PACIFIC JOURNAL OF MEDICAL SCIENCES
{Formerly: Medical Sciences Bulletin}
ISSN: 2072 – 1625

Pac. J. Med. Sci. (PJMS)

www.pacjmedsci.com. Email: pacjmedsci@gmail.com.

PERCEPTION OF RADIOGRAPHERS ON THE IMPACT OF COVID-19 PANDEMIC AT PORT MORESBY GENERAL HOSPITAL, PAPUA NEW GUINEA

MAKIS SILAS[1,2] and RUTH PAPE[2]*

1. **Port Moresby General Hospital, Radiology Department, Port Moresby, National Capital District, Papua New Guinea**
2. **School of Medicine and Health Sciences, Discipline of Medical Imaging Science, University of Papua New Guinea, Papua New Guinea**

***Corresponding author**. ruth.pape@cqumail.com

Submitted: December 2021; Accepted: February 2022

PERCEPTION OF RADIOGRAPHERS ON THE IMPACT OF COVID-19 PANDEMIC AT PORT MORESBY GENERAL HOSPITAL, PAPUA NEW GUINEA

MAKIS SILAS[1,2] and RUTH PAPE[2]*

3. **Port Moresby General Hospital, Radiology Department, Port Moresby, National Capital District, Papua New Guinea**
4. **School of Medicine and Health Sciences, Discipline of Medical Imaging Science, University of Papua New Guinea, Papua New Guinea**

***Corresponding author**. ruth.pape@cqumail.com

Submitted: December 2021; Accepted: February 2022

ABSTRACT

The World Health Organization (WHO) declared Coronavirus disease 2019 (COVID-19) a pandemic on March 11, 2020 and the global impact of this new epidemic is yet uncertain. Radiographers are among the front line healthcare workers (HCWs) in tackling the impact of this pandemic. This is a prospective observational study assessing the perception of radiographers on the impact of COVID-19 pandemic at the Port Moresby General Hospital (PMGH) over a ten-month period (March 2020 to December 2020). The personal experiences and observation of radiographers on the impact of COVID-19 pandemic in the ten-month period were evaluated using a paper-based survey after obtaining ethical clearance. The relevant information was recorded in Excel Spread sheet. The data was statistically analysed using Microsoft Excel 2013. A total of 18 radiographers participated in the survey. All participants identified personal protective equipment (PPE) being provided, with a majority (94.4%) identifying donning, doffing and decontamination training were also provided. More than half (55.6%) of the participants observed social distancing and reduced working staff as part of infection control and protection measures. Specific training on how to handle and deal with COVID-19 infected patients was noted among 66.7% of the participants. The perceived level of stress due to COVID-19 revealed 44.5% of the participants being stressful. This study has demonstrated that although some radiographers have experienced some level of stress in their line of work, there were no reported mental health programmes provided during the COVID-19 pandemic at PMGH.

Keywords: Coronavirus disease, severe acute respiratory syndrome-coronavirus 2, COVID-19 impact, radiographers, personal protective equipment, medical imaging, Papua New Guinea

INTRODUCTION:

Coronaviruses belong to a large family of single-stranded ribonucleic acid (ssRNA) viruses [1]. They are a group of zoonotic viruses that cause illness ranging from the common cold to severe respiratory diseases [2]. There are six coronavirus species which are responsible for human disease; four of them (OC43-CoV, NL63-CoV, HKU1-CoV, 229E-CoV) affect the respiratory system mildly causing symptoms of the common cold in people without any underlying disease [3]. The other two species (SARS-CoV and MERS-CoV) cause Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), respectively, have been associated with a fatal illness in many cases [3]. Since coronaviruses are widely distributed, their genetic material is constantly evolving due to recombination events, and they are also frequently transmitted between different species (e.g. human – animal interactions), the emergence of a new coronaviruses in a periodic pattern is possible to happen [3].

MERS-CoV of 2012 was found to transmit from dromedary camels to humans. SARS-CoV of 2002 was found to transmit from civet cats to humans. SARS spread rapidly in 2002–2003 [1-3, 4-5]. In 2002, the SARS-CoV originating in China had an 11% mortality rate, while in 2012 the MERS-CoV in Saudi Arabia had a mortality rate of 34%. Both viruses originated from wild animals [1, 5]. A cluster of patients presented with cases of severe pneumonia of unknown aetiology were first documented in Chinese city of Wuhan in December 2019 [1-5].

The novel severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2) was confirmed as the pathogenic cause of these cases by the World Health Organisation (WHO), and the outbreak was then named coronavirus disease (COVID-19) [6].

Many health experts believe that the new strain of coronavirus (SARS- CoV-2) likely originated in bats or pangolins [7]. Although the transmission of coronaviruses from animals to humans is rare, this new strain likely came from bats [5, 8], though other studies [5, 7] suggest pangolins may be the origin. It is still unclear as to how exactly the virus first spread to humans [1, 7]. Many of the initial cases had a common exposure to the Huanan wholesale seafood market that also traded live animals in Wuhan, a city in the Hubei province of China [5].

It may have been from there that SARS-CoV-2 started to spread to humans [7]. Since then, the virus has mostly spread through person-to-person contact [5]. Finding effective ways to prevent the spread of SARS-CoV-2 remains a global challenge. The Centres for Disease Control and Prevention (CDC) recommend washing the hands with soap and water for at least 20 seconds per time or using hand sanitizers with at least 60% alcohol after visiting public places [7].

The WHO declared the outbreak as a health emergency on January 30th, 2020 because of the rapidly increasing number of cases and deaths associated with the virus globally [6]. On March 11, 2020, the WHO declared COVID-19 a pandemic [7]. As of June 30, 2020 there were 10,117,687 confirmed cases and 502,278 deaths in 216 countries, areas and territories around the world [9]. Mostly affected countries include; USA, Italy, Spain, Germany, China, France, Iran, UK, Switzerland and Turkey [10]. The WHO reported that the risk of developing COVID-19 is higher in older adults, people with underlying chronic health conditions, and for anyone in close contact with people who have COVID-19, such as healthcare workers (HCWs) [5, 7]. HCWs deserve the right to decent, healthy and safe working conditions in the context of COVID-19. Primary prevention of COVID-19 among HCWs should be based on risk assessment and introduction of appropriate measures [11]. Provision of adequate personal protective equipment (PPE) is of paramount importance and is a critical component of infection control and prevention throughout the duration of COVID-19 pandemic [12].

HCWs are among the frontlines of this global crisis. They have the substantial task of diagnosing and treating an exponentially growing number of acutely ill patients, often having to make critical decisions under physical and psychological pressure [13-14]. Radiographers are among the HCWs front liners in tackling the COVID-19 pandemic. Multiple evidence reported elsewhere [1, 3-4, 6, 12, 15-20] demonstrate that radiographers require proper training for dealing with such patients to reduce the impact of COVID-19 in their line of work as health care professionals. In Papua New Guinea (PNG), there were no reported studies done to investigate the impact of the COVID-19 pandemic on radiographers.

PNG is a developing country with a growing population of over seven million [21]. There are twenty-two different provinces and the National Capital District (NCD) in four administrative regions. The rural areas of PNG comprise a higher population of 87.5% whilst only 12.5% of the populations live in urban areas and about 400,000 people (4.5%) live in the capital Port Moresby [21]. There are no published studies on the impact of COVID-19 among radiographers as front line HCWs in PNG.

The major objective of this study was to prospectively assess the perception of radiographers on the impact of COVID-19 pandemic at the Port Moresby General Hospital (PMGH) over a ten-month period (March 2020 to December 2020).

METHODOLOGY:

This was a hospital based prospective observational study conducted at the PMGH

Radiology Department. The PMGH is the major public general, specialist and reference hospital in the National Capital District (NCD) and PNG offering level 7 medical services. It is also the teaching hospital for the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG).

The personal experiences and observation of radiographers on the impact of COVID-19 pandemic in the ten-month period were evaluated using a paper-based survey. Since the number of radiographers present during the study period was very small, convenience sampling technique was used [21]. A total of 20 radiographers participated in the study.

Pre-tested questionnaires comprising close-ended and open-ended questions were administered to the radiographers using both quantitative and qualitative approach for data collection [23-24]. The questionnaire contains three sections. The demography of the radiographer; information collected include age of radiographers, gender, professional status and years of work experience.

In the other two sections variables collected the radiographers experience and observations during the COVID-19 pandemic lockdown, radiographers' knowledge of COVID-19, trainings provided, infection control and protection measures used at the facility, and radiographers' perception on the impact of COVID-19 on staff well-being [3-4, 6, 17, 19]. The data were recorded in Microsoft (MS) Excel Spreadsheets and analysed statistically using Excel Data Pack version 2013 [21-22].

Exclusion criteria**:**

Participants excluded from the study were those working in other specialised imaging modalities such as magnetic resonance imaging (MRI), mammography, ultrasound and fluoroscopy and those radiographers that were contract workers during the pandemic. Included in the study were those radiographers that have worked full time in general radiography, and other two imaging specialty including mobile radiography and computed tomography (CT) scan during the pandemic.

Ethical approval for this study was granted by the School of Medicine and Health Science Research and Ethics Committee (SMHS REC). Written consent was granted by the Director of Medical Service at PMGH with the approval from the Head of Radiology Department. Participation in the radiographer survey was entirely voluntary.

RESULTS:

Of the 20 radiographers that participated in the study, 18 of them responded to the survey with a response rate of 90%. Of the 18 respondents, 10 (55.6%) were female and 8 (44.4%) were male radiographers. Table 1 shows the

demographic distribution of all the respondents. Of the total respondents, 88.9% (n=16) were registered radiographers in general radiography with 11.1% (n=2) as registered radiographers from other imaging specialties. The other results are presented in Table 1.

Participants' response on COVID-19 in terms of infection control and protection measures; workshops and trainings; and well-being**:**

Table 2 provides detailed data on participants' response to survey. All (100%, n=18) of the participants strongly agreed that they are the front line HCWs in response to COVID-19; of which 55.6% (n=10) strongly agree that they have a good understanding on how the COVID-19 is transmitted with 33.3% (n=6) agree and 11.1% (n=2) being neutral. When asked whether the facility has provided full training on how to deal with/handle COVID-19 patients without getting COVID-19 infection, 66.7% (n=12) said yes and 33.3% (n=6) said no. Concerning the well-being of participants, 5.6% (n=1) strongly agree that the facility has provided Mental Health Programmes on how to manage work related stress regarding the COVID-19 pandemic, 5.6% (n=1) agreed, 33.3% (n=6) neutral, 50% (n=9) disagree and 5.6% (n=1) strongly disagreeing. The other results are presented in Table 2.

The free-text comments provided by the respondents were reviewed and two key themes on PPE and workshops are presented in Table 3.

Table 1: Demographic distribution of respondents.

Variables	% (n)
Age group (years)	
18 – 29	16.7 (3)
30 – 39	50.0 (9)
40 – 49	5.6 (1)
50 – 59	22.2 (4)
60+	5.6 (1)
Gender	
Male	44.4 (8)
Female	55.6 (10)
Professional status	
Resident Radiographers	0
Registered Radiographers in General Radiography	88.9 (16)
Registered Radiographers Specialising in Mobile and CT Radiography	11.1 (2)
Years of work experience	
1 – 5 years	27.8 (5)
6 – 10 years	27.8 (5)
11 – 15 years	11.1 (2)
16 years and above	33.3 (6)

Table 2: Participants' response to survey on the impact of COVID-19.

Statement/Question	**Response, n (%)**				
1. Radiographer's knowledge on COVID-19					
	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Radiographers are part of the frontline Health Care Workers in response to COVID-19.	18 (100)	0 (0)	0 (0)	0 (0)	0 (0)
I have a good understanding on how the COVID-19 virus is transmitted.	10 (55.6)	6 (33.3)	2 (11.1)	0 (0)	0 (0)
2. Perception of radiographers on infection, control protection measures and trainings					
	Yes		**No**		
The facility has provided the following strategies as means of infection protection and control;					
PPE (N95 mask, face shield)	18 (100)		0 (0)		
Donning /doffing, decontamination workshops/ trainings	17 (94.4)		1 (5.6)		
Social distancing & reduced working staff	10 (55.6)		8 (44.4)		
Specific training on how to deal with/handle COVID-19 patients	12 (66.7%)		6 (33.3%)		
Has the facility provided full training on how to deal with/handle COVID-19 patients without getting COVID-19 infection?	12 (66.7)		6 (33.3)		
3. Impact of COVID-19 on radiographers well-being					
	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Fear of COVID-19 infection, increased workload, changes in work routine, and other changes in department protocols has contributed largely to my stress.	3 (16.7)	7 (38.9)	7 (38.9)	0 (0)	1 (5.6)
The facility has provided Mental Health Programmes on how to manage work related stress regarding the COVID-19 pandemic.	1 (5.6)	1 (5.6)	6 (33.3)	9 (50)	1 (5.6)
I am confident to face similar pandemic in future in my line of work with my experience on this current ongoing COVID-19 pandemic.	5 (27.8)	7 (38.9)	1 (5.6)	5 (27.8)	0 (0)
	Very stressful	**Stressful**	**Neutral**	**Somewhat stressful**	**Not stressful at all**
What is your level of stress in regard to the impact of COVID-19 pandemic on your work performance?	5 (27.8)	3 (16.7)	9 (50)	0 (0)	1 (5.6)

Table 3: Participants' free-text comments to survey addressing two themes on PPE and workshops.

Respondent ID Number	Respondents' free-text comments
ID: 7, Registered Radiographer (RR7)	"The institution provided training/ workshop on PPE/ donning and doffing and visits from WHO personal as well"
ID: 8, Registered Radiographer (RR8)	"The hospital initially provided adequate amount of PPE to handle COVID-19 cases, but the workload was too much and at times we did not have enough PPE supply. Workshops were provided for proper donning and doffing of PPE, so that was good"
ID: 10, Registered Radiographer (RR10)	"Not adequate PPE was provided as well as training to prepare mentally"
ID: 4, Registered Radiographer (RR4)	"In regard to PPE we were not always fully given PPE, there were times we did not have swipe to wipe our equipment and other times communication was not related properly. You might be handling a symptomatic patient and not being told by the people who sent the patient over so you close down the whole place for infection control people to disinfect the whole place. With training, we were reminded every day"
ID: 13, Registered Radiographer (RR13)	"A continuous in-house training or practice in terms of PPE should/must be done, so staff members will be confident and well prepared for COVID-19 cases"
ID: 12, Registered Radiographer (RR12)	"I think trainings on protection of personal from infections should be done on routine basis to keep staff and students plus patients vigilant on cross infection prevention. PPE training here in Radiology was done only once as far as I could remember. Workshops on prep and post COVID counselling should be organized for staff who have acquired the virus or also for all staff to keep them mentally fit or to avoid episodes of psychological stress or breakdown"
ID: 15, Registered Radiographer (RR15)	"No workshop training was conducted during and after the pandemic. The pandemic has not really impacted our department in a large way. Maybe in terms of re-enforcing personal hygiene in the workplace then yes that has changed. Otherwise everything is the same as it was before the pandemic hit"
ID: 14, Registered Radiographer (RR14)	"There should be proper training involved in this situation. Especially the Mental Health programmes"

DISCUSSION:

To our knowledge, this is the first prospective study done since COVID-19 pandemic, and has surveyed about 90% of the registered radiographers on the perceived impact of COVID-19 at the PMGH. Half (50%) of all the radiographers who participated in this study were in the 30 to 39-year age group, which aligns with other studies [14, 17] reflective of an effective health care workforce with a predominance of females (55.6%) in the respondents [20].

Radiographers' knowledge and perception on COVID-19 infection, control protection measures and trainings**:**

Results from the present study revealed that all respondents (100%) are aware that radiographers are part of the frontline HCWs in response to COVID-19 while more than half (55.6%) have a good understanding on how the COVID-19 virus is transmitted. These findings concur with studies done elsewhere [6, 15-17] reflecting radiographers' knowledge on the importance of their role as key frontline HCWs and having a thorough understanding of transmission, infection control and prevention of COVID-19. All respondents (100%) in the present study identified PPE being provided, although at times 'workload' (RR8) and 'communication' (RR4) affected the supply of PPE. This finding supports the evidence that as more COVID-19 patients were being admitted during the pandemic period, enough manpower would be required to meet the demands of increased workload [12]. Furthermore, as the pandemic continues to spread globally, clear communication with radiographers is necessary to ensure infection control [12], to safeguard HCWs and to minimise unnecessary anxiety and distress [15]. A majority (94.4%) of respondents in the present study identified donning, doffing and decontamination training were provided, while more than half (55.6%) of the participants observed social distancing and reduced working staff as part of infection control and protection measures. These findings are consistent with those reported elsewhere [1, 6, 16]. However, in contrast to these findings, some radiographers in Gauteng South Africa (SA) [4] indicated that the correct guidelines for donning and doffing of PPE were not demonstrated in their departments noting concerns for the proper wearing of the PPE and its safety. Furthermore, a study in the Republic of Cyprus [3] revealed that participants have not received adequate training concerning decontamination methods while another study by Yasin and colleagues [19] reported radiographers facing significant challenges with the additional cleaning and decontamination routines that were required.

These differences could be attributed to limited resource and training on COVID-19 infection control guidelines [12] and confirms the evidence that radiology practices vary widely across different settings and among countries, often due to differences in both expert human and physical resource availability [18]. Although few radiographers in the present study reported that 'not adequate PPE was provided as well as training to prepare them mentally' (RR10) and 'no workshop training was conducted during and after the pandemic' (RR15), specific training on how to handle and deal with COVID-19 infected patients was noted among majority (66.7%) of the respondents. These differences in

radiographers' perception could be attributed to the patterns of work changed during the pandemic where some diagnostic radiographers may perform mobile radiography [16] and may undergo these trainings while other co-workers may be redeployed or re-assigned to other imaging modalities [12] due to changes in work routine, and other changes in department protocols.

Impact of COVID-19 on radiographers' well-being:

In terms of radiographers' well-being, more than half (55.6%) of the respondents in the present study reported that fear of COVID-19 infection, increased workload, changes in work routine, and other changes in department protocols contributed largely to their stress. The perceived level of stress in regard to the impact of COVID-19 pandemic on work performance revealed that half (50%) of the respondents in the present study were "neutral" while less than half (44.5%) of the respondents reported being in the "very stressful" to "stressful" level. These findings are consistent with studies done elsewhere [12, 18-20] reporting that frontline HCWs like radiographers, who often had to take on the role of caring directly for patients with COVID-19 were at a higher-level risk of having severe mental health symptoms, emotional/psychological dilemma, anxiety and workplace-related stress. Similar experiences of workplace-related stress and anxiety were reported among radiographers in the Republic of Cyprus [3], Gauteng SA [4], United Kingdom [6], Ireland [15], Australia [16] and Ghana [17]. These findings suggest that radiographers at PMGH experience workplace-related stress similar to their co-workers globally due to COVID-19 pandemic and should be provided with occupational health services, mental health and psychosocial support, adequate sanitation, hygiene and rest facilities to support them as front line HCWs [11].

Further results in the present study reveal that a majority (66.7%) of the respondents were confident to face similar pandemic in future in their line of work with their experience on this current on-going COVID-19 pandemic. This response could be attributed to 'training/workshop on PPE, donning, doffing and visits from WHO personal' as commented by a radiographer in the present study (RR7). Similar to radiographer 7 (RR7), more radiographers commented on the need for continued in-house training:

"A continuous in-house training or practice in terms of PPE should/must be done, so staff members will be confident and well prepared for COVID-19 cases." (RR13)

"I think trainings on protection of personal from infections should be done on routine basis to keep staff and students plus patients vigilant on cross infection prevention. PPE training here in Radiology was done only once as far as I could remember." (RR12)

These findings suggest that to prepare radiographers for and respond to such pandemic events in future, it is advocated by the WHO to ensure appropriate and quality training and education are in place for all staff [11-12, 25]. It is also important to note that PMGH is the teaching hospital for the SMHS, UPNG [21-22], hence highlighting the importance of academic institutions in raising the pandemic readiness of students in terms of training [12]. Some potential solutions for student radiographers to enhance their training may include virtual meetings for e-learning and participation in remotely accessible research opportunities, simulated daily radiographic exam sessions during protected education time slots, reconfiguring rotations to ensure distancing while enabling preparation for delayed core exams, need for targeted support for students undertaking clinical placement, and avoiding multiple radiographic procedures whenever feasible [20, 25].

Interestingly, findings in the present study revealed that more than half (55.6%) of the respondents "disagree" and "strongly disagree" that the facility has provided mental health programmes on how to manage work related stress regarding the COVID-19 pandemic. Similar comments were echoed from some radiographers on the need for mental health training:

"Workshops on prep and post COVID counselling should be organized for staff who have acquired the virus or also for all staff to keep them mentally fit or to avoid episodes of psychological stress or breakdown." (RR12)

"There should be proper training involved in this situation. Especially the Mental Health programmes" (RR14)

These findings show the importance of providing mental health programs which can prevent radiographers from experiencing psychological breakdowns in future pandemic events [11, 19, 25]. Although radiographers are highly resilient people who are used to dealing with difficult and sometimes traumatic situations, they were concerned about contracting COVID-19 [19] at the work place. It is however important to note that the associated risk of infecting family, friends and colleagues, isolation from family, childcare struggles, economic struggles, misinformation and lack of information from COVID-19 [19] among radiographers at PMGH were not reported in the present study.

Limitation of the study:

The primary limitation is the small sample size, which limits generalizability. The study only looked at the perception of radiographers on the impact of COVID-19 within the general radiography, mobile radiography and CT, excluding other imaging modalities such as MRI, mammography, ultrasound or fluoroscopy. A further limitation is the lack of one or more reference groups of survey

participants other than radiographers (including physicians from other specialties, radiologists, nurses, and/or a general public outside the healthcare environment), potentially allowing to better discriminate findings specific to radiographers from those (e.g. symptoms of psychological distress) that might be shared by other groups [25]. Results may not be transferrable to other professions within PMGH or even to the same profession (both in private or public health facilities) elsewhere. A more comprehensive research is needed to determine the true impact of the pandemic on PNG radiographers. Despite the small number in the surveyed population, impact of COVID-19 on PMGH radiographers well mirrored current global estimates.

CONCLUSION:

The results of the present study revealed that all participants (100%) identified personal protective equipment (PPE) being provided, with a majority (94.4%) identifying donning, doffing and decontamination training were also provided. More than half (55.6%) of the participants observed social distancing and reduced working staff as part of infection control and protection measures. Specific training on how to handle and deal with COVID-19 infected patients was noted among 66.7% of the participants. The perceived level of stress due to COVID-19 revealed 44.5% of the participants being stressful. This study has demonstrated that although some radiographers have experienced some level of stress in their line of work, there were no reported mental health programmes provided during the COVID-19 pandemic at PMGH.

Acknowledgement**:**

The authors would like to thank all the radiographers who took time from their busy schedules during the COVID-19 pandemic to take part in this study.

REFERENCES:

1. Stogiannos N, Fotopoulos D, Woznitza N and Malamateniou C. COVID-19 in the radiology department: What radiographers need to know? Radiography. 2020; 26: 254-263.
2. Mcleod V. COVID-19: A history of coronavirus.2020.www.labmanager.com/lab-health-and-safety/covid-19-a-history-of-coronavirus-22021.
3. Zervides C, Sassi M, Kefala-Karli P and Sassis L. Impact of COVID-19 pandemic on radiographers in the Republic of Cyprus. A questionnaire survey. Radiography. 2021; 27: 419-424. www.sciencedirect.com/science/article/pii/S1078817420302145
4. Lewis S and Mulla F. Diagnostic radiographers' experience of COVID-19, Gauteng South Africa. Radiography. 2021; 27:346-351. www.sciencedirect.com/science/article/pii/S1078817420301966
5. Singhal T. A review of coronavirus disease-2019 (COVID-19). Indian J Pediatr. 2020; 87(4): 281-286.
6. Akudjedu TN, Lawal O, Sharma M, Elliott J, Stewart S, Gilleece T, Mcfadden S and Franklin JM. Impact of the COVID-19 pandemic on radiography practice: Findings from a UK radiography workforce survey. BJR Open. 2020; 2: 1-11.

7. Kandola A. Coronavirus cause: Origin and how itspreads.2020.www.medicalnewstoday.com/articles/coronavirus-myths-explored#what-should-we-do?
8. The Johns Hopkins University. What is coronavirus? Johns Hopkins Medicine. 2021.www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus.
9. The Global Fund. COVID-19 Situation Report#19.2020.https://reliefweb.int/report/world/global-fund-covid-19-situation-report-19-30-june 2020.
10. Duddu P. COVID-19 coronavirus: Top ten most affected countries. 2020. www.pharmaceutical-technology.com/features/covid-19-coronavirus-top-ten-most-affected-countries/
11. World Health Organization and International Labour Organization Interim Guidance. COVID-19: Occupational health and safety for health workers. Geneva. 2021. WHO reference number: WHO/2019-nCoV/HCWadvice/2021.1. www.who.int/publications/i/item/WHO-2019-nCoV-HCW-advice-2021.1.
12. Tay YX, Kothan S, Kada S, Cai S and Lai CWK. Challenges and optimization strategies in medical imaging service delivery during COVID-19.World Journal Radiol. 2021; 13(5): 102-121.
13. Bandyopadhyay S, Baticulon RE, Kadhum M, Alser M, Ojuka DK, Badereddin Y, Kamath A, Parepalli SA, Brown G, Iharchane S, Gandino S, Markovic-Obiago Z, Scott S, Manirambona E, Machhada A, Aggarwal A, Benazaize L, Ibrahim M, Kim D, Tol I, Taylor EH, Knighton A, Bbaale D, Jasim D, Alghoul H, Reddy H, Abuelgasim H, Saini K, Sigler A, Abuelgasim L, Moran-Romero M, Kumarendran M, Jamie NA, Ali O, Sudarshan R, Dean R, Kisyova R, Kelzang S, Roche S, Ahsan T, Mohamed Y, Dube AM, Gwini GP, Gwokyala R, Brown R, Papon MRKK, Li Z, Ruzats SS, Charuvila S, Peter N, Khalidy K, Moyo N, Alser O, Solano A, Robles-Perez E, Tariq A, Gaddah M, Kolovos S, Muchemwa FC, Saleh A, Gosman A, Pinedo-Villanueva R, Jani A and Khundkar R. Infection and mortality of health care workers worldwide from COVID-19: A systematic review. BMJ Global Health. 2020; 5: 1-11. Doi: 10.1136/bmjgh-2020-003097.
14. Felice C, Tanna GLD, Zanus G and Grossi U. Impact of COVID-19 outbreak on health care workers in Italy: Results from a national E-survey. J Comm Health. 2020; 45: 675-683.
15. Foley SJ, O'Loughlin A and Creedon J. Early experiences of radiographers in Ireland during the COVID-19 crisis. Insights into Imaging. 2020; 11(104): 1-8.
16. Shanahan MC and Akudjedu TN. Australian radiographers' and radiation therapists' experiences during the COVID-19 pandemic. J Med Radiat Sci. 2021; 68: 111-120.
17. Akudjedu TN, Botwe BO, Wuni AR and Mishio NA. Impact of the COVID-19 pandemic on clinical radiography practice in low resource settings: The Ghanaian radiographers' perspective. Radiography. 2021; 27: 443-452.
18. Akudjedu TN, Mishio NA, Elshami W, Culp MP, Lawal O, Botwe BO, Wuni AR, Julka-Anderson N, Shanahan M, Totman JJ and Franklin JM. 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: 1219-1226.
19. Yasin B, Barlow N and Milner R. The impact of the COVID-19 pandemic on the mental health and work morale of radiographers within a conventional x-ray department. Radiography. 2021; 27: 1064-1072.
20. Jones GL, York H, Lawal O, Cherrill R, Mercer S and McCarthy Z. The experience of diagnostic radiography students during the early stages of the COVID-19 pandemic pandemic – a cross-sectional study. J Med Radiat Sci. 2021; 00: 1-8. Doi: 10.1002/jmrs.544.

21. Mokavelaga A and Pape R. Assessment on the effectiveness of communication between radiographers and patients during general radiographic examinations at Port Moresby General Hospital, PNG. Pac J Med Sci. 2021; 22(1): 13-24.
22. Gore I and Pape R. Retrospective assessment of the prevalence of traumatic brain injury among patients referred for computed tomography scan at Port Moresby General Hospital, PNG. Pac J Med Sci. 2021; 21(2): 70-76.
23. Varkevisser CM, Pathmanathan I and Brownlee A. Designing and conducting health systems research projects: Proposal development and field work. WHO & Int Dev Res Cent. 2003; 1:1-306.
24. Creswell JW. Research design: Qualitative, quantitative and mixed method approaches, 4th edn. University of Nebraska-Lincoln. SAGE Pub, Inc: United States of America. 2014.
25. Coppola F, Faggioni L, Neri E, Grassi R and Miele V. Impact of COVID-19 outbreak on the profession and psychological wellbeing of radiologists: A nationwide online survey. Insights into Imaging. 2021; 12(23): 1-12.