

Editorial

COVID-19 and the impact on the education of healthcare professionals across countries with a particular focus on developing countries

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COVID-19 has had an appreciable impact on morbidity, mortality and costs across countries^{1,2}, which is continuing. Before the advent of vaccines, the only effective measures to limit the spread of the virus and its impact were initiatives to limit contact between people through lockdown and other measures³⁻⁶. Public health measures included the closure of borders and hospital clinics, introduction of social distancing and improved prevention including the wearing of personal protective equipment (PPE) such as masks and regular hand washing, routine testing and subsequent tracing and quarantining of infected personnel as well as the closure of schools and universities^{1,4,7-10}. However, there was considerable variation in the rate of their implementation across countries, which appreciably impacted on prevalence and mortality rates⁹⁻¹².

Despite the closure of universities, it is important to ensure healthcare professionals, including medical and pharmacy personnel, are fully equipped on

graduation to tackle the ongoing challenges across countries given the concerns with managing patients posed by the pandemic¹³.

We have seen considerable misinformation regarding possible treatments for patients with COVID-19¹⁴. In the case of hydroxychloroquine, this has resulted in increased morbidity, mortality and costs without improving patient care¹⁵⁻¹⁸. Community pharmacists and others can play a key role addressing misinformation as well as assisting with preventative approaches including supplies of PPE, symptomatic relief and vaccinations¹⁹⁻²³. Consequently, it is important that they have the necessary skills on graduation to help out at this important time. This also means ensuring patients have adequate supplies of prescribed medicines, and know how to take them, given concerns with the pandemic on rising cases of non-communicable diseases and their associated morbidity and mortality^{9,13,21}.

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Alongside this, we have seen considerable over-prescribing of antibiotics for patients with COVID-19 across countries during the pandemic despite only a limited number of patients with COVID-19 having concomitant bacterial or fungal infections²⁴⁻²⁸. This is a concern as the inappropriate use of antibiotics in patients with COVID-19 increases antimicrobial resistance rates (AMR), with an associated increase in morbidity, mortality and costs²⁹⁻³³. Hospital pharmacists can play a key role, alongside infectious disease specialists, with introducing antimicrobial stewardship programmes (ASPs) to reduce inappropriate prescribing^{32,34-36}. However, there have been concerns with the level of activity and knowledge regarding ASPs among hospital clinicians in low- and middle-income countries (LMICs), which needs to be addressed with appropriate educational initiatives going forward^{37,38}. This also applies to addressing the considerable prescribing of antibiotics for viral upper respiratory tracts apart from COVID-19, which currently accounts for an appreciable proportion of the prescribing of antibiotics in ambulatory care^{32,39}.

Community pharmacists can also play a role with improving antibiotic utilisation in ambulatory care. This includes dissuading patients against unnecessarily purchasing antibiotics without a prescription when this occurs especially in those with suspected COVID-19^{23,40}. This builds on their major role as often the first contact point patients have with healthcare professionals, especially in countries with high patient co-payments, are community pharmacists^{41,42}. Alongside this, appropriately trained pharmacists can assist with the instigation of ASPs, as well as educational initiatives generally, in ambulatory care to improve future antimicrobial prescribing^{43,44}. Healthcare professionals, including community pharmacists, can also help address issues of vaccine hesitancy and other key issues going forward starting with appropriately trained medical and pharmacy students^{45,46}.

There also continues to be a rise in the prevalence rates of non-communicable diseases across countries, especially among LMICs including African and Asian countries⁴⁷⁻⁴⁹, with an increase in patients with multi-morbidities especially in African countries⁵⁰⁻⁵². Consequently, physicians and pharmacists need to be appropriately trained to deal with these increasing challenges. Without this, there will continue to be increasing rates of morbidity and mortality from both infectious and non-infectious diseases.

However, we are aware there has been considerable

variation across countries in terms of the readiness and ability of university faculty staff and students to instigate e-learning approaches, and away from didactic approaches, in response to restrictions and closure of Universities at the start of the pandemic^{50,53-58}. We are also aware that the transition to online learning has not been easy for a number of faculty members and students⁵⁸. Identified issues included appreciable variations in the necessary skills among both faculty staff members and students to conduct teaching and interactions on-line at the start of the pandemic, exacerbated by poor computer skills among some faculty members and students⁵⁹⁻⁶³. Alongside this, the necessary ICT equipment including laptops alongside available, reliable and affordable internet facilities, as well as quiet rooms, to fully undertake e-learning^{50,57,62,64-66}.

We are aware there has been considerable investment among high income countries such as Saudi Arabia prior to the pandemic to improve the e-learning infrastructure and familiarity among staff and students, helped by available resources. This resulted in a relatively smooth transition to e-learning approaches, including using Zoom® and BlackBoard™ platforms, alongside shifting problem-based learning (PBL) online using small groups, at the start of the pandemic^{56,67,68}. Blackboard™ as well as Blackboard Collaborate® were also used for teaching and examinations early on, with Zoom® used for discussion and interactive sessions⁶⁹.

At the start of the pandemic, the majority of Universities in the United Arab Emirates (UAE) were also pre-equipped with learning-management systems supported by service providers⁷⁰, with a number of students already using e-learning platforms and sharing experiences before the pandemic⁷¹. However, there were concerns with the level of preparedness among some faculty staff and students at the start of the pandemic as well as the challenges involved with conducting practicals and assessments on line^{63,72,73}, which needed to be addressed going forward. Encouragingly, the Telecommunications Regulatory Authority (TRA) in UAE worked with local telecommunication companies at the start of the pandemic to help provide free access to numerous on-line learning platforms among staff and students as well as sought to expand the internet bandwidth⁷⁰. These initiatives were welcomed since the rapid implementation of distance learning at the start of the pandemic caused surges in internet traffic volume exceeding network capabilities. This was particularly

the case with video conferencing platforms.

Ajman University like other universities in UAE also rapidly assembled systems for e-learning, which combined open-sources such as BigBlueButton™ with a subscription-based Blackboard Collaborate™ web conferencing tool to enhance e-learning at the start of the pandemic^{74,75}. These systems have now been replaced with a more flexible combination of tools, with Zoom® and Microsoft Teams™ being the principal platforms and instant messaging services such as WhatsApp® being used when appropriate. There were concerns initially including that some educators and students were outside the UAE when travel restrictions were introduced at the start of the pandemic; consequently, timetables had to be refined to meet the needs of students in multiple time zones. In addition, the video conferencing platforms required for e-learning placed heavy demands on limited bandwidths. However, these challenges have now been addressed. This is reflected by the levels of comfort and trust between educators and students, and confidence among students has increased as the e-learning experience has progressed, with e-learning here to stay with new developments continually evolving^{63,76,77}. Alongside this, there is ongoing research and evaluation among Arab countries to identify best practices to improve future online learning processes including assessments^{68,69,78}.

We have also seen encouraging developments among other Universities in UAE. The IT department at Zayed University rapidly provided network support to both staff and students at the start of the pandemic as well as instigated a call centre to help solve problems to enhance e-learning approaches. The library could also be accessed remotely if wished⁷⁰. At Khalifa University of Science and Technology, there were also rapid learning experiences. Learning management system platforms including Blackboard™ and Moodle™ were also provided to students and faculty members to support e-learning to quickly address identified concerns. Meeting tools including BigBlueButtons™, Microsoft Meetings™ and Zoom® were also used for self-demonstrations and those conducted on standardized patients among small groups replacing previous conventional patient examinations as part of new e-learning approaches^{63,70}. These developments are likely to persist post the pandemic to increase flexibility.

This contrast though with the situation among a number of LMICs. A considerable number of African countries faced difficulties at the start of the pandemic.

Both faculty members and students were appreciably under-equipped to deal with e-learning at the start of the pandemic across Africa alongside concerns with access to, and affordability, of the internet^{50,79-82}. Similar issues were also seen in Egypt, Jordan and Libya at the start of the pandemic, with technological support a key barrier to address^{55,57,64,83}. Chowdhury *et al.* (2022) and others also documented similar concerns in Bangladesh at the start of the pandemic, with a number of challenges still persisting especially among medical and dental students^{84,85}. These issues need to be addressed with increasingly complex cases among patients in LMICs including those with both infectious and non-infectious diseases to ensure fully trained healthcare professionals on graduation^{50,84}.

We have also seen similar issues and concerns regarding e-learning at the start of the pandemic among Central and Eastern European (CEE) countries. However, this was not universal. In Bulgaria, Getova *et al.* (2020) found that available platforms for e-learning worked slowly and frequently crashed, which negatively impacted on the experiences of both faculty members and students⁸⁶. There were also concerns that faculty members and students were poorly prepared for e-learning approaches in the Czech Republic at the start of the pandemic alongside concerns with excessive messaging and chatting during on-line lessons⁸⁷. Whilst there was excellent access to the Internet among over 40% of university students recently surveyed in Poland, this was less than seen in North Macedonia (60.0%) and Bosnia and Herzegovina (56.5%)⁵⁸. In addition, faculty members and students appeared poorly prepared for e-learning approaches in Poland at the start of the pandemic^{58,88}. Bączek *et al.* (2021) also ascertained there were technical problems with IT equipment among 844 medical students in Poland surveyed in the early of the pandemic. In addition, medical students were less active during on-line classes further impacting on their e-learning⁸⁹. However, this is now changing with generally good support from teachers and course instructors and greater flexibility^{58,89}. There were also concerns with limited e-learning experiences among some Universities in Romania at the start of the pandemic although transitioning to e-learning was rapid among the top universities^{90,91}. Despite this, the online theoretical learning ability was considered low among some dental students in Romania despite allocated times to e-learning⁹². However, others have ascertained that dental students in Romania considered online

activities a good alternative to face-to-face learning during the pandemic⁹³.

Encouragingly in Lithuania, universities and business establishments provided all university teachers free access to digital resources combined with opportunities to take part in training courses to improve their e-learning experiences⁹⁴. However, this was compromised by concerns with e-learning among students in Lithuania⁹⁵. This was different in Slovenia where students were typically positive towards e-learning and this is likely to continue⁹⁶. Faculty members and students in Latvia also believed remote on-line learning could help provide good quality education in the longer term after this current pandemic⁹⁷.

The situation in the Republic of Srpska (Bosnia and Herzegovina) has also been better than a number of other CEE countries since the state universities are typically well equipped with IT and affordable internet facilities and students were ready to accept e-learning as a new model. Soon after the Government declared the pandemic and introduced lock-down measures, the Ministry of Scientific and Technological Development, Higher Education and Information Society of the Republic of Srpska issued a decision that universities should rapidly organize remote learning. Based on this, the authorities at the University of Banja Luka in the Republic made the necessary preparations to switch from classical teaching methods to the Google Classroom e-learning platform⁹⁸. In addition, Google Meet™ and Zoom® platforms were also made readily available for distance/online learning, with staff members trained in how to use new techniques properly. Concurrent with this, all students received relevant information relating to the updated teaching methods through their personal e-mails, and all additional information was made available on the faculty's web pages. This comprehensive approach appeared to work well based on recent self-evaluation data. The findings showed the medical students at the University of Banja Luka were very satisfied with the new teaching opportunities emphasizing that new teaching methods are equal to the ordinary "ex cathedra" lectures and likely to stay.

Similarly, a recent study from the University of Kragujevac in Serbia showed that e-learning technologies were well accepted by dental students where 'augmented reality' technology was used in training delivered through mobile devices⁹⁹. Encouragingly as well, a recent study in Croatia

ascertained that a switch to e-learning platforms did not affect burnout levels among medical students or their perception regarding their study programmes¹⁰⁰.

There have though been concerns across countries with conducting examinations with integrity at the start of the pandemic to ensure graduates had the necessary knowledge and skills to perform their tasks on graduation^{50,101-103}. Tied in with this, certainly among healthcare professionals including medical and pharmacy students, there were challenges and concerns with how to conduct practicals, clinical teaching sessions as well as clinical examinations within the necessary social distancing and hygiene standards^{50,101,104,105}. This resulted in new approaches being introduced including the use of simulations in small peer groups, telehealth techniques and other approaches^{50,104-106}. However, there are continued concerns regarding the lack of interaction with lecturers and time pressures affecting students' understanding of the topics being discussed and leaning experiences^{105,107}. These need to be addressed going forward with blended learning likely to remain.

Potential ways forward to improve e-learning where there are still issues can build on examples across countries regarding activities instigated among medical and pharmacy colleges to address identified concerns. Examples include help from Governments, Universities and Internet providers⁵⁰. In addition to the examples Lithuania and UAE, which have already been mentioned, other examples include instigating trials of virtual platforms for teaching and practicing physical examination skills in Egypt to improve the learning experience¹⁰⁸. Alongside this, faculty members altering assignments and examinations in countries to better reflect being taught remotely¹⁰⁷, the Ivorian Ministry of Education, Technical and Professional Training and the Senegalese Ministry of Education establishing online platforms and resources for students¹⁰⁹, and key elements being identified in Namibia for the successful implementation of robust and resilient pharmacy education approaches during the pandemic including compounding skills^{110,111}. In addition, universities in South Africa sourcing ICT devices where necessary for staff and students as well as purchasing these at preferential rates, with some universities obtaining external sponsorships to help cover these costs^{109,112-114}.

We are also aware there is increased anxiety among health science students at university, especially those leaving home for the first time without parental support¹¹⁵. This situation has typically been

exacerbated as a result of the COVID-19 pandemic and associated activities^{93,116-120}. For instance, the forced exclusion from the social aspects of campus life has affected the mental health of students and their learning in Universities in UAE and other Universities¹²⁰, with students among Arab Universities encountering sociocultural challenges with e-learning approaches including privacy concerns among female students with webcams^{63,121,122}. Chandratre (2020) showed that medical students have experienced increasing anxiety as a result of the disruption caused by the COVID-19 pandemic¹²³. Saddik *et al.* (2020) also reported increased anxiety levels among medical students especially those on rotation in hospitals in UAE if they had been in contact with patients with COVID-19¹²⁴. Saraswathi *et al.* (2020) also demonstrated increased anxiety and stress levels among medical students in India as a result of COVID-19 and its implications¹²⁵, with Iosif *et al.* (2021) showing similar findings among dental students in Romania⁹². However, others have suggested that the impact of lockdown measures associated with COVID-19 on perceived stress and quality-of-life of students in UAE, in this case pharmacy students, may be minimal¹²⁶. In addition, as mentioned, Žuljević *et al.* (2021) ascertained that burn-out levels among medical students was no higher after the introduction of e-learning approaches¹⁰⁰. These differences may reflect differences in circumstances between studied countries. Further research though is needed before any concrete conclusions can be drawn.

In conclusion, a number of strategies have been introduced across both high-income countries as well as LMICs to improve the education of

healthcare professionals, including both physicians and pharmacists, during the current pandemic. These include universities and governments entering into agreements with internet providers, increased flexibility and support for students, partnerships with companies to raise funds for PPE for face-to-face teaching and practicals, provision of equipment to disadvantaged students, provision of electronic books free-of-charge, and continuing research to assess different approaches to address current challenges^{50,70,105}. In addition, counselling and other services to reduce the impact of COVID-19 and its consequences on the mental health of both students and staff⁵⁰.

We believe these multiple initiatives will continue with blended learning here to stay in view of its increased flexibility. Alongside this, there will be ongoing research into ways to continue to improve e-learning experiences, including addressing the challenges associated with practicals and clinical rotations, among all key stakeholder groups. Alongside this, continued research into addressing the mental health consequences of COVID-19 and associated lockdown measures among both faculty members and healthcare students to provide future guidance. These combined activities are seen as critical given the important role of physicians and pharmacists in managing increasingly complex patients in the future. We will continue to monitor the situation.

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References

1. Talic S, Shah S, Wild H, Gasevic D, Maharaj A, Ademi Z, et al. Effectiveness of public health measures in reducing the incidence of covid-19, SARS-CoV-2 transmission, and covid-19 mortality: systematic review and meta-analysis. *BMJ*. 2021;**375**:e068302. DOI: 10.1136/bmj-2021-068302
2. Forsythe S, Cohen J, Neumann P, Bertozzi SM, Kinghorn A. The Economic and Public Health Imperatives Around Making Potential Coronavirus Disease–2019 Treatments Available and Affordable. *Value in Health*. 2020;**23**(11):1427-31. DOI: 10.1016/j.jval.2020.04.1824
3. Krishan K, Kanchan T. Lockdown is an effective 'vaccine' against COVID-19: A message from India. *Journal of infection in developing countries*. 2020;**14**(6):545-6. DOI: 10.3855/jidc.12931
4. Ayouni I, Maatoug J, Dhouib W, Zammit N, Fredj SB, Ghammam R, et al. Effective public health measures to mitigate the spread of COVID-19: a systematic review. *BMC public health*. 2021;**21**(1):1015. DOI: 10.1186/s12889-021-11111-1
5. Pormohammad A, Zarei M, Ghorbani S, Mohammadi M, Razizadeh MH, Turner DL, et al. Efficacy and Safety of COVID-19 Vaccines: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. *Vaccines*. 2021;**9**(5):467. DOI: 10.3390/vaccines9050467
6. Harder T, Koch J, Vygen-Bonnet S, Külper-Schiek W, Pilic A, Reda S, et al. Efficacy and effectiveness of COVID-19 vaccines against SARS-CoV-2 infection: interim results of a living systematic review, 1 January to 14 May 2021. *Euro surveillance*. 2021;**26**(28):2100563. DOI: 10.2807/1560-7917.ES.2021.26.28.2100563.
7. Thai PQ, Rabaa MA, Luong DH, Tan DQ, Quang TD, Quach HL, Hoang Thi NA, Dinh PC, Nghia ND, Tu TA, Quang N, Phuc TM, Chau V, Khanh NC, Anh DD, Duong TN, Thwaites G, van Doorn HR, Choisy M; OUCRU COVID-19 Research Group. The first 100 days of SARS-CoV-2 control in Vietnam. *Clinical Infect Dis*. 2021;**72**(9):e334-e342. doi: 10.1093/cid/ciaa1130
8. Sahu P. Closure of Universities Due to Coronavirus Disease 2019 (COVID-19): Impact on Education and Mental Health of Students and Academic Staff. *Cureus*. 2020;**12**(4):e7541. DOI 10.7759/cureus.7541
9. Ogunleye OO, Basu D, Mueller D, Sneddon J, Seaton RA, Yinka-Ogunleye AF, Wamboga J, Miljković N, Mwita JC, Rwegerera GM, Masele A, Patrick O, Niba LL, Nsaikila M, Rashed WM, Hussein MA, Hegazy R, Amu AA, Boahen-Boaten BB, Matsebula Z, Gwebu P, Chirigo B, Mkhabela N, Dlamini T, Sithole S, Malaza S, Dlamini S, Afriyie D, Asare GA, Amponsah SK, Sefah I, Oluka M, Guantai AN, Opanga SA, Sarele TV, Mafisa RK, Chikowe I, Khuluzi F, Kibuule D, Kalemeera F, Mubita M, Fadare J, Sibomana L, Ramokgopa GM, Whyte C, Maimela T, Hugo J, Meyer JC, Schellack N, Rampamba EM, Visser A, Alfadl A, Malik EM, Malande OO, Kalungia AC, Mwila C, Zaranyika T, Chaibva BV, Oлару ID, Masuka N, Wale J, Hwenda L, Kamoga R, Hill R, Barbui C, Bochenek T, Kurdi A, Campbell S, Martin AP, Phuong TNT, Thanh BN, Godman B. Response to the Novel Corona Virus (COVID-19) Pandemic Across Africa: Successes, Challenges, and Implications for the Future. *Front Pharmacol*. 2020;**11**(1205). doi: 10.3389/fphar.2020.01205
10. Godman B, Haque M, Islam S, Iqbal S, Urmi UL, Kamal ZM, Shuvo SA, Rahman A, Kamal M, Haque M, Jahan I, Islam MZ, Hossain MM, Munzur-E-Murshid, Kumar S, Charan J, Bhatt R, Dutta S, Abhayanand JP, Sharma Y, Saleem Z, Phuong TNT, Kwon HY, Kurdi A, Wale J, Sefah I. Rapid Assessment of Price Instability and Paucity of Medicines and Protection for COVID-19 Across Asia: Findings and Public Health Implications for the Future. *Front Public Health*. 2020;**8**(744). DOI: 10.3389/fpubh.2020.585832
11. Ha BTT, Ngoc Quang L, Mirzoev T, Tai NT, Thai PQ, Dinh PC. Combating the COVID-19 Epidemic: Experiences from Vietnam. *Int J Environ Res Public Health*. 2020;**17**(9):3125. DOI: 10.3390/ijerph17093125
12. Ng Y, Li Z, Chua YX, Chaw WL, Zhao Z, Er B, Pung R, Chiew CJ, Lye DC, Heng D, Lee VJ. Evaluation of the Effectiveness of Surveillance and Containment Measures for the First 100 Patients with COVID-19 in Singapore - January 2-February 29, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;**69**(11):307-11. DOI: 10.15585/mmwr.mm6911e1
13. Kluge HHP, Wickramasinghe K, Rippin HL, Mendes R, Peters DH, Kontsevaya A, et al. Prevention and control of non-communicable diseases in the COVID-19 response. *Lancet*. 2020;**395**(10238):1678-80. DOI: 10.1016/S0140-6736(20)31067-9.
14. Chowdhury N, Khalid A, Turin TC. Understanding misinformation infodemic during public health emergencies due to large-scale disease outbreaks: a rapid review. *Z Gesundh Wiss*. 2021:1-21. DOI: 10.1007/s10389-021-01565-3
15. Abena PM, Decloedt EH, Bottieau E, Suleman F, Adejumo P, Sam-Agudu NA, Muyembe TamFum JJ, Seydi M, Eholie SP, Mills EJ, Kallay O, Zumla A, Nachega JB. Chloroquine and Hydroxychloroquine for the Prevention or Treatment of COVID-19 in Africa: Caution for Inappropriate Off-label Use in Healthcare Settings. *Am J Trop Med Hyg*. 2020;**102**(6):1184-8. DOI: 10.4269/ajtmh.20-0290
16. Haque M, Islam S, Iqbal S, Urmi UL, Kamal ZM, Rahman A, Kamal M, Haque M, Jahan I, Islam Z, Hossain MM, Murshid ME, Sefah I, Kurdi A, Godman B. Availability and price changes of potential medicines and equipment for the prevention and treatment of COVID-19 among pharmacy and drug stores in Bangladesh; findings and

- implications. *Bangladesh Journal of Medical Science* Special Issue on Covid 19, 2020: S36-S50. DOI: <https://doi.org/10.3329/bjms.v19i0.48106>
17. Haque M, Abubakar A, Ogunleye O, Sani I, Sefah I, Kurdi A, et al. Changes in availability, utilization, and prices of medicines and protection equipment for COVID-19 in an Urban population of Northern Nigeria. *J Res Pharm Pract.* **2021**;10(1):17-22. doi: 10.4103/jrpp.JRPP_20_92
 18. RECOVERY Collaborative Group, Horby P, Mafham M, Linsell L, Bell JL, Staplin N, Emberson JR, Wiselka M, Ustianowski A, Elmahi E, Prudon B, Whitehouse T, Felton T, Williams J, Faccenda J, Underwood J, Baillie JK, Chappell LC, Faust SN, Jaki T, Jeffery K, Lim WS, Montgomery A, Rowan K, Tarning J, Watson JA, White NJ, Juszczak E, Haynes R, Landray MJ. Effect of Hydroxychloroquine in Hospitalized Patients with Covid-19. *N Engl J Med.* 2020;**383**(21):2030-40. doi: 10.1056/NEJMoa2022926
 19. Erku DA, Belachew SA, Abrha S, Sinnollareddy M, Thomas J, Steadman KJ, et al. When fear and misinformation go viral: Pharmacists' role in deterring medication misinformation during the 'infodemic' surrounding COVID-19. *Res Social Adm Pharm.* 2021;**17**(1):1954-1963. DOI: 10.1016/j.sapharm.2020.04.032
 20. Elbeddini A, Prabakaran T, Almasalkhi S, Tran C. Pharmacists and COVID-19. *J Pharm Policy Pract.* 2020;**13**:36. DOI: 10.1186/s40545-020-00241-3
 21. Cadogan CA, Hughes CM. On the frontline against COVID-19: Community pharmacists' contribution during a public health crisis. *Res Social Adm Pharm.* 2021;**17**(1):2032-5. DOI: 10.1016/j.sapharm.2020.03.015
 22. Hedima EW, Adeyemi MS, Ikunaiye NY. Community Pharmacists: On the frontline of health service against COVID-19 in LMICs. *Res Social Adm Pharm.* 2021;**17**(1):1964-6. DOI: 10.1016/j.sapharm.2020.04.013
 23. Kibuule D, Nambahu L, Sefah IA, Kurdi A, Phuong TNT, Kwon H-Y, Godman B. Activities in Namibia to Limit the Prevalence and Mortality from COVID-19 Including Community Pharmacy Activities and the Implications. *Sch Acad J Pharm.* 2021; **10**(5): 82-92. DOI: 10.36347/sajp.2021.v10i05.001
 24. Langford BJ, So M, Raybardhan S, Leung V, Westwood D, MacFadden DR, et al. Bacterial co-infection and secondary infection in patients with COVID-19: a living rapid review and meta-analysis. *Clin Microbiol Infect.* **2020**;26(12):1622-9. DOI: 10.1016/j.cmi.2020.07.016
 25. Langford BJ, So M, Raybardhan S, Leung V, Soucy JR, Westwood D, et al. Antibiotic prescribing in patients with COVID-19: rapid review and meta-analysis. *Clin Microbiol Infect.* **2021**;27(4):520-31. DOI: 10.1016/j.cmi.2020.12.018
 26. Nusrat N, Haque M, Chowdhury K, Adnan N, Lutfur AB, Karim E et al. Pilot Study on the Current Management of Children with COVID-19 In Hospitals in Bangladesh; Findings and Implications. *Bangladesh Journal of Medical Science*, Special Issue on COVID-19. 2021: S188 - S198. DOI: <https://doi.org/10.3329/bjms.v20i5.55615>
 27. Beović B, Doušak M, Ferreira-Coimbra J, Nadrah K, Rubulotta F, Belliato M, et al. Antibiotic use in patients with COVID-19: a 'snapshot' Infectious Diseases International Research Initiative (ID-IRI) survey. *J Antimicrob Chemother.* 2020;**75**(11):3386-90. DOI: 10.1093/jac/dkaa326
 28. Kumar S, Haque M, Shetty A, Acharya J, Kumar M, Sinha V, et al. Current Management of Children with COVID-19 in Hospitals in India; Pilot Study and Findings. *Advances in Human Biology.* 2022;**12**(1):16-21.
 29. Hsu J. How covid-19 is accelerating the threat of antimicrobial resistance. *BMJ.* **2020**;369:m1983. DOI: 10.1136/bmj.m1983
 30. Hofer U. The cost of antimicrobial resistance. *Nat Rev Microbiol.* **2019**;17(1):3. doi: 10.1038/s41579-018-0125-x
 31. Founou RC, Founou LL, Essack SY. Clinical and economic impact of antibiotic resistance in developing countries: A systematic review and meta-analysis. *PloS One.* **2017**;12(12):e0189621. DOI: 10.1371/journal.pone.0189621
 32. Godman B, Egwuenu A, Haque M, Malande OO, Schellack N, Kumar S, et al. Strategies to Improve Antimicrobial Utilization with a Special Focus on Developing Countries. *Life.* **2021**;11(6):528. doi: 10.3390/life11060528
 33. Rodríguez-Baño J, Rossolini GM, Schultsz C, Tacconelli E, Murthy S, Ohmagari N, et al. Key considerations on the potential impacts of the COVID-19 pandemic on antimicrobial resistance research and surveillance. *Trans R Soc Trop Med Hyg.* 2021;**115**(10):1122-9. DOI: 10.1093/trstmh/trab048
 34. Schellack N, Bronkhorst E, Coetzee R, Godman B, Gous AGS, Kolman S et al. SASOCP position statement on the pharmacist's role in antibiotic stewardship 2018. *South African Journal of Infectious Disease.* 2018;**33**(1):28-35.
 35. Haque M, Godman B. Potential Strategies to Improve Antimicrobial Utilisation in Hospitals in Bangladesh Building on Experiences Across Developing Countries. *Bangladesh Journal of Medical Science.* 2021; **19** (3): 469-77. DOI: <https://doi.org/10.3329/bjms.v20i3.52787>.
 36. Nathwani D, Varghese D, Stephens J, Ansari W, Martin S, Charbonneau C. Value of hospital antimicrobial

- stewardship programs [ASPs]: a systematic review. *Antimicrob Resist Infect Control*. 2019;**8**:35. DOI: 10.1186/s13756-019-0471-0
37. Fadare JO, Ogunleye O, Iliyasu G, Adeoti A, Schellack N, Engler D, et al. Status of antimicrobial stewardship programmes in Nigerian tertiary healthcare facilities: Findings and implications. *Journal of global antimicrobial resistance*. 2018;**17**:132-6. DOI:10.1016/j.jgar.2018.11.025
 38. Kalungia AC, Mwambula H, Munkombwe D, Marshall S, Schellack N, May C, et al. Antimicrobial stewardship knowledge and perception among physicians and pharmacists at leading tertiary teaching hospitals in Zambia: implications for future policy and practice. *Journal of Chemotherapy*. 2019; **31** (7-8): 378-387, DOI:10.1080/1120009X.2019.1622293
 39. Godman B, Haque M, McKimm J, Abu Bakar M, Sneddon J, Wale J, et al. Ongoing strategies to improve the management of upper respiratory tract infections and reduce inappropriate antibiotic use particularly among lower and middle-income countries: findings and implications for the future. *Current medical research and opinion*. 2020;**36**(2):301-27. DOI:10.1080/03007995.2019.1700947
 40. Opanga SA, Rizvi N, Wamaita A, Sefah IA, Godman B. Availability of Medicines in Community Pharmacy to Manage Patients with COVID-19 in Kenya; Pilot Study and Implications. *Sch Acad J Pharm*. 2021; 10(3): 36-42. DOI: 10.36347/sajp.2021.v10i03.001
 41. Markovic-Pekovic V, Grubisa N, Burger J, Bojanic L, Godman B. Initiatives to Reduce Nonprescription Sales and Dispensing of Antibiotics: Findings and Implications. *J Res Pharm Pract*. 2017;**6**(2):120-5. DOI:10.4103/jrpp.JRPP_17_12
 42. Chowdhury M, Stewart Williams J, Wertheim H, Khan WA, Matin A, Kinsman J. Rural community perceptions of antibiotic access and understanding of antimicrobial resistance: qualitative evidence from the Health and Demographic Surveillance System site in Matlab, Bangladesh. *Glob Health Action*. 2019;**12**(sup1):1824383. doi: 10.1080/16549716.2020.1824383
 43. Haque M, Godman B. Potential strategies to reduce inappropriate prescribing and dispensing of antimicrobials in Bangladesh building on the experiences in other developing countries. *Bangladesh Journal of Medical Science*. 2021; **20** (4): 700-6. DOI: <https://doi.org/10.3329/bjms.v20i4.54123>.
 44. Gangat MA, Hsu JL. Antibiotic stewardship: a focus on ambulatory care. *S D Med*. 2015;Spec No:44-8.
 45. Shahwan M, Suliman A, Abdulrahman Jairoun A, Alkhoujah S, Al-Hemyari SS, Al-Tamimi SK, Godman B, Mothana RA. Prevalence, Knowledge and Potential Determinants of COVID-19 Vaccine Acceptability Among University Students in the United Arab Emirates: Findings and Implications. *J Multidiscip Healthc*. 2022;**15**:81-92. doi: 10.2147/JMDH.S341700.
 46. Kocatürk E, Salman A, Cherrez-Ojeda I, Criado PR, Peter J, Comert-Ozer E, et al. The global impact of the COVID-19 pandemic on the management and course of chronic urticaria. *Allergy*. 2021;**76**(3):816-30. DOI: 10.1111/all.14687
 47. Bigna JJ, Noubiap JJ. The rising burden of non-communicable diseases in sub-Saharan Africa. *Lancet Glob Health*. 2019;**7**(10):e1295-e6. DOI: 10.1016/S2214-109X(19)30370-5
 48. Gouda HN, Charlson F, Sorsdahl K, Ahmadzada S, Ferrari AJ, Erskine H, et al. Burden of non-communicable diseases in sub-Saharan Africa, 1990-2017: results from the Global Burden of Disease Study 2017. *Lancet Glob Health*. 2019;**7**(10):e1375-e87. doi: 10.1016/S2214-109X(19)30374-2
 49. Akter F, Haque M, Kalemeera F, Kurdi A, Godman B. Key issues surrounding the management of non-communicable diseases including the management of diabetes post COVID-19 among developing countries with a specific focus on Bangladesh. *Journal of Applied Pharmaceutical Science* 2021; **11** (10); i – vi. DOI: 10.7324/JAPS.2021.11012ed
 50. Etando A, Amu AA, Haque M, Schellack N, Kurdi A, Alrasheedy AA, et al. Challenges and Innovations Brought about by the COVID-19 Pandemic Regarding Medical and Pharmacy Education Especially in Africa and Implications for the Future. *Healthcare*. 2021;**9**(12):1722. DOI: 10.3390/healthcare9121722
 51. Modjadji P. Communicable and non-communicable diseases coexisting in South Africa. *Lancet Glob Health*. 2021;**9**(7):e889-e90. DOI: 10.1016/S2214-109X(21)00271-0
 52. Mwita J, Godman B. Poverty and cardiovascular diseases in Sub-Saharan Africa. IntechOpen. Chapter in Lifestyle and Epidemiology - Poverty and Cardiovascular Diseases a Double Burden in African Population. 2021. DOI: 10.5772/intechopen.98575. Available at URL: <https://www.intechopen.com/chapters/77227>.
 53. Oladipo AT, Fashola OT, Agboola EI, Adisa OO, Oyekanmi OD, Akinsete AM. Challenges with medical education in Nigeria in the COVID-19 era. *Pan Afr Med J*. 2020;**37**:223. DOI: 10.11604/pamj.2020.37.223.26418
 54. Sigdel S, Ozaki A, Dhakal R, Pradhan B, Tanimoto T. Medical Education in Nepal: Impact and Challenges of the COVID-19 Pandemic. *Acad Med*. 2021;**96**(3):340-2. DOI: 10.1097/ACM.0000000000003888
 55. Al-Balas M, Al-Balas HI, Jaber HM, Obeidat K, Al-Balas H, Aborajoo EA, et al. Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives. *BMC Med Educ*. 2020;**20**(1):341. DOI: 10.1186/s12909-020-02257-4

56. Alrasheedy AA, Abdulsalim S, Farooqui M, Alsahali S, Godman B. Knowledge, Attitude and Practice About Coronavirus Disease (COVID-19) Pandemic and Its Psychological Impact on Students and Their Studies: A Cross-Sectional Study Among Pharmacy Students in Saudi Arabia. *Risk Manag Healthc Policy*. 2021;**14**:729-741. doi: 10.2147/RMHP.S292354.
57. Alsoufi A, Alsuyhili A, Msherghi A, Elhadi A, Atiyah H, Ashini A, et al. Impact of the COVID-19 pandemic on medical education: Medical students' knowledge, attitudes, and practices regarding electronic learning. *PLoS one*. 2020;**15**(11):e0242905. DOI: 10.1371/journal.pone.0242905
58. Miloshevska L, Gajek E, Džanić ND, Hatipoğlu Ç. Emergency online learning during the first Covid-19 period: students' perspectives from Bosnia and Herzegovina, North Macedonia, Poland and Turkey. *ExELL*. 2020;**8**(2):110-43. DOI: 10.2478/exell-2021-0002
59. Yousuf R, Salam A. Teaching medical education during the era of COVID-19 pandemic: challenges and probable solutions. *Bangladesh Journal of Medical Science, Special Issue on COVID-19*. 2021: S3 - S6. DOI: <https://doi.org/10.3329/bjms.v20i5.55394>.
60. Wilcha RJ. Effectiveness of Virtual Medical Teaching During the COVID-19 Crisis: Systematic Review. *JMIR Med Educ*. 2020;**6**(2):e20963. doi: 10.2196/20963
61. Haque M, Godman B. Key findings regarding COVID 19 in Bangladesh and wider and their implications. *Bangladesh Journal of Medical Science, Special Issue on COVID-19*. 2021: S199-205. DOI: <https://doi.org/10.3329/bjms.v20i5.55616>.
62. Keržič D, Alex JK, Pamela Balbontín Alvarado R, Bezerra DDS, Cheraghi M, Dobrowolska B, et al. Academic student satisfaction and perceived performance in the e-learning environment during the COVID-19 pandemic: Evidence across ten countries. *PLoS One*. 2021;**16**(10):e0258807. doi: 10.1371/journal.pone.0258807
63. O'Sullivan SM, Khraibi AA, Chen W, Corridon PR. Lessons Learned Transitioning from Traditional Premedical and Medical Education to E-learning Platforms during the COVID-19 Pandemic within the United Arab Emirates. *J Med Educ Curric Dev*. 2021;**8**:23821205211025861. DOI: 10.1177/23821205211025861.
64. Zalut MM, Hamed MS, Bolbol SA. The experiences, challenges, and acceptance of e-learning as a tool for teaching during the COVID-19 pandemic among university medical staff. *PLoS One*. 2021;**16**(3):e0248758. DOI: 10.1371/journal.pone.0248758
65. Hassounah M, Raheel H, Alhefi M. Digital Response During the COVID-19 Pandemic in Saudi Arabia. *J Med Internet Res*. 2020;**22**(9):e19338. doi: 10.2196/19338
66. Nambiar D. The impact of online learning during COVID-19: students' and teachers' perspective. *The International Journal of Indian Psychology*. 2020;**8**. DOI: 10.25215/0802.094
67. Soliman M, Aldhaheri S, Neel K. Experience from a medical college in Saudi Arabia on undergraduate curriculum management and delivery during COVID-19 pandemic. *Journal of Nature and Science of Medicine*. 2021;**4**(2):85-9. DOI:10.4103/jnsn.jnsn_146_20
68. Altwaijry N, Ibrahim A, Binsuwaidan R, Alnajjar LI, Alsouk BA, Almutairi R. Distance Education During COVID-19 Pandemic: A College of Pharmacy Experience. *Risk Manag Healthc Policy*. 2021;**14**:2099-2110. DOI: 10.2147/RMHP.S308998
69. Shawaqfeh MS, Al Bekairy AM, Al-Azayzih A, Alkatheri AA, Qandil AM, Obaidat AA, et al. Pharmacy Students Perceptions of Their Distance Online Learning Experience During the COVID-19 Pandemic: A Cross-Sectional Survey Study. *J Med Educ Curric Dev*. 2020;**7**:2382120520963039. doi: 10.1177/2382120520963039
70. Al-Terri D, Hindi MN, AlMarar R, Shubair RM. Transition to distance learning during the COVID-19 pandemic: Efforts within the Higher Education sector in the United Arab Emirates. *Journal of Applied Learning & Teaching* 2020; **3** (2): 31-9 DOI: <https://doi.org/10.37074/jalt.2020.3.2.17>
71. Chaudhry IS, Paquibut R, Islam A, Chabchoub H. Testing the success of real-time online delivery channel adopted by higher education institutions in the United Arab Emirates during the Covid-19 pandemic. *Int J Educ Technol High Educ*. 2021;**18**(1):48. doi: 10.1186/s41239-021-00283-w
72. Mukasa J, Otim M, Monaco B, Al Marzouqi A, Breitener P, Jawahar L. Nursing Students' Perspectives and Readiness to Transition to E-Learning During COVID-19 in the UAE: A Cross-Sectional Study. *Adv Med Educ Pract*. 2021;**12**:1505-1512 DOI:10.2147/AMEP.S335578.
73. Alhasan M, Al-Horani Q. Students' perspective on the online delivery of radiography & medical imaging program during COVID-19 pandemic. *J Med Imaging Radiat Sci*. 2021;**52**(4S):S68-S77. DOI: 10.1016/j.jmir.2021.07.009
74. Bachmann C, Paz Hernandez AL, Müller S, Khalatbarizamanpoor S, Tschiesche T, Reißmann F, et al. Digital teaching and learning of surgical skills (not only) during the pandemic: a report on a blended learning project. *GMS J Med Educ*. 2020;**37**(7):Doc68. DOI: 10.3205/zma001361.
75. Byrnes KG, Kiely PA, Dunne CP, McDermott KW, Coffey JC. Communication, collaboration and contagion: "Virtualisation" of anatomy during COVID-19. *Clin Anat*. 2021;**34**(1):82-89. doi: 10.1002/ca.23649

76. Saiyad S, Virk A, Mahajan R, Singh T. Online Teaching in Medical Training: Establishing Good Online Teaching Practices from Cumulative Experience. *Int J Appl Basic Med Res.* 2020; **10**(3):149-155. doi: 10.4103/ijabmr.IJABMR_358_20
77. Dong C, Lee DW-C, Aw DC-W. Tips for medical educators on how to conduct effective online teaching in times of social distancing. *Proceedings of Singapore Healthcare.* 2021;**30**(1):59-63. <https://doi.org/10.1177/20101058209439>
78. Al Zahrani EM, Al Naam YA, AlRabeeah SM, Aldossary DN, Al-Jamea LH, Woodman A, et al. E- Learning experience of the medical profession's college students during COVID-19 pandemic in Saudi Arabia. *BMC Med Educ.* 2021;**21**(1):443. DOI: 10.1186/s12909-021-02860-z
79. Kawaguchi-Suzuki M, Nagai N, Akonoghre RO, Desborough JA. COVID-19 Pandemic Challenges and Lessons Learned by Pharmacy Educators Around the Globe. *Am J Pharm Educ.* 2020;**84**(8):ajpe8197. doi: 10.5688/ajpe8197
80. Ossai EN. Impact of COVID-19 on medical education and the challenges: how prepared is Nigeria? *Pan Afr Med J.* 2020; **37**(Suppl 1): 45. doi: 10.11604/pamj.supp.2020.37.45.24915
81. Shereni C. Covid-19 and challenges to education – Tell Zimbabwe. 2021. Available at URL: <https://zifmstereo.co.zw/covid-19-and-challenges-to-education-tell-zimbabwe/3457/>.
82. Mukute M, Francis B, Burt J, de Souza B. Education in Times of COVID-19: Looking for Silver Linings in Southern Africa's Educational Responses. *Southern African Journal of Environmental Education.* 2020; **36**: 1-16. DOI 10.4314/sajee.v36i1.7
83. Almaiah MA, Al-Khasawneh A, Althunibat A. Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Educ Inf Technol (Dordr).* 2020;1-20. doi: 10.1007/s10639-020-10219-y.
84. Chowdhury K, Haque M, Lutfor AB, Siddiqui TH, Ahmad R, Sultana I et al. Impact of the COVID-19 pandemic on dental and medical education in Bangladesh: a pilot study and the implications. *Bangladesh Journal of Medical Science.* 2022; **21** (02):444-454. doi: 10.3329/bjms.v21i2.58080
85. Kabir H, Nasrullah SM, Hasan MK, Ahmed S, Hawlader MDH, Mitra DK. Perceived e-learning stress as an independent predictor of e-learning readiness: Results from a nationwide survey in Bangladesh. *PloS one.* 2021; **16**(10): e0259281. doi: 10.1371/journal.pone.0259281
86. Getova A, Mileva E, Angelova-Igova B. Online Education During Pandemic, According To Students From Two Bulgarian Universities. *Pedagogy.* 2020; **92** (7s): 211-219.
87. Kaliba M, Ambrožová P. What Do University Students Do in Online Teaching? Reflections On Current Forms of Academic Procrastination, Experience from The Czech Republic. *Proceedings of INTED2021 Conference.* 2021; 357-3361. DOI: 10.21125/inted.2021.0702. Available at <https://library.iated.org/view/KALIBA2021WHA>
88. Tomczyk Ł. E-Learning in Poland: Challenges, Opportunities and Prospects for Remote Learning during the COVID-19 Pandemic. *HERB.* 2021;**2**:10-2.
89. Bączek M, Zagańczyk-Bączek M, Szpringer M, Jaroszyński A, Woźakowska-Kapłon B. Students' perception of online learning during the COVID-19 pandemic: A survey study of Polish medical students. *Medicine.* 2021;**100**(7):e24821-e. DOI: 10.1097/MD.00000000000024821
90. Edelhauser E, Lupu-Dima L. One Year of Online Education in COVID-19 Age, a Challenge for the Romanian Education System. *Int J Environ Res Public Health.* 2021;**18**(15). DOI: 10.3390/ijerph18158129
91. Edelhauser E, Lupu-Dima L. Is Romania Prepared for eLearning during the COVID-19 Pandemic? *Sustainability.* 2020;**12**(13):5438. DOI: 10.3390/su12135438
92. Iosif L, Tâncu AMC, Didilescu AC, Imre M, Gălbinașu BM, Ilinca R. Self-Perceived Impact of COVID-19 Pandemic by Dental Students in Bucharest. *Int J Environ Res Public Health.* 2021;**18**(10). DOI: 10.3390/ijerph1810524
93. Iurcov R, Pop LM, Iorga M. Impact of COVID-19 Pandemic on Academic Activity and Health Status among Romanian Medical Dentistry Students; A Cross-Sectional Study. *Int J Environ Res Public Health.* 2021;**18**(11). DOI: 10.3390/ijerph18116041
94. Cedefop. Lithuania: VET versus Covid-19: challenges and new opportunities for the future. 2020. Available at URL: <https://www.cedefop.europa.eu/en/news/lithuania-vet-versus-covid-19-challenges-and-new-opportunities-future>.
95. Petkevičiūtė N, Balčiūnaitienė A. Learning Challenges During Pandemic Situation: Lithuanian University Case. *RURAL ENVIRONMENT. EDUCATION. PERSONALITY.* 2021; **14**: 156-62. DOI: 10.22616/REEP.2021.14.017.
96. Gosak L, Fijačko N, Chabrera C, Cabrera E, Štiglic G. Perception of the Online Learning Environment of Nursing Students in Slovenia: Validation of the DREEM Questionnaire. *Healthcare.* 2021;**9**(8). DOI: 10.3390/healthcare9080998
97. Baranova S, Nīmanīte D, Kalniņa D, Oļesika A. Students' Perspective on Remote On-Line Teaching and Learning at the University of Latvia in the First and Second COVID-19 Period. *Sustainability.* 2021;**13**(21):11890.

- DOI: 10.3390/su132111890
98. University of Banja Luka. The University Starts Providing Online Learning. 2020. Available at URL: <https://www.unibl.org/en/news/2020/03/the-university-starts-providing-online-learning>.
 99. Mladenovic R, Matvijenko V, Subaric L, Mladenovic K. Augmented reality as e-learning tool for intraoral examination and dental charting during COVID-19 era. *J Dent Educ*. 2021 (EPrint). doi: 10.1002/jdd.12780
 100. Žuljević MF, Jeličić K, Viđak M, Đogaš V, Buljan I. Impact of the first COVID-19 lockdown on study satisfaction and burnout in medical students in Split, Croatia: a cross-sectional presurvey and postsurvey. *BMJ open*. 2021;**11**(6):e049590. DOI: 10.1136/bmjopen-2021-049590
 101. Choi B, Jegatheeswaran L, Minocha A, Alhilani M, Nakhoul M, Mutengesa E. The impact of the COVID-19 pandemic on final year medical students in the United Kingdom: a national survey. *BMC Med Educ*. 2020;**20**(1):206. doi: 10.1186/s12909-020-02117-1
 102. Goel N, Haque I, Bhyan SJ, Jain A, Kumari A, Thomas B. IMPACT OF COVID-19 ON PHARMACY STUDENTS IN INDIA. 2020. Preprint. doi: 10.20944/preprints202007.0702.v1.
 103. O'Byrne L, Gavin B, McNicholas F. Medical students and COVID-19: the need for pandemic preparedness. *J Med Ethics*. 2020;**46**(9):623-6. DOI: 10.1136/medethics-2020-106353
 104. Gaur U, Majumder MAA, Sa B, Sarkar S, Williams A, Singh K. Challenges and Opportunities of Preclinical Medical Education: COVID-19 Crisis and Beyond. *SN Compr Clin Med*. 2020:1-6. DOI: 10.1007/s42399-020-00528-1
 105. Sani I, Hamza Y, Chedid Y, Amalendran J, Hamza N. Understanding the consequence of COVID-19 on undergraduate medical education: Medical students' perspective. *Annals of medicine and surgery*. 2020;**58**:117-9. DOI: 10.1016/j.amsu.2020.08.045
 106. Giordano L, Cipollaro L, Migliorini F, Maffulli N. Impact of Covid-19 on undergraduate and residency training. *Surgeon*. 2021;**19**(5):e199-e206. DOI: 10.1016/j.surge.2020.09.014
 107. Nagy DK, Hall JJ, Charrois TL. The impact of the COVID-19 pandemic on pharmacy students' personal and professional learning. *Curr Pharm Teach Learn*. 2021;**13**(10):1312-1318. DOI: 10.1016/j.cptl.2021.07.014
 108. Shehata MH, Abouzeid E, Wasfy NF, Abdelaziz A, Wells RL, Ahmed SA. Medical Education Adaptations Post COVID-19: An Egyptian Reflection. *J Med Educ Curric Dev*. 2020;**7**:2382120520951819. DOI: 10.1177/2382120520951819
 109. Adefuye AO, Adeola HA, Busari J. The COVID-19 pandemic: the benefits and challenges it presents for medical education in Africa. *Pan Afr Med J*. 2021;**40**:42. DOI: 10.11604/pamj.2021.40.42.28489
 110. Mavu D, Lates J, Hango E, Rennie T, Lusepani M, Kibuule D, Mubita M. COVID-19 resilient pharmacy education: A grassroots work-integrated programme to strengthen the pharmaceutical workforce in Namibia. *Pharmacy Education*. 2020; **20**(2): 205 - 11. DOI:10.46542/PE.2020.202.205211
 111. Mavu D, Mubita M, Niaz Q, Lusepani M, Nowaseb S, Enkara T et al. Emergency compounding of COVID-19 medicines: A readiness programme to up-skill pharmacy graduates in Namibia. *Pharmacy Education*. 2020; **20**(2): 117-23. DOI: 10.46542/pe.2020.202.117123
 112. Eksteen MJ. EDITORIAL: Pharmacy workforce education challenges and responses to the COVID-19 pandemic in South Africa. *Pharmacy Education*. 2021; **20** (2): 74–77. DOI: 10.46542/pe.2020.202.7477
 113. David WH, Michelle G, Gregory DB, Werner N, Bettine Jansen van V. COVID-19 and the academe in South Africa: Not business as usual. *South African Journal of Science*. 2020;**116**(7/8).DOI: 10.17159/sajs.2020/8298
 114. Cranfield DJ, Tick A, Venter IM, Blignaut RJ, Renaud K. Higher Education Students' Perceptions of Online Learning during COVID-19—A Comparative Study. *Education Sciences*. 2021;**11**(8):403. DOI: 10.3390/educsci11080403
 115. de Sá Alves JV, de Paula W, Netto PRR, Godman B, do Nascimento RCRM, Coura-Vital W. Prevalence and factors associated with anxiety among university students of health sciences in Brazil: findings and implications. *J Bras Psiquiatr*. 2021;**70**(2):99-107. DOI: 10.1590/0047-2085000000322.
 116. Islam MA, Barna SD, Raihan H, Khan MNA, Hossain MT. Depression and anxiety among university students during the COVID-19 pandemic in Bangladesh: A web-based cross-sectional survey. *PloS One*. 2020;**15**(8):e0238162. DOI: 10.1371/journal.pone.0238162
 117. Sundarasan S, Chinna K, Kamaludin K, Nurunnabi M, Baloch GM, Khoshaim HB, et al. Psychological Impact of COVID-19 and Lockdown among University Students in Malaysia: Implications and Policy Recommendations. *Int J Environ Res Public Health*. 2020;**17**(17):6206. doi: 10.3390/ijerph17176206.
 118. Chinna K, Sundarasan S, Khoshaim HB, Kamaludin K, Nurunnabi M, Baloch GM, et al. Psychological impact of COVID-19 and lock down measures: An online cross-sectional multicounty study on Asian university students. *PloS One*. 2021;**16**(8):e0253059. DOI: 10.1371/journal.pone.0253059
 119. Rutkowska A, Liska D, Ciešlik B, Wrzeciono A, Brodźani J, Barcalová M, et al. Stress Levels and Mental Well-

- Being among Slovak Students during e-Learning in the COVID-19 Pandemic. *Healthcare*. 2021;**9**(10). DOI: 10.3390/healthcare9101356
120. Khalili H. Online interprofessional education during and post the COVID-19 pandemic: a commentary. *J Interprof Care*. 2020;**34**(5):687-690. DOI: 10.1080/13561820.2020.1792424
121. Al Lily AE, Ismail AF, Abunasser FM, Alhajhoj Alqahtani RH. Distance education as a response to pandemics: Coronavirus and Arab culture. *Technol Soc*. 2020;**63**:101317. DOI: 10.1016/j.techsoc.2020.101317
122. El-Bassiouny D, El-Bassiouny N. The challenge of online privacy preservation in Muslim-majority countries during the COVID-19 pandemic. *Journal of Islamic Marketing*. 2021;**12**(3):622-6. DOI: 10.1108/JIMA-08-2020-0227
123. Chandratre S. Medical Students and COVID-19: Challenges and Supportive Strategies. *J Med Educ Curric Dev*. 2020;**7**:2382120520935059. doi: 10.1177/2382120520935059
124. Saddik B, Hussein A, Sharif-Askari FS, Kheder W, Temsah M-H, Koutaich RA, et al. Increased Levels of Anxiety Among Medical and Non-Medical University Students During the COVID-19 Pandemic in the United Arab Emirates. *Risk Manag Healthc Policy*. 2020;**13**:2395-2406. doi: 10.2147/RMHP.S273333.
125. Saraswathi I, Saikarthik J, Senthil Kumar K, Madhan Srinivasan K, Ardhanaari M, Gunapriya R. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. *Peer J*. 2020;**8**:e10164-e. DOI: 10.7717/peerj.10164
126. Alomar M, Palaian S, Shanableh S. Perceived Stress and Quality of Life Among Final-Year Pharmacy Students in the United Arab Emirates During COVID-19 Pandemic Lockdown. *Adv Med Educ Pract*. 2021;**12**:1361-9. DOI: 10.2147/AMEP.S324274.
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