounds,\(^10\) and telehealth rotations.\(^11\) In virtual rounds of the medical intensive care unit, students engaged with physicians and patients with COVID-19 via live chat, gaining unique insight into clinical care. Ninety percent of students polled found this method of learning to be engaging, meaningful, and informative, with one student commenting that virtual rounds “helped remind all of us why we chose to pursue a path in medicine.”\(^10\) While universities were pushed to explore new ways for students to achieve high-quality education, medical students were innovating too. Students organized COVID-19 student response teams, which led to the development of a comprehensive COVID-19 curriculum that has reached over 80,000 learners worldwide.\(^12\) Similarly, one author’s (M.Z.) personal experience of increased flexibility with clinical rotations allowed him to partner with medical education streaming service GIBLIB and 20 other medical students to create free, video-based surgical education for students on clinical rotations.\(^13\) Students involved in these activities
met their community's needs while demonstrating agency, life-long learning, and creative problem-solving.

In addition to augmenting their own education, students found creative ways to utilize the skillsets they possessed to improve well-being in their communities. Students joined their institutions’ COVID-19 task forces or assembled task force teams themselves to support frontline workers, health systems, or vulnerable patient populations within their communities. Students with clinical training prior to medical school joined frontline workers as physician assistants, nurses, or emergency medical technicians. Others delved into research, activism, and education efforts in order to bolster ongoing public health efforts and mitigate health disparities.

Upon returning to in-person clinical rotations, students encountered reduced volumes and breadth of experience since students were advised to avoid caring for COVID-19 patients and hospitals experienced reduced non-COVID patient volumes. When elective surgeries resumed, many institutions did not return to a similar volume of surgeries, and the number of people allowed in operating rooms was minimized, limiting learner access to surgical experiences. The Coalition of Physician Accountability recommended limiting away rotations at a time when third-year medical students were choosing their specialties and actively applying for visiting rotations, resulting in concerns about decreased exposure to non-core specialties, limited opportunities for letters of recommendation, reduced networking and mentorship, and the inability to experience residency programs of interest. It was estimated that 1 in 5 students' specialty choice was affected by the changes brought on by COVID-19, with students most commonly citing lack of exposure to specialties and inability to bolster their applications.
Some students questioned if their clinical training was sufficient to prepare them for residency. Fourth-year students going into specialties outside of core-clinical curricula and those at lesser-known or rural schools rely on away rotations to gain exposure to specific patients and clinical experiences. Since away rotations were limited or canceled, some students who had just one specialty-specific rotation were concerned about being as prepared for intern year as previous classes who had more.

**Recommendations for clinical education**

When clinical rotations were interrupted, there was a robust response from the medical education community and medical students themselves to enhance clinical education opportunities. The pandemic illustrated numerous examples of student-faculty collaborations. Viewing students as co-creators and co-owners of their education empowered them to gain agency and encouraged their creativity, initiative, resilience and problem-solving skills.

Virtual clinical experiences, including virtual audition rotations, were shown to augment medical student education. Maintaining virtual options allows students the flexibility to navigate career exploration as well as barriers in their education, such as family, personal illness, and childcare. We recommend these virtual resources remain available as alternatives or means of augmenting traditional, in-person clinical experiences. We hope the multitude of mentorship opportunities through social media and virtual specialty-specific meetings also continue in the post-pandemic era.

**Disruption to time-based curricula**

Before the pandemic, most medical schools followed rigid time-based curricula without flexible means to accommodate students’ lives outside of school. A prolonged illness or need to attend to family could cause a student to have to take a leave of absence or repeat an entire year. While
rigid absence policies always had the potential to adversely affect student well-being, as we diversify medicine, they contribute to inequities in medical education since students who take a leave are less likely to graduate and are more likely to be non-White, racial/ethnic minorities or non-traditional students and/or come from low socioeconomic households. Motivations to maintain the physician pipeline throughout the pandemic meant that schools made more exceptions to absence policies than ever before. For example, at one of the author’s (M.W.) schools, symptomatic or exposed students were allowed to quarantine until a negative COVID-19 test was obtained without the expectation of make-up shifts. The culture of medicine radically shifted from learners being expected to work through illnesses to students signing mandates that they would self-monitor temperatures and stay home when sick.

Other rigid pre-pandemic absence policies such as “blackout days” where students absolutely cannot request time off and absence limits (e.g., 2 days off during a 4-week rotation) should be reconsidered. While not promoting absenteeism, it is important to contrast missing a few days due to quarantine or illness with the encouraging feedback from 3-year MD programs and students from the class of 2020 who graduated early, which suggest that students can become competent residents with variable time in clinical rotations.

**Recommendations to address disruption to time-based curricula**

We recommend that medical education maintain the flexibility and focus on self-care that the pandemic mandated. Students should be able to stay home when they or family members are sick or when they have pressing personal issues. Although studies have demonstrated positive correlations between medical school attendance and student performance, more research is needed to discern how strict attendance policies may exacerbate educational inequities by disproportionally harming students who are underrepresented minorities, non-traditional, or
who have disabilities. Furthermore, it is critical that students discover their professional limits by making decisions about which events and people take priority. Medical educators can look to 3-year curricular programs, entrustable professional activities, or competency-based education models to devise strategies that limit reliance on time-based curricula.

Life has to be more important than “blackout days,” assessments, or any part of medical education; absence, sick, and vacation policies should reflect that priority by allowing students to make up missed mandatory activities and/or by allowing students to complete competencies in a more individualized manner, as was accomplished during the pandemic. Although medical education is already shifting from time-based to individualized and flexible competency-based curricula, this change will not happen quickly enough to ameliorate the harm of time-based curricula for students who are already disadvantaged due to financial, health, or social factors. Policies should be updated, and increased flexibility should be inaugurated immediately rather than waiting for competency-based curricula to arrive.

Inequities in the virtual learning environment

The pandemic amplified inequities in education. Professional students who were first-generation college students, low-income, or caregivers were significantly more likely to experience increased financial hardships during the pandemic, including loss of income from family members. Students relied heavily on subscription-based resources to supplement their virtual learning, which magnified the academic advantage of financial wealth. Students from low-income backgrounds and students with learning or cognitive disabilities were less likely than their peers to adapt well to virtual education. The virtual environment created additional barriers to learning, such as lack of access to quiet study spaces and reliable technology. Students with disabilities disproportionately reported increased concerns about their physical and
mental health and the physical limitations associated with increased computer tasks compared to peers without disabilities. Students beginning medical school with ineffective study strategies, poor self-motivation, or gaps in their basic science knowledge may have had these weaknesses maximized in the home learning environment rather than rectified in an in-person classroom where they could have benefited from engaging with peers who already established these skills or knowledge.

**Recommendations to address inequities in virtual learning environments**

Since students were differentially affected by the pandemic, it is unlikely that one-size-fits-all solutions will effectively address the issues discussed above. Solutions must be tailored to meet the unique needs of individual learners. Students needing access to campus resources (e.g., reliable internet, quiet environment) should be offered alternative accommodations in the form of stipends or need-based financial aid to cover internet service, computers, or rent. Uniform decisions are more likely to disproportionately harm students who already have educational disadvantages related to social, economic, or demographic factors.

**COVID-19’s exacerbation of racialized trauma**

Racial disparities in health care, socioeconomics, policing, and so much more were all laid bare and exacerbated by the viral pandemic, which heightened trauma experienced by students, especially those who identify as Asian-American, Native Hawaiian, and Pacific Islander (AANHPI), Black, Brown, and Native American. Disproportionately higher rates of morbidity and mortality from COVID-19 for Black people and other people of color, viral videos of Black people being murdered by the police or anti-Black vigilantes, and heightened anti-Asian racism challenged the inherent resiliency of students of color, making performing their medical student duties more arduous than usual. While walking near campus in February 2021,
one Asian-American medical student was called the “Chinese virus” before being physically assaulted,\textsuperscript{33} giving life to fears that many AANHPI and Black students have been carrying. The physical and mental health effects of racial trauma are well documented.\textsuperscript{34,35} Therefore, many students experienced the deleterious health effects of the double pandemic (structural racism and COVID-19).

**Recommendations to address COVID-19’s exacerbation of racialized trauma**

Students appreciated humble and genuine acknowledgments from medical school officials about injustices taking place globally, nationally, and within the walls of their medical institutions. We recommend medical school leaders prioritize such action, as it is an appropriate first step in making students feel supported. Furthermore, we recommend acknowledgments originate from deans’ offices or joint statements be made by medical school leaders rather than solely coming from diversity offices, as is frequently the case. Addressing issues surrounding structural racism is the responsibility of the entire medical school.

Medical schools can provide tangible remedies in the form of listing mental health providers, resources, or offering protected and unencumbered time away when students need a mental health day to process traumatic events or seek care/support. The racialized trauma experienced by students during the pandemic likely will require specific expertise (by way of training or experiential expertise from providers), so we recommend medical schools increase student access to providers of color, providers with expertise in handling racial trauma, or preferably a combination of both. Also, schools can create spaces for students to build community amongst individuals who share identities. One author’s (T.A.) medical school, at the request of student leaders, created virtual events for Black and Latinx students to meet with Black and Latinx faculty to offer support using an affinity-based format.
Lastly, we recommend that medical schools do their part to disrupt and end racism within their own institutions and beyond. While this is a lofty goal given the centuries of racism at play, all steps to meaningfully dismantle racism move medical schools closer to creating an environment that equitably supports all medical students.

**Medical student activism during the pandemic**

During the pandemic, increased attention was paid to structural racism by U.S. medical schools, thereby amplifying longstanding medical student activism. Students capitalized on their medical schools’ newfound commitment to stand against racism with hopes of bringing about substantive change, despite processing trauma concurrently themselves.\(^{36,37}\) This effort, amidst a pandemic, came at a greater cost for racially minoritized students, exacerbating the existing burden placed on them and contributing to an increased minority tax.\(^{38}\)

While non-racially minoritized students may have used the unplanned time away from in-person medical student responsibilities to elect to be allies, study for board exams, or engage in extracurricular work to strengthen their CVs, racially minoritized students such as one author (T.A.) used the extra time to partake in necessary and life-affirming activism. One student, a cisgender gay White man, attributed his very high score on United States Medical Licensing Examination (USMLE) Step 2 to having extra months to study when pulled from clinical rotations. For many Black, Brown, and AANHPI students, such an excellent performance was not feasible amidst the stress, anguish, and other deleterious effects of the double pandemic. For this reason, student activism during the pandemic likely furthered the opportunity gap and contributed to decreased wellness for politically and socially engaged students.
**Recommendations for supporting medical student activism during the pandemic**

We recommend medical schools make genuine commitments backed by tangible action to address the structural racism surfaced and exacerbated by the pandemic. Examples of tangible action include funding to advance diversity, equity, inclusion (DEI) and antiracism efforts; working with expert consultants and/or community members, and changes in or the development of new institutional policies and practices that promote equity for students and within medical education. Moreover, medical schools should do what they can to ensure that their racially minoritized students who engage in these efforts are not engaging to the detriment of their well-being, medical education, or participation in other efforts that could be beneficial to their future careers as physicians.

To ensure sustainability of the DEI efforts made during the pandemic, schools should identify areas where immediate change is possible and areas where incremental change, long-term planning, and strategy are needed. Doing this prevents schools from succumbing to a potentially harmful self-imposed sense of urgency, which may result in efforts falling flat due to the unrealistic expectation of solving centuries of injustices via a short-lived task force or underfunded DEI office. Exemplar schools and residency programs have committed to both short-term and longitudinal, people-centered efforts to integrate equity and anti-oppressive lenses throughout their curricula, engaging experts and community members in these processes.

Students, particularly racially minoritized students, will continue to engage in these efforts as they directly impact their livelihoods. We recommend that medical schools work collaboratively with students, amplifying their efforts and, where appropriate, relieving students of the responsibility of creating equitable change. For students engaging in work that schools will benefit from, we recommend schools look to compensate students for their time, because their
efforts go well beyond the role of what a medical student should have to do to become a physician. One author’s (T.A.) medical school created a paid fellowship for students involved in student advocacy and DEI initiatives led by an expert faculty member, who was also given paid, protected time to work with students. These types of efforts create institutional memory, so projects are not lost as students transition through different parts of the medical school curriculum and also address the minority tax experienced by students of color who engage in these efforts.

**Increased conversations surrounding racism and race**

The social construction that is race is often used as a risk factor for contracting COVID-19 or being at increased risk for morbidity and mortality, but without any analysis of the legacy of racism that positioned racialized people as being at greater risk. This lack of commentary on race vs racism negatively impacted Black and AANHPI students, whose identities incorrectly became pathognomonic for severe or fatal COVID-19 disease or literally as the disease itself. While the pandemic advanced necessary conversations about racism (as opposed to race) being a social determinant of health, this had direct implications on the experiences of students in classroom and clinical learning environments. Conversations about race and racism in medical schools oftentimes dehumanize racially minoritized students, reducing them to social constructions of race. Furthermore, there is not unanimous agreement or awareness among all physicians, educators, and patients about racism as a social determinant, which leaves racialized medical students subject to further microaggressions and outright racism, dehumanization, and violence.
**Recommendations for increased conversations surrounding racism and race**

We recommend the creation of strategies that promote accountability and a sense of duty amongst educators and bystanders to better ensure racially minoritized students are not victims of racism or microaggressions without consequence or support, especially in a sociopolitical climate exacerbated by the COVID-19 pandemic. Bias-free medical curricula with guidelines for educators to utilize before giving a lecture as well as anonymous reporting systems to monitor and manage bias have been described in the literature. As for racism or microaggressions that occur outside the context of teaching, such as with patients, several bystander tools exist for student or trainee allies and educators to disrupt or otherwise intervene when a situation involves racist language or behaviors. Lastly, in this work, it is very important to not only understand racism and advocate for the targets of racism (i.e., racially minoritized people), but seek to dismantle white supremacy as a powerful construct weaponized against racially minoritized individuals. The absence of effective action allows unchecked white supremacy and the continued propagation of structural racism, even in the face of ongoing efforts to advocate for racially minoritized people.

**Medical students in LGBTQIA+ communities**

Discrimination against those identifying as LGBTQIA+ produces risk factors that increase vulnerability to the pandemic and resultant economic challenges. The year 2020 saw the highest number of violent murders of people who are transgender or gender non-conforming in recorded history. These additional traumas took energy and focus away from academic endeavors while simultaneously mobilizing some to support and advocate for their community.
When national efforts were employed to develop treatments for COVID-19, a friend of one author (M.W.) remarked, “Maybe if the country had responded this way back in the ‘80s, we’d still have the friends and family we lost.” Several memes and articles\textsuperscript{49,50} highlighting the differential responses to the AIDS versus COVID-19 pandemics revealed painful scars from an earlier pandemic that devastated and stigmatized the LGBTQIA+ community. Unfortunately, our government and health care leadership repeated historical harms by continuing to ignore and minimize calls for help from the LGBTQIA+ community.

One author (M.W.) felt stressful urgency while witnessing members of the LGBTQIA+ community suffer disproportionately from the pandemic but was met with inaction from medical leadership. We cannot appreciate the full impact of COVID-19 on LGBTQIA+ communities, nor can we develop LGBTQIA+-tailored interventions or monitor the effectiveness of interventions until our country systematically collects sexual orientation and gender identity (SOGI) data with regards to COVID-19, as researchers and LGBTQIA+ medical students have urged health and policy leaders to do.\textsuperscript{51,52} Dr. Cahill of Fenway Institute has called this failure “public health malpractice.”\textsuperscript{53} At the same time that LGBTQIA+ students are experiencing discouragement from a lack of institutional and societal support, they are still being asked to participate in diversity recruitment initiatives and deliver LGBTQIA+ curricula, all while processing the minority stress and microaggressions encountered regularly in medicine.

**Recommendations to support LGBTQIA+ students**

We hope sharing these perspectives empowers medical schools to check on, support, and believe LGBTQIA+ students because many people in positions of power have silenced them with reminders of their invisibility and powerlessness in society during the COVID-19 pandemic.\textsuperscript{54} Although the pandemic specifically spotlighted injustices and inequities experienced by those
who are Black, inequities experienced by any minoritized or disadvantaged group would be exacerbated by the pandemic. For example, while providing platforms for students who are Black or underrepresented minorities (URM), we must keep intersectionality in mind and also elevate the voices of LGBTQIA+ students, as well as those with disabilities, non-URM racial and ethnic minorities, students from low socioeconomic backgrounds, etc. When students share anecdotes about issues related to their marginalized identity impeding them from thriving in medical school, it is important to validate and address those concerns. Medical schools should mitigate the negative impact of disparities in responsibilities by hiring experts to create and deliver LGBTQIA+ curricula or by compensating students for their diversity-related work. One author (M.W.) partnered with her associate dean for medical education to create a minority tax elective, which formally assigns academic value to diversity work. Earned academic credits for diversity work can provide students with flexibility (e.g., mental health day, extra study time for boards) or can be redeemed during a student’s final year as non-clinical elective time. Schools are encouraged to similarly engage with students to brainstorm school-specific or individually tailored ways to offset disparities in responsibilities.

**Dual-degree students**

Medical students in the process of earning an MBA, MPH, PhD, or other dual degree experienced varying effects of COVID-19 on their education. Students completing theses in the winter or spring of 2020 had additional time to do so while clinical rotations were on hold. One student earning her MPH said the pandemic allowed her to volunteer at the county public health department for 3 months while clinical rotations were paused. She reflected that this opportunity would never have been possible pre-COVID-19, and it allowed her to try on a possible career
path. Other students reported that their education was affected minimally, if at all, because they were working remotely already before the pandemic began.

In contrast to students who were finishing their dual degrees, students who were beginning or in the middle of dual-degree programs experienced limited access to campus resources, in-person mentorship, and professional development. The ability to walk down the hall to troubleshoot with another researcher or to flesh out new ideas were diminished as research buildings never returned to their pre-COVID-19 physical capacity limits.\(^{55}\) Scientific conferences and poster sessions continued to be canceled during the 2020-2021 academic year. Weekly and monthly collaborative meetings, which are critical to the development of PhD students, did not resume. The loss of personnel, research animals, funding, and time due to the shutdown narrowed the opportunities of some students to continue their previous work.

**Recommendations for supporting dual-degree students**

Although students should have access to mentors and advisors within their dual-degree programs, we recommend that medical schools also reach out to students who are earning dual degrees to check on their wellness and inquire about barriers that may delay their return to medical school. With fresh sets of eyes and external perspectives, school administrators may better identify stalled projects and situations where students need interventions in order to maintain a realistic timeline. Schools may also be able to supplement professional networking and development opportunities that have decreased in the basic sciences, public health, or business sectors. In addition, medical schools, with their ready access to clinical expertise, can facilitate conversations with faculty in other fields to advocate for and advise how to safely reopen research buildings and classrooms. For students who cannot meet in-person, offering
alternative ways to collaborate, (i.e., social media, such as Clubhouse: Drop-in Audio Chat) could add means for students to share and develop their work with colleagues.

**Virtual residency application cycle**

The residency application timeline was delayed in 2020 to allow students extra time to choose their specialty, take required licensing exams, and gather recommendation letters.\textsuperscript{16} This extra time was critical for many students since canceled clinical time in the spring delayed opportunities for exposure to non-core specialties. Students also appreciated that specialty organizations rallied to provide guidance to applicants and reduce application requirements.\textsuperscript{56}

Still, students were apprehensive about virtually discerning the cultures and geographic locations of programs.\textsuperscript{57}

Despite reservations, the virtual residency interview process turned out to be one of the most benign and even favorable changes of the 2020-2021 academic year. Most, if not all, students experienced cost savings since travel expenses were eliminated. Likewise, students did not have to coordinate travel between one program and the next, which increased their flexibility to attend interviews more than ever before. Also, virtual interviews were shorter; rather than taking the pre-pandemic average of 1.5–3 days per interview (including travel), most virtual interviews this year occurred over the course of 2–9 hours. Pre-interview dinners were converted into informal virtual social hours where students could invite family to attend and also enjoy the flexibility of choosing whichever session worked for their schedule. Virtual tours, individual or small group interactions with residents, videos that demonstrate culture, updated residency websites, and packets of information about the programs were helpful tools in addition to the interview day that assisted students with gaining a feel of a program.
Recommendations for residency interviews

The reduced time and costs associated with virtual interviews was perceived as positive by many learners. We recommend that programs continue to provide as much information virtually as possible (e.g., group sessions with residents, videos, updated websites) in order to keep any in-person parts of the interview as short as possible. Systematic research, such as that currently underway by the National Resident Matching Program (NRMP), needs to assess whether the virtual residency interview process was valued by all students and what limitations the virtual environment engendered. With data to support interest and plausibility, it may be possible to keep most or all interviews virtual and to only offer in-person visits as second look opportunities for students who are strongly considering programs or are torn between their top programs.

Brainstorming other ways to reduce travel burden and time away from clinical learning is welcomed. The disruption to in-person interviews revealed improvements over the previous system and returning to an interview season exactly the same as before the pandemic is not recommended.

Conclusions

This report described challenges navigated by medical students during the COVID-19 pandemic, as well as triumphs resulting from the disruption, and actionable recommendations in key areas. While the pandemic presented new challenges for medical students, it also uncovered or exacerbated longstanding problems. Our hope is that medical schools and institutions utilize our recommendations to create learning environments that do not depend on medical student resilience to be tenable. Our primary takeaways are for medical schools to maintain an individualized and learner-centered ethos while remaining dynamic, flexible, and ready to embrace both immediate and incremental change. Additionally, maintaining open lines of
communication and implementing policies and practices that support students’ academic, physical, and mental well-being are encouraged. Students who bear historically disadvantaged identities on the basis of race, ethnicity, sexual orientation, gender, or disability need to be engaged in decision-making conversations considering that traditionally, these students have been excluded or harmed by discriminatory policies and practices. Creative and collaborative partnerships between medical institutions and students will continue to ensure the ongoing evolution of medical education to meet the needs of learners and patients.
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Figure 1 Timeline of educational, sociopolitical, and ecological events integral to understanding the medical student experience in the 2020-2021 academic year, including COVID-19 deaths within the United States. Source: Johns Hopkins University of Medicine. COVID-19 United States Cases. https://coronavirus.jhu.edu/us-map. Abbreviations: USMLE, United States Medical Licensing Examination; CS, Clinical Skills examination; COMLEX, Comprehensive Osteopathic Medical Licensing Examination; VSAS, Visiting Student Application Service; AAMC, Association of American Medical Colleges; ERAS, Electronic Residency Application Service.
Figure 1

COVID-19 Deaths in the United States in 2020/2021

- January 23: First confirmed case of COVID-19 in the U.S.
- February 23: Killing of Ahmaud Arbery
- March 13: Killing of Breonna Taylor
- March 16: USMLE Step 2 CS suspension
- March 25: Prominent testing center overrun, USMLE/COMLEX cancellations
- March 28: May at-home orders begin
- March 30: COMLEX Level 3 PE suspension
- April 2: Opening of George Floyd Square
- April 15: VaS reopens
- April 21: Prominent testing center to run at half capacity
- April 23: AAMC recommends virtual residency interviews
- May 21: May 11: AAMC for Physician Accountability board rotation recommendation
- May 26: USMLE Step 2 CS extension of suspension
- May 28: Tauhid, Rani, in the Southeast
- June: Partial resumption of clinical rotations
- July: COVID-19 cases in the U.S.
- August: COVID-19 Cases in the U.S.
- September: ERS opens for student submission
- September 30: ERS opens for student submission
- October: ERAS program access
- December: ERAS program access
- December 2: Death of Dr. Charlene Waddick
- December 22: Capital inscription
- December 29: Capital inscription
- November 3: 2020 presidential election
- November 8: 2020 presidential election
- December 22, 2021: COVID-19 deaths
- November 22: 10 million U.S. COVID-19 cases
- November 22: 10 million U.S. COVID-19 cases
- September 22: 200,000 U.S. COVID-19 deaths
- May 25: 100,000 U.S. COVID-19 deaths
- May 23: 100,000 U.S. COVID-19 deaths
- March 22: 1 million COVID-19 case
- January 23: First confirmed case of COVID-19 in the U.S.