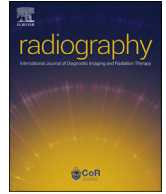




Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



The radiography students' perspective of the impact of COVID-19 on education and training internationally: a cross sectional survey of the UK Devolved Nations (UKDN) and the United Arab Emirates (UAE)



W. Elshami ^{a,*}, M.M. Abuzaid ^a, J. McConnell ^b, S. Stewart ^c, M. Floyd ^d, D. Hughes ^e,
C. McClintick ^f, K. Eckloff ^d, L. Leishman ^g, S. McFadden ^h

^a Medical Diagnostic Imaging Department, College of Health Sciences, University of Sharjah, Sharjah, United Arab Emirates

^b Leeds Teaching Hospitals NHS Trust, UK

^c Caledonian University, UK

^d Cardiff University, UK

^e Bangor University, UK

^f Queen Margaret University, UK

^g Robert Gordon University, UK

^h Diagnostic Radiography and Imaging School of Health Sciences, University of Ulster Shore Road Newtownabbey Co. Antrim, BT37 0QB, UK

ARTICLE INFO

Article history:

Received 12 April 2022

Received in revised form

15 June 2022

Accepted 12 July 2022

Available online 19 July 2022

Keywords:

COVID-19

Radiography

Training

Student education

Mental health/wellbeing

Student perspective

ABSTRACT

Introduction: The overnight change in hospital practice and service delivery during the COVID-19 pandemic raises the question whether undergraduate radiography students received an adequate clinical experience. Many students had their clinical placements cancelled, deferred or replaced with simulated learning. As a way of dealing with the pandemic some hospitals were dedicated to COVID-19 patients only resulting in many elective procedures being cancelled. Many patients also chose to stay away from the hospital out of fear of infection or the desire to reduce the burden on staff. This resulted in a limited range of examinations and clinical experience for those students who were able to complete their clinical placement.

Aim: This study aims to investigate the impact of COVID-19 on the education and training of radiography students internationally in the United Kingdom Devolved Nations (UKDN) and the United Arab Emirates (UAE), to determine any possible impact on their future careers.

Method: Ethical permission was sought and granted from the Research Ethics Committees (ID: 21-04-12-02 and ID:21/0032). An online survey was developed using Google Forms and link was shared with students via email.

Results: 262 students participated in the study [UAE (n = 60, 23%) and UKDN (n = 202, 77%)]. 72% stated that their clinical skills have improved and 82% were confident in the choice of radiography as a career. Participants from UAE displayed a higher tendency towards anxiety (p = 0.009). Students who were on clinical placements during the COVID-19 pandemic and worked with COVID-19 positive patients displayed less ongoing concern relating to COVID-19 (p = 0.004). 78% of the participants did not require wellbeing advice or request any type of wellbeing support from the higher education institutions (HEIs). Nevertheless, the study found that wellbeing of students was found to be negatively affected during the pandemic.

Conclusion: Completing clinical placement during the COVID-19 pandemic allowed the continuation of education as students were allowed to improve their skills, confidence and resilience in coping with uncertainties and challenges. Undergraduate students should not be excluded from the clinical department during subsequent waves of COVID-19 or future pandemics to ensure continued workforce planning is possible.

Implications for practice: HEIs should find solutions to compensate students for the loss of practical experience and skills due to the decreased number of patients in some areas of radiography practice.

* Corresponding author. Department of Medical Diagnostic Imaging, College of Health Sciences, University of Sharjah, P.O. Box 27272, Sharjah, United Arab Emirates
E-mail address: welshami@sharjah.ac.ae (W. Elshami).

Providing academic and career counselling can assist students achieve their professional objectives and decrease the risk of attrition and problems upon qualification.

© 2022 The College of Radiographers. Published by Elsevier Ltd. All rights reserved.

Introduction

The COVID-19 pandemic has presented many problems to health service delivery and ongoing education and training of healthcare staff. Many health disciplines reported the burden the pandemic has placed on clinical staff e.g. lack of personal protective equipment (PPE),¹ social distancing, emergency redeployment of clinical staff, lack of training for redeployed staff and failure to consider the skills of redeployed staff in new work areas.² This, in turn, has had a direct impact on the education and training of students. Consequently, Higher Education Institutions (HEIs) have reported difficulty in fulfilling training requirements for a range of different healthcare workers during the pandemic. Difficulties include a reduction in clinical experience due to reduced elective surgical cases,³ clinical rotations suspended,⁴ social distancing impacting on development of clinical skills,⁵ reduction or complete suppression of clinical training.⁶ These difficulties have accelerated the development and utilisation of online learning environments⁷ and in some cases led to a reduction in conventional lectures within clinically based teaching.⁸

In the United Kingdom (UK), Health Education England¹⁰ highlighted that the education and learning support of student allied health professionals was a priority during the pandemic to maintain a continued workforce and future supply line. NHS Education for Scotland (NES)¹¹ provided guidance at on face to face training, with HEIs and placement providers encouraged to undertake their own risk assessments before placement and ensure that wellbeing support was available for all staff and students.¹² In the United Arab Emirates (UAE), the National Emergency, Crisis, and Disaster Management Authority (NCEMA) was responsible for setting regulations for managing COVID-19. Schools were closed and changed to online learning in March 2020 and remained closed until the end of the academic year. From September 2020, schools utilised a blended learning approach to accommodate student training. UAE officially integrated a digital platform for COVID-19 testing that allowed the public to obtain COVID-19 test results on their smartphone and information on quarantine and isolation periods.¹³ However, variations in practice occurred internationally, across disciplines and amongst the different stages of undergraduate training. Some HEIs discontinued placement and refused to allow student/patient interactions,¹⁴ some placements were deferred for a few weeks/months, or used a blended placement model supplemented with simulation,¹⁵ whilst others recruited students into hospital-based roles before graduation.¹⁶ This variation in practice across countries will have led to a different placement experience for students with students graduating with different skills and competencies depending on the country they trained in.

As demand on clinical imaging continued to increase in the first phase of the pandemic, the UK Health and Care Professions Council (HCPC), who is responsible for regulating health and care professions in the UK including radiography, permitted final year students who had successfully passed all practical components of their training to join a temporary register which allowed them to practice before graduating.¹⁷ To protect the students, NHS England also introduced employment contracts whilst on placement. These provided employment protection which was inclusive of death in service.¹⁸ Similar approaches were adopted in Scotland across the non-medical professions with on-going guidance outlined in the letter of April 2021.¹⁹ Alternatively, service providers could offer a

work opportunity to support frontline services, which enabled students to be employed as support workers whilst being supported to achieve their required practice hours. This enabled a flow in the workforce and allowed academic progression to continue. Hence, the contribution that radiography students made to the front line workforce during COVID-19 pandemic cannot be underestimated and is worth remembering during future pandemics.

It is important to note that clinical placement is usually a challenging experience for undergraduate students,^{20,21} this would be without the additional burden of the unpredictable and challenging circumstances presented by the COVID-19 pandemic. Published data reports the clinical experiences of radiography students during the early stages of the pandemic,^{19,22–26} others have concentrated on final year graduates entering the workforce during the pandemic.^{27,28} However, there is limited information investigating the students' perceptions on what impact the pandemic had on their long term clinical education and training and how best to approach clinical placement delivery in the event of future waves of COVID-19 or subsequent pandemics.²⁹ The rationale for this study was to determine if clinical placements offered during the COVID-19 pandemic provided sufficient experience and clinical exposure to fulfil the required learning outcomes and to help inform the future delivery of undergraduate radiography programmes in the future.

Research aim

To investigate the impact of COVID-19 on the long-term clinical education and training of radiography students in the UK Devolved Nations (UKDN) and the United Arab Emirates (UAE).

Methods

Study context

Most studies frequently refer to the whole of the UK and often misrepresent the devolved nation communities of Northern Ireland, Scotland and Wales. In comparison with the UAE, the UKDN health services are delivered separately though may be strongly influenced by government entities such as Health Education England (HEE). However, there is recognition that specific requirements linked to governance demands from devolution may subtly require approaches outside the readily accessed guidelines from the larger organisations such as NHS England (NHSE) or HEE. The UAE is an Arabic country in Western Asia, it is located at the eastern end of the Arabian Peninsula and shares borders with Oman and Saudi Arabia. Health care services are provided through public and private facilities, regulated at the federal and local level. The service is governed by the Ministry of Health and Prevention (MOHAP) in the northern emirates, the Abu Dhabi Health Services Company (SEHA) in Abu Dhabi and Dubai Health Authority (DHA) in Dubai. The UAE population is 10 million (11.5% are Emirati citizens and 88.5% are expatriates).³⁰ Radiography education in the UAE is comparable to the UK and accredited and acknowledged by the Society & College of Radiographers (SCoR) and the European Federation of Radiographer Societies (EFRS). Consequently, due to the organisational and population demands, the UKDN and UAE were perceived as appropriate comparison partners to determine how clinical placement difficulties were addressed internationally.

In addition, as the COVID-19 pandemic was a global problem it would be beneficial to learn from geographically distinct countries to learn from each other and determine best practice for the future.

The study sample included radiography students (diagnostic and therapeutic) in the UKDN and UAE. The inclusion criteria were radiography students who underwent clinical placement during COVID-19 pandemic and were willing to participate in the study. The exclusion criteria were students who did not have any clinically based experience during COVID-19 pandemic. As the COVID-19 pandemic had been influencing educational delivery through several waves and viral variants this study aimed to gather information about the continuing impact for students on their education and training.

An electronic survey was developed using Google Forms (Google Inc, Mountain View/CA) to acquire information relating to participant demographics and details on clinical placements during the COVID-19 pandemic. Besides assessing the thoughts and feelings of students, the survey questioned the impact of COVID-19 on well-being and the ramifications of COVID-19 on radiography as a career choice. A pilot study was conducted with six senior academic staff and clinical radiographers to determine the time required to complete the survey, participant understanding of questions and content validity. Minimal language edits were performed based on the feedback received from participants. The reviewer's comments and suggestions were used to re-word some questions to avoid ambiguous questions and ensure clarity. Pilot data were not included in the main study.

The link to the survey was shared via email with students registered as radiography students in the UKDN and UAE through their academic institutions. Participants were invited to participate and provided with an electronic information sheet and consent form for participation in the study. A reminder email was sent on the fourth week. Data was gathered from June to July 2021. All participants who completed the survey, were included in the study. Ethical permission was sought and granted from the Research Ethics Committees (ID: 21-04-12-02 and ID:21/0032).

Data was transferred to Microsoft Excel and SPSS Version 22.0 for analysis. A T-test was conducted to statistically analyse the variation between countries whereas the ANOVA test was conducted to statistically analyse the variation in scores in the demographics and clinical exposure/experience of the students. Responses of the thoughts and feelings questions were used to calculate how stressed or worried participants were, where the maximum score of 40 = 'highest score' and the minimum score of 8 = 'lowest score'. Response to the questions related to 'actions taken to alleviate concerns during clinical training' were assigned scores and a maximum score of 30 meant the participants disagreed that the concern could be reduced by certain measures and a minimum score of six meant participants readily agreed measures were effective. A one-way ANOVA test was utilised to study the variation in opinions on reducing student concerns, by different means, to the demographic data and clinical exposure of the participants. P values of <0.05 were considered statistically significant.

Results

Demographic data

The survey collected data from 262 participants, with 23% from the UAE (n = 60) and 77% from the UKDN (n = 202) (Table 1). Most of the students were female (n = 219, 84%), and studying diagnostic radiography (n = 245, 94%). A higher number of responses were received from students in the 3rd year of undergraduate studies (n = 82, 31%). Respondents most commonly were between 21 and 23 years of age (n = 105, 40%) and have no postgraduate study/MSc

Table 1
Summary of participants by country.

Country/Region	UAE	Frequency	%
	UAE	60	23%
	Abu Dhabi	2	1%
	Dubai	5	2%
	Sharjah	49	19%
	Ajman	2	1%
	Fujairah	2	1%
	UKDN	202	77%
	Wales	88	34%
	Scotland	49	19%
	Northern Ireland	63	24%
	Not mentioned	2	1%

entries (n = 246, 94%) (Table-2). There were no participants from the UAE in the first year, radiotherapy or postgraduate studies. 31% of students from UKDN were over 30 years of age and none of the students in UAE were above thirty whilst 68% of them were aged 20 years and below.

Clinical placement

Despite the delay/rescheduling of clinical placement experienced by 163 (62%) of the participants, 245 (94%) had attended and completed clinical placement and 17 (6%) did not attend all clinical placement days during the start of the pandemic and at the time of data collection (Table 2). 72% (n = 188) of the participants have received training in PPE use at the clinical placement. 46% (n = 121) of clinical placements were rescheduled due to COVID-19 yet 72% (n = 189) of respondents stated that they continued to develop their clinical practical skills during the pandemic. When asked if they had been involved in imaging COVID-19 positive patients during clinical placement, 66% (n = 174) stated yes, while 4% (n = 11) stated it was not applicable. The students were asked what

Table 2
Summary of demographic and clinical placement information.

		UAE		UKDN		Total	
		n	%	n	%	n	%
Course/Field	Diagnostic Radiography	60	100%	185	92%	245	94%
	Radiotherapy	0	0%	17	8%	17	6%
Year of Study	1st year	0	0%	65	32%	65	25%
	2nd year	9	15%	61	30%	70	27%
	3rd year	18	30%	64	32%	82	31%
	4th year	33	55%	12	6%	45	17%
Gender	Female	46	77%	173	86%	219	84%
	Male	11	18%	28	14%	39	15%
	Prefer not to say	3	5%	1	0%	4	2%
Postgraduate studies, MSc	Yes	0	0%	15	7.4%	15	6%
	No	49	82%	186	92.1%	235	90%
	MSc Entry	0	0%	1	0.5%	1	0%
Age	<= 20 Years	41	68%	64	32%	105	40%
	21–23 Years	12	20%	31	32%	43	16%
	24–30 Years	7	12%	63	15%	70	27%
	>30 Years	0	0%	44	31%	44	17%
Clinical placement delayed/rescheduled	Yes	53	88%	110	54%	163	62%
	No	7	12%	99	49%	106	40%
Have completed all clinical placement during COVID-19	Yes	44	73%	201	100%	245	94%
	No	16	27%	1	0%	17	6%
Have completed clinical placement at designated COVID-19 hospital (for COVID-19 positive patients only)	Yes	15	25%	61	30%	76	29%
	No	45	75%	141	70%	186	71%

replacement activities were used to compensate for the lack of clinical placements and 21% (n = 55) students stated they had their clinical placement replaced with simulation/virtual lab experiences within the hospital or university setting whilst 37% (n = 97) of students had it replaced by online activities. 46% (n = 121) of the total respondents have stated that their clinical placements had to be changed due to COVID-19.

Thoughts and feelings

45% (n = 119) of responding students were stressed about catching COVID-19 and 50% (n = 132) agreed COVID-19 made them feel vulnerable. Students were worried about people they love or care for (86%, n = 224) and (81%, n = 211) were happy to continue with clinical practice placement as long as they adhered to social distancing (Fig. 1).

The possible score of the thoughts and feelings questions ranged from 8 to 40. A minimum score of nine was obtained by one (0.3%) participant and the maximum score of 40 was also obtained by one (0.3%) participant. The distribution of the scores is illustrated in Fig. 2. The ANOVA test concluded that there were equal means of scores across different genders, age, year of study, course of study, clinical placement in a COVID-19 hospital, delay in clinical placement and access to wellbeing and support (Table 3). Therefore, it

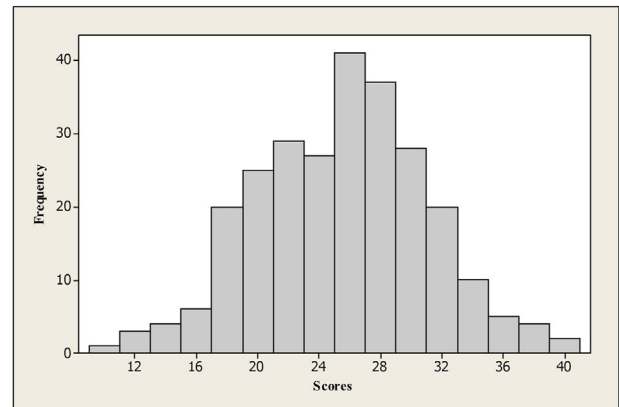


Figure 2. Distribution of the total scores of thoughts and feelings.

was deduced that there was no impact of the above variables on students' thoughts and feelings about COVID-19 during the clinical training. Nevertheless, the study found that students displayed less concern related to COVID-19 when in postgraduate education (e.g graduate entry programmes) (p = 0.03), those who were involved in imaging COVID-19 positive patients (p = 0.002), and students

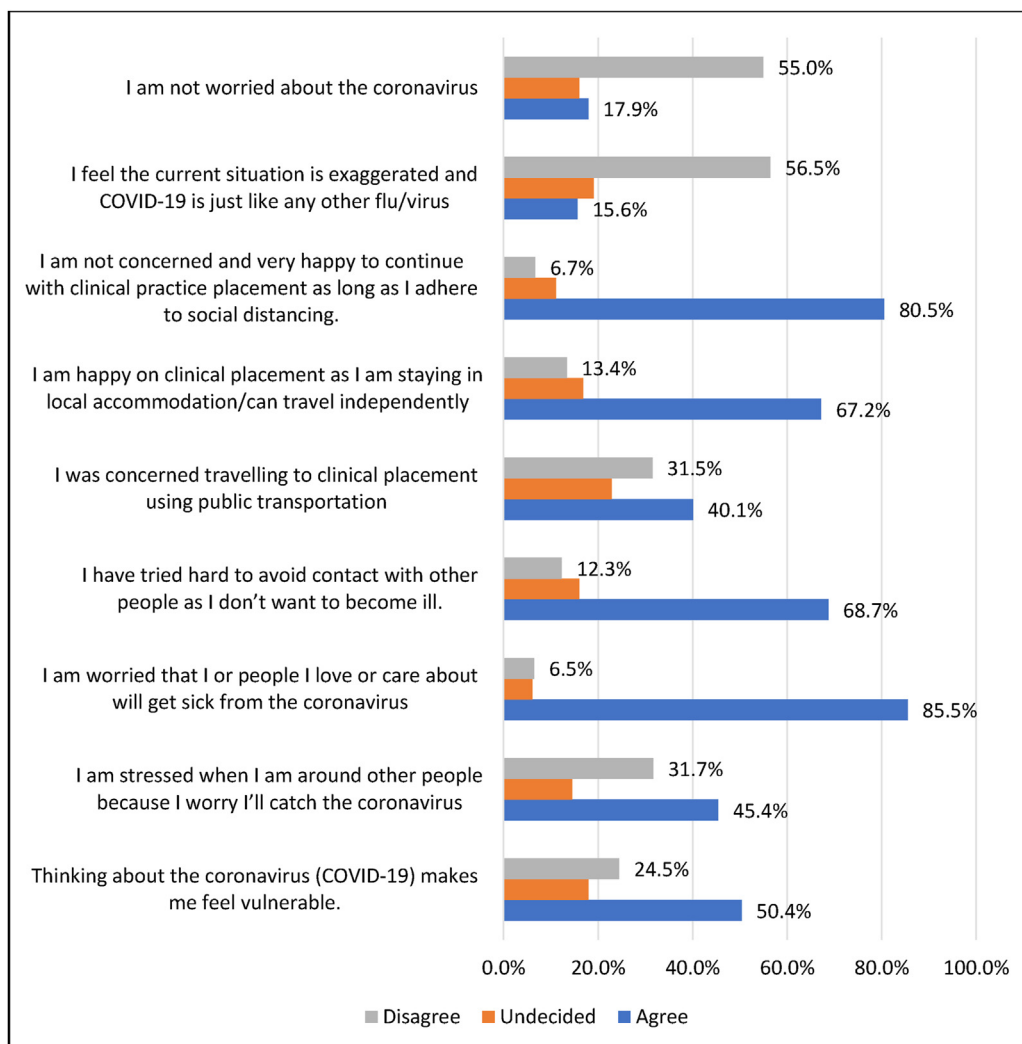


Figure 1. Thoughts and feelings of students about COVID-19.

Table 3
Results of one-way ANOVA and T-test of the score of thoughts and feelings of students.

Variable	p-value
Age	0.06
Course of study	0.07
Year of study	0.19
Gender	0.68
Clinical placement in COVID-19 hospital	0.33
Delay in clinical placement	0.13
Accessibility to wellbeing and support	0.80
Level of education	0.03
Have been in clinical placements during the COVID-19	0.004
Students who were hesitant of their choice in pursuing radiography as career	0.03
Students who have not been involved in imaging COVID-19 patients	0.002

who been at clinical placements during recognised COVID-19 waves or the occurrence of new variants ($p = 0.004$) (Table 3). Students who were hesitant of their career decision ($\mu = 27.23$) had a propensity to be more negatively affected by thoughts about COVID-19 (Table 3).

Impact on clinical placement

Of the participants, 62% ($n = 163$) stated that COVID-19 has negatively impacted HEI practical preparation (e.g. X-ray demonstration laboratories). COVID-19 had negatively impacted the development of practical experience in the hospital (52%, $n = 136$) and 40% ($n = 106$) identified professional experience/interpersonal skills were also affected. 102 students (39%) believed COVID-19 has negatively impacted their ability to engage with patients while only 10% ($n = 27$) believed it had a positive impact and 52% ($n = 136$), believed a negative impact on communication with peers was evident (Fig. 3).

Impact of COVID-19 on wellbeing

Of the respondents, 59% ($n = 155$) agreed that COVID-19 had a negative impact on their mental wellbeing. Nevertheless, 21% ($n = 55$) felt it had no impact and 5% ($n = 13$) reported that it had a positive impact on their wellbeing. The majority (78%, $n = 204$) did not seek wellbeing advice or support from the HEI and 8% ($n = 20$) of students reported that these services were unavailable to them. 88% of the respondents had at least one dose of a recognised COVID-19 vaccine at the time of the study.

In terms of alleviating the concerns related to clinical placement and improving wellbeing, 80% ($n = 210$), 79% ($n = 207$) and 74% ($n = 194$) agreed respectively that quick test results, availability of a vaccine and easy access to test centres reduced their concerns whilst on clinical placement (Table 4). The score ranges from a maximum score of 30 to a minimum of six. 13% ($n = 35$) students scored the minimum (six) and 1% ($n = 2$) scored the maximum (30) (Fig. 4).

A one-way ANOVA test was utilised to study the variation in opinions on reducing student concerns. The results showed equal means of scores in relation to year of study, gender, postgraduate status, age, clinical attendance during COVID-19, clinical experience in a designated COVID-19 hospital, delay in clinical experience, their (student) decision in choice of career, imaging a COVID-19 patient, clinical placement replaced by simulation/virtual labs and accessibility to wellbeing (Table 5). This led to the conclusion that the above factors have no variation to the collective opinions of the participants.

Radiography as a career choice

82% ($n = 215$) of the students were still confident in their choice of radiography as a career, 5% ($n = 13$) were considering a change in their program of study and (13%, $n = 34$) were not sure they had made the right choice.

Comparison between the UKDN and the UAE

In the evaluation of students' thoughts and feelings about COVID-19 during clinical training, t-test results supported the conclusion that participants from the UAE ($\mu = 26.61$) displayed a higher tendency to have worrisome thoughts and feelings ($p = 0.009$) compared to those from the UK ($\mu = 24.5$). On the other hand, there was no significant difference between UAE and UKDN ($p = 0.54$) in their opinions on reducing student concerns. This concludes that there is no variation to the collective opinions of the participants.

Comparison within the UKDN and the UAE

In evaluating the students' thoughts and feelings about COVID-19 during the clinical training, there was a statistically significant difference in the means of countries within UKDN ($p < 0.001$), students from Wales were more inclined to be concerned ($\mu = 29.05$) compared to those from Northern Ireland ($\mu = 24.49$) and Scotland ($\mu = 20.88$). Due to insufficient sample size in the states of Fujairah, Ajman, and Abu Dhabi, a t-test was conducted for Dubai ($\mu = 26.0$) and Sharjah ($\mu = 24.39$) and suggested that there was no statistically significant difference in their means ($p = 0.06$).

To compare the variation in opinions on reducing student concerns, by different means, within UKDN (Wales, Scotland, and Northern Ireland) an ANOVA test was conducted. This suggested that there was a significant difference between their means ($p = 0.025$), where Northern Ireland ($\mu = 13.29$) had a higher mean compared to Wales ($\mu = 12.98$) and Scotland ($\mu = 11.00$). The t-test conducted to for Dubai and Sharjah concluded no statistically significant difference ($p = 0.166$).

Discussion

Clinical placement

Virtual simulations provided an opportunity to continue clinical education when students were excluded from clinical placement during the pandemic. Use of simulated radiography was already a common practice in education in some countries but gained great recognition for compensating for the loss of clinical contact during COVID-19.^{9,25,31–33} Simulation provides asynchronous interactions, accessibility, and flexibility as it has been shown to be an excellent instructional approach for creating a pleasant learning environment.^{34,35} Our study shows large variation in practice whereby only 21% and 37% of clinical placements were replaced by simulation/virtual lab settings within the hospital/university and online activities, respectively. Leaders in healthcare education should invest in improving the current available simulation-based educational tools to enhance the training of undergraduate radiography students³⁶ and enable a more flexible approach to student learning in the event of another wave of COVID-19 or other future pandemics.

Although 72% of respondents stated that their skills had improved since the last clinical placement, students still faced many challenges in clinical placement during COVID-19. It is possible that the build-up of clinical skills and confidence may be

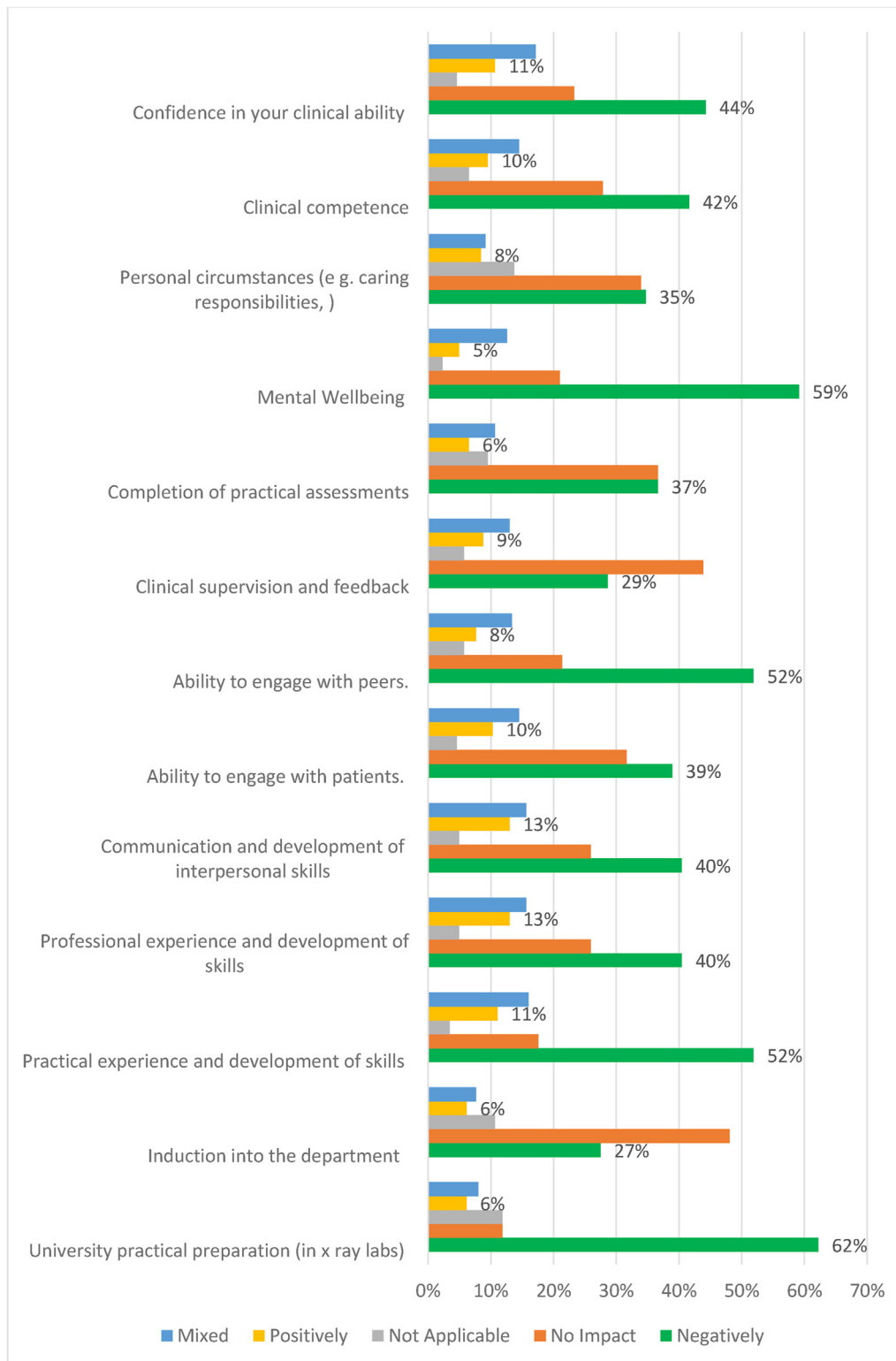


Figure 3. Impact of COVID-19 on clinical placement.

due to the extensive self-directed learning activities and utilisation of video and simulations to compensate for the loss of clinical practice experience.³⁷ This increased clinical confidence has also been reported by Mian and Khan (2020) as students felt they became more resilient and able to cope with the challenges faced during clinical placement.³⁸ However, this increased confidence is

disputed by other authors who reported a decline in clinical confidence during COVID-19.^{32,39}

Participants in the current study completed on site infection control training during their clinical placement. PPE training provides a solid base for safe practice and management of COVID-19 in radiology departments.⁴⁰ Nevertheless, some students reported

Table 4
Actions to alleviate the concerns raised relating to clinical placements.

	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree	
	%	n	%	n	%	n	%	n	%	n
Availability of testing	25.6%	67	41.2%	108	21.4%	56	10.7%	28	1.1%	3
Availability of vaccine	44.7%	117	34.0%	89	11.8%	31	7.6%	20	1.9%	5
Easy access to test centers	29.8%	78	43.9%	115	16.4%	43	8.4%	22	1.5%	4
Fast test results	35.1%	92	45.0%	118	10.3%	27	7.6%	20	1.9%	5
Periodic testing	26.0%	68	44.3%	116	18.3%	48	9.9%	26	1.5%	4
Self isolation	19.1%	50	38.2%	100	25.2%	66	14.1%	37	3.4%	9

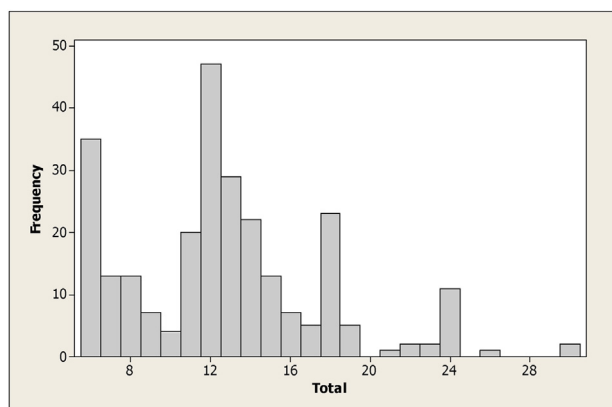


Figure 4. Scores of actions to alleviate the concerns relating to clinical placements.

Table 5
Results of one-way ANOVA and T-tests relating to actions alleviating students' concern.

Variable	p-value
Age	0.57
Course of study	0.01
Year of study	0.86
Gender	0.20
Clinical placement in a COVID-19 hospital	0.58
Delay in clinical placement	0.47
Access to wellbeing and support	0.19
Level of education	0.32
Have been in clinical placements during the COVID-19	0.85
Students who were hesitant of their choice in pursuing radiography as career	0.51
Students who have not been involved in imaging the COVID-19 patients	0.15
Some clinical placement replaced by simulation/virtual labs	0.18

that their department showed a lack of infection control training.^{41,42} This gap in knowledge needs to be addressed so students are prepared for future waves of COVID-19.

Thoughts and feelings of students

The current study showed that 86% of the students were worried that their loved ones may get sick from cross-infection, however 81% were very happy to continue with clinical practice placement as long as they were able to adhere to social distancing. This finding reflects the point that students are aware about the need to continue clinical practice while adhering to the safety guidelines and infection control measures. Clinical placements are essential modules in radiography education and safe completion of clinical placements was needed to graduate.⁹ It is imperative that students can maintain a safe social distance whilst completing their clinical practice and assessments.

Interestingly, students who had been on clinical placements throughout the COVID-19 pandemic displayed less concern related to contracting the COVID-19 infection during practice. Conversely, participants who had not been involved in imaging COVID-19 positive patients had more stressful thoughts and feelings compared to those who had actively worked with COVID-19 positive patients. This reiterates the results of Cushen-Brewster and colleagues who demonstrated that clinical experience during COVID-19 empowered students to be confident, contributed to reducing anxiety levels and increased their awareness about their own competence and skills.³⁸ This needs to be remembered for future pandemics when the appropriate authorities consider cancelling or rescheduling students' clinical placements.

Whilst online learning has been well received, other authors have reported that COVID-19 and online learning contributed to increased stress and anxiety among students, and that fear of COVID-19 is linked with career anxiety and stress.^{30,43,44} In the current study, 82% of the students were confident in their choice of radiography as a future career. Nevertheless, COVID-19 had a significant impact on the stress levels of a minority of students who expressed uncertainty for continuing to pursue radiography as their choice of career ($p = 0.03$). Of note, participants who were already hesitant of their career decision ($\mu = 27.23$) also had a propensity to be more negatively affected by thoughts about COVID-19, compared to those who were certain of their choice and those who were considering a change.

Impact on clinical placement

The result of the current study showed 62% of the participants felt that COVID-19 has negatively impacted the HEIs ability to prepare them for clinical practice. This was due to closures of HEIs and module delivery switching online "overnight". As a result of COVID-19 and due to safety measures, online learning has become a tool for curriculum delivery worldwide. Nevertheless, practical laboratory sessions are usually based on step-by-step practical tasks designed to ensure the consistent execution of radiography procedures. Students are required to integrate the knowledge of radiography into practical skills while building their critical thinking abilities. In medical and health sciences programs, academic staff compensate for the loss of procedural teaching using the laboratory setting. However, the acknowledged loss of experience of the laboratory setting was unavoidable due to it being delivered via online platforms, which caused a decrease in student satisfaction.⁴⁵

The common impression among the participants was that COVID-19 had negatively impacted the practical experience and skill development (52%). A huge change in patient workflow occurred due to COVID-19 with patients either choosing to stay away from hospitals or the cancellation of elective procedures, hence many studies reported a reduction of patient numbers except in general X-ray and CT, where the workload increased.^{18,46} Even though, X-ray and CT had a high number of patients, most of these

cases were COVID-19 patients and students lost the experience in the breadth of disease presentation. Reduction in patient numbers reduced the possibility of gaining comprehensive experience in some modalities. Consequently, HEIs should find interventions to compensate for the loss of some practical experience and skill for some radiography areas as the number of patients has reduced.

Slightly more than half of participants in the current study (52%) believed that COVID-19 negatively impacted their ability to communicate with peers. Peer interaction with colleagues and students is crucial to students' development and has been proven to be a tool that improves skills and provides psychological support.⁴⁷ COVID-19 isolated students and prevented open engagement with peers due to social distancing and online learning,³⁷ but there are some studies that reported satisfaction with the online communication mode with faculty and peers during the periods of infection spike and variation changes.⁴⁸

At the time of this study, 88% of the participants had already received the vaccine and 80% agreed that fast test results reduced their concerns. The acceptability of vaccines within healthcare workers is critical to the success of all immunisation programs worldwide. Studies in the UAE and UK reported the willingness of the population to get the COVID-19 vaccine.^{49,50} Nevertheless, there has been instances of reluctance among radiography personnel in some countries to receive the vaccination⁵¹ with this also evident amongst the student population with participation at a level of 12%.

Impact of COVID-19 on wellbeing

Radiography students appear very resilient in the face of adversity. An interesting finding in the current study was that 78% of the participants did not need wellbeing advice or approach any type of wellbeing support from the HEI. Despite this, the wellbeing of students was found to be negatively affected during the pandemic, even though it is a requirement of HEIs to provide academic and career counselling to students to reduce their psychological distress and improve their academic performance. It is imperative that academic and clinical staff should promote the contact details of these services and encourage students to approach them.^{40,44,52}

Radiography as a career choice

The minority of students who had doubts in pursuing radiography as their choice of career classified themselves as stressed and had negative feelings and thoughts about COVID-19 compared to those who were confident in their choice of career. Consequently, students need support and guidance from academic advisors. In a time of staff shortages and staff "burnout" educators must do everything to support student welfare and decrease the risk of attrition that may be a direct result of their perceptions of the pandemic. Students need support and guidance from academic advisors to support them with the information affirming their choice of career.

Comparison between the UKDN and the UAE

While the number of confirmed positive cases during the period of the study in the UAE and UK were around 2100 and from 3000 to 26,000-cases per day, respectively⁵³ the results of the current study showed that students in UAE displayed a higher tendency to have worrisome thoughts and feelings about COVID-19 ($p = 0.009$) compared to those from the UK. This may be due to the fact that students in UAE are younger as most of them aged 20 years and below ($n = 41, 68\%$) as previous studies have shown that younger

students had significantly more emotional health concerns than older students.⁵⁴ In addition, it is reported that younger students are usually more immature and have increased levels of stress.⁵⁵

Limitations of the study

The study was conducted a year after the start of the COVID-19 pandemic and students had different experiences in different countries according to the timing of "waves" of the pandemic. The data collected and results reported are relevant to experiences of the student population in the UKDN and UAE only.

Conclusion

Clinical placement during the COVID-19 pandemic successfully allowed the continuation of education, maintained the radiography workforce and prepared students with specialised skills to cope with future pandemics. This study has identified that students improved their skills, confidence and increased their resilience in coping with uncertainties and challenges. Students need support and guidance from academic advisors who could offer career consultations to avoid attrition due to the negative experience during COVID-19. Educational institutes should find alternative solutions to compensate for the loss of some practical experience and skill for some radiography areas as the amount of patients/range of experience has been reduced.

Conflict of interest statement

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.radi.2022.07.009>.

References

1. Akudjedu TN, Lawal O, Sharma M, Elliott J, Stewart S, Gilleece T, et al. Impact of the COVID-19 pandemic on radiography practice: findings from a UK radiography workforce survey. *BJR|Open* 2020;2(1):20200023. <https://doi.org/10.1259/BJRO.20200023>.
2. Vindrola-Padros C, Andrews L, Dowrick A, Djellouli N, Fillmore H, Gonzalez EB, et al. Perceptions and experiences of healthcare workers during the COVID-19 pandemic in the UK. *BMJ Open* 2020;(11):10. <https://doi.org/10.1136/bmjopen-2020-040503>.
3. Dedeilia A, Sotiropoulos MG, Hanrahan JG, Janga D, Dedeilias P, Sideris M. Medical and surgical education challenges and innovations in the COVID-19 era: a systematic review. *In Vivo (Brooklyn)* 2020;34:1603–11. <https://doi.org/10.21873/invivo.11950>.
4. Garg T, Shrigiriwar A, Patel K. Trainee education during COVID-19. *Neuroradiology* 2020;62(9):1057–8. <https://doi.org/10.1007/S00234-020-02478-W>. 2020 629.
5. Deery C. The COVID-19 pandemic; implications for dental education. *Evid Base Dent* 2020;21(2):46–7. <https://doi.org/10.1038/s41432-020-0089-3>.
6. Amparore D, Claps F, Cacciamani GE, Esperto F, Fiori C, Liguori G, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol* 2020;72(4):505–9. <https://doi.org/10.23736/S0393-2249.20.03868-0>.
7. Papananou M, Routsis E, Tsamakakis K, Fotis L, Marinos G, Lidoriki I, et al. Medical education challenges and innovations during COVID-19 pandemic. *Postgrad Med* 2021. <https://doi.org/10.1136/POSTGRADMEDJ-2021-140032>. Published online.
8. TMS Collaborative. The perceived impact of the Covid-19 pandemic on medical student education and training - an international survey. *BMC Med Educ* 2021;21(1):566. <https://doi.org/10.1186/s12909-021-02983-3>.
9. 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 Imag Radiat Sci* 2021;52(1):3–8. <https://doi.org/10.1016/J.JMIR.2020.10.004>.
10. Health Education England. Health education England. <https://www.hee.nhs.uk/covid-19/allied-health-professions>.
11. Health & Care Professions Council (HCPC). *Advice for education providers*. Published. 2020. <https://www.hcpcuk.org/covid-19/advice/advice-for-educationproviders>.

12. Taylor. *Placements post COVID-19 – time for Re-evaluation?* Google Scholar; 2020. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Placements+post+COVID-19+%5f+time+for+re-evaluation%3F&btnG=. [Accessed 3 March 2022].
13. Al Hosany Farida, Ganesan Subhashini, Al Memari Shammah, Al Mazrouei Shereena, Ahamed Faheem, Koshy Ashish, et al. Response to COVID-19 pandemic in the UAE: a public health perspective. *Journal of Global Health* 2021;**11**. <https://doi.org/10.7189/jogh.11.03050>. : 03050. Published online 2021 Mar 27.
14. Krieger P, Goodnough A. Medical students, sidelined for now. *Find New Ways to Fight Coronavirus*, March 23, 2020. Published, <https://www.nytimes.com/2020/03/23/health/medical-students-coronavirus.html>. [Accessed 3 March 2022].
15. Smith V, Behari N, Wright P. 32 A novel approach to practice-based learning for students in allied health professions. Published online, https://adc.bmj.com/content/106/Suppl_3/A12.2.abstract, 2021. [Accessed 3 March 2022].
16. Nadel Farber O. Medical students can help combat Covid-19. Don't send them home. *Med Educ* 2020;**37**(12):1–5. <https://www.statnews.com/2020/03/14/medical-students-can-help-combat-covid-19/>. [Accessed 3 March 2022].
17. Health Education England. *Current placement expectations of AHP regulators and professional bodies*. 2020. Published, <https://www.hee.nhs.uk/our-work/allied-health-professions/helping-ensure-essential-supply-ahps/placement-expansion-innovation/current-placement-expectations-ahp-regulators>. [Accessed 3 March 2022].
18. Health & Care Professions Council (HCPC). *Joint statement on how we will support and enable the student allied health professional workforce to respond to the covid-19 outbreak*. 2020. <https://www.hcpc-uk.org/news-and-events/news/2020/joint-statement-on-how-we-will-support-and-enable-the-student-allied-health-professional-workforce-to-respond-to-the-covid-19/>. [Accessed 3 March 2022].
19. NES, Frequently Asked Questions (FAQs) – answers for those practitioners supporting, supervising and assessing Nursing, Midwifery and Allied Health Professions students on practice learning experiences during COVID-19 Update 22/02/21 Viewed on v3-april-2021.pdf" >rapog-frequently-asked-questions-v3-april-2021.pdf (scot.nhs.uk) Accessed May 2022.
20. Marchant J. Understanding the allied health professions student experience of practice placements during the first wave of the coronavirus pandemic. *Int J Pract Learn Heal Soc Care* 2021;**9**(2):39–48. <https://doi.org/10.18552/ijphlsc.v9i2.741>.
21. Bwanga O. Radiography students' perceptions and experiences of their clinical placements-A qualitative systematic review. *East African Sch J Med Sci* 2019;**2**(7):367–80. Accessed March 3, 2022. https://www.researchgate.net/publication/342201279_Radiography_Students'_Perceptions_and_Experiences_of_their_Clinical_Placements-A_Qualitative_Systematic_Review.
22. Jones GL, York H, Lawal O, Cherrill R, Mercer S, McCarthy Z. OL-J of medical, 2021 undefined. The experience of diagnostic radiography students during the early stages of the COVID-19 pandemic—a cross-sectional study. *Wiley Online Libr* 2021;**68**(4):418–25. <https://doi.org/10.1002/jmrs.544>.
23. Teo LW, Pang T, Ong YJ, Lai C. Coping with COVID-19: perspectives of student radiographers. *J Med Imag Radiat Sci* 2020;**51**(3):358–60. <https://doi.org/10.1016/j.jmir.2020.05.004>.
24. Rainford LA, Zanardo M, Buissink C, Decoster R, Hennessy W, Knapp K, et al. The impact of COVID-19 upon student radiographers and clinical training. *Radiography* 2021;**27**(2):464–74. <https://doi.org/10.1016/j.radi.2020.10.015>.
25. Ofori-Manteaw BB, Dzidzornu E, Akudjedu TN. Impact of the COVID-19 pandemic on clinical radiography education: perspective of students and educators from a low resource setting. *J Med Imag Radiat Sci* 2022;**53**(1):51–7. <https://doi.org/10.1016/j.jmir.2021.11.002>.
26. 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 Imag Radiat Sci* 2020;**51**(4):560–6. <https://www.sciencedirect.com/science/article/pii/S1939865420302241>. [Accessed 20 November 2021].
27. 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):316–21. <https://doi.org/10.1016/j.radi.2020.09.001>.
28. 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):142–7. <https://doi.org/10.1016/j.radi.2021.09.005>.
29. McConnell J, McFadden S, Floyd M, Elshami W, Abuzaid MM, Leishman L, et al. Late non-physiological impacts of Covid-19 on radiography education. *Radiography* 2021;**27**(3):987–8. <https://doi.org/10.1016/j.radi.2021.04.006>.
30. Worldometer. *United Arab Emirates Population (2022)*. 2022. Published, <https://www.worldometers.info/world-population/united-arab-emirates-population/>. [Accessed 20 May 2022].
31. Rajhans V, Memon U, Patil V, Goyal A. Impact of COVID-19 on academic activities and way forward in Indian Optometry. *J Opt* 2020;**13**:216–26. <https://doi.org/10.1016/j.optom.2020.06.002>.
32. Shanahan MC, Akudjedu TN, Shanahan M. Australian radiographers' and radiation therapists' experiences during the COVID-19 pandemic. *J Med Radiat Sci* 2021;**68**:111–20. <https://doi.org/10.1002/jmrs.462>.
33. Sani I, Hamza Y, Chedid Y, Amalendran J, Hamza N. Understanding the consequence of COVID-19 on undergraduate medical education: medical students' perspective. *Ann Med Surg* 2020;**58**:117–9. <https://doi.org/10.1016/j.amsu.2020.08.045>.
34. Elshami W, Abuzaid M. Transforming magnetic resonance imaging education through simulation-based training. *J Med Imag Radiat Sci* 2017;**48**(2). <https://doi.org/10.1016/j.jmir.2017.01.002>.
35. Abuzaid MM, Elshami W. Integrating of scenario-based simulation into radiology education to improve critical thinking skills. *Rep Med Imag* 2016;**9**. <https://doi.org/10.2147/RMI.S110343>.
36. Tabatabai S. Simulations and virtual learning supporting clinical education during the COVID 19 pandemic. *Adv Med Educ Pract* 2020;**11**:513. <https://doi.org/10.2147/AMEP.S257750>.
37. Currie G, Hewis J, Nelson T, Chandler A, Nabasenja C, Spuur K, et al. COVID-19 impact on undergraduate teaching: medical radiation science teaching team experience. *J Med Imag Radiat Sci* 2020;**51**(4):518–27. <https://doi.org/10.1016/j.jmir.2020.09.002>.
38. Cushen-Brewster N, Strudwick RM, Doolan C, Driscoll–Evans P. An evaluation of the experiences of radiography students working on the temporary HCPC register during the COVID-19 pandemic. *Radiography* 2021;**27**(4):1000–5. <https://doi.org/10.1016/j.radi.2021.03.003>.
39. Mian A, Khan S. Medical education during pandemics: a UK perspective. *BMC Med* 2020;**18**(1). <https://doi.org/10.1186/s12916-020-01577-Y>.
40. Elshami W, Akudjedu TN, Abuzaid M, David LR, Tekin HO, Cavli B, et al. The radiology workforce's response to the COVID-19 pandemic in the Middle East, North Africa and India. *Radiography* 2021;**27**(2):360–8. <https://doi.org/10.1016/j.radi.2020.09.016>.
41. 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):443–52. <https://doi.org/10.1016/j.radi.2020.10.013>.
42. Akudjedu TN, Mishio NA, Elshami W, Culp MP, Lawal O, Botwe BO, 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):1219–26. <https://doi.org/10.1016/j.radi.2021.07.004>.
43. Mahmud MS, Talukder MU, Rahman SM. Does 'Fear of COVID-19' trigger future career anxiety? An empirical investigation considering depression from COVID-19 as a mediator. *Int J Soc Psychiatr* 2021;**67**(1):35. <https://doi.org/10.1177/0020764020935488>.
44. 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 Psychiatr* 2020;**11**. <https://doi.org/10.3389/fpsy.2020.582189>.
45. 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). <https://doi.org/10.1080/10872981.2021.1920090>.
46. Cavli B, Ozturk C, Senel HE, Pekar RB, Elshami W, Tekin HO. Coronavirus disease 2019 strategies, examination details, and safety procedures for diagnostic radiology facilities: an extensive multicenter experience in Istanbul, Turkey. *J Radiol Nurs* 2021;**40**(2):172–8. <https://doi.org/10.1016/j.jradnu.2020.12.013>.
47. Elshami W, Abuzaid M, Abdalla ME. Radiography students' perceptions of Peer assisted learning. *Radiography* 2020;**26**(2):e109–13. <https://doi.org/10.1016/j.radi.2019.12.002>.
48. Bdair IA. Nursing students' and faculty members' perspectives about online learning during COVID-19 pandemic: a qualitative study. *Teach Learn Nurs* 2021;**16**(3):220–6. <https://doi.org/10.1016/j.teln.2021.02.008>.
49. Muqattash R, Niankara I, Traoret RI. Survey data for COVID-19 vaccine preference analysis in the United Arab Emirates. *Data Brief* 2020;**33**:106446. <https://doi.org/10.1016/j.dib.2020.106446>.
50. Salali GD, Uysal MS. COVID-19 vaccine hesitancy is associated with beliefs on the origin of the novel coronavirus in the UK and Turkey. *Psychol Med* 2020: 1–3. <https://doi.org/10.1017/S0033291720004067>. Published online.
51. Botwe BO, Antwi WK, Adusei JA, Mayeden RN, Akudjedu TN, Sule SD. COVID-19 vaccine hesitancy concerns: findings from a Ghana clinical radiography workforce survey. *Radiography* October 8, 2021. <https://doi.org/10.1016/j.radi.2021.09.015>. Published online.
52. Michael Moores B. On the justification of justification in radiation protection – sociological considerations. *Radiography* 2020:704–8. <https://doi.org/10.1016/j.radi.2020.10.007>. Published online.
53. United Kingdom: Coronavirus pandemic country profile. <https://ourworldindata.org/coronavirus/country/unitedkingdom?country=--ARE#confirmcases> accessed 10 June 2022.
54. Appleby Jennifer, King Nathan, Saunders Kate E, Bast Anne, Rivera Daniel, Byun Jin, et al. Impact of the COVID-19 pandemic on the experience and mental health of university students studying in Canada and the UK: a cross-sectional study. *BMJ Open* 2022 Jan 24;**12**(1):e050187. <https://doi.org/10.1136/bmjopen-2021-050187>.
55. Aslan Hakime, Pekince Hatice. Nursing students' views on the COVID-19 pandemic and their perceived stress levels. *Psychiatr Care* 2020 Aug 17;**10**:1111:12597. <https://doi.org/10.1111/ppc.12597>.