Navigating the pandemic of a lifetime: COVID-19 morbidity, mortality, and vaccination through the eyes of a physician

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Introduction

The first case of COVID-19 caused by the novel coronavirus (SARS-CoV-2) was reported in Wuhan City, China in December 2019. COVID-19 spread rapidly and became a global threat causing a public health crisis. In March 2020, the World Health Organization (WHO) officially declared COVID-19 a global pandemic owing to its worldwide spread.[1] Overall, 220 countries were affected by the pandemic. By June 2023, over 768 million confirmed cases and over 6.9 million deaths had been reported worldwide.[2] COVID-19 has caused a massive burden on the global public healthcare system and has affected the socio-economic aspects and well-being of people worldwide.

The first case of SARS-CoV-2 infection in Sri Lanka was reported at the end of January 2020. By June 2023, 672,490 confirmed cases and 16,876 deaths attributed to COVID-19 had been reported in the country.[2] The impact of COVID-19 in Sri Lanka was enormous and included the extra burden placed on the public healthcare system and the socio-economic status of the public due to prolonged lockdowns and the resultant economic fallout, which is still being felt by the people.

Sri Lanka experienced three main waves of COVID-19. From January to September 2020, the first wave saw 13 deaths and 3396 persons infected. The second wave, from October 2020 to April 2021, saw 591 deaths and 92,341 persons infected. The third wave, which started in April 2021, was when the maximum number of confirmed cases (over 565,000) and maximum number of fatalities (over 15,800 with a case fatality rate of 2.8) were reported.[3] Since the detection of the first case in January 2020 Sri Lanka was able to manage the first two waves of the pandemic reasonably successfully. However, the country struggled to overcome the challenges posed by the massive third wave, which was finally controlled effectively with enforced preventive measures, strengthening of treatment facilities, and an island-wide vaccination program.[3]

This is the story of a physician who woke up one day in 2020 to find herself in the midst of a global pandemic of an unknown disease. Like many other physicians in Sri Lanka and elsewhere, I had to quickly learn about COVID-19 and adapt to a world that was literally changing before my eyes. From the start of COVID-19 in late 2019 until the WHO officially declared the end of the pandemic in mid-2023, my colleagues and I carried out several studies evaluating the impact of COVID-19 on healthcare workers and on certain chronic diseases, looking at side effects and the efficacy of COVID-19 vaccination and analyzing deaths due to COVID-19 at a tertiary referral center. I will discuss our findings and the lessons learnt so that physicians in an emerging economy like ours can handle similar situations more effectively in the future.

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Studies and Observations

Impact of COVID-19 on mental health of frontline and non-frontline healthcare workers in Sri Lanka Baminiwatta A, De Silva S, Hapangama A, Basnayake K, Abayaweera C, Kulasinghe D, Kaushalya D, Williams S. *Ceylon Medical Journal* 2021; **66**(1): 16-31.

As the pandemic unfolded worldwide, it became increasingly clear that healthcare workers were at risk of mental health problems. Being stationed at the frontline seemed to have significant implications for their mental health.This study was conducted during the first wave of COVID-19 in Sri Lanka at the Colombo North Teaching Hospital, which was receiving many COVID-infected patients at the time.

This study aimed to assess depression, anxiety, and stress among healthcare workers, explore differences between frontline and non-frontline workers, and investigate associated factors. This cross-sectional study recruited frontline and non-frontline healthcare workers after obtaining ethical approval. Mental health impact was assessed using the depression, anxiety, and stress scale (DASS-21) validated in Sinhala and Tamil. Sociodemographic data and perceptions of social and occupational circumstances were also collected. Categorical variables were analyzed using chi-square and logistic regression. Odds ratios were calculated to determine the effects of different perceptions on psychological morbidity.

A total of 467 healthcare workers participated, comprising 244 (52.2%) frontline and 223 (47.8%) non-frontline workers, with a female preponderance (n=341, 77%). The prevalence rates of depression, anxiety, and stress among healthcare workers were 19.5%, 20.6%, and 11.8%, respectively. The non-frontline group showed a higher prevalence of depression (27% vs. 11%, p<0.001), anxiety (27% vs. 14%, p=0.001), and stress (15% vs. 8%, p=0.026). Being married, having children, living with the family, and having a higher income were associated with better psychological outcomes. Perceived lack of personal protective equipment, inadequate support from hospital authorities, greater discrimination, and lack of training to cope with the situation predicted poor mental health outcomes.

This study highlighted that, in common with many other countries, the pandemic placed a great burden on the mental health of healthcare workers in Sri Lanka.[4-6] Addressing factors leading to negative psychological outcomes in healthcare workers should be a key concern during future pandemics.

As the pandemic progressed, the country went through regular periods of lockdown, placing severe restrictions on citizens' mobility. Additionally, problems in the transport sector caused many breakdowns in the supply chains of food, other consumables, and medicines. The effect of pandemic-related restrictions on the provision of medical facilities to those suffering from chronic diseases was the focus of our next study.

Morbidity and mortality patterns in patients with thalassemia during the COVID-19 pandemic in Sri Lanka; a single-center experience. Nisansala R, De Silva S, Ediriweera D, Premawardhena A. *Asian Journal of Internal Medicine* 2022; **1**(1): 73-8.

Patients with thalassemia syndrome affected by COVID-19 attending the Hemals Adult and Adolescent Thalassemia Care Center in Sri Lanka, situated in the region most affected by COVID-19, the Gampaha district of the Western province, were studied over a 16-month period, after obtaining ethical approval.To assess the collateral effects on overall thalassemia care in the center, data on transfusion, chelation, and clinic attendance were analyzed. Morbidity events and deaths recorded during the COVID-19 period and during a similar period before the beginning of the COVID-19 infection in Sri Lanka were recorded in all clinic registrants.

Seven patients (of 502) with thalassemia syndrome developed COVID-19 during the 16-month period; all were minimally symptomatic and recovered without complications.The number of monthly clinic visits decreased from 338 to 268 during COVID (p=0.004). Iron chelator usage was also reduced during the pandemic (p<0.001). Although admissions related to morbidity were reduced during the pandemic (58 vs. 16, p<0.001), there were more non-COVID deaths (8 vs. 4).

The numbers affected by COVID-19 were low, and the severity of infection was mild in this cohort of patients with thalassemia syndromes, but the collateral effect on the management of the unit and effects on mortality in this vulnerable population was substantial. The biggest challenge was the reduced availability of desferrioxamine (DFO), which about a third of patients use exclusively or in combination with deferasirox. These chelators are provided by the government and inadequate stocks are available in the private sector. The prolonged shortage of DFO during the second and third waves of the COVID-19 pandemic in the country may be indirectly linked to the outbreak itself, as most government supply chain efforts were directed towards COVID-related activities.The mortality figures doubled compared to a similar period pre-COVID. Delays in access to healthcare were a major problem during the pandemic, and this may have contributed to these deaths. The indirect collateral effects of COVID-19

seem to be far worse than the direct effect on the lives of patients with thalassemia at the Adult Treatment Center.

The vaccination program against COVID-19 in Sri Lanka commenced in January 2021, when frontline healthcare workers were given the AstraZeneca vaccine.[7] With the introduction of the vaccination program, there was great interest in the safety and efficacy of the vaccines used. The next study was conducted in this context.

Adverse events following COVISHIELD (ChAdOx1nCoV-19) vaccination among healthcare workers in Sri Lanka: A multicenter cross-sectional survey. Manilgama SR, Hettiarachchi NM, Jayasinghe IK, De Silva ST, Jayalath T, Wanigaratne T, Bandusiri RP, Suganthan N, Sudarshan P, Pathirage M, Rajaratnam N, Senaratne G, Rajapaksha V, Wickramasinghe A, Ranaweera SPAL, Thilakarathna HMA, Kulaweera MTD. *Asian Journal of Internal Medicine* 2022; **1**(1): 25-34.

A multicenter cross-sectional survey was conducted in six provinces to estimate the prevalence of adverse events following the first dose of COVISHIELD (ChAdOx1nCoV-19) among all categories of healthcare workers. A self-administered questionnaire was used to gather demographic data and adverse events.

Of the 5140 participants, the majority (67.8%) were females. The mean (SD) age was 40.69 (±9.85) years. At least one comorbidity was reported in 15.4% of participants. At least one adverse event was reported by 86.6% of the participants, and 49.3% had local adverse events. Fever (67.2%), headache (57.3%), body aches (54.4%), chills (51.2%), fatigue (37.5%), and arthralgia (36%) were the most frequently reported systemic adverse events. The majority of adverse events lasted less than 24 hours. Pain and redness at the site were the most frequently reported local adverse events. The mean duration of onset of fever and pain at the injection site from the time of vaccination were 6.65 and 9.67 hours respectively.

When participants were divided into two groups by mean age (≤40 and >40 years) and parameters were compared, most systemic (fever, nausea, fatigue, and itching) and all local adverse events were significantly more prevalent in the ≤40 age group. Two percent had reactions within the first 20 minutes and anaphylaxis developed in 12 participants. Despite minor adverse events, 71.1% attended routine work, and only 0.2% required hospitalization.

This multicenter cross-sectional study showed that adverse events following COVISHIELD vaccination among healthcare workers in Sri Lanka were mild to moderate. Those aged <40 years reported a higher number of systemic and local adverse events. While almost four-fifths of the study population reported minor events, serious adverse events were very few, and there were no thrombotic events or neurological complications. The first dose of the vaccine was well-tolerated by the majority of healthcare workers.

It is now apparent that a community vaccination program is the best approach for combating the COVID-19 pandemic. Post-vaccine surveillance is important for identifying adverse events following COVID-19 vaccination. There is also a need to dispel myths and false propaganda regarding vaccine adverse events and motivate the public to vaccinate themselves voluntarily in a pandemic situation.

Currently, seven vaccines are approved for use in Sri Lanka, namely Pfizer/BioNTech, Oxford Astra Zeneca (two formulations), Sinopharm, Moderna, Sinovac, and Sputnik V. BBIBP-CorV Sinopharm is the most used vaccine, accounting for approximately 60% of all vaccine doses administered.[8,9] As of March 2023, 40,116,590 vaccine doses have been administered, with 17,143,761 persons (77.3% of the population) vaccinated with at least one dose and 14,752,827 persons (66.6% of the population) fully vaccinated in Sri Lanka.[10] In a lower middle-income country with a total population of 22.16 million in 2021, this amounts to an impressive 187.34 total doses administered per 100 population.[10]

Many studies have investigated the effectiveness of the Pfizer, Moderna, and Oxford AstraZeneca vaccines. Limited research has been conducted on the real-world effectiveness of the BBIBP-CorV Sinopharm vaccine. This was the focus of our next study, which was a collaboration between the Faculty of Medicine, University of Kelaniya, State Pharmaceutical Corporation of Sri Lanka, and Ministry of Health.

Evaluation of Sinopharm COVID-19 vaccine effectiveness in Sri Lanka: A test-negative case-control study. De Silva ST, Ediriweera DS, Wimalasena W, Kariyawasam M, Kosinna KGC, Bogoda BAGM, Senaratne NHSS, Rathnayake RMDK, Weerarathna WMIS, Gunasena P, Premaratna R.

(This study won the award for the Best Oral Presentation at the Annual Academic Sessions of the Sri Lanka College of Internal Medicine, Colombo, Sri

Lanka, November 2022 and is currently under review for publication.)

This retrospective test-negative case-control study was conducted in 10 government hospitals.Consecutive adults aged ≥18 years attending outpatient depart-ments who tested for SARS-CoV-2 during the study period were recruited after obtaining informed consent. An interviewer-administered questionnaire was administered by telephone. Outcomes were assessed.

Of the 1829 participants recruited, 914 (49.9%) were male, and the mean age was 45.2 (SD 15.3) years; 1634 (89.3%) were vaccinated with two doses of BBIBP-CorV Sinopharm vaccine, while 195 (10.1%) were vaccine-naïve. Compared to vaccinated individuals, unvaccinated individuals were older but were otherwise similar in their demographic and medical profiles. Unvaccinated individuals were more likely to have fever, shortness of breath, and vomiting as symptoms, and were more likely to seek treatment. A significantly higher number of vaccinated individuals received treatment at home. After admission, the unvaccinated individuals were more likely to receive oxygen. Significantly more unvaccinated individuals died of COVID-19 than vaccinated individuals.

The Sinopharm vaccine was 79.6% effective in preventing COVID-19 infection, 88.8% effective in preventing severe infection, and 81.2% effective in preventing death. The BBIBP-CorV Sinopharm vaccine is effective in mitigating the severity of illness and reducing the likelihood of hospitalization, severe illness, and death.

The findings of this research are consistent with previous studies worldwide that have shown that BBIBP-CorV Sinopharm vaccination reduces the risk of COVID-19 infection and the severity of the disease.[11-13] The study highlights the importance of vaccination in reducing the incidence of COVID-19 infection and the severity of the disease. Vaccination should be encouraged, particularly among older individuals and among those with underlying health conditions.

The third wave of COVID-19 in Sri Lanka led to almost 15,800 deaths.[3] The number of affected patients almost exceeded the capacity of the health system, which may have contributed to the increased number of deaths. It was a huge challenge to treat a large number of critically ill patients and save lives by minimizing the progression to organ failure and death due to inadequate resources, mainly intensive care facilities. As the healthcare system had limited capacity during the third wave, many patients with minimum symptoms received home-based management,

patients with mild-moderate symptoms were managed in quarantine centers, and those who were more ill or had significant co-morbidities were hospitalized. Patients were transferred for hospita-lization from home-based management and quarantine centers whenever their condition deteriorated. Some patients were directly admitted for hospital care when they sought treatment at hospital outpatient departments.[14]

Although studies related to COVID-19 mortality have been published worldwide, little information is available on deaths due to COVID-19 in Sri Lanka, except for limited data released by the Epidemiology Unit. According to the WHO, when considering the total number of deaths Sri Lanka is placed 50th in the world.[15] When comparing the worldwide case fatality rate (CFR), Sri Lanka holds a high rank with a CFR of 2.5, whereas Peru is at the top with a CFR of 6.[16] These statistics show a need to carefully assess and evaluate COVID-19 deaths in Sri Lanka. This is what we attempted to do in the next study.

Analysis of deaths due to COVID-19 at Colombo North Teaching Hospital, Ragama, during the second and third waves of the pandemic in Sri Lanka. De Silva ST, Ediriweera DS, Ekanayake SPN, Solangaarachchi SATM, Wickrema-singhe A, Liyanage R.

(Preliminary results were presented at the Annual Academic Sessions of the Ceylon College of Physicians, Colombo, Sri Lanka, in September 2022. This paper is currently under review for publication.)

This study analyzed deaths due to COVID-19 at a single large treatment center in the country, the main draining hospital for the Gampaha District. This descriptive cross-sectional study examined deaths due to COVID-19 between November 2020 and December 2021 at the Colombo North Teaching Hospital, Ragama. Ethical approval was obtained, and data were extracted from hospital records. Family members were contacted by telephone for unavailable information, with informed consent. The Mann-Whitney U test and Pearson's chi-squared test were used to compare the groups.

Among the 1004 deaths, the median age was 72 years (IQR:62-79, range:19-99) years; 574 (57.2%) were males who were relatively older than females (mean (SD):71 (13) vs. 68 (15), P=0.008). The majority had studied up to GCE O/L (66.3%) and were unemployed (66%).Of these, 618 (61.6%) had diabetes, 370 (36.9%) had hypertension, and 373 (37.2%) had multiple comorbidities. The most common symptoms were fever (63%), cough (50%), and

breathlessness (44%). The majority (834 [83%]) died due to COVID-19 pneumonia, and 159 (15.8%) developed complications.

A majority, 786 persons (78.3%) were unvaccinated, 218 (21.7%) received one dose, and 78 (7.8%) received two doses. Compared to vaccinated individuals, unvaccinated individuals were older (mean (SD):71 (13) vs. 68 (15), P=0.008), were unemployed (52% vs. 70%, P<0.001), had more arthralgia / myalgia (15% vs. 23%, P=0.009), and were hospitalized longer (76% vs. 85%, P<0.05).

The deceased who received home-based care were older (mean (SD):72 (14) vs. 69 (13) years, P=0.020), had more respiratory illnesses, and had a contact history of COVID-19. The main reasons for delayed hospital admission were not being too ill (74%) or patient / family choice (23%). Most deaths occurred in elderly unvaccinated individuals with comorbidities. Universal vaccination of the elderly is advisable to reduce COVID-19 deaths. Hospitalization of elderly individuals with comorbidities is also recommended, and only low-risk individuals should be managed with home-based care.

With the disruption of every aspect of public life caused by the raging pandemic over three years medical education was also badly affected. This was the area that we looked at next.

Impact of the COVID-19 pandemic on medical education: Insights and recommendations. Niriella MA, Chandratilake M, De Silva ST, De Silva AP. *South-East Asian Journal of Medical Education* 2020; **14**(2): 14-22.

Disruptions in medical education were inevitable as healthcare systems across the world were stretched with the increasing burden of the COVID-19 pandemic. Given the risks of nosocomial infection, it was difficult to adapt to the required changes in medical education, particularly for medical students and training junior doctors.

The medical education systems of Sri Lanka and many other countries adapted quickly to meet the needs of healthcare learners during the pandemic, with online learning, telemedicine, and simulations that helped in both teaching and learning and assessment in basic and clinical education. However, the adaptation of these approaches was largely based on the intended learning outcomes and availability of resources. Teaching/learning strategies to develop reasoning

skills and increased focus on formative assessments are fundamental requirements in this context.[17] It is recommended that teaching programs should be flexible and collaborate as much as possible to mitigate the ill effects of the pandemic on medical education.

The effect of the pandemic on the healthcare system of Sri Lanka and how its frontline warriors, the physicians, responded to the pandemic was the topic of the next paper, an editorial in the *Journal of the Ceylon College of Physicians.*

Physicians' response to the COVID-19 pandemic: A view from Sri Lanka-Editorial. Wanigasuriya K, Dassanayake S, De Silva S, Jayasinghe S. *Journal of the Ceylon College of Physicians* 2021; **52**(2): 69-70.

The first two waves and in particular the third wave of COVID-19 in Sri Lanka almost overwhelmed the treatment facilities and hospitals in the country, with shortages in intensive care beds, ventilators, oxygen supplies, and other necessities required to care for critically ill patients. The challenge was to quickly transform the existing infrastructure to accommodate the rapidly increasing number of critically ill patients. Physicians made dramatic changes to their work schedules in their stride and effectively staved off a collapse of the health system.

The editorial discussed the multiple roles played by physicians during the pandemic in coordinating and mobilizing financial, technical, and procurement support, developing clinical guidelines, conducting webinars and seminars to educate peers and medical staff, and giving leadership to medical teams of junior doctors who provided care to the thousands of patients with COVID-19 admitted to hospitals and intermediate care centers.

Physicians played a major advocacy role by providing correct information to the public and countering misinformation regarding COVID-19. False information on various treatment strategies and conspiracy theories on vaccines were commonplace, leading to the dismissal of proven public health measures. Physicians were at the forefront of conducting public webinars and media conferences to address these trends.

Conclusions

There are many lessons learnt from this pandemic. Here is a summary of our findings from the research and publications discussed.

- Healthcare workers, particularly frontline staff, are vulnerable to depression, anxiety, and stress during pandemics. These issues should be identified, and practical efforts made to mitigate their impact on work performance.

- The indirect collateral effects of COVID-19 were far worse than the direct effects on the lives of patients, as demonstrated in adult patients with thalassemia. This is likely to be common to most other non-communicable diseases in a pandemic situation and needs to be prioritized and actively addressed by ensuring adequate supplies of medication and medical care on a continuous basis, even during the worst disruptions caused by a pandemic, to avert excess mortality.

- Adverse events following vaccination against COVID-19 are minor and mostly self-limiting. Serious events are rare. Post-vaccination surveillance is extremely important to counteract misinformation on vaccination and to encourage the public to vaccinate themselves in any future pandemic situation.

- The most widely used vaccine against COVID-19 in Sri Lanka, the BBIBP-CorV Sinopharm vaccine, was effective in mitigating the severity of illness and reducing the likelihood of hospitalization, severe illness, and death.

- Most deaths due to COVID-19 occur in elderly unvaccinated persons with comorbidities. Universal vaccination is advisable for the elderly. Elderly individuals with comorbidities should be hospitalized, and only low-risk individuals should be managed with home-based care.

- Medical education has adapted well to the challenges posed by COVID-19 with online delivery of teaching and assessment; however, there is still much to learn and improve in this area.

- Physicians played multiple roles in controlling the COVID-19 pandemic and should learn from this experience to be better prepared to face similar or worse challenges in the future.

It was the worst of times but also the best of times, because this pandemic of a lifetime brought out the best in many people. Not all heroes wear capes. This oration is dedicated to all frontline healthcare workers in Sri Lanka, the true heroes of the pandemic, who risked their lives each day to treat the sick. May we never have to go through such a terrible time again in our lifetime, but if we must, let us learn lessons from this pandemic experience so that we can provide an even better service to our patients.

Acknowledgements

References

1. Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: An Overview. *J Chin Med Assoc.* 2020; **83**(3): 217-20. DOI: 10.1097/JCMA.0000000000000270.

2. World Health Organization (WHO) COVID-19 Dashboard https://covid19.who.int/

3. Epidemiology Unit, Ministry of Health, Sri Lanka https://www.epid.gov.lk/storage/post/pdfs/en_6401f1 862b0cb_esummery-december.pdf

4. Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among healthcare workers exposed to coronavirus disease 2019. *JAMA Netw Open* 2020; **3**(3): e203976-e203976.

5. Rossi R, Socci V, Pacitti F et al. Mental health outcomes among frontline and second-line healthcare workers During the Coronavirus Disease 2019 (COVID-19) Pandemic in Italy. *JAMA Netw Open* 2020; **3**(5): e2010185- e2010185.

6. Spoorthy MS, Pratapa SK, Mahant S. Mental health problems faced by healthcare workers due to the COVID-19 pandemic – A review. *Asian J Psychiatr.* 2020; **51**: 102119.

7. COVID-19 Vaccination Sri Lankan Approach - Concept paper https://www.presidentsoffice.gov.lk/.Documents/ Concept_Paper_COVID_19_Vaccination_Sri%20Lankan_A pproach2.pdf?fbclid=IwAR3romfWkLrjrV3YrsBfq0yITkIkk NO9PA6Ienp0N3wxyDAuuKOBGTe7UWE

8. COVID-19 National Epidemiological Report. Epidemiology Unit Accessed 26.03.2023 https://www.epid.gov.lk/web/ index.php?option=com_content&view=article&id=231& Itemid=487&lang=en

9. COVID-19 Vaccination Summary. Epidemiology Unit. Accessed on 26.03.2023 https://www.epid.gov.lk//storage/ post/pdfs/covid_vaccination_2022-10_30.pdf

10. COVID-19 WHO Vaccine tracker – Sri Lanka https://covid19.who.int/region/searo/country/lk Last accessed date26.03.2023

11. Mira Mousa, Mohammed Albreiki, Fatima Alshehhi, et al. Similar effectiveness of the inactivated vaccine BBIBP-CorV

(Sinopharm) and the mRNA vaccine BNT162b2 (Pfizer-BioNTech) against COVID-19 related hospitalizations during the Delta outbreak in the UAE. *Journal of Travel Medicine* 2022; **9**(6). taac036, https://doi.org/10.1093/jtm/taac036

12. Rearte A, Castelli JM, Rearte R, et al. Effectiveness of rAd26-rAd5, ChAdOx1 nCoV-19, and BBIBP-CorV vaccines for risk of infection with SARS-CoV-2 and death due to COVID-19 in people older than 60 years in Argentina: A test-negative, case-control, and retrospective longitudinal study. *Lancet* 2022; **399**(10331): 1254-64. DOI: 10.1016/S0140-6736(22)00011-3.

13. Al Kaabi N, Oulhaj A, Ganesan S, et al. Effectiveness of the BBIBP-CorV vaccine against severe outcomes of COVID-19 in Abu Dhabi, United Arab Emirates. *Nat Commun.* 2022; **13**: 3215. DOI: 10.1038/s41467-022-30835-1

14. COVID-19 Disease Surveillance and Vaccination, Epidemiology Unit, Ministry of Health https://www.epid.gov.lk/epid/public/index.php/covid-19-data.

15. WHO COVID-19 Dashboard Deaths https://covid19.who.int/?mapFilter=deaths

16. Mortality Analysis, Johns Hopkins Corona virus Resource Center. https://coronavirus.jhu.edu/data/mortality

17. Hodgson JC, Hagan P. Medical education adaptations during a pandemic: transitioning to virtual student support. *Medical Education* 2020; **54**(7): 662-3. DOI: 10.1111/medu.14177.