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Elshami, W., Abuzaid, M. M., McConnell, J., Floyd, M., Hughes, D., Stewart, S., & McFadden, S. (2022). The impact of COVID-19 on the clinical experience and training of undergraduate Student radiographers internationally: The clinical tutors' perspective. *Radiography*, 28(S1), S59-S67. Advance online publication. <https://doi.org/10.1016/j.radi.2022.07.012>

[Link to publication record in Ulster University Research Portal](#)

**Published in:**  
Radiography

**Publication Status:**  
Published online: 18/08/2022

**DOI:**  
[10.1016/j.radi.2022.07.012](https://doi.org/10.1016/j.radi.2022.07.012)

**Document Version**  
Author Accepted version

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## The Impact of COVID-19 on the Clinical Experience and Training of Undergraduate Student Radiographers internationally: The Clinical Tutors' perspective

### Abstract

#### Introduction:

The impact on the clinical training and education of healthcare students by COVID-19 has been documented. However, the thoughts and experiences of clinical tutors (CTs) about radiography students attending for clinical training and education during this now elongated period beyond first recognition of the virus has not been explored. This paper will discuss data collected from CTs in the UK Devolved Nations (UKDN) and the United Arab Emirates (UAE) who were compared because of their similarities in delivery based on individual 'rules of engagement' devised by their various health departments.

**Aim:** The purpose of this study was to examine the clinical tutors' thoughts and experiences of supervising radiography students attending clinical placement during the COVID-19 pandemic.

**Rationale:** It is important for countries to learn from each other and determine the best course of action in subsequent waves of COVID-19 or future pandemics.

#### Methods:

The UK Devolved Nations (UKDN) and the United Arab Emirates (UAE) were selected for comparison on an international level as they are geographically distinct with a comparable population and education accredited/acknowledged by the Society Of Radiographers (SoR). Google Form's was used to collect data from CTs across the UKDN and the UAE. The study used an online questionnaire with closed questions in four themes including: experience of students, impact on students' clinical placement, attitude of clinical staff and the effect of COVID-19 on future graduates skills and competencies. Data was gathered on the experience of CTs mentoring students during the COVID-19 pandemic, the perceived effect on clinical placement and the skills of future graduates.

#### Results:

Data were collected from 59 CTs, (81%, n=48) from UKDN and (19%, n=11) UAE . 46% of respondents (n=27) reported that COVID-19 had a negative impact on clinical practical

experience. However, 54% (n=32) identified COVID-19 had no impact on student supervision/feedback or on clinical achievements. 19% (n=11) of respondents thought that students should not have been on clinical placement during the pandemic but a further 51% (n=30) were happy with the students on placement and expressed willingness to delegate work to students. Interestingly, 58% (n=34) of CTs suggested that future graduates may need a longer preceptorship after they graduate due to receiving decreased clinical experience during the pandemic. Overall, 78% (n=46) of respondents thought that students improved their clinical confidence by working directly with COVID-19 positive patients.

#### Conclusion:

The current study has identified conflicting opinions across CTs in different clinical departments. Whilst some felt that students should not be in the hospital during the pandemic, others reported that working directly with COVID-19 patients had a positive impact on students as it improved their clinical confidence. Despite the challenges presented by COVID-19, CTs were able to provide direct clinical supervision and feedback to students on clinical placement throughout the pandemic. Nevertheless, future graduates may need a longer preceptorship period due to decreased clinical experience during the pandemic.

#### Implications for practice:

Clinical placement should continue during subsequent COVID-19 pandemic waves or future pandemics to ensure development of skills in resilience and adaptability. Underdeveloped skills due to a decreased range of examinations can be rectified when any wave of the infection subsides by providing tailored training based on students' needs.

#### Keywords

COVID-19; Radiography; healthcare worker; student education; mental health/ wellbeing; clinical tutor

## Introduction

Since the original outbreak in China, COVID-19 spread globally and posed challenges for educational institutions and healthcare professionals worldwide. Many countries found demand for their health services increased dramatically, (including radiography and radiology), and in some cases services became overwhelmed; clinical practices changed, and radiography student training was impacted in various ways<sup>1-5</sup>. As key frontline Health Care Workers (HCW),

radiographers are involved in imaging COVID-19 patients to ensure the correct patient pathway is followed and appropriate clinical decisions are implemented.

Guidance on best practice for infection control has changed regularly over the course of the pandemic, and the statistics of infection transmission and deaths among HCW, including radiographers caused great alarm<sup>6-9</sup>. In this rapidly changing environment student training was impacted, some placements were cancelled or curtailed, elective placements opportunities lost, and where placements resumed, they involved novel ways of working e.g simulation software or university practicals<sup>1,3,4,10</sup>. Earlier research into previous recent pandemics such as Severe Acute Respiratory Syndrome (SARS) found that HCWs who help maintain services during pandemics and epidemics often suffer increased workloads and stress, which can affect their mental health<sup>7,11</sup>.

It is evident that the COVID-19 pandemic has had an impact on the health care system and educational institutes globally. Understanding the impact on the clinical training of students' is crucial for the radiography community to enable strategic planning for the future. Radiography professional bodies need to evaluate different approaches taken in different countries, assess outcomes and determine best practice for future waves of COVID-19. This is especially important as current experts have predicted that the next wave of the pandemic has already started and the same difficulties as before may arise<sup>12,13,14</sup>. By investigating the changes in practice placement and how competences gained through placement can be met, student training can be maintained to allow graduates to begin their careers and maintain the workforce. CTs are essential members of the teaching team who are either based solely in the clinical department or the clinical centre to facilitate students learning<sup>15</sup>. CTs are responsible for supervising, mentoring and assessing radiography students on clinical placement and can provide a unique and valuable insight into the impact of changes to placement and practice due to COVID-19. More recently, research in the form of systematic reviews, have reported that COVID-19 has impacted healthcare worker's mental health and wellbeing in the form of burnout, stress, anxiety, insomnia, and depression<sup>1,7,11,16</sup>. The rationale for this study is the paucity of research focusing on the experiences and wellbeing of radiography students and their CTs during the pandemic. Studies evaluating the impact of the COVID-19 pandemic on students clinical placement will help identify the best approach for overcoming difficulties in future waves of the pandemic and moving forward beyond the pandemic. Moreover, understanding the current experience will provide the

radiography community with the knowledge to prepare for similar future pandemics. Therefore, the aim of this study was to explore the perceptions and experiences of CTs and their insight into student experiences attending clinical placement during the COVID-19 pandemic. It has been hypothesised that the COVID-19 pandemic had a wholly negative impact on the clinical experience and training of undergraduate radiography students.

## Methods

Ethical permission was sought and granted from the Research Ethics Committees in XXX university in United Arab Emirates (UAE) and XXX University in the UK and (ID: 21-04-12-02), (ID:21/0032). An online survey was constructed using Google Form's (Google, Mountain View, CA).The UK Devolved Nations (UKDN) and the UAE were compared for their similarities in delivery based on individual 'rules of engagement' devised by their various health departments, relative population sizes and recognised similarity in course provision in the UAE, as assessed by the College of Radiographers.

The survey was devised following four online virtual discussion meetings involving radiography educators and clinical tutors from across the UAE and the UKDN namely Scotland, Wales and Northern Ireland. Representatives from each country identified 4 main areas of difficulty encountered delivering radiography programmes during the COVID\_19 pandemic i.e. (i) experience of students, (ii) impact on students' clinical placement, (iii) attitude of clinical staff towards students being on placement and (iv) the effect of COVID-19 on future graduates skills and competencies. Items were discussed, reviewed and edited leaving the final survey with 6 sections (1) collected data on demographic information, the remaining sections investigated the clinical tutors perspective of the following (2) experience of students during the pandemic using a 5 Likert scale (strongly agree to strongly disagree), (3) the impact on students' clinical placement. The responses were in terms of "negatively impacted", "no impact", "not applicable", "positively impacted" and "mixed impact", (4) the experience of the wider clinical staff towards students on placement using a 5 Likert scale (strongly agree to strongly disagree), (5) the effect of COVID-19 on future graduates and the responses were in a 5 Likert scale (strongly agree to strongly disagree), and (6) collected binary data (Yes/No responses) about availability of tutorials and lecture delivery during the clinical placement. The CTs confidence in securing the relevant clinical experience for

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students supervised during the COVID-19 pandemic was evaluated in a scale of 0-10 with 0 = not confident and 10 = most confident. Initially, a pilot study was conducted with five CTs in the respective institutions with a range of 5-20 years clinical experience. minimal language edits were made to avoid ambiguity. Participants of the pilot study were not included in the main study.

Data was gathered from the CTs across the UKDN and UAE. The inclusion criteria included CTs who had supervised radiography students' clinical placement during the COVID-19 pandemic. Data collection was completed in a 6-week period (June-July 2021). The link to the online survey was shared with CTs via email and a reminder was sent at the end of the fourth week. Participants were provided with an electronic information sheet and consent form for participation in the study that enabled them to click to authorise informed consent before completing the survey.

### **Data Analysis**

Analysis was completed utilising Microsoft Office Excel 2013, and SPSS Statistics for Windows, Version 28. Armonk, NY. The basic descriptive statistics for all questions and responses were calculated via SPSS. Data was collected using a Likert scale for perception and the scores of individual items in the group were summed and ANOVA was conducted thereafter to the total score. Inferential statistics, ANOVA, was used to compare the relationship between the perceptions of the impact of COVID-19 on students' clinical experience among the CTs.

### **Results**

#### **Demographic information**

CTs from the UKDN (81%, n=48) and the UAE (19%, n=11) participated in this survey. 92% (n=54) were CTs for diagnostic radiography and 8% (n=5) were for radiotherapy. 71% (n=42) of the CTs were from the National Health service (NHS) and 31% (n=18) were employed by universities (Table 1).

#### **Experience of students**

Table 2 shows CTs perceptions of students' clinical experience during COVID-19. The majority of the CTs, 75% (n=44), agreed students were worried that loved ones could get sick. Of the

participants 58% (n=34) thoughts that students were stressed about working with COVID-19 positive cases. 91% (n=10) and 69% (n=33) of CTs thought that students felt vulnerable whilst working in the clinical department in the UAE and UKDN, respectively. 91% (n=10) and 50% (n=24) of the participants thought that students were stressed about working with COVID-19 positive cases in the UAE and UKDN, respectively (Table 2).

### **Impact on students' clinical placement**

Table 3 illustrates the CTs thoughts on the impact of COVID-19 on clinical placement. Only 39% (n=23) felt that the pandemic had a negative impact on the completion of practical clinical assessment, whilst 46% (n=27) stated there were no impact on student induction into the department. 46% (n=27) identified a negative impact of COVID-19 on the development of practical clinical experience and skills, with 34% (n=20) CTs identifying a negative impact on the development of professional skills. Of the CTs, 54% (n=26) and 55% (n=6) stated that COVID-19 had no impact on providing clinical supervision and feedback from UKDN and UAE, respectively (Table 3).

### **Experience of clinical staff towards students**

Figure 1 - A bar chart illustrates the CTs thoughts on the experience of other clinical staff about radiography students attending clinical training during COVID-19. It shows that CTs (44%, n=26) indicated that other clinical staff agreed that students should not be in the clinical department during the pandemic. When asked if the staff were too busy to be worried about teaching students, 42% (n=25) of CTs agreed and 51% (n=30) disagreed. 73% (n=8) of the CTs in the UAE agreed that they were too busy compared to 35% (n=17) in the UKDN. 51% (n=30) of CTs agreed that the other clinical staff were delighted to have the students available for extra help and 42% (n=25) were keen to delegate work to the students when the department was exceptionally busy (Figure-1).

### **Effect of COVID-19 on future graduates**

Figure 2 illustrates CTs thoughts about the impact of COVID-19 on future graduates. It shows that 58% (n=34) of CTs identified that the lack of clinical experience and range of examinations experienced during the COVID-19 pandemic meant that radiography graduates would require a longer period of preceptorship post qualification. In UKDN, (75%, n=36) CTs felt that working with COVID-19 patients had a positive impact as it improved the clinical confidence of students compared to (91%, n=11) in the UAE. (Figure-2).

#### **Availability of Tutorial and lecture delivery**

70% of all (n=41) CTs used simulation as a form of clinical education whilst still in the clinical department, and 31% (n=18) used clinical simulation as an alternative to clinical education and delivered it in the university setting (figure 3) -Indeed, 94% (n=45) of CTs in the UKDN and 64% (n=7) in the UAE identified that face-to-face clinical education, using appropriate PPE and working directly with patients, including COVID-19 positive patients, continued throughout the duration of clinical placement (Figure-3).

The CTs' confidence in ability to secure appropriate clinical experience for students during the COVID-19 pandemic was evaluated using a scale of 0-10 with 10 being most confident. 27.8% (n=16) of the CT's selected a score of 8; the lowest scores were 0 and 2 given by 1.7% (n=1) and 3.5% (n=2) of CTs, respectively (Figure 4).

In the evaluation of the thoughts CTs had about the impact of COVID-19 on students clinical training, the ANOVA test concluded that there were equal means of scores across material taught in the university (via practical) ( $p = 0.42$ ) and that programme content taught in the clinical department ( $p=0.84$ ); consequently it was deduced that there was no impact on the above variables. Age of CT's was borderline statistically significant in their thoughts about impact of COVID-19 on students clinical training ( $p=0.06$ ).

T-test was conducted to compare if CTs believed if there was a difference in the degree of student concern in the UKDN compared with the UAE about working in the COVID-19 environment on placement. In the UKDN, CTs believed students were more worried with a mean score of ( $\mu=15.20$ ) than those from the UAE ( $\mu=12.09$ )  $p=0.017$ .

A one-way ANOVA test was conducted to statistically analyse the variation in the perception of the impact of COVID-19 on students' clinical experience among the CTs within UKDN. It was concluded that there is a statistically significant difference in their means ( $p=0.016$ ) where the mean of the participants from the Scotland ( $\mu=25.33$ ) was higher compared to the mean for those in Wales ( $\mu=24.60$ ) and Ireland ( $\mu=22.41$ ). The sample size for the UAE was not sufficient to conduct statistical analysis.

## **Discussion:**

### **Experience of students**

COVID-19 has resulted in significant changes to the provision of education for HCW's<sup>17,18</sup> with effects reported on clinical education across a wide range of healthcare programs<sup>19-21</sup>. Such changes have included shortened clinical placements, as students have been withdrawn from placement at peak periods of COVID-19 infection<sup>22</sup>, and a limit in the range of non-COVID-19 clinical presentations<sup>1,23</sup>. A loss of clinical placement and reduced clinical experience have been identified as significant disadvantages in the provision of clinical education, as students may fail to achieve key clinical skills<sup>20,24,25</sup>. The current study identified that 46% ( $n=27$ ) of CTs felt there was no negative impact on induction and orientation to clinical placement. Furthermore, 46% ( $n=27$ ) of CTs reported that COVID-19 had a negative impact on practical clinical experience, however, 34% ( $n=20$ ) reported a negative impact on the development of professional skills. Nine (15%) CTs identified a positive impact of COVID-19 on clinical education and the development of clinical skills during adverse and challenging conditions. The ability of students to develop and maintain their clinical skills during the COVID-19 pandemic reflects the resilience of the profession and illustrates the flexibility and adaptability shown by radiographers in managing a changing COVID-19 clinical environment<sup>23,26</sup>. The fact that the pandemic has had a minimal negative impact on practical and professional experience is potentially a direct result of the CTs dedication and remaining able to provide direct clinical supervision and feedback to students on clinical placement. Indeed, 54% ( $n=32$ ) of CTs identified that despite the presence of COVID-19 within hospital facilities, student supervision and feedback on clinical achievements, remained

possible. Overall 34% (n=20) of CTs identified that COVID-19 had a negative impact on the clinical competence of the students whilst 41% (n=24) of CTs felt that it had a negative impact and on their confidence in clinical ability. Clinical assessments progressed as normal however, 39% (n=23) of CTs identified that COVID-19 had a negative impact on their ability to get assessments completed. This compares with other health professional degree programmes who reported challenges in completing their clinical assessments<sup>27</sup>.

While COVID-19 may have resulted in challenges in communication, mask wearing and social distancing<sup>23,26</sup>, with both clinical colleagues, fellow students, and patients, only 17% (n=10) of CTs identified that COVID-19 had a negative impact on communication. Being able to maintain good communication and promoting communication within the radiography team has been associated with a more positive outcome of COVID-19<sup>28</sup>. The negative impact of the COVID-19 pandemic on the mental health of students and clinical staff has been a point of concern, with research identifying evidence of increased stress, anxiety and burnout associated with clinical work during the pandemic<sup>26,28</sup>. Such increased levels of stress and anxiety have been associated with increased workload, changing shift patterns, fear of contracting COVID-19 themselves or passing COVID-19 to family and friends<sup>29,30</sup>. The current study identifies that 37% (n=22) of CTs agreed with such studies<sup>29-32</sup>, suggesting that COVID-19 has had a negative impact on the mental health of students internationally. With more mature students entering the profession, concerns such as caring responsibilities, of transmission of COVID-19 to family, friends, and children have been expressed to CTs.

### **Experience of clinical staff**

The pandemic has resulted in increased pressure on clinical departments which has impacted the experience that student radiographers have received and influenced how the clinical staff in those departments feel about students being on placement. Students learn “what” to do in the academic setting but learn “how” to do it in the clinical practice setting. This is achieved, through a process of emulation of the radiographers they work alongside, and the students’ professional practice is developed through these social and professional bonds formed in the practicum<sup>33</sup>. Whilst it is encouraging that only 19% (n=11) of respondents agreed or strongly agreed with the statement that students should not have been on placement at the height of the pandemic this needs to be

explored for the future. If CTs think students should not be on placement it may feel like an additional burden and may not be as dedicated to the student experience as they could be. The results of this study showed that clinical placement, assessments and module delivery did progress successfully on an international scale during the worst of the pandemic. It is imperative that clinical placements continue to be delivered where possible in similar circumstances in the future to ensure workforce delivery is maintained. In addition, both universities and hospitals need to build on the work already done to ensure the return to placements is as smooth and safe as possible<sup>3</sup>

It is therefore possible that HCW staff felt that students in the department were an additional hindrance and made social distancing more difficult in small clinical rooms. It is therefore important to highlight the significant contribution made by students during the pandemic and their need to gain valuable clinical experience during these challenging times. Reassuringly, 51% (n=30) of CT's responded that they were keen to delegate work to students on placement when departments were busy during the pandemic. This work will provide the student with a suitable learning experience that may have a positive effect on their confidence when examining patients.

### **Effect on future graduates**

While COVID-19 has been identified as having a negative impact on healthcare students in the development of clinical skills<sup>20,24,27</sup>, the current study has identified a positive impact in the development of clinical confidence for future graduates. Forty-six (78%) CTs identified that clinical placement during the COVID-19 pandemic had a positive impact on clinical confidence. Studies of qualified radiographers working during the COVID-19 pandemic have also identified positive outcome in terms of flexibility and willingness to adapt clinical working patterns at short notice<sup>1</sup>. Nevertheless, the current study found that future graduates may need longer preceptorship due to decreased clinical experience during the pandemic. Therefore, underdeveloped skills due to a decreased range of examinations can be captured when the wave of the pandemic subsides.

The challenge of communication with patients and professional colleagues, including mask wearing and social distancing has been identified as a negative impact of COVID-19<sup>23,26</sup>. However, developing a professional resilience is supportive in times of a rapidly changing clinical

environment, as experienced during the COVID-19 pandemic<sup>26</sup>. Only 29% (n=17) CTs felt that the impact of COVID-19 has resulted in a less resilient workforce. Sim et al suggest that the experience of radiographers working in clinical departments undergoing rapid organisational changes in response to COVID-19 may result in radiographers with improved skills of flexibility and resilience<sup>23</sup>.

### **Tutorial and lecture delivery**

Changing the delivery of education, both academic and clinical, has become the norm during the COVID-19 pandemic<sup>24</sup>. Radiology departments have faced significant challenges as COVID-19 related workload has increased. While non-COVID-19 clinical work has reduced, and staffing has been impacted by staff self-isolation, redeployment etc impacting on the clinical education of student radiographers<sup>22</sup>.

Clinical simulation and the use of virtual cases, has been identified as a very reliable tool for clinical education and an appropriate alternative to patient contact<sup>34,35</sup>. Indeed, the sudden impact of COVID-19 necessitated an immediate move to clinical simulation and virtual patients as a form of clinical education as radiology departments focused on the prime function of COVID-19 management including the removal of students from clinical placement<sup>36</sup>. Such evidence of the successful use of clinical simulation as an alternative to face-to-face patient interaction<sup>34-36</sup>, was reflected in the current study as 69% (n=41) of CTs used clinical simulation as replacement for patient based practical education. However, only 27% (n=16) of CTs used clinical simulation as an alternative to clinical education in the university setting. Such limited clinical simulation in the university setting may be because of the challenges of maintaining the university simulation laboratory<sup>37</sup>. Again, while evidence suggests that online asynchronous educational material has been used successfully in the COVID-19 pandemic<sup>17,36</sup>, CTs in the study were reluctant to replace clinical education with online asynchronous education, only 29% (n=17) of CTs used online education as an alternative to patient facing clinical education. Nevertheless, in this study, 28% of the CT's (n=16) were confident to secure a good clinical experience for supervised students during the COVID-19 pandemic.

CTs thoughts about the impact of COVID-19 on students clinical training was borderline statistically significant with increasing age of CT's (p=0.06). Studies to date have reported that

fear of COVID-19 had a significant relationship with age and was not related to work place<sup>38,39</sup>. Respondents from the UKDN believed UK students were more worried than those from the UAE. However, this finding can be due to the reported number of COVID-19 cases at the time of the study. The data of the current study were collected in June and July of 2021, when the number of cases were rapidly increasing. In this period when the present study conducted, the number of confirmed positive cases in the UAE and UK were around 2,100 and from 3,000 to 26,000-cases per day, respectively<sup>40</sup>

### **Limitation of the study**

This study presents the perceptions CT's, however their thoughts about students might not be an exact match with the actual students' perception. The study was conducted a year after the start of the COVID-19 pandemic, and because we had been responding to the virus for a longer than expected period, the experiences and perceptions were likely to be different to those reported in the first wave. Also, the results of the study are representative of the UKDN and UAE only. Nevertheless, the authors believed that the aim of the study outweighs this limitation, as the main aim is to understand the continued impact of COVID-19 on the course of study and future careers for radiography students

### **Conclusion**

Although academic staff continue to meet the educational demand innovatively, it should be borne in mind that the effects of a disturbed educational and clinical experience are likely to have a negative effect on future radiographers. The current study highlighted that the new graduate may require a longer period of preceptorship post qualification to overcome gaps in clinical training. Nevertheless, the overall clinical competence and confidence of students remained high and was protected from the impact of COVID-19 and appears to have benefitted according to the impressions of the CTs. Undergraduate radiography and radiotherapy students are an asset in the clinical department and have been shown to be a reliable members of the workforce during a global pandemic. Clinical placement, with appropriate protective equipment, should continue during subsequent waves of the COVID-19 pandemic (or future pandemics) to ensure the continued training of the future workforce as they develop valuable skills in resilience and adaptability.

Future studies are needed to assess underdeveloped skills during the COVID-19 pandemic to enable implementation of coping strategies for both students and CTs. The experience of working in the clinical department during COVID-19 had improved preparedness, knowledge and skills that will be invaluable if another pandemic occurs.

## References

1. Akudjedu TN, Mishio NA, Elshami W, et al. The global impact of the COVID-19 pandemic on clinical radiography practice: A systematic literature review and recommendations for future services planning. *Radiography*. 2021;27(4):1219-1226. doi:10.1016/J.RADI.2021.07.004
2. Tay YX, Cai S, Chow HC, Lai C. The needs and concerns of clinical educators in radiography education in the face of COVID-19 pandemic. *J Med Imaging Radiat Sci*. 2021;52(1):3-8. doi:10.1016/J.JMIR.2020.10.004
3. Tay YX, Sng LH, Chow HC, Zainuldin MR. Clinical placements for undergraduate diagnostic radiography students amidst the COVID-19 pandemic in Singapore: Preparation, challenges and strategies for safe resumption. *J Med Imaging Radiat Sci*. 2020;51(4):560-566. Accessed November 20, 2021. <https://www.sciencedirect.com/science/article/pii/S1939865420302241>
4. Blackburn NE, Marley J, Kerr DP, Martin S, Tully MA, Cathcart JM. Transitioning into the workforce during the COVID-19 pandemic: Understanding the experiences of student diagnostic radiographers. *Radiography*. 2022;28(1):142-147. doi:10.1016/J.RADI.2021.09.005
5. Fadden SM, Flood T, Shepherd P, Radiography TG-. 2022 undefined. Impact of COVID-19 on service delivery in radiology and radiotherapy. *Elsevier*. Accessed June 28, 2022. <https://www.sciencedirect.com/science/article/pii/S1078817422000414>
6. Flood T, McFadden S, Shepherd P. The impact of COVID-19 on the mental health of radiography staff and managers in Northern Ireland, UK: The radiography managers' perspective. *Radiography*. 2022;0(0). doi:10.1016/J.RADI.2022.06.011
7. Cabarkapa S, Nadjidai SE, Murgier J, Ng CH. The psychological impact of COVID-19 and other viral epidemics on frontline healthcare workers and ways to address it: A rapid systematic review. *Brain, Behav Immun - Heal*. 2020;8:100144. doi:10.1016/j.bbih.2020.100144
8. Cook TM. Personal protective equipment during the coronavirus disease (COVID) 2019 pandemic – a narrative review. *Anaesthesia*. 2020;75(7):920-927.

doi:10.1111/ANAE.15071

9. Sheraton M, Deo N, Dutt T, Surani S, Hall-Flavin D, Kashyap R. Psychological effects of the COVID 19 pandemic on healthcare workers globally: A systematic review. *Psychiatry Res.* 2020;292:113360. doi:10.1016/J.PSYCHRES.2020.113360
10. An investigation of the long term impact of the COVID-19 pandemic on the education and clinical development of Diagnostic/Therapeutic Radiography students in Northern Ireland. — Ulster University. Accessed June 28, 2022.  
<https://pure.ulster.ac.uk/en/publications/an-investigation-of-the-long-term-impact-of-the-covid-19-pandemic>
11. Chau RMW, Tsui AYY, Wong EYW, et al. Effectiveness of a structured physical rehabilitation program on the physical fitness, mental health and pain for Chinese patients with major depressive disorders in Hong Kong—a randomized controlled trial with 9-month follow-up outcomes. *Disabil Rehabil.* Published online 2020.  
doi:10.1080/09638288.2020.1800833
12. The Guardian. Don't be complacent, another Covid wave is coming. Here's how we can manage it | Devi Sridhar | The Guardian. Published 2022. Accessed June 29, 2022.  
<https://www.theguardian.com/commentisfree/2022/jun/13/rise-covid-cases-what-we-know-so-far>
13. The Guardian. Is UK at start of new Covid wave driven by BA.4 and BA.5 subvariants? | Coronavirus | The Guardian. Published 2022. Accessed June 29, 2022.  
<https://www.theguardian.com/world/2022/jun/14/uk-at-start-of-new-covid-wave-driven-by-ba4-and-ba5-new-data-suggests>
14. McConnell J, McFadden S, Floyd M, et al. Late non-physiological impacts of Covid-19 on radiography education. *Radiography.* 2021;27(3):987-988.  
doi:10.1016/J.RADI.2021.04.006
15. Society of Radiographers. Roles and Responsibilities in Clinical Education. Society of Radiographers. Published 2011. Accessed June 20, 2022. <https://www.sor.org>
16. Elshami W, Akudjedu TN, Abuzaid M, et al. The radiology workforce's response to the COVID-19 pandemic in the Middle East, North Africa and India. *Radiography.*

2021;27(2):360-368. doi:10.1016/j.radi.2020.09.016

17. Elshami W, Taha MH, Abuzaid M, Saravanan C, Al Kawas S, Abdalla ME. Satisfaction with online learning in the new normal: perspective of students and faculty at medical and health sciences colleges. *Med Educ Online*. 2021;26(1). doi:10.1080/10872981.2021.1920090
18. Taha MH, Abdalla ME, Wadi M, Khalafalla H. Curriculum delivery in Medical Education during an emergency: A guide based on the responses to the COVID-19 pandemic. *MedEdPublish*. 2020;9(1). doi:10.15694/MEP.2020.000069.1
19. Courtier N, Brown P, Mundy L, Pope E, Chivers E, Williamson K. Expectations of therapeutic radiography students in Wales about transitioning to practice during the Covid-19 pandemic as registrants on the HCPC temporary register. *Radiography*. 2021;27(2):316-321. doi:10.1016/J.RADI.2020.09.001
20. Darras KE, Spouge RJ, De Bruin ABH, et al. Undergraduate radiology education during the COVID-19 pandemic: a review of teaching and learning strategies. *journals.sagepub.com*. 2021;72(2):194-200. doi:10.1177/0846537120944821
21. Smith CA. Covid-19: Healthcare students face unique mental health challenges. *BMJ*. 2020;369. doi:10.1136/bmj.m2491
22. Rainford LA, Zanardo M, Buissink C, et al. The impact of COVID-19 upon student radiographers and clinical training. *Radiography*. 2021;27(2):464-474. doi:10.1016/j.radi.2020.10.015
23. Sim WY, Chen RC, Aw LP, et al. How to safely and sustainably reorganise a large general radiography service facing the COVID-19 pandemic. *Radiography*. 2020;26(4):e303-e311. doi:10.1016/j.radi.2020.05.001
24. Ferrel MN, Ryan JJ. The Impact of COVID-19 on Medical Education. *Cureus*. 2020;12(3):7492. doi:10.7759/CUREUS.7492
25. Harries AJ, Lee C, Jones L, et al. Effects of the COVID-19 pandemic on medical students: a multicenter quantitative study. *BMC Med Educ*. 2021;21(1). doi:10.1186/S12909-020-02462-1

26. Lewis S, Mulla F. Diagnostic radiographers' experience of COVID-19, Gauteng South Africa. *Radiography*. 2021;27(2):346-351. doi:10.1016/J.RADI.2020.09.009
27. Rainbow S, Dorji T. Impact of COVID-19 on medical students in the United Kingdom. *GERMS*. 2020;10(3):240-243. doi:10.18683/germs.2020.1210
28. Pereira JM, Silva C, Freitas D, Salgado A. Burnout among Portuguese radiographers during the COVID-19 pandemic. *Radiography*. 2021;27(4):1118-1123. doi:10.1016/j.radi.2021.05.001
29. Ruiz C, Llopis D, Roman A, Alfayate E, Radiography IH-P-, 2021 U. Spanish radiographers' concerns about the COVID-19 pandemic. *Radiography*. 2021;27. Accessed November 20, 2021. <https://www.sciencedirect.com/science/article/pii/S107881742030211X>
30. Yasin B, Barlow N, Milner R. The impact of the Covid-19 pandemic on the mental health and work morale of radiographers within a conventional X-ray department. *Radiography*. 2021;27(4):1064-1072. doi:10.1016/j.radi.2021.04.008
31. Akudjedu TN, Botwe BO, Wuni AR, Mishio NA. Impact of the COVID-19 pandemic on clinical radiography practice in low resource settings: The Ghanaian radiographers' perspective. *Radiography*. 2021;27(2):443-452. doi:10.1016/j.radi.2020.10.013
32. Saravanan C, Mahmoud I, Elshami W, Taha MH. Knowledge, Anxiety, Fear, and Psychological Distress About COVID-19 Among University Students in the United Arab Emirates. *Front Psychiatry*. 2020;11. doi:10.3389/FPSYT.2020.582189
33. Gherardi S. Practice-Based Theorizing on Learning and Knowing in Organizations. *Organization*. 2000;7(2):211-223. doi:10.1177/135050840072001
34. Ekert JO, Luchesa Smith A, Ramsey CL, et al. Medical student-led simulation in COVID-19 crisis. *Clin Teach*. 2021;18(3):252-257. doi:10.1111/tct.13308
35. Rose S. Medical Student Education in the Time of COVID-19. *JAMA - J Am Med Assoc*. 2020;323(21):2131-2132. doi:10.1001/jama.2020.5227
36. Stoehr F, Müller L, Brady A, et al. How COVID-19 kick-started online learning in medical education-The DigiMed study. *PLoS One*. 2021;16(9 September).

doi:10.1371/journal.pone.0257394

37. Castro M e, Healthcare GL-S in, 2020 undefined. Simulation in Healthcare Education During and After the COVID-19 Pandemic. *journals.lww.com*. Published online 2020. doi:10.1097/SIH.0000000000000492
38. Moussa ML, Moussa FL, Alharbi HA, et al. Fear of Nurses During COVID-19 Pandemic in Saudi Arabia: A Cross-Sectional Assessment. *Front Psychol*. 2021;12:4545. doi:10.3389/FPSYG.2021.736103/BIBTEX
39. Ali SM, Nausheen S. Psychosocial Impact of COVID-19 on Healthcare Workers: A cross-sectional survey from Pakistan. *Sultan Qaboos Univ Med J*. 2022;22(1):82. doi:10.18295/SQUMJ.4.2021.067
40. Our world in data. Coronavirus Pandemic Country Profile. doi:10.1787/e7d7b426-en

Table 1: Demographic Information

		UK		UAE		Total	
		n	%	n	%	n	%
Course of study	Diagnostic Radiography	43	72.9%	11	18.6%	54	91.5%
	Radiotherapy	5	8.5%	0	0.0%	5	8.5%
Gender	Female	36	61.0%	8	13.6%	44	74.6%
	Male	11	18.6%	3	5.1%	14	23.7%
	Prefer not to say	1	1.7%	0	0.0%	1	1.7%
Age	20-30 years	8	13.6%	4	6.8%	12	20.3%
	31-40 years	20	33.9%	3	5.1%	23	39.0%
	41-50 years	11	18.6%	4	6.8%	15	25.4%
	51-60 years	6	10.2%	0	0.0%	6	10.2%
	More than 60 years	3	5.1%	0	0.0%	3	5.1%
Work	University / Teaching Hospital	23	39.0%	8	13.6%	31	52.5%
	District Hospital	20	33.9%	3	5.1%	23	39.0%
	Community Hospital	5	8.5%	0	0.0%	5	8.5%
	NHS / Government	37	62.7%	4	6.8%	41	69.5%
	University	5	8.5%	7	11.9%	12	20.3%
	Joint Contract	6	10.2%	0	0.0%	6	10.2%
Year of study	1st year	46	78.0%	0	0.0%	46	78.0%
	2nd year	38	64.4%	8	13.6%	46	78.0%
	3rd year	23	39.0%	22	37.3%	45	76.3%
	4th year	17	28.8%	18	30.5%	35	59.3%
Country / Region		48	81.4%	11	18.6%	-	-

		UK			UAE			Total		
		Agree	Undecided	Disagree	Agree	Undecided	Disagree	Agree	Undecided	Disagree
Felt vulnerable	n	33	4	11	10	0	1	43	4	12
	%	68.8%	8.3%	22.9%	90.9%	0.0%	9.1%	72.9%	6.8%	20.3%
Worried about people they love or care	n	37	8	3	7	3	1	44	11	4
	%	77.1%	16.7%	6.3%	63.6%	27.3%	9.1%	74.6%	18.6%	6.8%
Stressed to work with confirmed positive cases	n	24	16	8	10	1	0	34	17	8
	%	50.0%	33.3%	16.7%	90.9%	9.1%	0.0%	57.6%	28.8%	13.6%
Some of them refuse to work with confirmed positive cases	n	10	10	28	6	4	1	16	14	29
	%	20.8%	20.8%	58.3%	54.5%	36.4%	9.1%	27.1%	23.7%	49.2%
Meticulous about PPE	n	37	7	4	11	0	0	48	7	4
	%	77.1%	14.6%	8.3%	100.0%	0.0%	0.0%	81.4%	11.9%	6.8%
Not worried about COVID-19	n	4	12	32	0	1	10	4	13	42
	%	8.3%	25.0%	66.7%	0.0%	9.1%	90.9%	6.8%	22.0%	71.2%
Not remotely concerned and confident to get on	n	5	12	31	2	2	7	7	14	38
	%	10.4%	25.0%	64.6%	18.2%	18.2%	63.6%	11.9%	23.7%	64.4%
Situation is exaggerated	n	1	8	39	0	3	8	1	11	47
	%	2.1%	16.7%	81.3%	0.0%	27.3%	72.7%	1.7%	18.6%	79.7%

Table 2: Thoughts of CTs on students' experience during COVID-19

		Negatively		No Impact		Not applicable		Positively		Mixed	
		n	%	n	%	n	%	n	%	n	%
Induction into the department	UKDN	14	29.2%	24	50.0%	2	4.2%	6	12.5%	2	4.2%
	UAE	4	36.4%	3	27.3%	0	0.0%	1	9.1%	3	27.3%
	Total	18	30.5%	27	45.8%	2	3.4%	7	11.9%	5	8.5%
Practical experience and development of skills	UKDN	21	43.8%	5	10.4%	2	4.2%	7	14.6%	13	27.1%
	UAE	6	54.5%	1	9.1%	1	9.1%	2	18.2%	1	9.1%
	Total	27	45.8%	6	10.2%	3	5.1%	9	15.3%	14	23.7%
Professional experience and development of skills	UKDN	15	31.3%	6	12.5%	2	4.2%	10	20.8%	15	31.3%
	UAE	5	45.5%	0	0.0%	1	9.1%	4	36.4%	1	9.1%
	Total	20	33.9%	6	10.2%	3	5.1%	14	23.7%	16	27.1%
Communication and development of interpersonal skills	UKDN	9	18.8%	16	33.3%	2	4.2%	15	31.3%	6	12.5%
	UAE	1	9.1%	5	45.5%	0	0.0%	3	27.3%	2	18.2%
	Total	10	16.9%	21	35.6%	2	3.4%	18	30.5%	8	13.6%
Clinical supervision and feedback	UKDN	8	16.7%	26	54.2%	2	4.2%	6	12.5%	6	12.5%
	UAE	0	0.0%	6	54.5%	1	9.1%	3	27.3%	1	9.1%
	Total	8	13.6%	32	54.2%	3	5.1%	9	15.3%	7	11.9%
Ability to engage with students	UKDN	15	31.3%	16	33.3%	3	6.3%	8	16.7%	6	12.5%
	UAE	1	9.1%	5	45.5%	2	18.2%	2	18.2%	1	9.1%
	Total	16	27.1%	21	35.6%	5	8.5%	10	16.9%	7	11.9%
Completion of practical assessments	UKDN	19	39.6%	12	25.0%	3	6.3%	6	12.5%	8	16.7%
	UAE	4	36.4%	5	45.5%	1	9.1%	1	9.1%	0	0.0%
	Total	23	39.0%	17	28.8%	4	6.8%	7	11.9%	8	13.6%
Mental Wellbeing of self	UKDN	22	45.8%	8	16.7%	4	8.3%	4	8.3%	10	20.8%
	UAE	3	27.3%	2	18.2%	2	18.2%	0	0.0%	4	36.4%
	Total	25	42.4%	10	16.9%	6	10.2%	4	6.8%	14	23.7%
Mental Wellbeing of students	UKDN	19	39.6%	4	8.3%	4	8.3%	4	8.3%	17	35.4%
	UAE	3	27.3%	2	18.2%	1	9.1%	0	0.0%	5	45.5%
	Total	22	37.3%	6	10.2%	5	8.5%	4	6.8%	22	37.3%
Personal circumstances of students (e.g. caring responsibilities, )	UKDN	15	31.3%	10	20.8%	11	22.9%	2	4.2%	10	20.8%
	UAE	3	27.3%	2	18.2%	1	9.1%	2	18.2%	3	27.3%
	Total	18	30.5%	12	20.3%	12	20.3%	4	6.8%	13	22.0%
Clinical competence	UKDN	16	33.3%	11	22.9%	3	6.3%	5	10.4%	13	27.1%
	UAE	4	36.4%	5	45.5%	0	0.0%	1	9.1%	1	9.1%
	Total	20	33.9%	16	27.1%	3	5.1%	6	10.2%	14	23.7%
confidence in clinical ability	UKDN	20	41.7%	6	12.5%	3	6.3%	5	10.4%	14	29.2%
	UAE	4	36.4%	3	27.3%	0	0.0%	2	18.2%	2	18.2%
	Total	24	40.7%	9	15.3%	3	5.1%	7	11.9%	16	27.1%

Table 3: Thoughts of CTs on the impact of COVID-19 on clinical placement

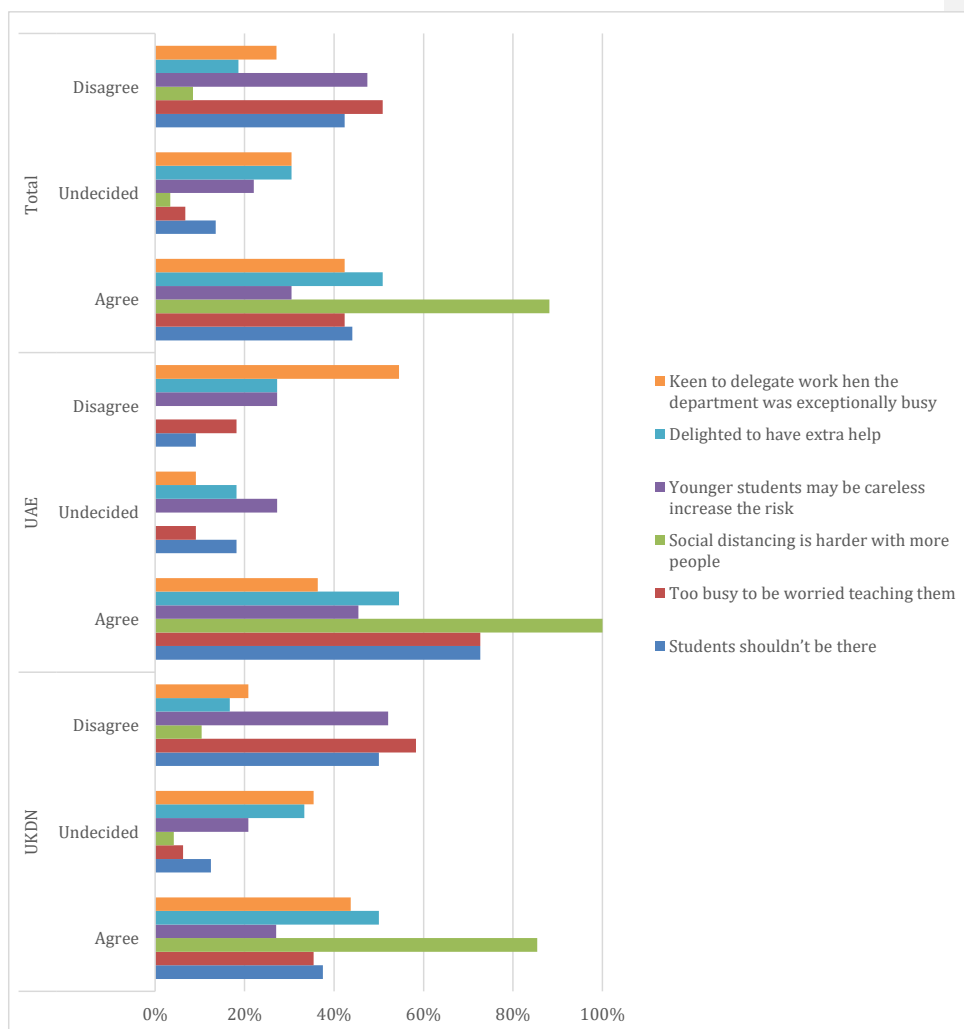


Figure 1: Thoughts of CTs on the experience of other clinical staff with radiography students having clinical training during COVID-19

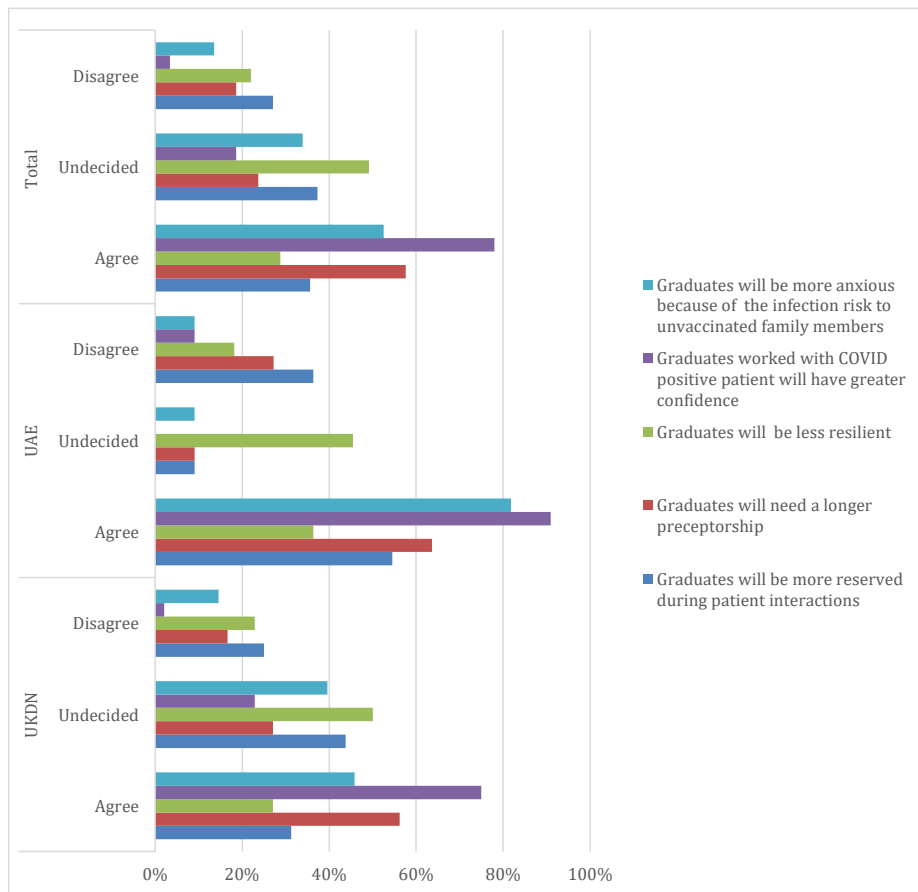


Figure 2: Thoughts of CTs on the effect on of COVID-19 on future graduates

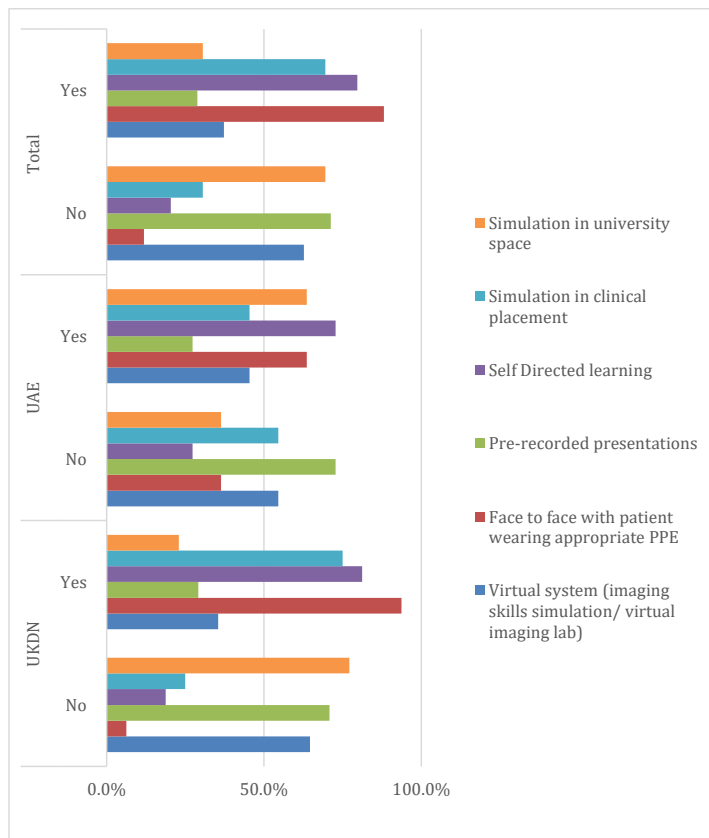


Figure 3: Experiences of CTs with tutorials and lectures delivered during the COVID-19 pandemic

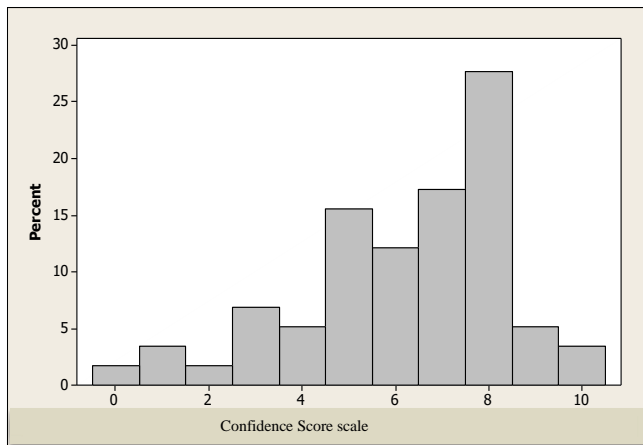


Figure 4: Confidence to secure a relevant clinical experience for students supervised during COVID-19