

Novel Coronavirus International Public Health Emergency: Guidance on Radiation Oncology Facility Operation

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Introduction

With the outbreak of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the novel coronavirus responsible for coronavirus disease 2019 (COVID-19), a once-every-century event is being experienced in many countries that is leading to disruptions and uncertainty.^{1,2,3}

Studies have suggested that COVID-19 can have high transmission rates with the average infected person able to spread the disease to two or three other individuals.⁴ SARS-CoV-2 transmission is thought to occur mainly through respiratory droplets, which can also infect an individual through direct contact with mucous membranes such as ocular surfaces.^{5, 6} Infection can also occur through fomite-mediated transmission through close unprotected contact⁷. Close contact with SARS-CoV-2 infected individuals can expose people to high concentrations of aerosolized respiratory droplets that increases the risk of transmission^{5, 6, 8, 9}. Fecal shedding has been demonstrated from some patients and its significance for COVID-19 to be determined.^{7, 10} COVID-19 is characterized by a long incubation period with most cases occurring approximately four to five days after exposure¹¹ and there is strong evidence that the SARS-CoV-2 can be transmitted by individuals who are mildly ill or even asymptomatic.^{12, 13} Sometimes, patients can have delayed onset of symptoms or have absence of typical symptoms including fever.^{14, 15}

Compared to other potentially susceptible populations, oncology patients with immunosuppression are at a higher risk of developing severe post-infection events during the SARS-CoV-2 outbreaks. Throughout the process of preparing for and receiving radiation therapy, the exposures between inter- and intra-departmental medical professionals with patients may lead to a possibility of cross-infection. Therefore, developing infection prevention protocols and procedures specifically for managing radiation oncology patients is necessary to protect patients and staff. The capacity to ensure safe and orderly administration of radiation therapy to our patients during this pandemic is critical.

In this article, we discuss how radiation therapy departments or centers can most effectively respond to this public health emergency through discussing the procedures and protocols implemented at the Pingshan District People's Hospital, Pingshan General Hospital of Southern Medical University, Shenzhen, Guangdong; the National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital & Shenzhen Hospital, the Chinese Academy of Medical Sciences and Peking Union Medical College; and the First Affiliated Hospital of

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Anti-Pandemic Protocols and Operations

1. Establishing at the Department Level a COVID-19 Working Group

A working group on the clinical procedures and workflow during the pandemic should be established and led by an individual at each radiotherapy facility. Within the working group, each team member should have a clear assignment role and be familiar with the necessary protocols on infection prevention and control. At the above hospitals, these working groups have created protocols covering hospital and ambulatory care workflow, facility infection prevention and control, emergency operations, protective material management, and radiotherapy procedures and equipment maintenance. There have also been personnel trainings on infection protection that have included information on basic prevention precautions, airborne infection isolation room specifications, epidemiological and clinical characteristics of COVID-19 cases, and simulation exercises on various possible situations with assessments. All personnel must be trained and screened (Supplemental Materials: Forms 1, 2) to work.^{16, 17} All trainings should practice maintaining distance between individuals and limiting the number of individuals in one area, which can be accomplished via remote meetings and conference calls.

A humanistic approach to patients should be employed including treating patients with compassion and respect for their concerns, values, and preferences. The availability of psychological counseling services should be prioritized to individuals in need during the pandemic. Furthermore, patient education of COVID-19 should be emphasized. In the above-mentioned hospitals, educational campaigns have been employed that publicize the latest scientific knowledge about the prevention, diagnosis, and treatment of COVID-19. Medical personnel are provided training and encouraged to discuss information regarding the infection with patients. Providing factual information is paramount in reducing panic and promoting high quality care.

Appointment based medical procedures and visits should be adopted to streamline the flow of patients to the hospital or radiation therapy facility. Working areas are divided based on functions to ensure a smooth workflow in the radiation therapy facility and to limit transmission. This is further described in the following section on medical staff and patient flow management.

1.1 The "Three Zones and Two Channels " Medical Staff and Patient Flow Management

At the above-mentioned hospitals, the “three zones and two channels” management is used for facilitation of medical staff and patient flow through the hospital. There have been three zones arranged to help facilitate treatment of patients: a “contaminated” area (Red), a “semi-contaminated” area (Yellow), and a “clean” area (Green). The risk of personnel cross-infection is divided into three levels of risk. Level 1 indicates high risk level is for the “contaminated” zone; level 2 indicates medium risk level is for “semi-contaminated” zone, and level 3 indicates low risk one for the “clean” zone. There are also two “channels” or areas that are only accessible by patients with suspected or confirmed infections and areas that are only accessible by routine patients and staff.

The “contaminated” zone at facilities is the area accessed by patients with SARS-CoV-2. The “semi-contaminated” area at facilities is the area accessed by all patients including the entrance to the radiation therapy facility, the registration office/front desk, the waiting room, the patient examination rooms, the patient access elevator, and patient bathrooms. The “clean” area is a staff only area that includes employee offices and other non-patient work areas. For each zone, personnel should adhere to specific environment infection control protocols and strict routine disinfection of the workspace and equipment (Table 1). Individuals are prohibited from crossing between different zones and channels to reduce contamination and cross-infection. Keeping meticulous records of disinfection is necessary to also ensure a clean and safe environment.

Table 1: Control level (zone) and disinfection policies

Control level (zone)	Disinfection and Sterilization	Machine, surface, and floor disinfection
Level 1: “contaminated” zone	Air sterilizer continuous operation/UV irradiation (1 hour each time, at least 2 times per day with 2 hours terminal disinfection)	2000 mg/L chlorine disinfectant (with an action time of at least 30 minutes followed by cleaning with water after using disinfectant on metal instruments), 75% ethanol (use as directed in manufacturer instructions)
Level 2: “semi-contaminated” zone	Disinfection according to the regulation of disinfection techniques in the healthcare setting as issued by the	Disinfection as according to the regulation of disinfection techniques in healthcare settings as issued by the
Level 3: “clean” zone		

	country prior to COVID-19	country prior to COVID-19
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Our experiences have shown that hand washing, respiratory hygiene including wearing masks, and keeping a safe distance between individuals can effectively mitigate transmission of SARS-CoV-2. Therefore, medical staff must strictly implement diligent hand hygiene before and after any contact with patients, before wearing protective equipment, and before and after removing protective equipment. Medical staff should wash hands after leaving a patient examination room, after contacting potentially contaminated environment and articles, after exposure to any body fluids, before meals, and after using the restroom. Hand hygiene should be performed prior to touching hand-held electronics such as mobile phones or medical devices or aids such as glasses.

Prior to their appointment in a health care facility, patients are screened at a screening checkpoint to determine if they are exhibiting signs of a SARS-CoV-2 infection. Triage nurses are available to assess and help individuals at the main entrance outside of facilities and in the reception area of facilities. They may need to help answer patient questions about the virus, and issue up-to-date visiting notices (Figure 1). They must wear personal protective equipment including masks, caps, latex gloves, protective goggles or face shields, disposable waterproof isolation gowns, and shoe covers when they are escorting suspected or confirmed patients with SARS-CoV-2 to fever clinics, which are special infectious disease clinics that provide further evaluation and management.

Consultant physicians or medical staff from other departments also have specific procedures to limit infection risk. Upon finishing their clinical duties in a different department, the medical provider must change out of their masks, clean and disinfect frequently touched items including personal medical aids, electronic devices, pens, and other hand-held items with a 75% alcohol disinfectant solution or wet disinfectant wipes. Then, they wash their hands and return to the department only after changing into clean work clothes at designated facility changing rooms. Reusable protective goggles are collected and brought to the facility's disinfection and sterilization division for disinfection prior to the next use.

1.2 Common Area Procedures and Meeting Procedures

In all common areas, a distance of at least one meter between seats is encouraged. For dining, limit the number of individuals that are simultaneously dining as well as encourage distance between individuals. If conditions permit, only one person should be seated per dining table. If possible, the dining area should be set up in a clean area that is separate from the work area with staff eating in different clothes than their work clothes.

Facilities are recommended to avoid holding large conferences and to work in limited numbers at a time to reduce exposure to multiple people. Events that must be held should be properly planned to reduce the number of participants and to reduce the duration of time that individuals may be exposed to potential infection. If it is necessary to meet, a large group meeting can be divided into smaller group meetings in which individuals should also wear appropriate protective equipment. It is recommended to have virtual meetings using video, audio and text to share information remotely.

1.3 Diagnosis of COVID-19

Understanding the clinical presentation of patients with suspected and confirmed infection is vital in protecting both the medical staff and uninfected patients. Physicians should proactively educate themselves on the clinical presentation and the prevention strategies for COVID-19. The diagnosis for COVID-19 combines the following epidemiological history and clinical manifestations⁸ :

A. Epidemiological history : See COVID-19 Screening Questionnaire (Supplemental Form 1)

B. Clinical manifestations

(1) Fever and/or respiratory symptoms

(2) Characteristic COVID-19 imaging features on chest CT

(3) Laboratory findings include normal or decreased total number of white blood cell count in the early stage of disease onset and normal or decreased lymphocyte count

If patients meet any one criterion from A and meet any two criteria of B, OR do not meet any criteria from A and meet three criteria from B, then they enter the facility's emergency procedures. A confirmed case is diagnosed if one of the following criteria is met: ^{1, 8, 15, 18} ;

(1) Reverse transcriptase–polymerase chain reaction (RT-PCR) of the new coronavirus nucleic acid detection test result is positive; (2) Result of gene sequencing is highly homologous with known new coronaviruses; or (3) Serum of the new coronavirus-specific IgM antibodies and IgG antibodies are positive. Note: IgG antibodies can change from negative to positive or increase to 4 times or higher during the recovery phase than during the acute phase.

1.4 Clinical Procedures for Patients Receiving Radiation Therapy

When faced with major public health emergencies from infectious diseases, infection prevention and control should begin with the initial patient appointment.

Clinic and treatment areas should streamline flow through the clinic and limit traffic including the number of patient escorts. If there is a patient who requires assistance, the patient can be accompanied by another person. The requirements for the escort are the same as the requirements for the patients receiving radiation treatment. Only patients and escorts who are not suspected to have a SARS-CoV-2 infection can enter the radiation facility. Figure 2 displays a flow chart of suggested radiation oncology facility processing.

In the Pingshan District People's Hospital, the appointment registration group have various signs that provide visual guidance to patients as well as voice instructions through different electronic channels to issue up-to-date visiting notices to patients. Prior to their appointment, patients are screened at a screening checkpoint to determine if they are exhibiting signs of a SARS-CoV-2 infection. For example, initially all individuals undergo infrared temperature detection before entering the radiation oncology facility (Figure 2). This type of temperature measurement uses a portable infrared thermometer to measure the temperature of the patient's head from a distance.¹⁹

All medical staff receive training regarding the appropriate protocols and procedures to follow if patients have suspected or confirmed COVID-19 or if they have fever. Physicians are trained to understand and recognize the clinical features of COVID-19. If patients are suspected or confirmed to have COVID-19 or if they have a fever, then their current radiation therapy treatment is on hold and the emergency procedure is enacted. The emergency procedure is outlined in section 1.5. For patients who have confirmed COVID-19, the evaluation and treatment of their acute infection takes precedence. For pre-screened patients who do not have suspected or confirmed COVID-19, they can continue to undergo their radiation treatments and follow-up appointments as scheduled. These appointments can continue as scheduled due to the strict implementation of the above-mentioned protocols and procedures to mitigate infection risk.

1.5 Emergency Procedure

Patients who have suspected COVID-19 or if they have fever enter the emergency procedure and their current radiation therapy treatment plan is suspended.

In "contaminated" zones, the following standard prevention and control measures are implemented for suspected and confirmed patients with COVID-19 or fever:

- 1) Personnel protection measures are employed including personal protection equipment against the spread of droplets and aerosols. Individuals in contact with the patient should wear appropriate personal protective equipment including masks, caps, latex gloves, protective goggles or face shields, disposable waterproof isolation gowns, and shoe covers.

- 2) When encountering a suspected patient with COVID-19 or with fever, the reporting physician or medical staff immediately alerts the supervising physician as well as contacts the medical professionals from the fever clinic who provides further evaluation and treatment. A patient handoff process is completed with the fever clinic professionals.
- 3) Medical staff who are directly exposed during work are also placed in infection isolation rooms immediately and medically observed.
- 4) If the hospital or clinic is unable to appropriately manage a suspected or confirmed COVID-19 patient, then exposures need to be immediately reported to hospitals that are prepared for external transfers. After the emergency procedure is followed, the patients are then transferred to a designated treatment hospital.⁸
- 5) In terms of environmental infection control, the area that the patient is transferred from is disinfected as according to the level 1 risk category^{16,17}. The facility should be would be strictly disinfected with all personnel wearing appropriate personal protective equipment.

Conclusions

Radiation therapy facilities are places of concentrated patient interactions. In the face of acute infectious diseases, it is critical to maintain strict infectious disease control procedures and to create a clear clinical workflow protocol to best protect medical staff and patients from the impact of acute infectious diseases. The current situation of COVID-19 is rapidly evolving, but the impact of the virus in radiation therapy facilities can be mitigated and managed with appropriate and timely implementation of infection control procedures and protocols. We hope our paper can provide guidance and be a reference to medical professionals in radiation oncology so that they may provide oncology patients with safe and high-quality care.



Figure 1. Triage nurse with personal protective equipment including medical mask, cap, medical grade gloves, and protective goggles in the main entrance of a facility.

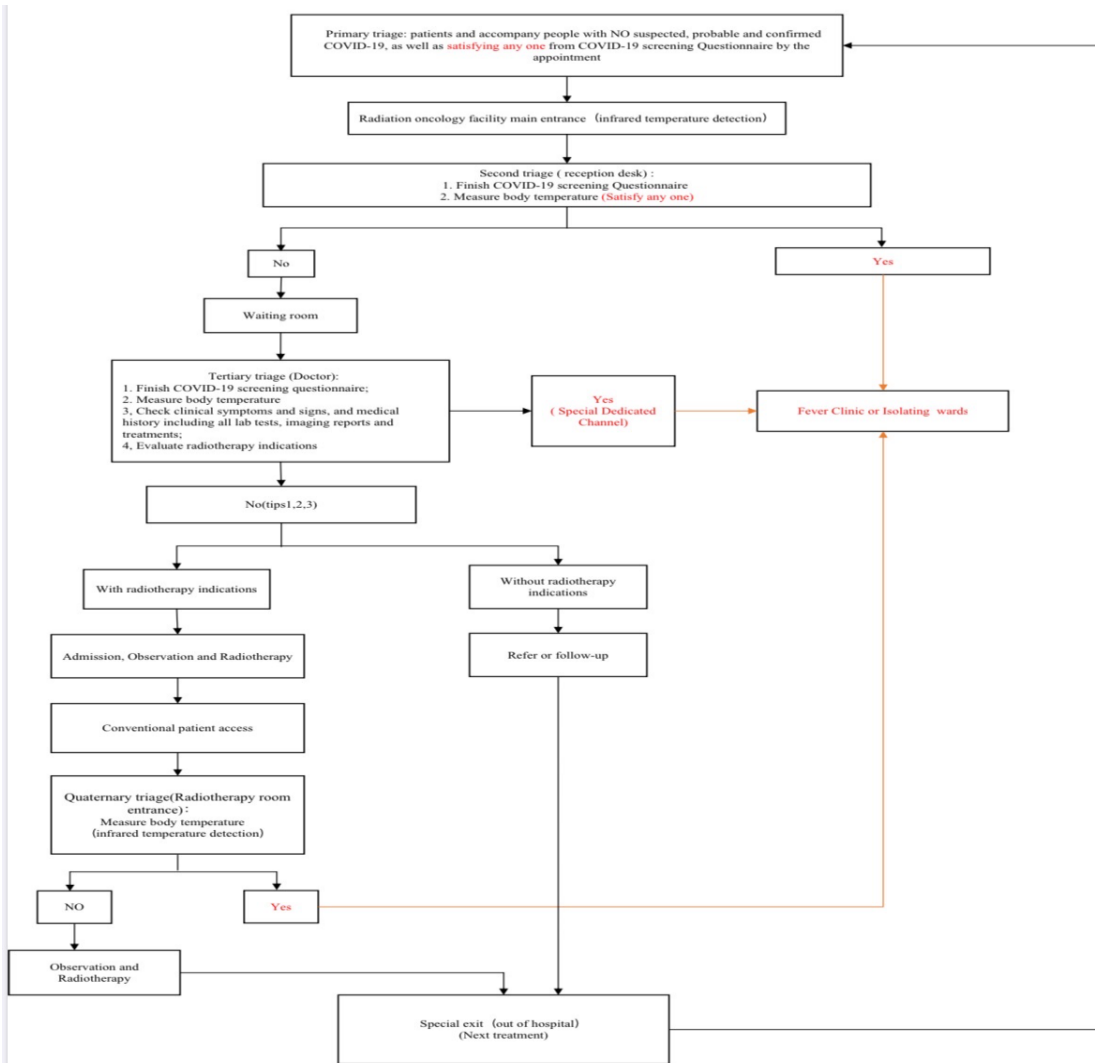


Figure 2. Suggested radiation oncology facility processing map

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Supplementary Materials

- 1, COVID-19 Screening Questionnaire (English and Chinese version)
- 2, Employee Questionnaire

COVID-19 Screening Questionnaire

I. Basic information

Name: Case number / clinic number: Category: Patient Accompanying People

II. Do you have the following contact history (patients and accompanying people , please fill in the truth, and mark ✓ in according to your situation)

1. Is there a history of travel or residence in the epidemic area and the COVID-19 reported community in the past 14 days?

No Yes

2. Have you been exposed to the person with fever and / or respiratory symptoms from the epidemic area or COVID-19 reported communities in the past 14 days?

No Yes

3. Have you had contact history with people infected with SARS-CoV-2 (positive nucleic acid test) in the past 14 days?

No Yes

4. Have you ever had a clustering event in the past 14 days? (Within 2 weeks in small areas such as homes, offices, schools, churches, etc., there were 2 or more people with fever and / respiratory symptoms.)

No Yes

5. Have you ever had fever and / respiratory symptoms within 14 days?

No Fever Cough Vomiting / Diarrhea Fatigue

I promise: The above information is true, and I will consciously abide by the Law on Prevention and Treatment of Infectious Diseases, and fulfill the obligations of providing truthful information and medical history, and cooperating with treatment, isolation, and transfer to the hospital. I understand that if I conceal my illness and medical history, refuse to cooperate with treatment, isolation and transfer to the hospital, I will bear the corresponding legal liabilities according to law.

Signature:

Date:

COVID-19 流行病学史调查表

一、基本信息

姓名： 病案号/门诊号： 类别： 患者 陪人

二、是否有以下接触史（患者及陪人，请如实填写，根据本人的情况在□内打√）

1、近 14 日是否有疫区、新冠病例报告社区的旅行史或居住史？

否 是

2、近 14 日内是否有接触过疫区或新冠病例报告社区的发热和 / 或有呼吸道症状者？

否 是

3、近 14 日是否与新型冠状病毒感染者（核酸检测阳性者）有接触史？

否 是

4、近 14 日是否遭遇聚集性发病事件？（2 周内在小范围如家庭、办公室、学校、教会等场所，出现 2 例及以上发热和/呼吸道症状的病例。）

否 是

5、14 日内是否出现过发热和/呼吸道症状？

否 发热 咳嗽 呕吐/腹泻 乏力

我承诺：以上填写信息属实，将自觉遵守《传染病防治法》履行如实提供病情、病史，配合治疗、隔离、转院等义务。我明白如隐瞒病情、病史，拒不配合治疗、隔离、转院等行为将依法承担相应法律责任。

被调查者签字：

日期： 年 月 日

Employee Questionnaire

I. Basic information

Name:

Employee ID:

II. Please fill in the following information truthfully (mark√in according to your situation)

1. Is there a COVID-19 case reported in your community?

No Yes

2. Is there facial / hand skin damaged?

No Yes

3. Is there ineffective protection or improper protection?

No Leaked medical protective mask Damaged protective clothing Damaged gloves Other

4. Is there any discomfort?

No Fever Weakness Dry cough Diarrhea Other

5. Is there the COVID-19 Screening Questionnaire abnormal ?

No Yes

I promise: The above information is true, and I will consciously abide by the Law on Prevention and Treatment of Infectious Diseases, and fulfill the obligations of providing truthful information and medical history, and cooperating with treatment, isolation, and transfer to the hospital. I understand that if I conceal my illness and medical history, refuse to cooperate with treatment, isolation and transfer to the hospital, I will bear the corresponding legal liabilities according to law.

Signature:

Date: