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Résumé de l'article

Contexte : On s'attendait à ce que la pandémie de la COVID-19 ait des conséquences sur la formation médicale, mais les constats relatifs à son impact sur les étudiants en médecine demeurent anecdotiques et plutôt spéculatifs. L'objectif de cette étude était d'explorer l'étendue des premiers effets de la COVID-19 sur les étudiants en médecine dans le monde et d'examiner les tendances et les schémas qui se dégagent, quels que soient la région géographique ou le niveau d'études.

Méthodes : Une enquête transversale sur les étudiants en médecine a été menée entre le 25 mars et le 14 juin 2020, peu après que l'Organisation mondiale de la santé ait déclaré que la COVID-19 était une pandémie.

Résultats : Le sondage a été réalisé auprès de 6492 étudiants de 140 pays. La plupart des facultés de médecine ont retiré les apprenants de l'environnement clinique et adopté l'apprentissage en ligne, mais les étudiants ont exprimé des préoccupations quant à sa qualité, à la progression de la formation et à l'atteinte de divers jalons. Les résidents jugent qu'ils pourraient être plus utiles et s'inquiètent de l'avancement de leur carrière. Les apprenants se sentent généralement sous-utilisés et souhaitent s'engager cliniquement de manière plus significative; cependant, certains estiment qu'il n'est pas à propos de demander aux étudiants de contribuer aux soins de santé pendant une pandémie. Des écarts importants ont été relevés entre les différents niveaux de formation et les différentes régions géographiques en ce qui concerne la satisfaction face aux réponses organisationnelles, l'impact de la COVID-19 sur leur bien-être et l'anxiété chronique et réactionnelle.

Conclusions : La perturbation du statu quo dans l'éducation médicale est perçue par les étudiants de tous les niveaux et de toutes les régions géographiques, mais davantage encore par les résidents, comme ayant affecté négativement et leur formation et leur bien-être. Ces résultats fournissent des aperçus empiriques préliminaires sur les domaines qui méritent des recherches futures et qui devraient être pris en compte dans la formulation des politiques actuelles et à venir.

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Exploring the global impact of the COVID-19 pandemic on medical education: an international cross-sectional study of medical learners

L'impact de la pandémie de la COVID-19 sur l'éducation médicale : une étude internationale transversale sur les étudiants en médecine

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Abstract

Background: The evidence surrounding the impact of COVID-19 on medical learners remains anecdotal and highly speculative despite the anticipated impact and potential consequences of the current pandemic on medical training. The purpose of this study was to explore the extent that COVID-19 initially impacted medical learners around the world and examine global trends and patterns across geographic regions and levels of training.

Methods: A cross-sectional survey of medical learners was conducted between March 25–June 14, 2020, shortly after the World Health Organization declared COVID-19 a pandemic.

Results: 6492 learners completed the survey from 140 countries. Most medical schools removed learners from the clinical environment and adopted online learning, but students reported concerns about the quality of their learning, training progression, and milestone fulfillment. Residents reported they could be better utilized and expressed concerns about their career timeline. Trainees generally felt under-utilized and wanted to be engaged clinically in meaningful ways; however, some felt that contributing to healthcare during a pandemic was beyond the scope of a learner. Significant differences were detected between levels of training and geographic regions for satisfaction with organizational responses as well as the impact of COVID-19 learner wellness and state-trait anxiety.

Conclusions: The disruption to the status quo of medical education is perceived by learners across all levels and geographic regions to have negatively affected their training and well-being, particularly amongst postgraduate trainees. These results provide initial empirical insights into the areas that warrant future research as well as consideration for current and future policy planning.

Résumé

Contexte : On s'attendait à ce que la pandémie de la COVID-19 ait des conséquences sur la formation médicale, mais les constats relatifs à son impact sur les étudiants en médecine demeurent anecdotiques et plutôt spéculatifs. L'objectif de cette étude était d'explorer l'étendue des premiers effets de la COVID-19 sur les étudiants en médecine dans le monde et d'examiner les tendances et les schémas qui se dégagent, quels que soient la région géographique ou le niveau d'études.

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Résultats : Le sondage a été réalisé auprès de 6492 étudiants de 140 pays. La plupart des facultés de médecine ont retiré les apprenants de l'environnement clinique et adopté l'apprentissage en ligne, mais les étudiants ont exprimé des préoccupations quant à sa qualité, à la progression de la formation et à l'atteinte de divers jalons. Les résidents jugent qu'ils pourraient être plus utiles et s'inquiètent de l'avancement de leur carrière. Les apprenants se sentent généralement sous-utilisés et souhaitent s'engager cliniquement de manière plus significative; cependant, certains estiment qu'il n'est pas à propos de demander aux étudiants de contribuer aux soins de santé pendant une pandémie. Des écarts importants ont été relevés entre les différents niveaux de formation et les différentes régions géographiques en ce qui concerne la satisfaction face aux réponses organisationnelles, l'impact de la COVID-19 sur leur bien-être et l'anxiété chronique et réactionnelle.

Conclusions : La perturbation du statu quo dans l'éducation médicale est perçue par les étudiants de tous les niveaux et de toutes les régions géographiques, mais davantage encore par les résidents, comme ayant affecté négativement et leur formation et leur bien-être. Ces résultats fournissent des aperçus empiriques préliminaires sur les domaines qui méritent des recherches futures et qui devraient être pris en compte dans la formulation des politiques actuelles et à venir.

Introduction

The coronavirus pandemic (COVID-19) represents the first global interruption to medical education since World War II. This public health emergency has required undergraduate and postgraduate medical training programs around the world to rapidly respond, including re-deploying learners to other clinical spaces or removing them entirely, and moving education online to promote physical distancing.¹⁻³ The current COVID-19 pandemic has changed the status quo of medical training as we know it – whether for better or for worse remains unclear and may have profound implications.

Prior localized disruptions to medical training have negatively affected trainees, such as pandemics and climate emergencies. The severe acute respiratory syndrome (SARS) pandemic in 2003 revealed the tension between embracing learning opportunities that a public health emergency offers and protecting the needs and well-being of learners.⁴⁻⁶ The SARS pandemic adversely affected the mental health of learners and healthcare professionals, and heightened anxiety amongst learners was associated with a perceived negative educational experience.^{4,7-9} In 2005, the rapid restructuring of the medical school curriculum in response to Hurricane Katrina resulted in a decline in academic performance.¹⁰ Lessons from both SARS and Hurricane Katrina highlighted the importance of support networks and attention to learner wellness, recognizing the additional stressors that these disruptions can place on medical trainees.^{4,7,10,11} These emergencies led to significant and rapid innovation in curriculum structure and content.¹¹ While disruptions to medical education can provide an impetus to reconsider ethical and practical implications of training during emergencies, training models may remain stagnant.^{7,11} Despite a heightened awareness fifteen years ago of the potential implications of interruptions to medical education, many organizations and systems entered the current pandemic relatively unprepared.

Medical education's understanding of the impact of global emergencies and disruptions to medical training remained limited to SARS and localized emergencies, yet the current pandemic remains the single most substantial disruption to contemporary medical training with global impact. Critical decisions made during the pandemic may lead to long-term consequences.¹²

The extent to which COVID-19 has impacted medical training remained speculative and anecdotal, despite the

potential implications to not only the future generations of physicians, but to patient care. Understanding how medical learners were initially impacted by the pandemic and the medical school and health system responses is an important first step in our broader understanding of how COVID-19 has impacted medical training. The research question for this exploratory study was: How have medical learners been impacted by the COVID-19 pandemic around the world?

Methods

Data collection

We administered a cross-sectional survey between March 25 and June 14, 2020, shortly after the World Health Organization declared COVID-19 a pandemic. Criterion and snowball sampling techniques were used to collect data from undergraduate (e.g., medical students) and postgraduate (e.g., interns, house staff, resident physicians) medical learners at any medical school around the world. This study explicitly focused on medical learners given that they provide a significant proportion of patient care yet are still considered learners.

Our decision to use a survey was based on the ability of this method to efficiently collect empirical data from a large population.¹³ The survey instrument was designed to include both quantitative and qualitative questions in order to later compare variables across groups, allow participants to provide insight into how they have been impacted using their own words, and use the qualitative data to potentially expand upon the results of the quantitative data. All participants completed demographic questions followed by questions specific to their level of training. Next, shared questions explored the effect of the pandemic on learner wellbeing and their communications with others. Open-ended questions collected qualitative data surrounding the impacts of the pandemic on training, utilization of residents, and strategies used in response to the pandemic. Items were constructed by a member of our research team (AB) a PhD-trained medical education scientist with formal training in psychometrics and survey development. All items were newly developed based on best practices for scale development¹⁴ and designed to capture key information specific to the research question with the exception of the 6-item State-Trait Anxiety Inventory (STAI-6) which is an established instrument.¹⁵ One 5-item scale exploring the impact of the pandemic on five domains of wellness was informed by a holistic framework for learner wellness.¹⁶

An initial survey underwent pilot testing with seven individuals (two medical students, four residents, and one graduate student) to examine item comprehension and survey functionality, leading to refinements to both the content and usability of the survey. The final survey (Supplemental File A) was translated to 19 additional languages (based on the availability of volunteer translators) to increase the inclusion of learners from around the world. The survey was administered online using Qualtrics software by distributing an anonymous, reusable link over social media (e.g., Twitter, Facebook, Reddit), emailing key contacts, and through snowball sampling. Each time the study was promoted, we encouraged others to pass along information about the study through their social networks (e.g., re-tweeting). The final page of the survey thanked learners for their participation and asked them to forward the study to their colleagues and peers to help diversify responses.

Data analysis

Quantitative data were imported into SPSS Version 26 (IBM Corp., New York) for analysis. Countries were coded to the geographic regions defined by the World Bank to explore geographic differences.¹⁷ Descriptive statistics were calculated for each item. Total scores were computed for scaled questions, with positively worded items reverse coded in the calculation. Independent t-tests were used to compare total scores between medical students and residents, and an Analysis of Variance test was used to compare data across geographic regions using a post-hoc correction to account for multiple comparisons. To examine the psychometric properties of the survey, Cronbach's alpha was computed for scaled items to assess reliability evidence and an exploratory factor analysis was used to examine construct validity.

Qualitative data were manually back-translated to English by fluent translators (i.e., not through automated software) to ensure accuracy. Data were then analyzed in NVivo Version 12 (QSR International, Melbourne). Three investigators read through the data to identify preliminary themes, which were then organized into a coding framework for deductive thematic and content analysis to similarly examine patterns in the data between levels and across geographic regions.¹⁸ Using content analytic techniques, two investigators (KB, MM) independently

coded 100 responses to refine the initial coding framework and assess the degree of coding consistency using the Kappa statistic, a measure of inter-coder agreement between 0 (no agreement) and 1 (perfect agreement), where $K > .40$ is considered to reflect moderate agreement and $K > .60$ is considered to reflect substantial inter-coder agreement (19). After an additional 400 responses were double coded and the Kappa statistics for each code continued to suggest acceptable inter-coder agreement ($K > .60$) and confidence that the framework could be applied consistently, a decision was made to divide the codes between investigators to improve the efficiency of coding given the volume of data. Upon completion of the coding for all responses, thematic analytic techniques were used to further analyze the data. Themes in the coding framework were divided amongst the research team, and each member analyzed the data coded to their assigned themes and summarized the patterns in the data. Theme summaries were compiled for interpretation by the study team, who then compared and contrasted the results of the qualitative data with the quantitative data to examine how these findings converge or diverge from, and ultimately expand upon, the quantitative results.

The University of Calgary Conjoint Health Research Ethics Board reviewed and approved this study (File #20-0484). Participation in this study was voluntary. Implied consent was obtained from all participants. Participants had the option to either skip individual questions or select "prefer not to answer."

Results

A total of 6492 learners from 140 countries completed the survey ($N = 5260$ medical students, $N = 1007$ residents, $N = 225$ did not specify level; see Appendix A, Table 1 for demographics). The majority of participants were from the World Bank regions of Europe and Central Asia (43.4%, $N = 2819$). Over half (53.4%, $N = 3465$) completed the survey in English. The results for both medical student-specific and resident-specific questions are summarized in Appendix A, Table 2. Figure 1 visualizes the responses to the scaled questions for both levels (see Supplemental Data, File B for additional visualizations of the data by level of training and geographic region).

Figure 1. Scaled questions exploring the impact of COVID on learners

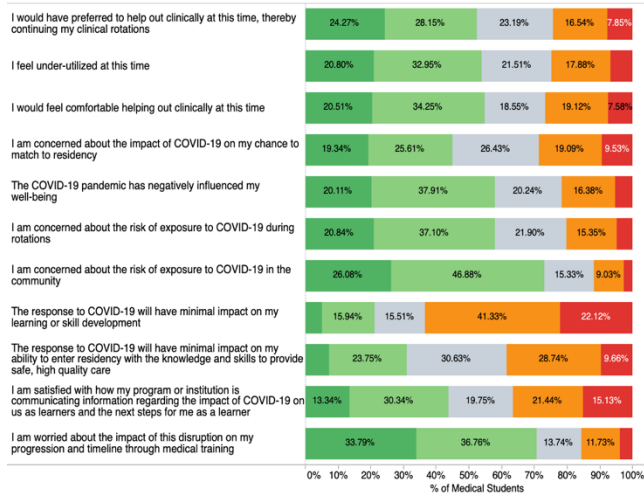


Figure 1.1 Medical student scale

Undergraduate medical learners

The majority (84.3%, *N* = 2044/2426) of clinical-level medical students were excused from clinical duties; however, some worked clinically in some capacity (9.0%, *N* = 473/5260). Most spent their time in online learning coordinated by their medical school (68.2%, *N* = 3587/5260), pursuing self-directed learning (44.1%, 2322/5260), resting (36.4%, *N* = 1913/5260), and engaging in more wellness activities than normal (31.4%, 1654/5260). Most (80.9%, *N* = 3997/4938) had online learning coordinated by their school but 66.5% (*N* = 2608/3919) felt their education would be of lower quality as a result. Some had difficulties learning from home (21.3%, *N* = 835/3919) and accessing the internet (11.0%, *N* = 431/3919).

Students reported that their core electives (23.5%, *N* = 1235/5260) and visiting electives (19.5%, *N* = 1027/5260) were cancelled or postponed. The qualitative data highlighted how reduced clinical exposure limited opportunities to explore specialties, decreased career interests, and created anxiety about implications for future milestones (e.g., examinations, residency match). While the majority of medical students did not report the pandemic influenced their career interests, 11.4% (*N* = 600/5260) of medical students reported increased interests in both Public Health and Infectious Disease as a result of the pandemic, as well as Family Medicine (*N* = 314/5260), other clinical specialties (e.g., Emergency Medicine, Critical Care, Internal Medicine), and new interests in incorporating epidemiology into their future careers. Decreased interest in clinical careers and concerns

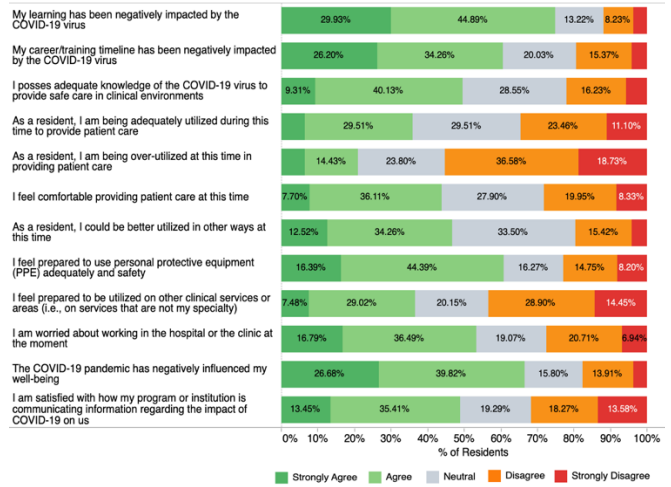


Figure 1.2 Resident scale

about the impact of the pandemic on job prospects in their country were noted qualitatively.

Over half of medical students reported feeling under-utilized (53.8%, *N* = 2119/3942); 52.4% (*N* = 1797/3428) wanted to assist clinically and felt comfortable doing so (54.8%, *N* = 2117/3866). While 57.9% (*N* = 1963/3388) worried about the risk of exposure to the virus during rotations, 73.0% (*N* = 3217/4409) worried about the risk of exposure in the community. Over two-thirds (70.6%, *N* = 2942/4170) reported feeling worried about the disruption to their progression through medical training, with 45.0% (*N* = 1420/3159) worrying about their chances to match to residency. Only 21.0% (*N* = 933/4435) thought the pandemic would have a minimal impact on their learning or skill development, and only 31.0% (*N* = 1193/3852) felt that it would have a minimal impact on their ability to enter residency with sufficient knowledge and skill to provide safe, high-quality care. The majority of students (58.0%, *N* = 2571/4431) felt that the pandemic negatively affected their wellbeing.

Postgraduate resident learners

Residents were from a variety of specialties, mostly in urban settings (66.7%, *N* = 766/1148). Three-quarters of residents agreed their learning was negatively impacted by COVID-19 and 60.5% (*N* = 480/794) felt it disrupted their career progression and timeline. Only 16.0% (*N* = 184/1148) reported working more than normal during the pandemic and 36.7% (*N* = 421/1148) working less than normal. Some residents felt adequately utilized (35.9%, *N* = 285/793) or over-utilized (20.9%, *N* = 165/790); however, 46.8% (*N* = 370/791) reported they could be better utilized.

Over one-third (43.8%, $N = 347/792$) felt comfortable providing patient care at this time, and 60.8% ($N = 482/793$) felt prepared to use personal protective equipment (PPE). Half of residents (49.4%, $N = 393/795$) reported adequate knowledge of COVID-19 to provide care, 36.5% ($N = 288/789$) were prepared to be redeployed to other clinical services, and 53.3% ($N = 422/792$) were worried about working in the hospital. 66.5% ($N = 526/791$) agreed that COVID-19 had negatively impacted their wellbeing. The qualitative data provided further evidence that residents felt under-utilized – but highlighted how they saw their re-deployment in a clinical setting as conflicting with their educational goals.

Shared questions

All scaled items had acceptable internal consistency ($\alpha > .7$) and factor loadings, suggesting reliability and validity evidence. Statistically significant differences were detected between undergraduate (i.e., medical student) and postgraduate (i.e., resident) levels of training ($p < .05$) and geographic regions ($p < .007$) for the items examining

satisfaction with organizational responses [$t = 7.517, p < .000$; $F(6,5258) = 73.85, p < .007$], the impact of COVID-19 on wellness [$t = -7.774, p < .000$ [$F(6,5165) = 11.81, p < .007$]], and state-trait anxiety [$t = -4.710, p < .000$; $F(6, 5131) = 10.48, p < .007$] (Supplemental File C). In general, residents reported lower satisfaction with organizational responses than medical students ($\bar{x} = 15.67, 95\% \text{ CI} = 15.36\text{—}15.98$) as well as a greater negative impact on their wellbeing ($\bar{x} = 18.52, 95\% \text{ CI} 18.24\text{—}18.80$) and anxiety ($\bar{x} = 15.13, 95\% \text{ CI} 14.83\text{—}15.42$). Learners from the East Asia and Pacific region were most satisfied with organizational responses compared to other geographic regions, and learners from Sub-Saharan Africa and Latin America and Caribbean were least satisfied (Figure 2.1). Medical students from the Latin America and Caribbean region as well as residents from North America reported the largest negative impact of COVID-19 on their wellness (Figure 2.2). Residents from South Asia, Latin America and Caribbean reported the highest state-trait anxiety (Figure 2.3)

Figure 2. Comparison of shared scaled items between levels and geographic regions

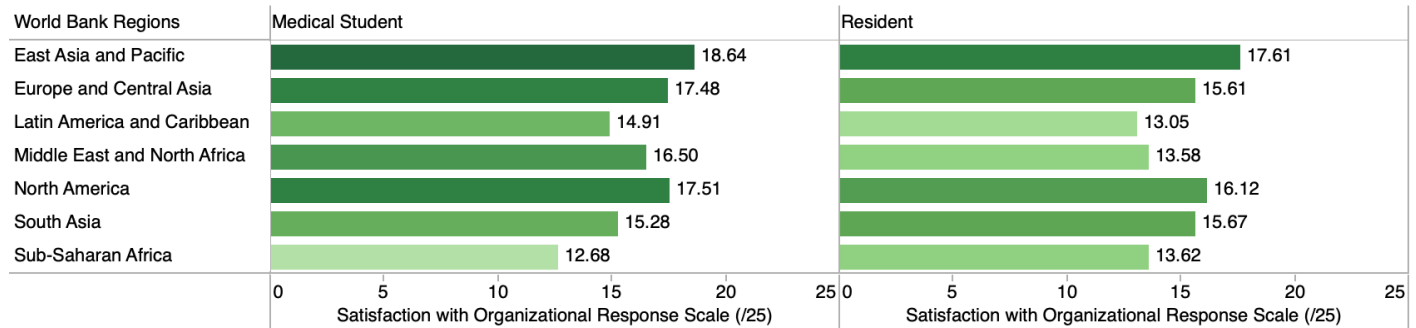


Figure 1.1. Mean satisfaction with organizational responses to COVID-19

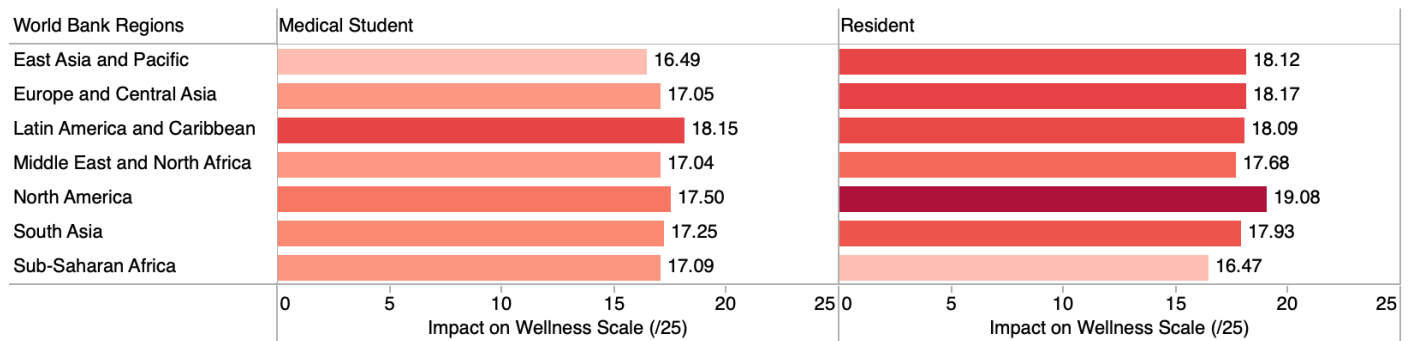


Figure 2.2. Mean Impact of COVID-19 on Wellness

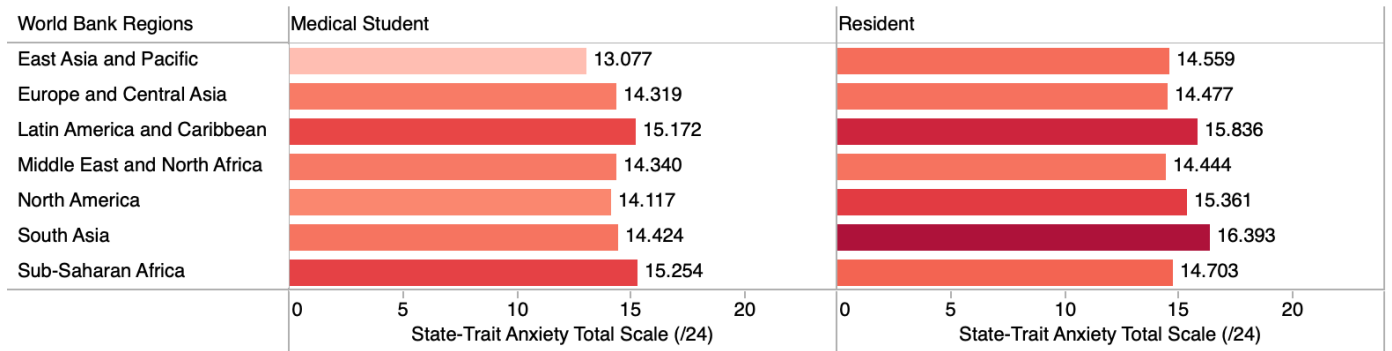


Figure 2.3. Mean State-Trait Anxiety (STAI-6) scores

Seventy-four percent of residents and 57% of medical students reported being more anxious than usual (Appendix A, Table 3; Figure B.4). Common concerns were the health and wellbeing of family members, the impact of the pandemic on their learning, the health of the public, their personal health, the financial situation of others, and their personal financial situation (Figure B.3). One-quarter of participants identifying as Asian reported an increase in racist comments or behaviours in the clinical setting during COVID-19. Over half (54.7%) of learners living with a disability felt their school's response to the pandemic would further disadvantage them due to their disability.

14.8% ($N = 775$) of learners reported having to be in quarantine or isolation at the time of the survey. Nearly all learners were practicing physical and social distancing.

The qualitative data highlighted how normal education and training processes were severely disrupted by the pandemic across ten themes, including: communication, training, utilization of learners, future concerns and implications, and silver linings (see Supplemental File D for a summary of themes). Learners identified a need for institutions to adapt and innovate in order to mitigate these impacts and continue education. Learners also desired to have input into their institutions' pandemic response. Strategies such as town halls, surveys, and learner representation on decision-making committees helped ensure their circumstances were accurately understood and enabled them to raise concerns overlooked by decision-makers.

Clear and effective communication during the pandemic was essential for learners, while poor or absent communication left learners uncertain of what was happening and contributed to their anxiety. Effective communication provided clarity and reassurance about the pandemic's impacts and the institutional response. Learners wished to be informed about impacts on their

programs, details of the pandemic response, their role (including how to help), and resources they could access. Effective communications about these topics were clear, specific, decisive, concise, and reassuring. Irregular (sporadic) communication created an "information vacuum" that was filled with speculation, rumours, and misinformation. Overly frequent communication was overwhelming and led students to ignore institutional communications.

Numerous interventions were implemented in response to COVID-19, including virtual teaching strategies (e.g., Zoom, Microsoft Teams), office hours and town halls, and clinical strategies (e.g., patient handover via teleconference, alternating call schedules to minimize exposure). When done effectively, online learning maintained educational momentum and provided learners with motivation, a routine, and a sense of purpose. Self-directed learning was frequently used to augment online learning, and when provided with support and guidance, this motivated learners and provided them with a sense of progress. Programs with too much content overwhelmed them, whereas programs that provided minimal guidance left learners feeling aimless. Some participants stated that their program or school had done nothing in response to the pandemic and that either their education had continued as usual or, in some instances, students were told to stay at home and self-direct their learning without any guidance from their program.

Discussion

This study provides empirical data about the impact of COVID-19 on medical education around the world, notably the effects on learning and wellbeing. Taken together, our findings highlight how learners have been impacted regardless of their program's response to the pandemic and whether or not they were removed from the clinical environment. However, the extent that COVID-19 has

impacted learners differs significantly between levels of training and geographic regions.

COVID-19 has disrupted the traditional format and process of medical training for the vast majority of medical students and residents around the world. The rapid adoption of online learning by most schools may raise concerns about the quality of education, particularly at the pre-clinical stage of training where the vast majority of learning typically occurs in the classroom.²⁰ Despite these concerns, equivalent educational outcomes between online and offline methods have been reported in the literature.²¹ It can also be argued that the uptake and refinement of technology to allow for online learning – which has been long resisted at some schools – may represent a key innovation in medical training as it has increased accessibility for many medical students who can now learn remotely, and, if recorded, revisit materials that were previously inaccessible outside of the lecture theatre. In considering the broad range of strategies that medical training programs have adapted during the pandemic, this may be an opportunity to reconceptualize, innovate, and improve the current models of medical training, and ultimately catalyze broader educational transformation.^{22,23}

The removal of learners from the clinical setting may diminish training (particularly for residents in time-based models of training), influencing clinical competence acquisition and career-decision making – all of which may affect patient care and health system outcomes.²² For instance, medical students in our study reported that the loss of clinical experiences, such as clinical electives, impacted their decision-making regarding which specialties to apply to. In this way, one could argue that the removal of medical students from the clinical environment has consequences for their professional identity and career-decision making. On the other hand, the consequences of removing resident physicians from the clinical environment may have a lesser influence on their professional identity formation, and a greater influence on their clinical competence acquisition depending on the extent their clinical rotations were influenced. While it was common in Canada and the US for clerkship rotations and electives to be cancelled, thus removing nearly all medical students from the clinical environment during the initial wave, most resident physicians continued to provide clinical care.

The removal of medical students from the classroom and clinical environment meant that many learners experienced significant disruption to their routine.

Consistent with early reports, medical students felt under-utilized and have a strong desire to help out clinically during times of need.^{24–28} However, not all learners may share these views. In addition to concerns about physical safety, numerous resident participants in our study believed a primary role of trainees is to be educated and that any deviation from that role is inappropriate. Other learners felt personally invested in contributing to care and viewed it as their personal calling and professional obligation. The optimal role of trainees during pandemics is complicated given their dual role as learners and healthcare providers – particularly with respect to resident physicians, who can provide patient care with minimal supervision and function with increasing autonomy throughout their training. The extent to which each role is prioritized during emergencies remains debated. On one hand, it has been argued that medical students specifically, as an unpaid workforce, are not essential workers, and may increase disease transmission and waste scarce supplies of PPE.²⁹ In contrast, it can also be argued that medical students are a semi-skilled workforce that can alleviate the burden on residents and staff and should gain experience in preparation for future pandemics when they will no longer be trainees. In one study, hospital leaders viewed medical students who graduated early to help during COVID-19 as “game-changers.”³⁰ It has also been argued that medical education is equally important to patient care during a pandemic.³¹ This may be a unique opportunity to cultivate leadership skills if learners are well-supported.³² For learners in the clinical environment, supervision, feedback, and evaluation as well as access to adequate wellness supports remain crucial.^{31,32} The ethical and practical considerations of utilizing medical learners during a pandemic remains an ongoing point of discussion and needs to be weighed against potential benefits of learning and implications to patient care.^{33,34}

COVID-19 is anticipated to affect the mental health of the public³⁵ as well as that of healthcare professionals.³⁶ Previous health emergencies and disruptions to training, such as SARS and Hurricane Katrina, have been shown to diminish the mental health of trainees and healthcare professionals.³⁷ Our study provides similar evidence but from a global perspective that the wellbeing of medical learners has been negatively impacted by COVID-19 across all levels of training and geographic regions. This is concerning given the existing evidence on the alarming prevalence of burnout and psychiatric morbidities in learners, as COVID-19 may amplify these pre-existing issues.^{38–41} Pandemic responses have superimposed new

stressors while exacerbating existing stressors for learners. The “anticipatory loss” associated with the disruption of traditional processes and milestones — the loss of clerkship rotations and electives for medical students, disruption to the residency match processes and timelines, and the cancellation of licensing exams for residents — appear associated with heightened anxiety and decreased wellness. Similarly, front-line learners (e.g., residents) may be particularly prone to wellness stressors at this time given the occupational hazards associated with providing clinical care during a pandemic.^{24,27} Postgraduate participants in our study often commented on the numerous challenges they faced working in clinical environments at this time, including their lack of PPE, resources, infrastructure, support, and advocacy during this time. Suggestions for mitigating the psychological consequences of COVID-19 on front-line care providers include providing clear communication, education, and psychological support, among others.³⁷ Tailored strategies to support medical learners during a pandemic in various contexts to mitigate their situational stressors may be a key area for educators to share their innovations and lessons learned in order to better support learners.

This pandemic remains an ongoing challenge for medical education. At the moment of this publication, many countries are challenged with an even more critical challenge during the second wave of the pandemic — when multiple vaccines have been approved and countries are adopting diverse vaccination strategies. While the uncertainty of the initial COVID-19 wave required organizations to adopt a “worst-case scenario” approach, medical schools not only continue to react to the current needs of health systems, but proactively plan for the future. While some participants in this study applauded their program’s response, it is important to learn from this experience and improve planning and policies for current and future emergencies that may disrupt medical education.⁴² Recommendations are increasingly being discussed in the literature.^{31,42–45} As this is a critical opportunity to learn from the COVID-19 pandemic, a synthesis of key considerations for medical educators synthesized from our results and existing recommendations are summarized in Appendix A Table 4, spanning five key areas: teaching and learning (e.g., online learning), utilization of learners (e.g., using medical students during emergencies in clinical and non-clinical roles), supporting learner well-being, communicating with learners, and planning and decision-making. The COVID-19 pandemic may transform medical education for the better

— if newly embraced innovations that are working well are sustained rather than returning to the status quo.^{46,47} This represents a pivotal moment in our field to consider sustaining innovations that have been long resisted, such as online learning. We must continue to evaluate and share innovations and lessons learned from the pandemic amongst the global medical education community.^{12,46,48,49}

Limitations

We acknowledge that this study has several limitations, including the response and selection bias. The use of snowball sampling techniques may have inevitably introduced bias into the sample and results. Further, we cannot calculate a response rate as we do not know the number of learners who declined to participate in this study. The response rates from residents are low, potentially because they continued working clinically and the disruptions to their training were less extreme than for medical students who were completely removed from their training environments. Further, this study excluded participants who did not speak any of the 20 languages of the survey and there may be inconsistencies across the survey translations despite our best attempts to ensure questions and constructs translated accurately. Due to the public circulation of the survey, participants could not be validated as medical learners. A small fraction (3.5%) of participants did not specify their level of training and were excluded from the comparisons across levels of training. The geographic comparisons remain limited, as other classification systems (e.g., the World Health Organization regions) may have generated different results and there may be more pronounced differences between countries within similar regions (e.g., the United States vs. Canada). Finally, the variable responses to COVID-19 across countries and time is worth noting. Numerous qualitative comments highlighted how national responses informed the responses of professional organizations and training programs. Future research could examine potential associations between temporality and the political and health system responses to examine how these factors may influence medical learners.⁵⁰ Future research is also warranted to understand the long-term impact and potential consequences of the COVID-19 pandemic on education, patient care, and health system outcomes.

Conclusions

This global study provides empirical data surrounding the profound impact that COVID-19 has had on medical learners, which can inform responses to the current

pandemic, future disruptions to training, and future research. Despite the global shift toward online education, all education may not be created or perceived equally, as the results of this study suggest medical students fear their education will be of lower quality at this time. Both medical students and residents report their under-utilization, yet the role of the medical learner during a pandemic remains controversial. A delicate balance remains between medical training and the acute needs of the health system to ensure that both education and patient care remain safe. Finally, this study highlights how the COVID-19 pandemic has negatively impacted the wellbeing of medical learners globally, particularly those at the postgraduate level of training, which may be associated with their anxiety relating to the anticipatory losses of their educational experience. While the goal of this study was to broadly examine the impacts of COVID-19 on medical education, it highlights several areas for further exploration. Future research is warranted to better understand the implications of COVID-19 on learner outcomes and to generate evidence-based strategies surrounding how best to teach, engage, and support medical learners during similar events.

Conflicts of Interest: The authors have no conflicts of interest to declare.

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Appendix A.

Table 1. Demographic characteristics of participants

N (%)			
Level of Training			
Medical Student	5260 (81.0%)		
Resident	1007 (15.5%)		
Prefer not to answer	225 (3.5%)		
World Bank Geographic Region			
East Africa and Pacific	445 (6.9%)		
Europe and Central Asia	2819 (43.4%)		
Latin America and Caribbean	944 (14.5%)		
Middle East and North Africa	191 (2.9%)		
North America	1607 (24.8%)		
South Asia	170 (2.6%)		
Sub-Saharan Africa	316 (4.9%)		
Gender Identity			
Woman	4195 (64.7%)		
Man	2138 (32.9%)		
Non-Binary	25 (0.4%)		
Woman + Non-Binary	3 (0.05%)		
Prefer to self-describe	21 (0.3%)		
Prefer not to answer	110 (1.7%)		
Race			
<i>Participants who selected East Asian, South Asian, and/or West Asian: Have you noticed or experienced an increase in racist comments or behaviors towards you or other Asian individuals in the clinical setting since the emergence of COVID-19? N = 944</i>			
Black	320 (4.9%)	Yes	231 (24.5%)
East Asian	315 (4.9%)	No	631 (66.8%)
Hispanic/Latinx	779 (12.0%)	Prefer not to answer	82 (8.69%)
South Asian	430 (6.6%)		
Southeast Asian	181 (2.8%)		
West Asian	222 (3.4%)		
White	3540 (54.5%)		
Multi-racial	276 (4.25%)		
Prefer to self-describe	191 (2.9%)		
Prefer not to answer	238 (3.7%)		
Do you have a physical disability?			
Yes	157 (2.4%)		
No	6138 (94.6%)		
Prefer not to answer	197 (3.0%)		
Do you have a learning disability?			
<i>If yes to either physical or learning disability: Has the response to COVID-19 from your school or program resulted in any concern(s) about how you may be disadvantaged at this time as a result of your physical or learning disability?</i>			
Yes	256 (3.9%)	Yes	188 (54.7%)
No	5994 (92.3%)	No	147 (42.7%)
Prefer not to answer	242 (3.73%)	Prefer not to answer	9 (2.6%)
Do you have children?			
<i>If yes: Do you feel that you have adequate childcare during this time?</i>			
Yes	286 (4.4%)	Yes, I have adequate childcare at this time	117 (43.5%)
No	6036 (93.0%)	No, I do not have adequate childcare at this time	104 (38.7%)
Prefer not to answer	170 (2.6%)	Not applicable, my children do not require supervised childcare at this time	41 (15.2%)
		Prefer not to answer	7 (2.6%)
Are you currently a caregiver to others?			
<i>If yes: Are you able to continue to maintain your caregiver responsibilities at this time?</i>			
Yes	548 (8.4%)	Yes	410 (77.7%)
No	5640 (86.9%)	No	103 (19.5%)
Prefer not to answer	304 (4.7%)	Prefer not to answer	15 (2.8%)

Table 2. Medical student and resident specific questions

Medical Students ^a (N = 5260)	N (%) [*]
<i>Clinical level students only: Did your medical school formally excuse you from clinical duties (i.e., clerkship rotations, other clinical rotations or experiences) as a result of the COVID-19 pandemic?*</i> (N = 2426 clinical level students)	
Yes	2044 (84.3%)
No	231 (9.5%)
Prefer not to answer	151 (6.22%)
Are you currently working clinically?	
Yes, I am currently working in my planned clinical rotations as a medical student	246 (4.7%)
Yes, I am currently working clinically but in other ways at this time	227 (4.3%)
No, I am not working clinically	2033 (38.7%)
No, I am not working clinically because I am in the pre-clinical stage of training	2483 (47.2%)
Prefer not to answer	271 (5.1%)
If your medical school has excused you from clinical duties or moved your scheduled curriculum to online learning modalities, did you leave or depart from your primary residence (i.e., where you live during the school year) to go to another location during this time?***	
Parent(s) or family member's house	2028 (38.6%)
Friend's house	58 (1.1%)
Somewhere else	132 (2.5%)
Did not leave	2624 (49.9%)
Prefer not to answer	135 (2.6%)
How are you spending your time at the moment?***	
My learning/training has not been disrupted so I am spending my time as I typically would during the medical school year	757 (14.4%)
My learning is now online as coordinated by the medical school	3587 (68.2%)
I am engaging in self-directed learning	2322 (44.1%)
I am studying for licensing examinations	838 (15.9%)
I am working on research or scholarly projects	887 (16.9%)
I am volunteering	622 (11.8%)
I am helping with contact tracing	140 (2.7%)
I am taking this time to relax or rest	1913 (36.4%)
I am taking care of someone who is ill	123 (2.3%)
I am personally unwell and need to self-isolate	121 (2.3%)
I am spending this time taking care of my children/family	437 (8.3%)
I am taking this time to engage in more wellness activities than I usually would	1654 (31.4%)
Other	267 (5.1%)
Prefer not to answer	26 (0.5%)
If Yes to volunteering: How are you currently volunteering?***	
Contact tracing	102 (1.9%)
Call centres	122 (2.3%)
Screening centres	64 (1.2%)
Providing child care to healthcare professionals	79 (1.5%)
Providing child care to others	27 (0.5%)
Other	357 (6.8%)
Prefer not to answer	19 (0.4%)
Have you participated in any online learning during this time that was coordinated or organized by your medical school for aspects of your core curriculum (e.g., lectures or clerkship teaching sessions on Zoom)? (N = 4938 valid responses)	
Yes	3997 (80.9%)
No	914 (18.5%)
Prefer not to answer	27 (0.5%)
If yes to Online learning: Do you feel that the quality of your medical education will be lower as a result of any online learning your school is coordinating at this time? (N=3919 valid responses)	
Yes	2608 (66.5%)
No	1225 (31.3%)
Prefer not to answer	86 (2.2%)
If yes to Online learning: Do you have any challenges accessing online learning modalities (e.g., Zoom, online lectures)? (N=3919 valid responses)***	
I have difficulties accessing a computer	89 (2.27%)
I have difficulties accessing the internet	431 (11.0%)
I have difficulties learning from home	835 (21.3%)
I have other difficulties	202 (5.15%)
No, I do not have any difficulties accessing online learning	2743 (70.0%)
Prefer not to answer	31 (0.79%)

How has the COVID-19 pandemic directly impacted your clinical electives?	
My visiting electives at other institutions have been cancelled or postponed at this time	1027 (19.5%)
My core electives at my own medical school have been cancelled or postponed at this time	1235 (23.5%)
My electives have not yet been influenced at this time	203 (3.9%)
Not applicable, as all of my electives have been completed	213 (4.0%)
Prefer not to answer	110 (2.1%)
How has the COVID-19 pandemic influenced your career decision-making (e.g., residency interests, career planning)?**	
It has influenced the residency program(s) I wish to apply to	564 (10.7%)
It has increased my interest in Public Health as a specialty	600 (11.4%)
It has increased my interest in Infectious Diseases as a specialty	600 (11.4%)
It has increased my interest in Family Medicine as a specialty	314 (6.0%)
It has increased my interest in other programs (open-ended)	268 (5.1%)
It has not influenced my career decision making or interests	2944 (56.0%)
Prefer not to answer	130 (2.5%)
Residents^b (N = 1148)	N (%)
Setting	
Urban	766 (66.7%)
Rural	121 (10.5%)
Other	23 (2.0%)
Prefer not to answer	238 (20.7%)
Program	
Anesthesiology	50 (4.4%)
Emergency Medicine	30 (2.6%)
Family Medicine	142 (12.3%)
Internal Medicine (core)	147 (12.8%)
Medical Subspecialty	38 (3.3%)
Neurology	11 (1.0%)
Obstetrics and Gynecology	45 (3.9%)
Pediatrics	42 (3.6%)
Public Health	28 (2.4%)
Psychiatry	42 (3.6%)
Radiology	19 (1.6%)
Surgery	113 (9.8%)
Other	290 (25.3%)
Prefer not to answer	
Are you working more than usual during the COVID-19 pandemic?	
Yes, I am working more than usual	184 (16.0%)
No, I am working the same amount	254 (22.1%)
No, I am working less than usual	421 (36.7%)
Prefer not to answer	289 (25.1%)
FM or Psychiatry Residents: Do you think residents in these programs could potentially be utilized at this time to provide peer-to-peer mental health support and/or counseling to other residents or healthcare professionals at this time over videoconferencing modalities (N=184)	
Yes, I think we could be useful to provide mental health supports at this time to any and all other residents at this time	89 (48.4%)
Yes, I think we could be useful to provide mental health supports at this time to residents who are working at the front lines of care, or who may be additionally stressed or burnt out as a result of the pandemic	66 (35.9%)
Yes, I think we could be useful to provide mental health supports at this time to other healthcare professionals (e.g., nursing) at this time	50 (27.2%)
No, I do not think we could be useful at this time in providing mental health supports to other residents	51 (27.7%)
^a N=5260 respondents for medical student-specific items; ^b N=1148 respondents for resident-specific items – participants who did not specify their level of training could complete the resident-specific items; *N=% = of all respondents for at that level for each item; **participants could select all options that applied;	

Table 3. Shared questions

Which of the following are concerns or stressors for you at this time?*	Medical Student	Resident	Did not specify level	Total
My personal health and well-being	2281 (43.4%)	440 (43.7%)	58 (25.8%)	2779 (42.8%)
The health and well-being of my family members	3518 (66.9%)	605 (60.1%)	87 (38.7%)	4210 (64.9%)
The health and wellbeing of the public	2761 (52.49%)	509 (50.6%)	72 (32.0%)	3342 (51.5%)
My personal financial situation	1391 (26.5)	200 (19.9%)	51 (22.7%)	1642 (25.3%)
The financial situation of others	2089 (39.7%)	339 (33.7%)	57 (25.3%)	2485 (38.3%)
The impact of this pandemic on my learning	3046 (57.9%)	468 (46.5%)	71 (31.6%)	3585 (55.2%)
Other	253 (4.81%)	83 (8.24%)	9 (4.00%)	345 (5.31%)
Would you consider yourself more anxious during this time than you typically are during the year?	Medical Student (N = 4361)	Resident (N = 737)	Did not specify level (N = 131)	Total (N = 5229)
Yes	2505 (57.4%)	547 (74.2%)	65 (49.6%)	3117 (59.6%)
No	1779 (40.8%)	181 (24.6%)	51 (38.9%)	2011 (38.5%)
Prefer not to answer	77 (1.8%)	9 (1.22%)	15 (11.5%)	101 (1.93%)
Are you practicing social or physical distancing?	Medical Student (N = 4367)	Resident (N = 742)	Did not specify level (N = 132)	Total (N = 5241)
Almost always	3206 (73.4%)	430 (58.0%)	72 (54.5%)	3708 (70.7%)
As much as I can	1099 (25.2%)	293 (39.5%)	51 (38.6%)	1443 (27.5%)
Not at all	49 (1.1%)	13 (1.75%)	4 (3.03%)	66 (1.26%)
Prefer not to answer	13 (0.3%)	6 (0.81%)	5 (3.79%)	24 (0.46%)
Have you had to quarantine or self-isolate?	Medical Student (N = 4360)	Resident (N = 741)	Did not specify level (N = 130)	Total (N = 5231)
Yes	596 (13.7%)	160 (21.6%)	19 (14.6%)	775 (14.8%)
No	3749 (86.0%)	574 (77.5%)	103 (79.2%)	4426 (84.6%)
Prefer not to answer	15 (0.34%)	7 (0.94%)	8 (6.15%)	30 (0.57%)
Are you being asked by others to provide medical expertise or information regarding the COVID-19 pandemic?*	Medical Student	Resident	Did not specify level	Total
Yes – Family	2477 (38.2%)	529 (52.5%)	71 (31.6%)	3077 (47.4%)
Yes – Friends	1965 (30.3%)	452 (44.9%)	60 (26.7%)	2477 (38.2%)
Yes – Others	591 (9.10%)	180 (17.9%)	23 (10.2%)	794 (12.3%)
No	1392 (21.4%)	111 (11.0%)	38 (16.9%)	1541 (23.7%)
Prefer not to answer	46 (0.71%)	10 (0.99%)	5 (2.22%)	61 (0.94%)
Are you using social media to communicate to others about COVID-19?	Medical Student	Resident	Did not specify level	Total
Yes – Twitter	506 (7.79%)	123 (12.2%)	25 (11.1)	654 (10.1%)
Yes – Instagram	1065 (16.40%)	135 (13.4%)	37 (16.4%)	1237 (19.1%)
Yes – Facebook	1208 (18.6%)	247 (24.5%)	38 (16.9%)	1493 (23.0%)
Yes - Other	352 (5.42%)	78 (7.75%)	25 (11.1%)	455 (7.01%)
No	2220 (34.2%)	347 (34.5%)	45 (20.0%)	2612 (40.2%)
Prefer not to answer	58 (0.89%)	9 (0.89%)	11 (4.89%)	78 (1.20%)

N=respondents for each question; questions were not mandatory so total number of responses per question does not equal the total number of participants throughout the study; **"select all that apply" question percentages calculated using sample size for each level of training (N = 5260 for medical students, N = 1007 for residents, N = 225 for participants who did not specify) or the total sample size (N = 6492) if not specified

Table 4. Considerations for medical education during COVID-19

Area	Considerations for Medical Schools and Residency Programs
Teaching and Learning	<ul style="list-style-type: none"> • Recognize that the rapid shift to online learning modalities likely requires ongoing evaluation, refinements, and improvement. • Acknowledge that learners may have difficulties learning from home as well as challenges accessing a computer or the internet. • Provide learners with self-directed learning resources with structure and guidance to promote student motivation and accountability. • Simultaneously collect real-time feedback and use rapid-cycle improvement to promote continuous improvements while adapting new formats or processes. • Identify potential innovations to maintain the fidelity and benefits of in-person learning, particularly for clinical skills. • Consider integrating educational innovations created in response to COVID-19 (e.g., online learning modules and resources) into the core curriculum to be sustained after the pandemic. • Scale what is working to other areas of your curriculum. Share success stories with others who may be struggling with similar challenges and could benefit from these strategies, particularly those in similar institutions (e.g., between residency programs). • Conduct program evaluations of the new formats and processes adopted in response to COVID-19 to compare outcomes and provide evidence of merit and worth to learners and stakeholders.
Utilizing Learners	<ul style="list-style-type: none"> • Recognize that learners may be highly motivated to help out clinically during times of need and consider potential opportunities to engage them in meaningful roles – especially medical students when removed from their clinical rotations. • Consider the training level, skillset, and experiences of learners. When appropriate, junior learners (e.g., medical students or junior residents) may be helpful to provide care in less acute settings or assist with low-risk roles to free senior residents and faculty to provide acute and intensive care. • Provide learners working clinically with proper training on how to use personal protective equipment and provide care to COVID-19 patients. • As learners have diverse needs, an individualized approach should be considered when engaging learners in the workforce – don't assume all learners want to help out clinically. Learners may also be willing to help out in non-clinical ways, such as volunteering in the community. • Continue providing learners with adequate supervision, feedback, and evaluation in the clinical setting as much as possible. • Ensure safety equipment is available to learners in the clinical environments as well as health insurance if it is not already provided
Supporting Learners	<ul style="list-style-type: none"> • Recognize the potential burden of COVID-19 on learner well-being and proactively provide systemic and programmatic support, appropriate access to counselling, peer support systems, and social networking. • Acknowledge that the diverse and unique needs of learners may differ for some groups at this time, including students who may have a disability, parents, caregivers, and international learners. • Approach medical learner well-being holistically to ensure that mental, physical, intellectual, social, and occupational wellness is achieved. • Cultivate a culture of wellness both systemically and programmatically (upstream) so that learners are able to thrive (downstream) during their training as well as disruptive events such as COVID-19. • Recognize that “anticipatory loss” of milestones may be associated with learner anxiety and try to mitigate concerns relating to these areas, including: cancellation of electives, reduced clinical exposures, concerns about career decision making, anxiety about what specialties to apply to for residency with limited clinical exposure and the cancellation of electives, disruption of traditional timelines and processes, cancellation of licensing examinations, impact on career progression and obtaining employment, etc.
Communicating with Learners	<ul style="list-style-type: none"> • Communicate with learners clearly, early, and often – but not too often. • Use centralized and streamlined modalities to reduce information overload, such as an e-mail update or frequently updated website, rather than social media. Consider surveying learners to ask about communication preferences and tailor the communication in response to their needs. • Provide clear and concise updates to learners relating to the impacts of COVID-19 on their education, including changes to their program, timelines, and milestones. • Be transparent about decision-making processes, outcomes, and contingency plans. • Provide reassurance as much as possible and clearly communicate supports and resources to learners, such as institutional wellness resources, career counselling, academic advisors, peer supports, etc.
Policy, Planning, and Decision Making	<ul style="list-style-type: none"> • Engage learners in the decision-making process as much as possible, and as early as possible. • Include learners on planning committees and in the development of policies. • Create avenues for learners to be engaged in decision-making and to provide feedback to administrators and decision-makers, such as town halls, open office hours, or surveys. • Acknowledge the diverse experiences and needs of learners and allow for flexibility in solutions. For instance, recognize that some – but not all – junior learners may wish to help, and that the health system may benefit from utilizing this skilled workforce. Provide multiple options to learners when possible to promote autonomy and flexibility. • Develop robust policies and procedures from this experience. Plan for how the program or institution will respond to disruptions to medical training, including any subsequent waves of COVID-19, future pandemics, climate change emergencies, etc.

Exploring the impact of the COVID-19 pandemic on medical learners

Start of Block: Country

Q2.1 What **level of learner** are you currently? (select one)

- Medical Student, Pre-Clerkship or Pre-Clinical Years
 - Medical Student, Clerkship or Clinical Years
 - 1st year resident or intern (i.e., PGY1 Resident)
 - 2nd year resident (i.e., PGY2 Resident)
 - 3rd year resident (i.e., PGY3 Resident)
 - 4th year resident (i.e., PGY4 Resident)
 - 5th year resident (i.e., PGY5 Resident)
 - 6th year resident or above (i.e., PGY6 or higher Resident)
 - I prefer to not answer this question
-

Q2.2 In which **country** is your medical school or residency program located? (select one)

▼ Afghanistan ... Zimbabwe

End of Block: Country

Start of Block: Demographic Questions

*Display This Question:
If Q2.2 = Canada*

Q3.1 What **academic institution** are you currently a registered learner at in Canada? (select one)

▼ University of British Columbia (1) ... I prefer to not answer this question (18)

Supplemental File: Survey Questionnaire

34 Q3.2 Which of the following best describes your **gender identity**? (select all that apply)

- 35 I identify as a woman
- 36 I identify as a man
- 37 I identify as non-binary
- 38 I prefer to self-describe: _____
- 39 I prefer to not answer this question
-

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42
43 Q3.3 Which of the following condensed categories best describe your **race or how you are racialized**? (select all
44 that apply)

- 45 White/Caucasian
- 46 Black/African American (e.g., African American)
- 47 Hispanic/Latinx (e.g., Latin American, Spanish, Portugese, etc.)
- 48 South Asian (e.g., Indian, Pakistani, Bangladeshi, Sri Lankan, etc.)
- 49 Southeast Asian (e.g., Vietnamese, Cambodian, Laotian, Thai, Filipino, etc.)
- 50 West Asian (e.g., Middle Eastern, etc.)
- 51 East Asian (e.g., Chinese, Japanese, Korean, etc.)
- 52 I prefer to self describe: _____
- 53 I prefer to not answer this question
-

55
56 *Display This Question:*
57 *If Q2.2 = Canada*

59 Q3.4 Do you consider yourself an Aboriginal or Indigenous person, that is, First Nations, Metis, or Inuit? (select
60 one)

61 ▼ Yes (1) ... I prefer not to answer this question

64 Q3.5 Do you consider yourself to live with a **physical disability**? (select one)

65 ▼ No (1) ... I prefer not to answer this question

68 Q3.6 Do you consider yourself to live with a **learning disability**? (select one)

69 ▼ No (1) ... I prefer not to answer this question

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Supplemental File: Survey Questionnaire

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Display This Question:
If Q3.5 = Yes
Or Q3.6 = Yes

Q3.7 Has the response to the COVID-19 pandemic from your medical school or residency program resulted in any concern(s) about how you may be **disadvantaged** at this time as a result of your physical or learning disability? (select one)

▼ Yes (1) ... I prefer not to answer this question

Q3.8 Do you have **children**? (select one)

▼ No (1) ... I prefer not to answer this question

Display This Question:
If Q3.8 = Yes

Q3.9 Do you feel that you have **adequate childcare** during this time? (select one)

▼ Yes, I have adequate childcare at this time... I prefer not to answer this question

Q3.10 Are you currently a **caregiver** to others (e.g., family members)? (select one)

▼ No ... I prefer not to answer this question

Display This Question:
If Q3.10 = Yes

Q3.11 Are you able to continue to **maintain** your caregiver responsibilities at this time? (select one)

▼ Yes ... I prefer not to answer this question

End of Block: Demographic Questions

Supplemental File: Survey Questionnaire

107 **Start of Block: Questions for Medical Clerks**

108 *Display This Question:*

109 *If Q2.1 = Medical Student, Clerkship or Clinical Years*

110
111 Q4.1 Did your medical school formally **excuse you from clinical duties** (i.e., clerkship rotations, other clinical
112 rotations or experiences) as a result of the COVID-19 pandemic? (select one)

113 Yes

114 No

115 I prefer not to answer this question

116
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118 *Display This Question:*

119 *If Q2.1 = Medical Student, Pre-Clerkship or Pre-Clinical Years*

120 *Or Q2.1 = Medical Student, Clerkship or Clinical Years*

121
122 Q4.2 Are you **currently** working clinically? (select one)

123 Yes, I am currently working in my planned clinical rotations as a medical student

124 Yes, I am currently working but in other clinical ways at this time

125 No, I am not currently working clinically at this time

126 No, I am still in pre-clerkship or the pre-clinical stage of my training

127 I prefer not to answer this question

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130 *Display This Question:*

131 *If Q2.1 = Medical Student, Pre-Clerkship or Pre-Clinical Years*

132 *Or Q2.1 = Medical Student, Clerkship or Clinical Years*

133
134 Q4.3 If your medical school has excused you from clinical duties or moved your scheduled curriculum to online
135 learning modalities, did you **leave or depart from your primary residence** (i.e., where you live during the school
136 year) to go to another location during this time? (select all that apply)

137 Yes, I left my primary residence where I live during the school year to go to stay at my parent(s) or family
138 member's house

139 Yes, I left my primary residence where I live during the school year to go to stay at a friend's house

140 Yes, I left my primary residence to go somewhere else during this time (specify)
141 _____

142 No, I have not left the primary residence where I live during the school year

143 I prefer to not answer this question

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146 *Display This Question:*

147 *If Q2.1 = Medical Student, Pre-Clerkship or Pre-Clinical Years*

148 *Or Q2.1 = Medical Student, Clerkship or Clinical Years*

Supplemental File: Survey Questionnaire

150 Q4.4 How are you **spending your time** at the moment? (select all that apply)

- 151 My learning or training has not been disrupted so I am spending my time as I typically would during the
152 medical school year
- 153 My learning is now online as coordinated by the medical school
- 154 I am engaging in self-directed learning
- 155 I am studying for licensing examinations
- 156 I am working on research or scholarly projects
- 157 I am volunteering
- 158 I am helping with contact tracing
- 159 I am taking this time to relax or rest
- 160 I am taking care of someone who is ill
- 161 I am personally unwell and need to self-isolate
- 162 I am spending this time to take care of my children/family
- 163 I am taking this time to engage in more wellness activities than I usually would
- 164 Other (please describe) _____
- 165 I prefer not to answer this question

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167 *Display This Question:*

168 *If Q4.4 = I am volunteering*

169

170

171 Q4.5 How are you currently **volunteering**? (select all that apply)

- 172 Contact tracing
- 173 Call centres
- 174 Screening centres
- 175 Providing child care to healthcare professionals
- 176 Providing child care to others
- 177 Other (please describe) _____
- 178 I prefer not to answer this question

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Supplemental File: Survey Questionnaire

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Display This Question:
If Q4.4 = I am volunteering

Q4.6 How did you **get involved** in the volunteer opportunities you are currently engaged in as a result of, and/or during, the COVID-19 pandemic? Please provide a brief description about how you found out about these opportunities, or how you may have sought them out yourself.

Display This Question:
If Q2.1 = Medical Student, Pre-Clerkship or Pre-Clinical Years
Or Q2.1 = Medical Student, Clerkship or Clinical Years

Q4.7 Have you participated in any **online learning** during this time that was coordinated or organized by your medical school for aspects of your core curriculum (e.g., lectures or clerkship teaching sessions on Zoom)? (select one)

- Yes
- No
- I prefer not to answer this question

Display This Question:
If Q4.7 = Yes

Q4.8 Do you feel that the quality of your medical education will be **lower as a result of any online learning** your school is coordinating at this time? (select one)

- Yes
- No
- I prefer not to answer this question

Display This Question:
If Q4.7 = Yes

Supplemental File: Survey Questionnaire

219 Q4.9 Do you have any challenges **accessing** online learning modalities (e.g., Zoom, online lectures)? (select all that
220 apply)

221 Yes - I have difficulties accessing a computer

222 Yes - I have difficulties accessing the internet

223 Yes - I have difficulties learning from home

224 Yes - I have other difficulties I wish to describe
225

226 No - I do not have any difficulties accessing online learning

227 I prefer not to answer this question
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230 *Display This Question:*

231 *If Q2.1 = Medical Student, Clerkship or Clinical Years*
232
233

Q4.10 How has the COVID-19 pandemic directly impacted your **clinical electives**? (select all that apply)

234 My visiting electives at other institutions have been cancelled or postponed at this time

235 My core electives at my own medical school have been cancelled or postponed at this time

236 My electives have not yet been influenced at this time

237 Not applicable, as all of my clinical electives have already been completed

238 Not applicable, as I am a pre-clerkship or pre-clinical level of learner

239 I prefer not to answer this question
240

241 -----
242 *Display This Question:*

243 *If Q4.10 = My visiting electives at other institutions have been cancelled or postponed at this time*

244 *Or Q4.10 = My core electives at my own medical school have been cancelled or postponed at this time*
245

246 Q4.11 How many **weeks of electives** have been impacted so far? Feel free to provide any additional information
247 below about how these electives have been impacted or any concerns about this area.

248 _____
249 _____
250 _____
251 _____
252 _____
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255 *Display This Question:*

256 *If Q2.1 = Medical Student, Pre-Clerkship or Pre-Clinical Years*

257 *Or Q2.1 = Medical Student, Clerkship or Clinical Years*
258

Supplemental File: Survey Questionnaire

259 Q4.12 How has the COVID-19 pandemic influenced your **career decision-making** (e.g., residency interests, career
260 planning)? (select all that apply)

261 It has influenced the residency program or programs I wish to apply to

262 It has increased my interest in Public Health as a specialty

263 It has increased my interest in Infectious Diseases as a specialty

264 It has increased my interest in Family Medicine as a specialty

265 It has increased my interest in other programs (specify)
266 _____

267 It has not influenced my career decision making or interests

268 I prefer not to answer this question
269

270 -----
271 *Display This Question:*

272 *If Q2.1 = Medical Student, Pre-Clerkship or Pre-Clinical Years*

273 *Or Q2.1 = Medical Student, Clerkship or Clinical Years*
274

Supplemental File: Survey Questionnaire

275 Q4.13 Please respond to each of the following statements by selecting a response regarding your level of agreement:
 276 (select one response per row)

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Not Applicable (X)
I would have preferred to help out clinically at this time , thereby continuing my clinical rotations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel under-utilized at this time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would feel comfortable helping out clinically at this time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am concerned about the impact of COVID-19 on my chance to match to residency (<u>select Not Applicable if you have already matched</u>)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The COVID-19 pandemic has negatively influenced my well-being	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am concerned about the risk of exposure to COVID-19 during rotations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am concerned about the risk of exposure to COVID-19 in the community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The response to COVID-19 will have minimal impact on my learning or skill development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The response to COVID-19 will have minimal impact on my ability to enter residency with the knowledge and skills to provide safe, high quality care	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with how my program or institution is communicating information regarding the impact of COVID-19 on us as learners and the next steps for me as a learner (e.g., remainder of my training, career progression, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am worried about the impact of this disruption on my progression and timeline through medical training, including matching to a residency program, following a defined timeline, completing licensing exams on time, and/or starting a residency program on schedule	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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 279 **End of Block: Questions for Medical Clerks**
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282 **Start of Block: Questions for Residents**

283 *Display This Question:*

- 284 *If Q2.1 = 1st year resident or intern (i.e., PGY1 Resident)*
285 *Or Q2.1 = 2nd year resident (i.e., PGY2 Resident)*
286 *Or Q2.1 = 3rd year resident (i.e., PGY3 Resident)*
287 *Or Q2.1 = 4th year resident (i.e., PGY4 Resident)*
288 *Or Q2.1 = 5th year resident (i.e., PGY5 Resident)*
289 *Or Q2.1 = 6th year resident or above (i.e., PGY6 or higher Resident)*

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291 Q5.1 What of the following best describes the **primary setting** for your residency program? (select one)

- 292 Urban (i.e., large city)
- 293 Rural (i.e., outside of a large city or in a remote location)
- 294 Other (please describe) _____
- 295 I prefer not to answer this question

296
297 *Display This Question:*

- 298 *If Q2.1 = 1st year resident or intern (i.e., PGY1 Resident)*
299 *Or Q2.1 = 2nd year resident (i.e., PGY2 Resident)*
300 *Or Q2.1 = 3rd year resident (i.e., PGY3 Resident)*
301 *Or Q2.1 = 4th year resident (i.e., PGY4 Resident)*
302 *Or Q2.1 = 5th year resident (i.e., PGY5 Resident)*
303 *Or Q2.1 = 6th year resident or above (i.e., PGY6 or higher Resident)*

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306 Q5.2 Which of the following category best describes your **residency program**? (select one)

- 307 Family Medicine
- 308 Public Health
- 309 Emergency Medicine
- 310 Internal Medicine (core training)
- 311 Pediatrics (core training)
- 312 Medical Subspecialty Training (fellowship training)
- 313 Surgery
- 314 Obstetrics and Gynecology
- 315 Anesthesiology
- 316 Psychiatry
- 317 Other: _____
- 318 I prefer not to answer this question

Supplemental File: Survey Questionnaire

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Display This Question:
If Q2.1 = 1st year resident or intern (i.e., PGY1 Resident)
Or Q2.1 = 2nd year resident (i.e., PGY2 Resident)
Or Q2.1 = 3rd year resident (i.e., PGY3 Resident)
Or Q2.1 = 4th year resident (i.e., PGY4 Resident)
Or Q2.1 = 5th year resident (i.e., PGY5 Resident)
Or Q2.1 = 6th year resident or above (i.e., PGY6 or higher Resident)

Q5.3 Are you **working more than usual** during the COVID-19 pandemic? (select one)

- 330 Yes, I am working more than usual
- 331 No, I am working the same amount as usual
- 332 No, I am working less than usual
- 333 I prefer not to answer this question

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Display This Question:
If Q5.2 = Family Medicine
Or Q5.2 = Psychiatry

Q5.4 You selected that your residency program is either in Family Medicine or Psychiatry. Do you think residents in these programs could potentially be utilized at this time to provide **peer-to-peer mental health support and/or counseling** to other residents or healthcare professionals at this time over videoconferencing modalities? (select all that apply)

- 344 Yes, I think we could be useful to provide mental health supports at this time to any and all other residents
345 at this time
- 346 Yes, I think we could be useful to provide mental health supports at this time to residents who are working
347 at the front lines of care, or who may be additionally stressed or burnt out as a result of the pandemic
- 348 Yes, I think we could be useful to provide mental health supports at this time to other healthcare
349 professionals (e.g., nursing) at this time
- 350 No, I do not think we could be useful at this time in providing mental health supports to other residents

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Display This Question:
If Q2.1 = 1st year resident or intern (i.e., PGY1 Resident)
Or Q2.1 = 2nd year resident (i.e., PGY2 Resident)
Or Q2.1 = 3rd year resident (i.e., PGY3 Resident)
Or Q2.1 = 4th year resident (i.e., PGY4 Resident)
Or Q2.1 = 5th year resident (i.e., PGY5 Resident)
Or Q2.1 = 6th year resident or above (i.e., PGY6 or higher Resident)

Supplemental File: Survey Questionnaire

361 Q5.5 Please respond to each of the following statements by selecting a response regarding your level of agreement:
 362 (select one response per row)

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
My learning has been negatively impacted by the COVID-19 virus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My career/training timeline has been negatively impacted by the COVID-19 virus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I possess adequate knowledge of the COVID-19 virus to provide safe care in clinical environments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As a resident, I am being adequately utilized during this time to provide patient care	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As a resident, I am being over-utilized at this time in providing patient care	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel comfortable providing patient care at this time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As a resident, I could be better utilized in other ways at this time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel prepared to use personal protective equipment (PPE) adequately and safely	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel prepared to be utilized on other clinical services or areas (i.e., on services that are not my specialty)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am worried about working in the hospital or the clinic at the moment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The COVID-19 pandemic has negatively influenced my well-being	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with how my program or institution is communicating information regarding the impact of COVID-19 on us as learners and the next steps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Display This Question:
 If Q2.1 = 1st year resident or intern (i.e., PGY1 Resident)
 Or Q2.1 = 2nd year resident (i.e., PGY2 Resident)
 Or Q2.1 = 3rd year resident (i.e., PGY3 Resident)
 Or Q2.1 = 4th year resident (i.e., PGY4 Resident)
 Or Q2.1 = 5th year resident (i.e., PGY5 Resident)
 Or Q2.1 = 6th year resident or above (i.e., PGY6 or higher Resident)

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Q5.6 How could you, as a resident, potentially be **better utilized** at this time?

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End of Block: Questions for Residents

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Supplemental File: Survey Questionnaire

382 **Start of Block: Common Questions**

383 Q6.1 Please select the response that best reflects how you feel at this time **regarding the response of organizations**
 384 to the COVID-19 pandemic (select one response per row)

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
I am satisfied with how the local/municipal government (i.e., the city where I live) has responded to the COVID-19 pandemic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with how the provincial government (i.e., the province, state, or region where I live) has responded to the COVID-19 pandemic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with how the federal government (i.e., country where I live) has responded to the COVID-19 pandemic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with how the professional organizations my clinical specialty is affiliated with have responded to the COVID-19 pandemic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with how the professional organizations for medical learners have responded to the COVID-19 pandemic (e.g., resident unions or medical student organizations).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

386
 387 **End of Block:**

390 **Start of Block: Impact of COVID-19 on Wellness for Learners**

391 Q7.1 The following questions are from a short-form version of the **State/Trait Anxiety Inventory for Adults**
 392 (Tluczek, 2009). Please select the response that best reflects how you feel at this time for each row.
 393

	Not at all (1)	Somewhat (2)	Moderately (3)	Very much (4)
I am comfortable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am anguished	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel at ease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel nervous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel concerned	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Right now I feel good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Supplemental File: Survey Questionnaire

398 Q7.2 The COVID-19 pandemic has **negatively influenced** the following aspects of my **well-being**: (select one per
399 row)

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Physical wellness (e.g., physical activity, nutrition, your own disease management)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mental wellness (e.g., mood, anxiety, stress management, emotional well-being)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social wellness (e.g., sense of inclusion, equity)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Intellectual wellness (e.g., ability to learn or fulfill educational goals)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Occupational wellness (e.g., safety in learning and working environments)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Display This Question:
 If Q3.3 = South Asian (e.g., Indian, Pakistani, Bangladeshi, Sri Lankan, etc.)
 Or Q3.3 = Southeast Asian (e.g., Vietnamese, Cambodian, Laotian, Thai, Filipino, etc.)
 Or Q3.3 = West Asian (e.g., Middle Eastern, etc.)
 Or Q3.3 = East Asian (e.g., Chinese, Japanese, Korean, etc.)

409 Q7.3 At the beginning of this survey, you indicated that you are racialized as Asian. Have you noticed or
410 experienced an **increase in racist comments or behaviors** towards you or other Asian individuals in the clinical
411 setting since the emergence of COVID-19? (select one)

- 412 Yes
- 413 No
- 414 I prefer not to answer this question

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Supplemental File: Survey Questionnaire

418 Q7.4 Which of the following are **concerns or stressors** for you at this time? (select all that apply)

- 419 My personal health and well-being
- 420 The health and well-being of my family members
- 421 The health and well-being of the public
- 422 My personal financial situation
- 423 The financial situation of others
- 424 The impact of this pandemic on my learning
- 425 Other (specify) _____
- 426 I prefer not to answer this question

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430 Q7.5 Would you consider yourself **more anxious during this time** than you typically are during the medical school
431 or residency year? (select one)

- 432 Yes
- 433 No
- 434 I prefer not to answer this question

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438 Q7.6 Are you practicing **social or physical distancing** (e.g., staying home as much as possible to minimize the
439 spread of COVID-19) at this time? (select one)

- 440 Almost always
- 441 As much as I can
- 442 Not at all
- 443 I prefer not to answer this question

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447 Q7.7 Have you had to be in **quarantine or self-isolation** due to testing positive for COVID-19, potential exposure
448 to COVID-19, or having symptoms associated with COVID-19 at this time? (select one)

- 449 Yes
- 450 No
- 451 I prefer not to answer this question

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Q7.8 Are you being asked by family and friends to **provide medical expertise or information** regarding the COVID-19 pandemic? (select all that apply)

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Yes - Family Members

458

Yes - Friends

459

Yes - Others

460

No

461

I prefer not to answer this question

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Q7.9 Are you using **social media** to communicate information to others about the COVID-19 pandemic? (select all that apply)

467

Yes - Twitter

468

Yes - Instagram

469

Yes - Facebook

470

Yes - Other _____

471

No

472

I prefer not to answer this question

473

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End of Block: Impact of COVID-19 on Wellness for Learners

Supplemental File: Survey Questionnaire

477 **Start of Block: Open Ended Questions and Feedback**

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479 Q8.1 What could medical schools or residency programs do in the future **to better inform you**, as learners, about
480 the impact of similar events on your training?

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489 Q8.2 How can medical schools or residency programs **improve your educational experience** during this time or
490 any similar temporary disruptions to your training?

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499 Q8.3 Which strategies or innovations is your program or school using at the moment that could be beneficial for
500 others to consider implementing? (e.g., setting up Zoom meetings for residents to check in with program directors,
501 involving medical students in online screening or volunteer opportunities, etc.)

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510 Q8.4 Please provide any additional thoughts, comments, or feedback during this time.

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Supplemental File B: Supplemental Analysis

Figure B.1 Comparison of Medical Student Scale Items by Geographic Region

Medical Student Specific Scale

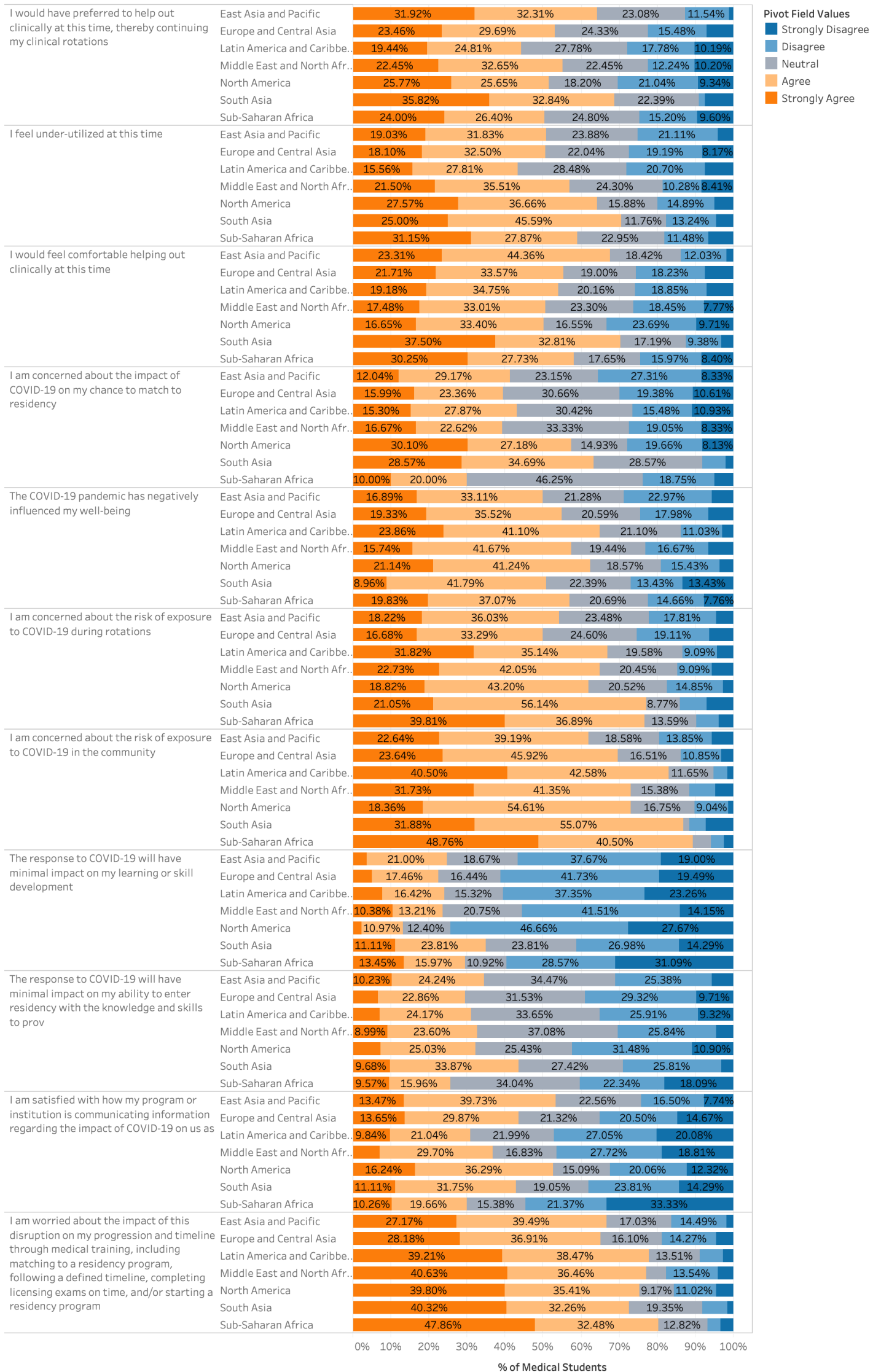
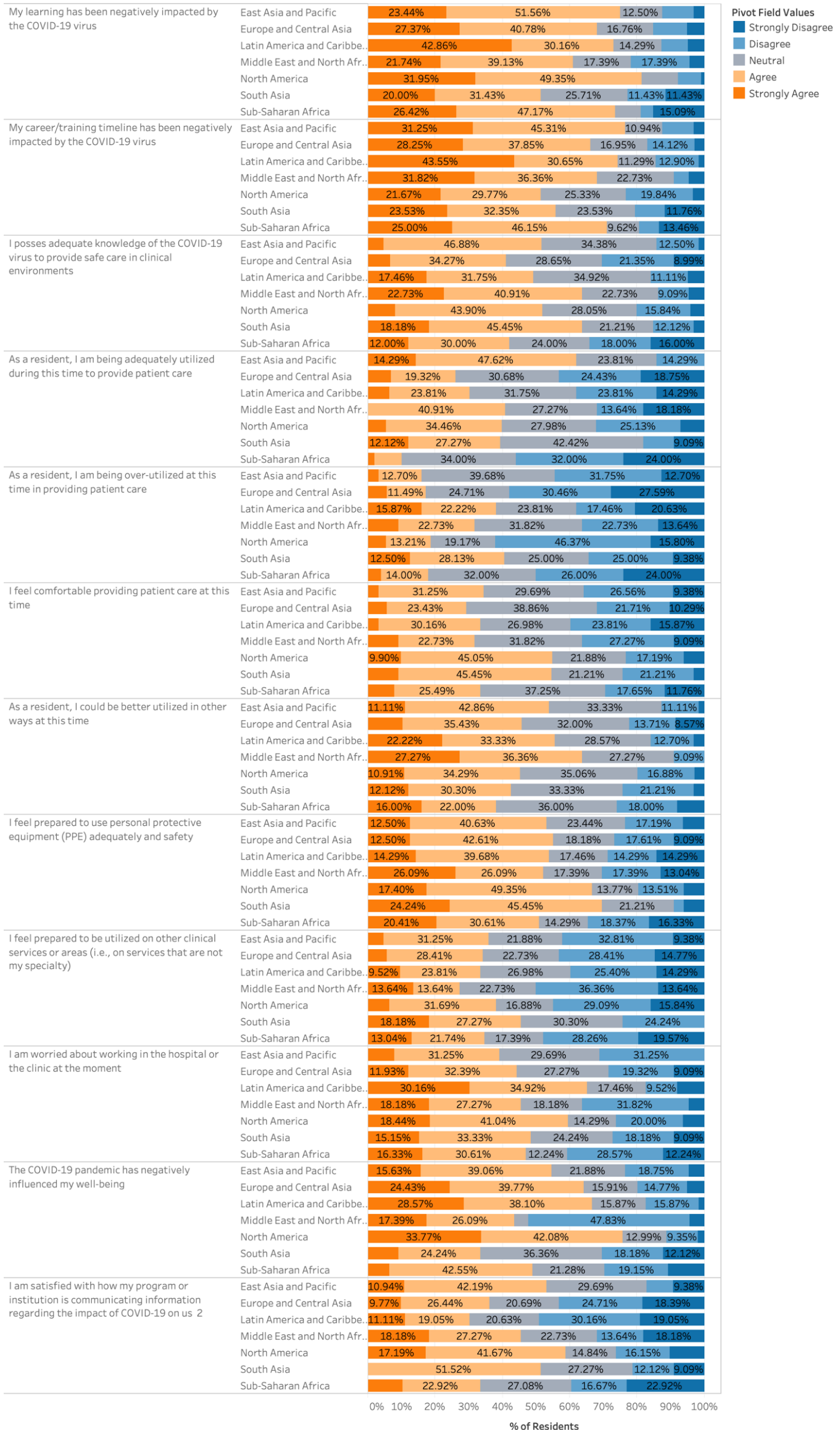


Figure B.2 Comparison of Resident Scale Items by Geographic Region

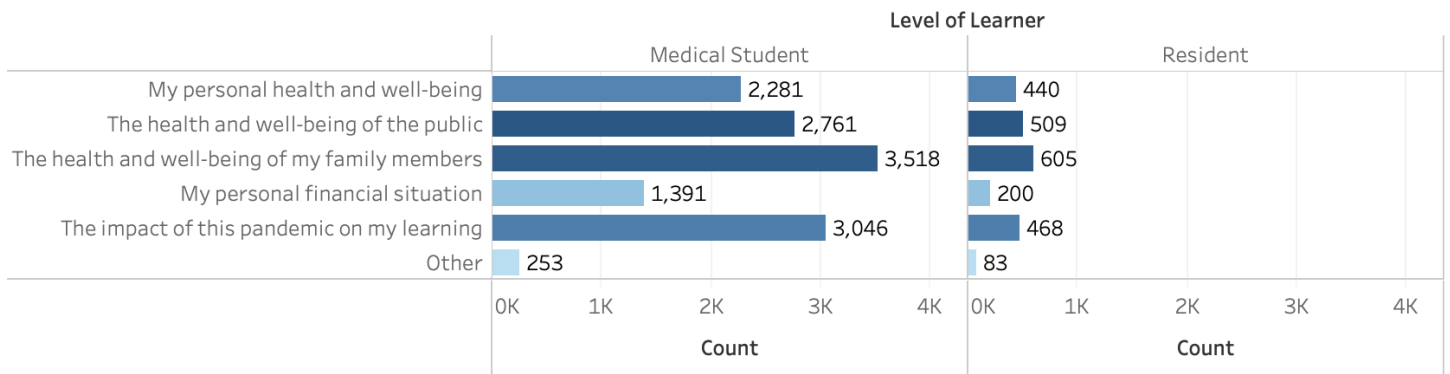
Resident Scale



0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
% of Residents

11
12
13

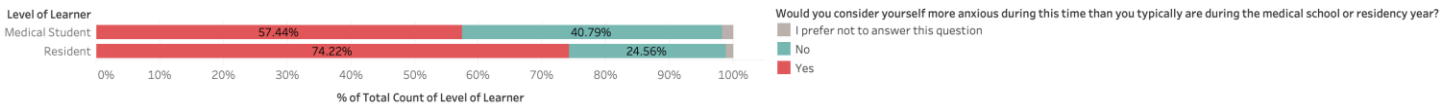
Figure B.3 Frequency of Learner Concerns by Level of Training



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Figure B.4 Comparison of Learner Perceptions of Anxiety by Level of Training

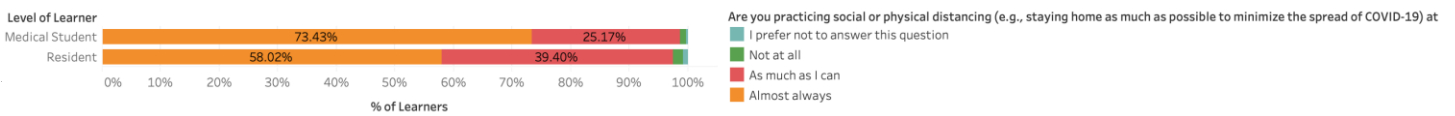
Would you consider yourself more anxious during this time than you typically are during the medical school or residency year?



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Figure B.5 Comparison of Social and Physical Distancing by Level of Training

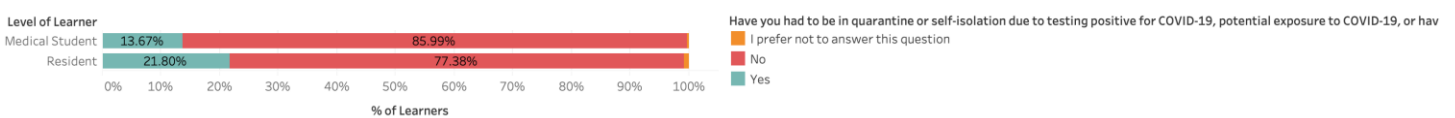
Are you practicing social or physical distancing (e.g., staying home as much as possible to minimize the spread of COVID-19) at this time?



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Figure B.6 Comparison of Quarantine or Self-Isolation by Level of Training

Have you had to be in quarantine or self-isolation due to testing positive for COVID-19, potential exposure to COVID-19, or having symptoms associated with COVID-19 at this time?



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1 Supplemental File C: Inferential Statistical Analyses

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	Satisfaction with Organizational Responses (/25)			State-Trait Anxiety Inventory (/24)			Impact of COVID-19 on Wellness		
	Mean (SD)	95% CI	p-value	Mean (SD)	95% CI	p-value	Mean (SD)	95% CI	p-value
<i>Level of Training^a</i>									
Medical Student	16.95 (4.32)	16.82-17.08	.000	14.36 (4.12)	14.23-14.48	.000	17.31 (4.07)	17.19-17.43	.000
Resident	15.67 (4.32)	15.36-15.98		15.13 (4.06)	14.83-15.42		18.52 (3.86)	18.24-18.80	
<i>Geographic Regions^b</i>									
East Asia and Pacific	18.46 (4.28)	18.01-18.91	.000	13.33 (3.77)	12.93-13.73	.000	16.77 (4.22)	16.33-17.22	.000
Europe and Central Asia	17.34 (4.25)	17.16-17.52		14.33 (4.18)	14.15-14.51		17.14 (4.09)	16.96-17.31	
Latin American and Caribbean	14.78 (4.19)	14.48-15.07		15.22 (4.12)	14.93-15.51		18.15 (4.10)	17.86-18.44	
Middle East and North Africa	16.04 (5.10)	15.13-16.96		14.36 (3.81)	13.66-15.05		17.14 (3.97)	16.42-17.86	
North America	17.14 (3.78)	16.94-17.34		13.45 (4.01)	14.24-14.66		17.92 (3.78)	17.72-18.11	
South Asia	15.39 (5.19)	14.37-16.41		15.01 (4.51)	14.09-15.93		17.45 (4.62)	16.54-18.37	
Sub-Saharan Africa	12.93 (4.28)	12.20-13.66		15.12 (4.23)	14.44-15.80		16.94 (4.42)	16.24-17.65	

α = Cronbach's alpha (reliability statistic); upon exploratory factor analysis, all items in each scale loaded to one factor, suggesting each scale is unidimensional (construct validity)

^a = Independent samples t-test, equal variances not assumed based on Levene's test for equality of variances; statistical significance if $p < .05$

^b = Analysis of Variance with Bonferroni correction to adjust for post-hoc corrections statistical significance if $p < 0.007$;

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1 Supplemental File D: Summary of Qualitative Themes

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Code	Summary of Qualitative Data
Career Decision Making	Students noted additional increased interests in: EM, critical care, IM, anesthesia, and psychiatry; graduate training in epidemiology and public health. Some noted a decreased interest to pursue a clinical career, and many expressed concerns about the impact of the pandemic on the healthcare system and job prospects in their country, stating they would broaden the countries they apply to for residency. The limited clinical exposure resulting from their removal from the clinical environment limited their opportunities to explore various specialties, decreasing their career interests.
Communication	Communication (Parent Node): Clear and effective communication from institutions was essential for learners. Poor or absent communication left learners uncertain of what was happening, contributing to their stress.
A) Channels or Mode	Effective communication provided clarity and reassurance about the pandemic's impacts and the institutional response.
B) Content	Channels or Mode: Learners preferred an integrated communications strategy which centralized and streamlined delivery to reduce information overload. Email and a regularly updated webpage were the most favoured communications channels. Social media was seen as a useful supplement in some cases, but not as a replacement for established channels.
C) Frequency	Content: Learners wished to be informed about impacts on their programs, details of the pandemic response, their role (including how to help), and resources they could access. Effective communications about these topics were clear, specific, decisive, and reassuring.
D) Learner Input	Frequency: Learners preferred regular communication from their institutions, which kept them up to date and provided a social tether to their school community. Irregular (sporadic) communication created an information vacuum that was filled by speculation, rumours, and misinformation. Overly frequent communication created information overload and led some to ignore institutional communications.
E) Transparency	Learner Input: Learners desired to have input into their institutions' pandemic response. This helped ensure their circumstances were accurately understood and enabled them to raise concerns overlooked by decision makers. Input mechanisms included surveys, virtual town hall meetings, and learner representation on decision making bodies. Transparency: Learners expressed a strong desire for transparency. They wished to have information shared with them about what their institution was doing, and thinking of doing, in response to the pandemic. These included things such as policies under consideration, details of the decision-making process, and contingency plans.
Education and Training	Education and Training (Parent Node): Normal education and training processes were severely disrupted by the pandemic. Learners identified a need for institutions to adapt and innovate in order to mitigate these impacts and continue education.
A) Clinical Learning or Activities	Clinical Learning or Activities: Institutions struggled to mitigate the substantial loss of clinical learning opportunities. All learners emphasized that practical, hands-on learning cannot be substituted. They worried about long term impacts on their clinical proficiency and competence.
B) Educational Content	Educational Content: Learners suggested their education shift focus to topics of immediate practical relevance: public health, critical care, infectious disease, and management of covid-19. They felt these adjustments to be prudent should they be called upon to support the pandemic response.
C) Electives	Electives: Most learners lost multiple months of electives, and often core rotations as well. While they recognized the practical need for these cancellations, they were concerned their professional competence and confidence would suffer if lost electives could not be made up in the future.
D) Exams and Assessment	Exams and Assessment: Institutions attempted to cope with the impact on exams and assessments in various ways (e.g., cancellation, postponement, alteration). How these responses were executed was essential to whether learners were helped or hindered by them. Institutions were judged to have done well when they acted decisively, communicated clearly, consulted learners, and tested tools such as online exams before implementing them.
E) International Learners	International Learners: The situations of international learners presented a number of significant vulnerabilities unique to their group. These learners and their circumstances were frequently overlooked or deliberately ignored by decision makers. Institutions must plan for crises in advance and seek learner input to prevent international learners from continuing to fall through the cracks of pandemic responses.
F) Online Learning	Online Learning: Learners requested the use of online platforms to maintain some continuity of education and training. Online learning differs in fundamental ways from in-person learning, with unique social and technological barriers; successful adoption resulted from careful planning and consideration of content, format, and delivery. When done well, online learning maintained educational momentum and provided learners with motivation, a routine, and sense of purpose.
G) Self-Directed Learning	Self-Directed Learning: Self-directed learning was frequently used to accompany or substitute for an online learning curriculum. When they included appropriate support and guidance, self-directed learning programs furthered education and provided learners with motivation, accountability, and a sense of progress. Programs with too little guidance left learners aimless, and those with too much content overwhelmed them.
Future Concerns or Long-Term Implications	Worries about completing next steps in their training or career trajectory (i.e., locum, certifying exams, electives, residency matching, job availability, getting paid, graduation, completing appropriate activities to bolster residency applications, cancellation of hands-on teaching sessions).
Patient Care	Learners were concerned about lack of PPE and potentially putting patients at risk. Concerns were also articulated about how no matter the response from their program/school, the disruptions to their training would negatively impact patient care.
Responses to the Pandemic	Responses to the Pandemic: Programs/schools applauded for doing the best they could in these circumstances, but a clear theme was the need for proactive planning for the future. Medical schools responded to the pandemic in various ways but it appeared that a lot of the responses to the pandemic, and the subsequent impact on learners, was influenced by how the country was responding (or not responding) to the pandemic.
A) Strategies or Innovations	Strategies/Innovations: Numerous strategies and innovations were described in response to the pandemic, such as: virtual teaching strategies (via Zoom, Microsoft Teams, Google Hangouts, WebEx), virtual sessions between learners and the program via virtual office hours, check ins, and town halls; clinical strategies (e.g., patient handover via teleconference, alternating call schedules to minimize exposure). However, a substantial number of learners commented that their program or school had done nothing in response to the pandemic – it was business as usual or they were being told to just stay at home and figure out their own learning.
Silver Linings	Many trainees find that there are silver linings that have been uncovered by the pandemic, such as: opportunities to be involved in new clinical spaces (i.e., volunteering with health link/contact tracing/testing centres, redeployment, telemedicine), opportunities for innovation in scheduling (i.e., studying, clinical rotations, free time, research), opportunities for supporting others non-clinically (i.e., mental health support for co-residents, daily calls to COVID positive patients, creating medical education modules), opportunities to train for the pandemic rapidly and support heavier hit rotations (i.e., Medical and critical care units), opportunities to contribute directly to creating diagnostic tests and vaccines for COVID-19.
Spending or Utilizing Time	Since being quarantined, medical learners are spending their time: working, volunteering, engaging in academic activities, relaxing, catching up on personal responsibilities, or struggling financially and/or mentally.

<p>A) Feeling under-utilized</p> <p>B) Opportunity – offered to them</p> <p>C) Opportunity – personal</p> <p>D) Personal activities</p> <p>E) Volunteering – Medical</p> <p>F) Volunteering – Non-medical</p>	<p>Feeling under-utilized: learners expressing their desire to be useful clinically or through public health efforts. Many find being sidelined an affront to their training thus far, others feel they are missing valuable learning experience, and some just want to improve the wellbeing of the public. Controversy over whether learner education or public health should be prioritized by their university.</p> <p>Opportunity – offered to them: Most medical students had opportunities offered to them by their medical student associations, schools, hospitals, or through personal and professional connections. This information was often relayed through social media or email.</p> <p>Opportunity – personal: A few volunteers either searched/ asked for opportunities or created their own</p> <p>Personal activities: The pandemic has offered medical students and residents a surplus of free time. Some have used this time to engage in self-care, self-betterment, and helping family. Others have found this challenging as they are struggling with either financial or mental health troubles.</p> <p>Volunteering – Medical: A minority of those volunteering in the medical field are providing hands-on patient care, the rest are helping with: PPE drives, working in public health, providing care via telehealth, hospital/ clinical assistants, helping with research, education (public and other HCW).</p> <p>Volunteering – Non-medical: Most of the non-medical volunteering still strives to help with consequences of the pandemic: running errands and making food for essential workers and those that need help, coordinating volunteers for various services, helping community organizations, visiting elderly/ getting them in touch with family, working with medical student organizations/ support groups, tutoring, IT services, fundraising, and providing public education.</p>
<p>Utilizing Residents</p>	<p>Residents regularly felt they were under-utilized. If placed in a clinical context outside of their field, many saw it as a conflict with their educational goals, with little yield for patient care. Residents stated a preference for supporting their departments over redeployment. The pandemic has exacerbated tensions in the residents dual role; as a learner and as an employee of the health system. This is evidenced in statements around studying, compensation and learning.</p>
<p>Wellness</p>	<p>Mental Health: Learners reported poor mental health because of the stressors brought about by COVID-19 in their own lives such as their learning and working conditions but were also distressed by the impact COVID-19 has had on others including their family members, friends, colleagues, patients, the broader community, their country’s political climate and economy.</p> <p>Physical wellness: They reported that proper access to personal and protective equipment was most important to protect themselves, each other and the broader community.</p> <p>Social wellness: Learners also understood the importance of self-isolation but recognized the impact this had on their wellness and learning.</p> <p>Spiritual: COVID-19 also allowed a time for reflection and spirituality to signify what really matters to learners and the broader community in which they belonged.</p> <p>Strategies: The need for support and advocacy for their own and each other’s wellness. Access to counselling, peer support systems and while practicing self-compassion as well as having compassion for others was emphasized.</p>