HOSPITAL CHRONICLES 2021, 16(1): 26–31

REVIEW

Best Practices for Radiographers During the COVID-19 Pandemic

Sotirios Koubardas, MSc[1], Panagiotis Lagomitzis, BSc[2], Iliana Chatzitzanou, MSc[3], Elena Lampropoulou, MSc[4], Charilaos Kantsos, MD, PhD[5], Elena Riza, MD, MPH, PhD[6], Lida Gogou, MD, PhD[7]

[1]Radiological Technologist, Medical Imaging Section of Radiology - Radiotherapy Department of Biomedical Sciences, School of Health Sciences, University of West Attica, Athens, Greece and Radiology Department of General Oncology Hospital in Kifissia "Saints Anargyri", Kifissia, Greece
[2]Radiological Technologist, Thoracic Disease General Hospital "Sotiria", Athens, Greece
[3]Radiological Technologist, Attica General Hospital "KAT", Athens, Greece
[4]Public Health Supervisor, Greece
[5]Cardiothoracic Surgeon and Medical Imaging Section of Radiology - Radiotherapy Department of Biomedical Sciences, School of Health Sciences, University of West Attica, Athens, Greece
[6]Epidemiologist - Public Health Specialist, Department of Hygiene, Epidemiologist and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Greece
[7]Nuclear Medicine, Dean of the Schools of Health Professions of the University of West Attica, Athens, Greece

KEY WORDS: *radiographers, radiological technologists, COVID-19, personal protective equipment*

Correspondence to:
Sotirios Koubardas, MSc Radiological Technologist, Medical Imaging Section of Radiology - Radiotherapy Department of Biomedical Sciences, School of Health Sciences, University of West Attica, Athens, Greece, and Radiology Department of General Oncology Hospital in Kifisia "Saints Anargyri", Kifisia, Greece
Tel.: +30 2103501500
E-mail: koubardas@gmail.com

Manuscript received August 8, 2020; Accepted November 29, 2020

ABSTRACT

Radiographers or Radiological Technologists (RTs) as health professionals are called upon to stand up to the circumstances and to modify practical applications to deal with suspected and confirmed cases of Corona Virus Disease 19 (COVID-19). They perform chest X-ray examinations and Computed Tomography scans, which are key tools for diagnosing and monitoring patients with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). They are also an integral part of the departments of Magnetic Resonance Imaging, Nuclear Medicine, Radiotherapy, Mammography, Orthopantomography - Cephalometric, Bone Density Measurement, and Interventional Radiology – Hemodynamic. The purpose of this article is to provide RTs guidance throughout the scope of their work and to keep the Hospital community informed. They are required to fully adhere to personal protective equipment (PPE) practices, such as the use of gloves, high-protection mask, special clothing, eye and feet protection. They should maintain safety distance and come into as little contact as possible with the patients. It is necessary to thoroughly disinfect and use protection for all their work components, stable or not. There should be separated spaces, in the presence suspicious and confirmed cases, as well as the rational distribution of staff in their workstations and their continuous training and briefing. RTs are present in medium and high-risk zones. As they are potential virus carriers in hospital units, PPE must be applied and strictly monitored. Moreover, workplaces should adapt to the current precautionary measures to ensure personal and occupational safety.

INTRODUCTION

Experts' warnings about possible outbreaks and relapses of the Corona Virus Disease 19 (COVID-19) pandemic,[1] require Radiographers or Radiological Technologists (RTs) to modify their current work practices. 17,396,943 confirmed cases and 675,060 deaths Until August 1st 2020, have been recorded in 216 countries.[2] The most common symptoms of the disease are fever, severe dry cough, and dyspnea. In severe cases, the disease causes severe pneumonia, acute respiratory failure syndrome, multi-organ failure, and subsequently death.[3] It is characterized by a high rate of transmission after di-

Conflict of Interest: none declared

rect contact of patients' via droplets with the mucosa of healthy individuals, but also by indirect contact via a transmitter or conduit.[3] Chest X-ray and Computed Tomography (CT) are the selected tests in order to check of lung parenchyma lesions that provide signs of severe disease.[4] RTs are an integral part in the pandemic by dealing with cases that are subsequently confirmed. Due to the lack of appropriate treatment, vaccine, and non-collective immunity of the population, the course of the pandemic may be very long.[5]

A study performed on healthcare staff assisting with treatment shows that staying in a room with COVID-19 patients for less than 2 meters (m) and for at least 10 minutes (min) exposes staff to aerosols.[6] RT staff in a radiology ward, bedside radiographs, and CT scans are in direct contact with suspected and confirmed cases, which puts the radiology department from a medium[7] to a potentially high-risk spread area. Other departments or sections of employment are characterized medium risk areas. Proper hand hygiene, the use of appropriate masks and clothing, keeping distance, and minimum contact with patients, whenever and wherever possible, are the main pillars of protection and prevention of the spread of the disease, especially in-hospital.[8]

RADIOGRAPHERS

The COVID-19 pandemic has brought RT new challenges. RTs should manage all patients as potential carriers in all their tasks,[4] as they may be asymptomatic who can transmit the virus.[4] Cases of re-infection have also been recorded in patients who have already recovered.[9] The suggested examination for the lung parenchyma lesions is a chest CT scan,[10] as included in the diagnostic algorithm of the disease.[11] Daily imaging monitoring of the disease is performed with chest X-ray in bed to reduce the possibility of in-hospital dispersion, by avoiding patient movement, but at the expense of the quality of the radiographic image.[10] In addition, in complications of the disease, such as pulmonary embolism,[12] these patients may go to departments of Nuclear Medicine (NM) or Interventional Radiology for diagnostic or therapeutic purposes. Departments that do not contribute to the diagnosis or treatment of the disease and its complications, such as other radiological sections (Mammography, Magnetic Resonance Imaging (MRI), Orthopantomography - Cephalometric, and Bone Density Measurement) and Radiotherapy (RadT), are suggested, in suspected cases, to expect the swab's results prior an examination. On the other hand, in confirmed cases, in order to prevent the disease's spreading, if they do not need immediate diagnostic or therapeutic intervention it is suggested to postpone the examination. The application of the rules about personal protection, antiseptic routines and disinfection are imperative between patient and RT as well as among colleagues and collaborators. Finally, the interactions of RTs with each other and RTs with other personnel of the healthcare units should be carried out with responsibility in order to secure the protection of public health.

Abbreviation List:
COVID-19: Corona Virus Disease 19
CT: Computed Tomography
ER: Emergency Room
ICU: Intensive Care Unit
m: meters
min: minutes
MRI: Magnetic Resonance Imaging
NM: Nuclear Medicine
PPE: Personal Protective Equipment
RadT: Radiotherapy
RT: Radiological Technologist
SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2

PERSONAL PROTECTIVE EQUIPMENT

The RTs should apply the appropriate PPE. At the beginning of their shift, it is recommended to wear special exclusive hospital uniforms, shoes and to remove all jewelry. When performing any imaging examination in any section, they should use disposable gloves, if possible, with a long cuff so that the hands are covered over the wrists and a surgical mask. It should be noted that the application of disposable dual gloves, N95 or higher protective mask, goggles or face shield, and feet protection are necessary in suspected or confirmed cases.[13,14] It is emphasized that in suspicious and confirmed cases, the correct disposal of PPE components and their immediate replacement is imperative.

DISINFECTANTS

Disinfection of premises, machinery, and other objects, such as peripherals and fixed cabin components, should be carried out with appropriate disinfectants.[13,15] Table 1 lists the most effective solutions, at least $4\log_{10}$, that reduce viral infectivity against COVID-19.[16,17]

GENERAL INSTRUCTIONS

Potentially contaminated and non-contaminated areas should be applied and demarcated in each section. Regardless of the department, it is recommended to disinfect the equipment from patient to patient and apply transparent plastic films to the equipment, such as control console, keyboard, mouse, control buttons of all machines - components and display systems, which should be replaced at least in each shift or operator. Particular emphasis should be given to the cooling air conditioners of the workplaces that are considered necessary for the proper operation of the machines. It is necessary to

TABLE 1. Recommended solutions against Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2).

Disinfectants substances/ Chemicals	Concentration (%)	Inactivate SARS-CoV-2 infectivity (log10)	Incubation period (seconds)
Ethanol	78-95	5.5	30 - 600
2-propanole	70-100	4	30
2-propanole & 1-propanole	45 & 30	4	30
Formaldehyde	0.7-1	3.5	120-600
Glutaraldehyde	2	4	300
Iodized povidone	0.23-7.5	4.4	15-60
Sodium hypochlorite*	0.21	4	30

*According to the European Center for Infection Control and Prevention, the effectiveness is proportional to the concentration, up to 0.5% and the strain of the virus.[16]

continuously train and inform the RTs for proper management of PPE and in general practices that contribute to collective security. All the examinees, visitors and employees are obliged upon their arrival in healthcare units, to properly apply the protective mask during their stay and to make a meticulous control of thermometry at the entry points of the units.

RADIOLOGY DEPARTMENT

Imaging methods are the means of strengthening the diagnosis and monitoring of the treatment, a fact that should make the RT of the radiology and CT scan departments, frontline health personnel. It is legitimate for patients with COVID-19 to stay in their beds and have on bed X-rays because they are direct, rapid, and satisfactory means of monitoring the disease, while at the same time they help to reduce the in-hospital spread risk. As occupationally exposed to ionizing radiation, RT must adhere strictly to radiation protection rules and avoid unnecessary use of this practice. Finally, in each workstation per shift, it is proposed to have two specific RTs to avoid in-hospital dispersion of employees and patients.

RADIOLOGY WARD

It is necessary to designate a separate ward for suspected or confirmed cases. Contact with cooperative patients requires a distance of 2 m and verbal commands, for example through a sound system - loudspeaker, giving them instructions for the correct positioning of the body and the execution of the X-ray. The preparation of the equipment must be completed before the arrival of the patient in the radiology ward. Also, in order to avoid the use of a cassette, the use of a digital imaging system, if available, is advised. On the contrary, in the absence of patient cooperation, the practical applications of RT should be limited to the most necessary and time as short as possible. Chest X-rays may be performed at 2 m distance from source to image, as a maximum droplet range of 1.83 m[15] has been confirmed. After each radiological operation, the area, the machine and other materials, such as peripheral and fixed chamber components, should be disinfected with the appropriate available disinfectants.[13,15] It is recommended that patients enter the radiology ward every 3 to 10 min depending on the workload and the disinfectants used.[16,17] An additional measure for the sterilization of the cartridge is the installation, possibly, of a hydrogen peroxide-plasma type furnace, an efficient and fast method for materials sensitive to temperature and humidity, following the manufacturer's specifications and after its approval. Especially, for the radiology ward, it is proposed the shifts should be divided in two halves and each half will be covered by two RTs, one of which will perform the X-rays, always depending on the existing human resources and the workload.

PORTABLE X-RAYS

RTs, based on their professional duties, may visit different parts of the hospital to perform X-rays in bed, which potentially makes them in-hospital virus spreading units. When performing examinations in areas outside the radiology laboratory, such as Intensive Care Unit (ICU) and Emergency Room (ER), hospital wards and Resuscitation Room, PPE is still required. It is noted that ICU and ER are areas with a very high probability of the presence of the virus on the surfaces and floors of hospitals hosting COVID-19 patients.[17] In this case, it is recommended to apply additional protection means, such as the use of a disposable suit, a waterproof robe with long

sleeves and a disposable cuff.[15] The cassette or panel should be disinfected with the recommended disinfectants It is advised to be placed in a disposable protective bag with safety tape, which in the end should be carefully discarded with the help of a second RT. After each examination, except from the careful removal of the extra media, the portable radiology machine must be thoroughly disinfected. Also, where it is possible, the portable radiology machine as well as the workstation (the printer) can be placed, in an isolated area, locked and accessible only by the radiology staff, after the end of the examination and disinfection. These practices are proposed to be applied in all areas where the use of a portable device is required. Especially, in ER patients, the X-rays could be performed in specially designed areas using a portable X-ray machine.

COMPUTED TOMOGRAPHY SCANNER

As for the CT scanner, for its proper operation, a cooling system in continuous operation is required to achieve optimal room temperature. To prevent the spread of the virus through the air conditioner, it is proposed to operate exclusively with outside air intake and at the same time operation of a direct ventilation system. Alternatively, it is recommended to install an air filtration system, especially in hospitals which receive confirmed COVID-19 patients. On the other hand, in hospitals which do not receive COVID-19 patients and in suspected cases, the air conditioning should be switched off before the exam, the room needs to be thoroughly cleaned after their departure and the air conditioner will then be reactivated. The above may be tolerable practices, but with unknown effects on the operation of the system.

MAMMOGRAPHY

The use of the simple surgical mask should be applied by each examinee throughout the examination. During breast implantation, it is recommended that the patient's head be turned to the opposite side. The necessity of the examination should be assessed in particular in cases where a biopsy may be needed.[18]

MAGNETIC RESONANCE IMAGING SCANNER

The materials which the PPE are made must be compatible with the magnetic field exposure of the MRI scanner. The examination room and the peripherals of the machine must be disinfected after its completion. It is suggested that there be a time gap between the exams depending on the workload of the department. This reduces the likelihood that the next patient will be exposed to aerosol of the previous one. Given the presence of the metal plate in the plain surgical mask and the strong magnetic field within the gantry, the patient cannot enter wearing such a mask, as the plate is not compatible,[19] in such cases a fabric mask should be used. In the case of examination, with the patient unable to wear a simple surgical mask for medical and imaging reasons, it is recommended to disinfect the gantry after the patient leaves. It is also suggested to provide an hour's break between MRI exams in suspected or confirmed cases.[20] It is advisable to explain the imaging process, from a distance of two meters, before the patient enters the examination area in order to minimize the contact time between RT and patient. All of the above could also be achieved by applying a special shield, compatible with the magnetic field which is attached to the patient as it can minimize the dispersion and facilitate the disinfection of the room.[21]

BONE DENSITY MEASUREMENT

During the examination, the examinee should wear a simple surgical mask. The RT should minimize contacts with the examinee. Commands must be given remotely because these are usually cooperative patients. The processing of the data should take place strictly after the end of the examination, the ventilation, and the disinfection of the place.

ORTHOPANTOMOGRAPHY - CEPHALOMETRIC

It is recommended that the examinees wear a fabric or simple surgical mask before and after the panoramic X-ray. It is advised to use a jaw socket first. Instructions for the examination can be given remotely. The surgical mask should be worn throughout the examination provided that the metal plate is outside the irradiated area. If this is not possible, the surgical mask should be removed only during the irradiation by the patient and after the proper steps of performing the X-ray imaging have been properly explained. The protective nylon which is applied at the site of the denture or the consumable socket should be discarded by the patient after the examination in a special waste bin followed by disinfection of their hands.

INTERVENTIONAL RADIOLOGY - HEMODYNAMIC

Although this area does not contribute to the daily diagnosis of patients with COVID-19 it is considered dangerous enough to spread and transmit the disease among staff, especially in emergencies. In patients undergoing scheduled surgery, a preoperative check is applied which now includes the examination of a pharyngeal swab. The same procedure should

be applied in cases of transportation from other hospitals as well as informing staff to treat the patient accordingly.[22] Before surgery, it is recommended that staff who come into contact with patients for procedures such as information should maintain a distance of more than 2 m. Spaces and surfaces should be disinfected and special attention is paid to disinfect the walls for a distance of up to 2 m above the operating table and below it. Between patients, the chamber should remain empty for at least 30 minutes to one hour.[23] It is proposed to create a negative pressure room where possible and to direct COVID-19 suspected or confirmed patients there.[23] In this way, the possibility of virus transmission to the healthcare staff is reduced and thus the protection from patient to patient is increased. In this room, it is recommended that specific staff is assigned and that their health is monitored daily.

NUCLEAR MEDICINE

The organization of NM departments must be carried out with great care and requires proper planning of the examinations in order to avoid congestion in the waiting rooms of the cold and the hot living rooms. Additional shifts may be needed with circular or overlapping staff hours and an extension of the time gap between examinations, always depending on the manpower available.[24] A good practice is the daily separation of cases/exams such as to separate cardiology from oncology patients and the possibility of immediate support to patient, especially emergency scintigraphy, such as V/Q lung scan.[25] Thorough cleaning of both the radiopharmaceutical compounded area and the gamma-camera / PET-CT with the recommended disinfectants from patient to patient, as well as the treatment rooms after the completion of treatment and the de-radiation of the room is required. Also, disinfection is required in the hot living room with the opening of the department, before the arrival of the first patient.[26] Transparent dividers could be applied in the hot living room for the individual precaution of the patients during their waiting and at the same time inflow of natural air. Patients should go unaccompanied to be examined if possible. NM is a department of great challenges because it has to manage both the usually long stay of patients in the laboratory and their biological fluids - wastes. For patients, before they arrive at the scheduled appointment, written, detailed instructions may be sent to inform them of the anti-dispersion precautions. It is recommended that the hands be frequently washed or disposable gloves be worn and single use blouses be offered to the examinee, which they should wear throughout their staying. Their personal belongings must be removed and placed in disposable plastic bags which they will receive before they leave the department. Telephone taking of the medical history[27] or written note by the attending physician could be applied in particular in cases of treatment with radiopharmaceuticals. The results of the examinations, alternatively, should be sent via courier companies or electronically, with the consent of patients adhering to the data protection rules, to themselves, or the referring physician.[27] Those responsible for the manufacture of radiopharmaceuticals and the storage of supply materials, such as cold tracers, should comply with PPE and disinfection rules before entering the hot laboratory to carry out their work.

RADIOTHERAPY

Patients with malignancies, because of immunosuppression due to either their condition or treatment, are more vulnerable to respiratory infections and, by extension, to SARS-CoV-2 virus infection.[28] Knowing from studies that the average incubation time of the virus corresponds to 4-7 days[29,30] it is recommended to divide the staff into groups so that at the end of 7 days they can be replaced in a circular way.[28] Appointments are recommended to be rescheduled based on the previous patient's length of stay. The result of this process is to avoid overcrowding and to reach the maximum action of disinfectants. Also, it is recommended that patients bring with them a daily report of their health status containing thermometry and oxygen saturation measurements.[28] If the patient has fever, it is recommended to observe the appropriate protocol for COVID-19 patients.[31] In cases where the discontinuation of RadT is not possible, and there are indications or evidence of infection with the virus, these patients may be programmed towards the end of the shift to avoid possible spread of it.[32] In this case, the PPE applied by the staff is high protection masks, double gloves, face and feet protectors, and disposable or full-body suits. It is recommended that a specific RT come into contact with the patient and be in the RadT room, while the second RT is exclusively in the control room. At the same time, air conditioning for the duration in the RadT in a patient with COVID-19 may be turned off after the approval of the machine manufacturer in order not to affect the operation of the linear accelerator.

CONCLUSION

In conclusion, RTs are essential human resources in the treatment of COVID-19. They move between medium and high-risk zones and this makes them both frontline health personnel and potential in-hospital dispensary units. PPE should be strictly applied daily and patients treated as potential carriers of the virus. In confirmed cases requiring imaging or therapeutic practice, specific protocols should be followed to reduce virus transmission and to protect staff. A strong recommendation to the staff of these departments is:

- the continued training and information updates through evidence-based bibliographical sources,
- the follow-up of patient management seminars for confirmed or suspected cases, when provided,

- the proper use of PPE and the proper disinfection of working areas.

Workplaces must be harmonized in the context of the requirements of current conditions in the light of personal and workplace safety, given the uncertain development of the pandemic.

REFERENCES

1. Kissler SM, Tedijanto C, Goldstein E, Grad YH, Lipsitch M. Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science* 2020; 368:860-868.
2. World Health Organization. Coronavirus disease 2019 (COVID-19) Situation Report 1st August 2020.
3. Park M, Cook AR, Lim JT, Sun Y, Dickens BL. Systematic Review of COVID-19 Epidemiology Based on Current Evidence. *Journal of Clin Med* 2020; 9:967.
4. Li B, Li X, Wang Y et al. Diagnostic value and key features of computed tomography in coronavirus disease 2019. *Emerg Microbes Infect* (just-accepted) 2020; 1-14.
5. Setti L, Passarini F, De Gennaro G, Barbieri P, Pallavicini A, Ruscio M. Searching for SARS-COV-2 on particulate matter: A possible early Indicator of COVID-19 epidemic recurrence. *MDPI* 2020; 2986.
6. Ng K, Poon BH, Puar THK, Quah SJL, Loh WJ, Wong YJ. COVID-19 and the risk to health care workers: a case report. *Ann Intern Med* 2020.
7. Rutala WA, Weber DJ. Guideline for disinfection and sterilization in healthcare facilities, 2008.
8. Ferioli M, Cisternino C, Leo V, Pisani L, Palange P, Nava S. Protecting healthcare workers from SARS-CoV-2 infection: practical indications. *Eur Resp Rev* 2020; 29(155).
9. Lafaie L, Célarier T, Goethals L, et al. Recurrence or relapse of COVID-19 in older patients: A description of three cases. *JAGS* 2020.
10. Araujo-Filho JDAB, Sawamura MVY, Costa AN, Cerri GG, Nomura CH. COVID-19 pneumonia: what is the role of imaging in diagnosis? *J Bras Pneumol* 2020; 46(2).
11. Sverzellati N, Milanese G, Milone F, Balbi M, Ledda RE, Silva M. Integrated radiologic algorithm for COVID-19 pandemic. *J Thorac Imaging* 2020.
12. Poggiali E, Bastoni D, Ioannilli E, Vercelli A, Magnacavallo A. Deep vein thrombosis and pulmonary embolism: two complications of COVID-19 pneumonia? *Eur J Case Pep Intern Med* 2020; 7(5).
13. Suen LKP, Guo YP, Ho SSK, Au-Yeung CH, Lam SC. Comparing mask fit and usability of traditional and nanofibre N95 filtering facepiece respirators before and after nursing procedures. *J Hosp Infect* 2020; 104:336-343.
14. Use Personal Protective Equipment (PPE) When Caring for Patients with Confirmed or Suspected COVID-19, CDC 30rd March 2020.
15. Kooraki S, Hosseiny M, Myers L, Gholamrezanezhad A. Coronavirus (COVID-19) Outbreak: What the Department of Radiology Should Know. *JACR* 2020.
16. European Centre for Disease Prevention and Control. Interim guidance for environmental cleaning in non-healthcare facilities exposed to SARS-CoV-2. *ECDC,* Stockholm, 2020.
17. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *J Hosp Infect* 2020; 104:246-251.
18. Pediconi F, Galati F, Bernardi D et al. Breast imaging and cancer diagnosis during the COVID-19 pandemic: recommendations from the Italian College of Breast Radiologists by SIRM. *La Radiologia Medica* 2020; 1-5.
19. Murray OM, Bisset JM, Gilligan PJ, Hannan MM, Murray JG. Respirators and surgical facemasks for COVID-19: implications for MRI. *Clin Radiol* 2020; 75:405-407.
20. Kooraki S, Hosseiny M, Raman SS, Myers L, Gholamrezanezhad A. Coronavirus disease 2019 (COVID-19) precautions: What the MRI suite should know. *JACR* 2020; 17:830.
21. Ong SJ, Renfrew I, Gopinathan A et al. SIR HELMET (Safety In Radiology Healthcare Localised Metrological EnviromenT): a low-cost negative-pressure isolation barrier for shielding MRI frontline workers from COVID-19 exposure. *Clin Radiol* 2020.
22. Repici A, Maselli R, Colombo M et al. Coronavirus (COVID-19) outbreak: what the department of endoscopy should know. *Gastrointest Endosc* 2020.
23. Wong J, Goh QY, Tan Z et al. Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. *Can J Anesth* 2020; 1-14.
24. Czernin J, Fanti S, Meyer PT et al. Nuclear medicine operations in the times of COVID-19: strategies, precautions, and experiences. *J Nucl Med* 2020; 61:626-629.
25. Zuckier LS, Moadel RM, Haramati LB, Freeman LM. Diagnostic evaluation of pulmonary embolism during the COVID-19 pandemic. *J Nucl Med* 2020; 61:630-631.
26. Huang HL, Allie R, Gnanasegaran G, Bomanji J. COVID19–nuclear medicine departments, be prepared! *Nucl Med Commun* 2020; 41:297.
27. Paez D, Gnanasegaran G, Fanti S et al. COVID-19 pandemic: guidance for nuclear medicine departments. 2020
28. Wei W, Zheng D, Lei Y et al. Radiotherapy workflow and protection procedures during the Coronavirus Disease 2019 (COVID-19) outbreak: Experience of the Hubei Cancer Hospital in Wuhan, China. *Radiother Oncol* 2020.
29. Backer JA, Klinkenberg D, Wallinga J. Incubation period of 2019 novel coronavirus (2019-nCoV) infections among travellers from Wuhan, China. *Euro Surveill* 2020; 25:2000062.
30. Chan JFW, Yuan S, Kok KH et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *The Lancet* 2020; 395:514-523.
31. Meattini I, Franco P, Belgioia L et al. Radiation therapy during the coronavirus disease 2019 (covid-19) pandemic in Italy: a view of the nation's young oncologists. *BMJ* 2020.
32. Aghili M, Ghalehtaki R, Darzikolaee NM, Jafari F, Moshtaghian M. Radiotherapy and COVID-19: Practical recommendations from Iran. *Radiother Oncol* 2020; 149:70-71.