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Commentary

# Get comfortable with being uncomfortable: Experiences from diagnostic radiographers a year into the COVID-19 pandemic

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## Introduction

Many of us worldwide are living through an unprecedented crisis with the reemergence and rapid spread of coronavirus disease (COVID-19). It may seem like a lifetime to many, but it was only slightly more than a year ago that Singapore reported its first COVID-19 case on January 23, 2020 where, at that point, the virus had yet to be named. As the situation worsened with global outbreaks, the World Health Organization (WHO) eventually declared COVID-19 a pandemic on March 11, 2020 [1].

In Singapore, the ripple effect from the first imported case has been powerful. In the first few days there was little sign of the impact that was coming. While there was some sense of worry, everyday life went on. No one expected the impact of COVID-19 to be so dramatic that certain aspects of the population's daily life had to be permanently modified. Drastic changes were made to the country's working lifestyle, society, economy, and healthcare sector - a result of public health measures introduced by the government.

Through local transmission, the pandemic rapidly reached statistical milestones. Within 2 weeks after first case was reported, Singapore's risk assessment was raised following increased local community spread [2]. The tipping point occurred when Singapore experienced increased risk of asymptomatic spread, which led to the implementation of an elevated set of safe distancing measures from April 7 to June 1 (1 month,

3 weeks and 4 days) [3,4]. The duration of the “circuit breaker”, which included partial lockdowns, had a significant impact on many. From an economic perspective, this safe distancing measure has been estimated to have reduced Singapore's annual real gross domestic product (GDP) by 2.2% [5].

Singapore has since embarked on a three-phase approach to resuming activities, with the country moving into the third and final phase of re-opening on December 28, 2020 [6]. Throughout the journey, many of us wrestled back some sense of normalcy with a gradual but controlled re-opening of the country. The final phase of re-opening brought to many a sense of relief. More positive news followed, with some healthcare workers receiving their first dose of the COVID-19 vaccine on December 30, 2020 [7]. Since then, more than 1.6 million doses of vaccines [8] have been administered.

Throughout the pandemic, diagnostic radiographers have worked tirelessly on the frontline in local hospitals and community facilities in the fight against COVID-19. This has certainly been the case in Singapore since chest radiography continues to be the most utilized diagnostic technique for triaging and managing of COVID-19 patients. Many aspects of medical practice changed, and feelings of discomfort were prevalent amongst the radiographers. In addition, many radiographers described their initial experience as hectic and stressful, with feelings of being burned out. Those feelings were vivid, especially with no silver bullet in sight and the increasing uncertainty surrounding the pandemic. Fortunately, radiographers adapted well, demonstrating resilience and grit during this challenging period. Against the backdrop of a new landscape of the healthcare industry, it is timely for the medical imaging profession to look back and also look forward at the one-year mark of the pandemic. Here, in this commentary, we focus on narrating the experience of radiographers (general radiography) from Singapore General Hospital (SGH) on the run up to the one-

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year anniversary of WHO's official declaration of COVID-19 pandemic. We will also share some of the lessons learned as we look forward to a new dawn in battle against COVID-19.

### The beginning of changes

After Severe Acute Respiratory Syndrome (SARS), which arrived on Singapore shores like a silent killer in the night, Singapore was better prepared to handle similar outbreaks. SGH received Singapore's first COVID-19 patient on January 23, 2020 after the patient presented with fever and cough at the hospital's emergency department [9]. The patient was immediately isolated and subsequently tested positive on the same day for the coronavirus. Fortunately, safety measures such as wearing of surgical masks at all high-risk clinical areas had already been in place following reports of an outbreak of atypical pneumonia in late 2019 in Wuhan, China. This aided SGH in being able to respond effectively and in a timely manner to the situation. Moreover, lessons from the SARS outbreak in 2003 had strengthened Singapore's defense in its pandemic management capabilities in fighting infectious diseases [10].

Though the 2003 SARS outbreak served as a 'wake-up call' for the country, many of the young radiographers could not relate to the painful experience nor appreciate the lessons from nearly 17 years ago. These young radiographers (including all the authors) did not experience the harshness of the outbreak and thus, COVID-19 was a very real first experience with intense fear and anxiety. However, the shadow of SARS and the sense of déjà vu was vivid [11] to the more senior group of radiographers. This led to many radiographers feeling uncomfortable in different ways as the virus spread throughout the local community within weeks after the first reported COVID-19 case.

Upon the government's announcement of heightened risk of COVID-19 in the community, safety measures were elevated. In the hospital, temperature monitoring was mandated twice a day, and staff had to input temperatures to an online platform. Staff who were not compliant were subjected to disciplinary actions. This was deemed a burden, and many struggled with timely entry of temperature, especially on rest days and off days. Such guidance was also instituted in Australia by the Communicable Disease Network of Australia [12]. Undeniably, monitoring of temperature by staff can raise health awareness and contribute positively to the preparedness and infection control measures, preventing transmission and thus protecting the patients and public [12].

### The COVID-19 peak

As the number of local community cases was rising, social distancing measures were stepped up. All radiographers were to adhere to the stipulated 1-meter safe distancing at the workplace and during dining. Yellow boxes were demarcated at clinical areas and seating facilities in the staff pantry were re-arranged to comply with the stricter safe (social) distancing measures to reduce the risk of further local transmission

of COVID-19. Such social distancing measures were disruptive to many radiographers who had to avoid socializing over meals—an activity that many looked forward to since peer interactions helps to foster bonds, especially after a busy clinical session. Such removal of a fundamental human need presents many psychological downsides and can eventually affect mental health, as highlighted clearly by Sikali [13].

Similarly, the outbreak also resulted in large-scale disruption to medical education. As a major teaching hospital, SGH provides medical training programmes for medical, nursing, and allied health students—including radiography students. With the increased risk of infection, all clinical placements for undergraduate radiography students were suspended and students who were amid their clinical posting were withdrawn from the hospital [14]. A similar picture was painted across other healthcare professions whereby medical students, including radiography students, had their clinical rotations stopped [15]. This approach was in line with the global trend of suspending student participation in activities that involved contact with patients [16,17]. Indeed, such a decision was made with concerns for the safety of students and their potential role as a vector of transmission of COVID-19. However, this had profound impacts for the various healthcare professions as students would lose substantial hands-on clinical experiences that are fundamental in their training, education, and progression [18].

As more clusters of new infection surfaced, coupled with the rising number of daily imported cases, the government had to employ new strategies to curb the spread of COVID-19 locally. The slew of measures was instituted in the form of a circuit breaker that involved partial lockdowns, quarantine, and enhanced social distancing measures. This added a toll to the radiographers' emotional, mental, and interpersonal well-being [19]. A survey from Ipsos [20] reported that 1 in 4 Singaporeans claimed a lack of good mental health during the circuit breaker and, more importantly, it highlighted that the population's general mental health declined as the days passed. With the surge in infections already stretching the capacity of the healthcare system, there was a clear need to safeguard the mental well-being of the radiographers who had already been tremendously strained by the COVID-19 pandemic.

In a fast-evolving COVID-19 pandemic with many unknowns, the demand for healthcare resources was fraught with uncertainties. As infection rates rose, the demand for medical equipment, such as ventilators and Personal Protective Equipment (PPE) rose. The evidence for mask-wearing in the containment of communicable diseases is well documented and hence masks were arguably the most important piece of PPE [21]. However, supplies for these resources were limited and many countries were experiencing a shortage for these essential medical resources. Coupled with the overseas partner export controls on medical supplies, respirators supplies were unstable and, as such, Singapore had to ramp up its domestic production of masks to meet the needs of healthcare workers [22]. As a result, throughout the pandemic, radiographers had to be mask-fit tested for another respirator when a specific model of respirator was low in supply or rendered unavailable.

In SGH, chest radiography was utilized as part of a triage tool to determine patient disposition. Chest radiography was performed in the emergency department designated screening areas and in the wards for patients presenting with acute respiratory symptoms, and for monitoring of symptoms, as well as for non-COVID-19 related emergent conditions [23]. Therefore, re-organization of the general radiography service during the pandemic was essential, considering the potential workload and the need to provide continual high-quality services to the patients [4]. Such re-organization involved a slew of key measures to aid general radiography services in fighting the battle against COVID-19. This also resulted in a significant impact on the pool of general radiographers.

One of the key measures in the re-organization was the modification to the traditional roster. Changes had to be made to minimize manpower movement and the risk of cross-infection among the radiographers. Like other Singapore institutions [25], 12 h shifts were introduced with segregated teams formed in the radiology centers of the emergency and inpatient settings. While such shift duration is common in the field of nursing, the 12 h shift pattern was new to radiographers in SGH. Moreover, findings from a local study [25] exploring the perspectives of radiographers on the 12 h shift pattern had reported radiographers experiencing fatigue and an increased risk of burnout during a prolonged outbreak—a growing concern, as there was no silver bullet in sight at the point of implementation.

As was the case for PPE, the supply of disinfectant wipes was also affected by the global outbreak. The usual brand of disinfectant wipes (Wip'Anios Premium) used in the department was an overseas product. Unfortunately, the supply chain was disrupted during the pandemic. Over a period, the stockpiles fell below the baseline and the hospital had to source for alternative products. The remaining supply was strictly reserved for use on dedicated medical equipment such as ultrasound probes and high-grade medical monitors. Locally produced alternatives were subsequently permitted for use for the cleaning of X-ray equipment and other surfaces. Detailed charts on the respective use of the wipes were placed at various departments to remind radiographers about the correct use of the different type of wipes available. However, charts had to be constantly updated as the available stockpiles changes throughout the pandemic. Radiographers had to update themselves frequently with the ever-changing guidelines for the use of disinfectant wipes. Similar experiences on the rapidly changing environment were also reported by radiography students who joined the Health and Care Professions Council during the early phase of the pandemic [26].

At the same time, there was an urgent need to keep track of the available stock within each imaging center while preventing misuse of these limited stocks. A good example was in the inpatient imaging center whereby senior radiographers developed a documentation log for active logistics monitoring. All radiographers or radiology staff had to record the date and the amount of supply taken from the storeroom. This created a sense of accountability for all staff. The seniors could also better monitor the supplies daily aided by the documentation log.

As the radiographers adapted through the different changes implemented within the short timeframe, key lessons were reaped from the experience of being part of the team in the fight against COVID-19.

## Key lessons

### *Resilience and teamwork*

Many have been scared and anxious during the pandemic since the global outbreak has brought about a lot of uncertainties and led to a collective loss of normalcy. In addition, it can overwhelm our ability to manage stress while providing high quality care to our patients [27]. Furthermore, the 12 h shift was challenging and exhausting for many as it disrupted most of the radiographers' sleeping patterns due to constant change in the circadian rhythm. However, it was the resilience and strong teamwork of the radiographers that made it possible to pull through the early phases of the pandemic despite the uncertainties and the constant changes in the workflow.

Daily check-in among the team were conducted by respective team leaders. This served as a platform to maintain a strong communication network with all team members, to listen to and address their concerns and, most importantly, to boost their morale during this challenging period. Indeed, such an approach was documented as an evidence-based tip in managing teamwork in the face of pandemic [28].

*"It was scary during the beginning and gradually, we started to get more comfortable with the workflow and being more clearly aware of each other's duty. It was important to have a good team who is able to be flexible and adapt with the changes."*

*"As a new radiographer, I officially started work with the 12 h shift and it was quite overwhelming in the beginning. As I was rostered together with my supervisor, she was very helpful, and my entire team also guided me a lot. The main takeaway is that during the 12 h shift, I am working closely with the same group of radiographers. But now that we have resumed the normal shift pattern, each shift has different radiographers. This taught me to be more flexible in my working style when working with each of them."*

### *Core communication skills*

Undeniably, in this COVID-19 pandemic, our communication performance was undermined due to the pressure of responding rapidly to this unprecedented crisis [29]. Foley et al [30] presented the early experiences of radiographers in Ireland during the COVID-19 crisis and reported that, due to poor communication, radiographers in Ireland were inadvertently exposed to COVID-19-positive patients without appropriate PPE. Indeed, even the most skillful practitioners of humanistic communication can fumble under such intense pressure [29]. The Irish experience demonstrated the need for clear communication among healthcare professionals. With the everchanging workflow, protocols, and patients'

infectious status, the importance of clear communication cannot be overemphasized. Clearly, effective communication was essential to safeguard healthcare workers and to minimise unnecessary anxiety and distress [30].

On a lighter note, the pandemic prompted the radiographers to think of creative ways in delivering breathing instructions for chest radiography. Singapore experienced an epidemic's trajectory surge in April 2020 with outbreaks surfacing in foreign worker dormitories. Community Care Facilities (CCF) were set up to house these COVID-19 patients [31]. As a majority of the patients were foreign workers from dormitories, the language barrier was a challenge when performing chest radiography at the CCF. Radiographers had to improvise by using body language or pick up simple breathing instructions in other languages to communicate with these group of patients. Some of the radiographers also resorted to using Google Translate to aid in communication.

In addition to communication with patients, effective communication among nurses, clinicians, and radiographers was also important to prevent lapses in infection control and to ensure that all concerns were addressed appropriately:

*“During the beginning of COVID-19 when we were under the watchful eyes of the nurses outside, we really had to make sure that every part of the machine was cleaned and whenever we don / doff our PPEs. The nurses were helpful in rectifying any errors noted which allowed us to learn from there.”*

*“For me, I was posted to the Polyclinic for a few months, and I managed to pick up Breathe in and Breathe out in Tamil. They are “Muchi yeadnger and muchi Vdnger” and instructions like “Oru mani neram Vanthu report Yaduga”. Ever since I have picked up these simple Tamil phrases, I have been using it whenever there is a need to.”*

#### *Strict compliance to infection control*

Another key lesson that was reaped from this pandemic was the importance of strict compliance to infection control. Upon completion of an examination, all the equipment and surroundings that the patient contacted had to be thoroughly wiped down to prevent cross-contamination. Heng et al [32] described the stringent infection prevention measures implemented at SGH to prevent COVID-19 nosocomial transmission. The team also highlighted the need to ensure that the measures implemented were sustainable in the long term. The measures have since proven to be successful with no single case of known nosocomial transmission of the disease in SGH. This was indeed a contrast to when there was an outbreak of 60 SARS cases in SGH [33]. In fact, during the Singapore SARS outbreak, 40.8% of the patients were healthcare workers and it resulted in 5 deaths [34].

It was evident that strict compliance to appropriate infection control measures was crucial for the safety of healthcare workers and their patients. Moreover, it was essential for the successful control of the pandemic. Hudson et al. [35] reported low staff sickness levels during COVID-19 and suggested that

the strict adherence to the infection control measures may have contributed to this. This was especially crucial as there was no locum nor cross department duty coverage permissible during the COVID-19 period. There was a need to maintain the efficiency of the team by ensuring a full workforce attendance.

Furthermore, in SGH, a Pandemic Audit Tool entry was introduced to monitor radiographers' compliance to hand hygiene and isolation protocol. Walkabouts and random audits were conducted frequently to foster a strong culture of strict compliance to infection control. Over a period, this culture was inculcated among the radiographers.

*“After doing so many COVID-19 cases, we were so used to the infection control workflow that it became a good practice being inculcated.”*

#### *Collaboration for safe resumption of student clinical placement*

While the UK and parts of Canada mobilized senior students to assist as part of the workforce in the battle against COVID-19<sup>18</sup>, Singapore suspended clinical placements to ensure that students' safety was prioritized. However, this had potential implications on the students' graduation and, most importantly, their competency and confidence as healthcare professionals when they subsequently enter the workforce. With the end of COVID-19 still a huge uncertainty, there were growing concerns of a prolonged suspension of clinical placements. The future healthcare workforce could be in greater jeopardy, which also translates to a possible compromise in the safety of our patients.

In an international study exploring the impact of COVID-19 on radiography students and on clinical education, which included Singapore, Rainford et al [36] discussed such issues and highlighted the need for clear communication between education providers, students, and clinical departments. They also identified the importance of managing individual students in terms of personal health, family health and other concerns; together with recommending that students are actively mentored, as the pandemic continues to impact our departments, so students are better supported.

Fortunately, through collaboration and coordinated responses, the hospitals and the local academic institutions managed to mitigate the challenges resuming clinical training within restrictions [14,37]. It was clear that both stakeholders had to be flexible, responsive, and creative in adapting to the new norms of the pandemic while nurturing the next generation of healthcare professionals amid social distancing [18]. While international students' clinical placement remained suspended, the department had, since May 2020, welcomed back different cohorts of radiography students. The first batch of COVID-era radiography students have since completed their final clinical placement of the pandemic and will be joining the workforce in the subsequent months. These were effective demonstrations of the successful and collaborative relationship between teaching hospitals and academic institutions. Moreover, with the radiography educators' active contribution,

sustainable clinical education during COVID-19 was ensured [38]. Additionally, the newly graduated radiographers would be well prepared to meet the evolving healthcare demands and threats from the ongoing pandemic.

#### *“The new norms”-strategies to refine our clinical practice*

For the past one year, the radiographers have had to adopt and adapt to many new changes that have gradually become the “new norms”. As the medical imaging profession moved forward, some of these new norms will remain intact as they have brought value to the current clinical practice. Indeed, as quoted from Hudson et al [35], “These may be lessons to learn for maintained advantages after COVID-19”.

#### *Infection control*

Before the COVID-19 pandemic, a mask fit test was usually performed for the new radiographers at a pre-scheduled time *after* they had commenced working, which could often be months later. However, due to the greater emphasis placed on isolation protocols and infection control in the pandemic situation, all new radiographers had to be mask-fitted before being deployed to the clinical environment. Hence, there was a need to have in-house fit test administrators who were able to perform in-house mask fit tests for the new radiographers. Two radiographers were subsequently trained and certified as mask fit test administrators. Fast forward to the present, the general radiography modality has since leveraged the administrators to perform mask fit tests for all the new radiographers during their initial days of orientation. This approach can be continuously adopted beyond post-COVID so that any future radiographers will not have to wait for the pre-scheduled sessions to be mask-fitted, thus safeguarding their safety in the workplace.

Since the emergence of COVID-19 till present, dedicated teams of radiographers (isolation team) had been rostered for patients with Acute Respiratory Infection symptoms and COVID-19 positive patients. Similarly, a dedicated mobile radiography unit was deployed solely for these group of patients. The isolation team comprised of two radiographers had to perform the wipe down of the mobile radiography unit thoroughly, using appropriate disinfectant wipes and/or terminal cleaning. This strategy has been proven to be effective in preventing cross-infection and transmission of infection among radiographers during the pandemic [32].

Another possible strategy as the profession moves towards post-pandemic is the consideration of radiographers participating in the design of X-ray facilities of the future. During the pandemic, many hospitals [39,40] including Sengkang General Hospital locally [41], explored performing chest radiography through a glass panel in ward settings. The authors of these publications had concluded that the method was technically feasible as it increased the efficiency of the procedure and at the same time reduced the usage of PPE. The SG SafeR x-ray booth [42] was one example where SGH radiographers con-

tributed to the planning and design, through which the risk of exposure was reduced for radiographers performing the radiography, alongside manpower and usage of PPE. In hindsight, one would reflect that the medical imaging profession should play a contributory role in the design of our future wards. This could improve the radiographers’ efficiency in performing chest radiography in times of pandemic, while minimizing risk of infection.

In similar vein, radiographers could also be involved in the brainstorming of ideas for safeguarding of essential resources. The *Journal of the American Medical Association* (JAMA) [43] had, at the start of the pandemic, called for ideas to conserve the supply of PPE, which has since drawn approximately 291 responses over the period of a month. Some ideas that the radiographers had brainstormed include digital documentation to manage essential resources and mandatory training on PPE utilization with reference to the different health precaution status of the patients.

#### *Mental well-being*

Another aspect that radiographers have come to be more aware about is the emphasis and importance of mental well-being. Last year’s World Mental Health day came at a time when many of our daily lives had changed considerably. Before COVID-19, mental well-being was not a common topic of discussion, though healthcare professionals were subjected to considerable levels of stress during clinical practice. With the outbreak, there was growing concern about the mental well-being of healthcare professionals [44], including radiographers on long shift work. Local experience [25] reminded leaders that radiographers’ mental well-being should be taken into careful consideration for future planning. This has been a timely reminder to all on recognizing the warning signs of psychological distress among our colleagues.

Within the institution, efforts have been made to introduce activities to raise awareness of mental health among staff. In addition, community initiatives such as #BraveHeartSG [45] and COVID-19 care packs played an important role in supporting and encouraging the radiographers through the COVID-19 outbreak. At the team level, incorporation of check-ins into daily roll call was introduced. Radiographers were encouraged to share their concerns or to voice any emerging issues faced during work. This was reassuring for team members since there were many ongoing changes to the workflow and uncertainties during the early phase of the pandemic.

*“Being the team lead for one of the segregated teams, I think the two main take-aways are morale and communication. At that point of time going through the 12 h shift with the different ongoing changes, we are unsure of what to do. We were always waiting for information and with such constant worries and fears, I think there should always be someone who will build up the morale within the team. What I am afraid of is that at the end of the day, everyone becomes tired, fatigue and mentally drained and these are not beneficial for the patients.*

*At least for my strategy is by practicing strong communication, I try to spend 5 minutes talking to them, learning with them and understanding what difficulties and concerns they are experiencing.”*

### *Continuing professional development (CPD)*

The myriad effects of COVID-19 had a profound impact on SGH radiographers' CPD [46]. Without avenues for updating knowledge and skills to match the changing complexity of the healthcare needs in the pandemic, this had implications on the radiographer's ability to practice safely and effectively [47]. In the era of social distancing, the mode of CPD had to be modified and tele-conferencing platforms played an essential role. This allowed radiographers to overcome the challenges of social distancing in the workplace while continuing to engage in CPD activities. Furthermore, the use of tele-conferencing platforms enabled the CPD to overcome geographical limitations. Weekly CPD sessions for the radiographers in general radiography were held in collaboration with presenters across the island. This has opened the potential for future collaboration in CPD with international speakers.

Similarly, international societies have leveraged technology advances to coordinate and create online resources for CPD. The International Society of Radiographers and Radiologic Technologists (ISRRT) and European Federation of Radiographer Societies (EFRS) created a free resource to support radiographers [48]. Within the first week, over 4,000 people from 107 countries (from across the continents) were accessing the resources [48]. Such outreach was unsurprising, especially with the digital surge during COVID-19 pandemic [49]. Indeed, this was a good illustration on how to maximize the advantages of using technology enhanced CPD during the pandemic, as shared by Kitto in his editorial [50].

### **Research**

The COVID-19 pandemic upended many research activities around the world, including at SGH. During the circuit breaker, research activities involving patient recall came to a halt in SGH [51]. Clearly, there was a need to maximize social distancing and reduce the risk of infection transmission to researchers and patients through physical contact [52]. However, as highlighted by the Radiology Scientific Expert Panel [52], researchers would now need to reconsider some of the accustomed processes as they navigate the post-COVID-19 world.

While COVID-19 has thrown many challenges to the field of research, it has also created opportunities. One example is the continued improvement in clinical trial processes that many would have previously deemed inconceivable [53]. Extensive research is required to examine the effectiveness of new norms in medical education and the use of emergent technology for education [54]. In a similar vein, new research opportunities have arisen in the imaging community, such as applications of artificial intelligence in the diagnosing of COVID-19 by imaging and new funding related to research on COVID-19 [55].

Indeed, as emphasized in an editorial in *Nature Medicine* [56], researchers must continue to adapt to trends and changes in today's fast-paced research landscape. Additionally, researchers need to be aware of the ethical challenges in research presented by COVID-19 and to continue to identify and address these ethical challenges [57]. Clearly, these must be managed while we appraise best practices to prepare for any future pandemic response [57].

### **Conclusion**

The impact of the COVID-19 pandemic on radiographers has been unprecedented. The threat of COVID-19 has underscored the importance that radiographers be nimble, resilient, and resourceful. Many of the changes, while uncomfortable, have been crucial in the battle against COVID-19. As Singapore moves past the worst moments, there are lasting lessons to be drawn from it. The radiographers have transitioned well and have been more 'comfortable being uncomfortable'. Over a year, many radiographers have emerged stronger from the pandemic, and more appreciative of what they have. Indeed, like the quote from Oscar Wilde—"What seems to us as bitter trials are often blessings in disguise for which we are later, in the fullness of time and understanding, very grateful for!".

### **References**

- [1] World Health Organisation. WHO director-general's opening remarks at the media briefing on COVID-19-11 March 2020. Retrieved from <https://www.who.int/director-general/speeches/detail/who-director-general-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020>.
- [2] Singapore Ministry of Health. Risk assessment raised to dorscon orange. Retrieved from <https://www.moh.gov.sg/news-highlights/details/risk-assessment-raised-to-dorscon-orange> 2020.
- [3] Singapore Ministry of Health. Circuit breaker to minimise further spread of COVID-19. Retrieved from <https://www.moh.gov.sg/news-highlights/details/circuit-breaker-to-minimise-further-spread-of-covid-19> 2020.
- [4] Singapore Government. Ending circuit breaker: phased approach to resuming activities safely-what you need to know about the three phases after the circuit breaker ends on 1 June 2020. Retrieved from <https://www.gov.sg/article/ending-circuit-breaker-phased-approach-to-resuming-activities-safely>.
- [5] Singapore Ministry of Trade and Industry. Impact of the circuit breaker and budget measures in response to COVID-19. Retrieved from <https://www.mti.gov.sg/Resources/feature-articles/2020/Impact-of-the-Circuit-Breaker-and-Budget-Measures-in-Response-to-COVID-19> 2020.
- [6] Singapore Government. Moving into phase 3 of re-opening on 28 Dec 2020- resuming more activities safely. Retrieved from <https://www.gov.sg/article/moving-into-phase-3-of-re-opening-on-28-dec-2020>.
- [7] Channelnewsasia. NCID nurse becomes first person in Singapore to receive COVID-19 vaccine. Retrieved from <https://www.channelnewsasia.com/news/singapore/covid-19-first-vaccinations-ncid-healthcare-workers-pfizer-13864346>.
- [8] Singapore Ministry of Health. COVID-19 vaccination. Retrieved from <https://www.moh.gov.sg/covid-19/vaccination> 2020.
- [9] Channelnewsasia. Singapore confirms first case of Wuhan virus. Retrieved from <https://www.channelnewsasia.com/news/singapore/wuhan-virus-pneumonia-singapore-confirms-first-case-12312860> 2020.
- [10] Singapore National Centre for Infectious Diseases. Lessons from Sars will help Singapore tackle virus from China. Retrieved from <https://www.nccid.gov.sg/newsroom/press-releases/2020/03/2020-03-23-lessons-from-sars-will-help-singapore-tackle-virus-from-china>.

- <http://www.ncid.sg/News-Events/News/Pages/Lessons-from-Sars-will-help-Singapore-tackle-virus-from-China.aspx> 2020.
- [11] Cheng LT, Chan LP, Tan BH, Chen RC, Tay KH, Ling ML, Tan BS. Déjà Vu or Jamais Vu? How the severe acute respiratory syndrome experience influenced a singapore radiology department's response to the coronavirus disease (COVID-19) epidemic. *AJR Am. J Roentgenol.* 2020;214(6):1206–1210. doi:10.2214/AJR.20.22927.
  - [12] Australian Government Department of Health. Guidance for symptom monitoring in health and aged care workers during the COVID-19 outbreak. Retrieved from <https://www.health.gov.au/sites/default/files/documents/2020/04/cdna-guidance-for-symptom-monitoring-in-health-and-aged-care-workers-during-the-covid-19-outbreak.pdf> 2020.
  - [13] Sikali K. The dangers of social distancing: How COVID-19 can reshape our social experience. *J Commun Psychol.* 2020;48(8):2435–2438. doi:10.1002/jcop.22430.
  - [14] 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):560–566. doi:10.1016/j.jmir.2020.08.012.
  - [15] Samarasekera D, Goh D, Yeo S, Ngiam N, et al. Response and lessons learnt managing the COVID-19 crisis by school of medicine. *Nat Univ Singap.* 2020;92 MedEdPublish, 9, [1]. doi:10.15694/mep.2020.000092.1.
  - [16] Goldenberg MN, Hersh DC, Wilkins KM, Schwartz ML. Suspending medical student clerkships due to COVID-19. *medical science educator*, 1–4. *Adv Online Publ.* 2020. doi:10.1007/s40670-020-00994-1.
  - [17] Hickland MM, Gosney ER, Hare KL. Medical student views on returning to clinical placement after months of online learning as a result of the COVID-19 pandemic. *Med Edu Online.* 2020;25(1). doi:10.1080/10872981.2020.1800981.
  - [18] Gill D, Whitehead C, Wondimagegn D. Challenges to medical education at a time of physical distancing. *Lancet.* 2020;396(10244):77–79 London, England. doi:10.1016/S0140-6736(20)31368-4.
  - [19] Singapore Agency for Science, Technology and research. angst and anger: why does the COVID-19 pandemic make us so upset?. Retrieved from <https://www.a-star.edu.sg/sics/news-views/blog/blog/covid-19/angst-and-anger-why-does-the-covid-19-pandemic-make-us-so-upset> 2020.
  - [20] Ipsos. 1 in 4 Singaporeans say they are not in good mental health. Retrieved from [https://www.ipsos.com/sites/default/files/ct/news/documents/2020-05/ipsos\\_press\\_release\\_singaporeans\\_mental\\_health\\_8\\_may\\_2020\\_updated.pdf](https://www.ipsos.com/sites/default/files/ct/news/documents/2020-05/ipsos_press_release_singaporeans_mental_health_8_may_2020_updated.pdf) 2020.
  - [21] Chua MH, Cheng W, Goh SS, Kong J, Li B, Lim J, Mao L, Wang S, Xue K, Yang L, Ye E, Zhang K, Cheong W, Tan BH, Li Z, Tan BH, Loh XJ. Face masks in the new COVID-19 normal: materials, testing, and perspectives. *Research.* 2020 Washington, D.C.2020. doi:10.34133/2020/7286735.
  - [22] The Straits Times. Coronavirus: singapore boosting production of masks since February. Retrieved from <https://www.straitstimes.com/singapore/singapore-boosting-production-of-masks-since-feb> 2020.
  - [23] Chia A, Cheng LT, Wijaya L, Png MA, Sim WY, Hong WL, Chen RC. Chest radiographs and CTs in the era of COVID-19: indications, operational safety considerations and alternative imaging practices. *Acad Radiol.* 2020;27(9):1193–1203. doi:10.1016/j.acra.2020.06.022.
  - [24] Sim WY, Chen RC, Aw LP, Abu Bakar R, Tan CC, Heng AL, Ooi CC. How to safely and sustainably reorganise a large general radiography service facing the COVID-19 pandemic. *Radiography.* 2020;26(4):e303–e311 (London, England: 1995). doi:10.1016/j.radi.2020.05.001.
  - [25] Ooi J, Er A, Lee WC, Chee HC. The 12-hour shift: radiographers' perspectives and its applicability during a pandemic. *Radiography.* 2020 (London, England: 1995)S1078-8174(20)30236-4. Advance online publication. doi:10.1016/j.radi.2020.11.007.
  - [26] 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.* doi:10.1016/j.radi.2021.03.00.
  - [27] Centers for Disease Control and Prevention. Coping with stress. Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/managing-stress-anxiety.html>. 2020.
  - [28] Tannenbaum SI, Traylor AM, Thomas EJ, Salas E. Managing teamwork in the face of pandemic: evidence-based tips. *BMJ Qual Saf.* 2021;30(1):59–63. doi:10.1136/bmjqs-2020-011447.
  - [29] Rubinelli S, Myers K, Rosenbaum M, Davis D. Implications of the current COVID-19 pandemic for communication in healthcare. *Pat Edu Couns.* 2020;103(6):1067–1069. doi:10.1016/j.pec.2020.04.021.
  - [30] Foley SJ, O'Loughlin A, Creedon J. Early experiences of radiographers in Ireland during the COVID-19 crisis. *Insights Into Imag.* 2020;11(1):104. doi:10.1186/s13244-020-00910-6.
  - [31] Chia ML, Him Chau DH, Lim KS, Yang Liu CW, Tan HK, Tan YR. Managing COVID-19 in a novel, rapidly deployable community isolation quarantine facility. *Ann Intern Med.* 2021;174(2):247–251. doi:10.7326/M20-4746.
  - [32] Heng AL, Ooi CC, Wen Eu BJ, San Kiew Y, Wong A, Da Zhuang K. The bug stops with me: prevention of COVID-19 nosocomial transmission during radiographic procedures. *J Med Imaging Radiat Sci.* 2020;51(4):540–545. doi:10.1016/j.jmir.2020.07.054.
  - [33] Singapore Ministry of Health. Special feature: severe acute respiratory syndrome (SARS). Retrieved from [https://www.moh.gov.sg/docs/librariesprovider5/resources-statistics/reports/special\\_feature\\_sars.pdf](https://www.moh.gov.sg/docs/librariesprovider5/resources-statistics/reports/special_feature_sars.pdf) 2020.
  - [34] Singapore Ministry of Health. The communicable disease surveillance in Singapore 2003. Retrieved from <https://www.moh.gov.sg/resources-statistics/reports/the-communicable-disease-surveillance-in-singapore-2003> 2020.
  - [35] Hudson BJ, Loughborough WW, Oliver HC, Callow ME, Pressdee DJ, Bond SJ, Freeman RJ, Wood RJ, Laugharne MJ, Hughes-Roberts Y, Collier RJ, Robinson G, Rodrigues J, Phillips AJ. Lasting lessons learnt in the radiology department from the battle with COVID-19. *Clin Radiol.* 2020;75(8):586–591. doi:10.1016/j.crad.2020.06.001.
  - [36] Rainford LA, Zanardo M, Buisson C, Decoster R, Hennessy W, Knapp K, Kraus B, Lanca L, Lewis S, Mahlaola TB, McEntee M, O'Leary D, Precht H, Starc T, McNulty JP. 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.
  - [37] Ashokka B, Ong SY, Tay KH, Loh N, Gee CF, Samarasekera DD. Coordinated responses of academic medical centres to pandemics: sustaining medical education during COVID-19. *Med Teach.* 2020;42(7):762–771. doi:10.1080/0142159X.2020.1757634.
  - [38] 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.
  - [39] Brady Z, Scoullar H, Grinstead B, Ewert K, Kavnoudias H, Jarema A, Crocker J, Wills R, Houston G, Law M, Varma D. Technique, radiation safety and image quality for chest X-ray imaging through glass and in mobile settings during the COVID-19 pandemic. *Phys Eng Sci Med.* 2020;43(3):765–779. doi:10.1007/s13246-020-00899-8.
  - [40] Rai A, Ditkofsky N, Hunt B, Dubrawski M, Deva D, Mathur S. Portable chest radiography through glass during COVID-19 pandemic-initial experience in a tertiary care center. *Can Assoc Radiol J J Assoc Can Des Radiol.* 2021;72(1):175–179. doi:10.1177/0846537120942885.
  - [41] Sng LH, Arlany L, Toh LC, Loo TY, Ilzam NS, Wong B, Lanca L. Initial data from an experiment to implement a safe procedure to perform PA erect chest radiographs for COVID-19 patients with a mobile radiographic system in a "clean" zone of the hospital ward. *Radiography.* 2021;27(1):48–53 (London, England: 1995). doi:10.1016/j.radi.2020.05.011.
  - [42] Singapore General Hospital. Battle with COVID-19. Retrieved from <https://www.sgh.com.sg/SGH200/Pages/Battle-with-COVID-19.aspx>. 2020.
  - [43] Bauchner H, Fontanarosa PB, Livingston EH. Conserving supply of per-

- sonal protective equipment—a call for ideas. *JAMA*. 2020;323(19):1911. doi:10.1001/jama.2020.4770.
- [44] Vizheh M, Qorbani M, Arzaghi SM, Muhidin S, Javanmard Z, Esmaeili M. The mental health of healthcare workers in the COVID-19 pandemic: a systematic review. *J Diabet Metab Disord.* 2020;19(2):1–12 Advance online publication. doi:10.1007/s40200-020-00643-9.
- [45] StandUpfor.SG. #BraveheartSG. Retrieved from <https://www.braveheart.sg/>.
- [46] Y.X. Tay, R.B. Abu Bakar, & B. Kaur. (2021). Hospital training challenges during COVID-19 in Singapore: radiographers' experience of continuing professional development in social distancing mode. the journal of continuing education in the health professions, 41(1), 13–15. doi:10.1097/CEH.0000000000000336.
- [47] K. Manley, A. Martin, C. Jackson, & T. Wright (2018). A realist synthesis of effective continuing professional development (CPD): a case study of healthcare practitioners' CPD. *nurse education today*, 69, 134–141. doi:10.1016/j.nedt.2018.07.010.
- [48] Hogg P, Holmes K, McNulty J, Newman D, Keene D, Beardmore C. Covid-19: Free resources to support radiographers. *Radiography*. 2020;26(3):189–191 (London, England: 1995). doi:10.1016/j.radi.2020.05.002.
- [49] De' R, Pandey N, Pal A. Impact of digital surge during Covid-19 pandemic: a viewpoint on research and practice. *Int J Inf Manag.* 2020;55. doi:10.1016/j.ijinfomgt.2020.102171.
- [50] Kitto S. The importance of proactive and strategic technology-enhanced continuing professional development. *J Cont Edu Health Prof.* 2021;41(1):3–4. doi:10.1097/CEH.0000000000000343.
- [51] Liow M, Tay K, Yeo N, Tay D, Goh SK, Koh J, Howe TS, Tan A. Ensuring business continuity of musculoskeletal care during the COVID-19 pandemic: experience of a tertiary orthopaedic surgery department in Singapore. *JB JS Open Access.* 2020;5(2):e0050. doi:10.2106/JBJS.OA.20.00050.
- [52] Vagal A, Reeder SB, Sodickson DK, Goh V, Bhujwala ZM, Krupinski EA. The impact of the COVID-19 pandemic on the radiology research enterprise. *Radiol Sci Expert Panel Radiol.* 2020;296(3):E134–E140. doi:10.1148/radiol.2020201393.
- [53] Singapore Health. The trial must go on. Retrieved from <https://www.singhealth.com.sg/about-singhealth/newsroom/Documents/Singhealth%20Issue%2061%20%28Low%20Res%29.pdf>.
- [54] Gaur U, Majumder M, Sa B, Sarkar S, Williams A, Singh K. Challenges and opportunities of preclinical medical education: COVID-19 crisis and beyond. *SN Com Clin Med.* 2020;1–6 Advance online publication. doi:10.1007/s42399-020-00528-1.
- [55] Luker GD, Boettcher AN. Impact of COVID-19 on clinical care and research in cancer imaging: where we are now. *Radiol Imaging Cancer.* 2021;3(1). doi:10.1148/rycan.2021210003.
- [56] Nature Medicine. Safeguard research in the time of COVID-19. *Nat Med.* 2020;26:443. doi:10.1038/s41591-020-0852-1.
- [57] Hsu NS, Hendriks S, Ramos KM, Grady C. Ethical considerations of COVID-19-related adjustments to clinical research. *Nat Med.* 2021;27(2):191–193. doi:10.1038/s41591-020-01216-2.