Dear the Editor-in-Chief Dr. Robert C. Miller,

We are submitting the Brief Opinions with Opinion Pieces entitled “Efforts to reduce the impacts of COVID-19 outbreak on radiation oncology in Taiwan” for your consideration of publication in Advances in Radiation Oncology.

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has rapidly spread from China to almost all the countries including Taiwan in recent months. Taiwan government has made tremendous efforts to minimize the spread of SARS-CoV-2 from abroad, and hospitals throughout Taiwan have taken steps to minimize the virus spread. Cancer patients are more vulnerable to infection, so precautionary measures are necessary especially in radiation oncology departments.

In the opinion pieces, we briefly share the strategies and actions for patients and staffs of the Departments of Oncology in Taiwan to face the challenges of COVID-19. With initial success in containing COVID-19 spread in Taiwan, the impact on RT service is minimal.

This manuscript has not been previously published and has not been submitted for publication elsewhere.

All authors declare no competing financial interests in relation to this work.

We look forward to your review and comments.

Respectfully Yours,

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Efforts to Reduce the Impacts of COVID-19 Outbreak on Radiation Oncology in Taiwan

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1. COVID-19 outbreak and pandemic progression in Taiwan

On January 3, 2020, the World Health Organization (WHO) was notified of 44 patients in Wuhan, China experiencing pneumonia of unknown cause, which was later identified as Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Within one month the disease spread far beyond Wuhan, a city with a population of 11 million, and infected nearly ten thousand people in China. As the number of infected individuals continued to rise exponentially, China’s closest neighbors such as Taiwan, Japan, and South Korea soon faced the risk of their residents being infected. To date, more than 800 individuals in Japan and 8,000 in South Korea have been diagnosed with COVID-19. With early proactive disease surveillance and contact isolation, Taiwan has had significantly fewer cases, with less than 100 confirmed cases and one death as of March 17, 2020.

2. Policies and responses of healthcare system in Taiwan

Taiwan has made tremendous efforts to minimize the spread of SARS-CoV-2 from abroad. The government has assigned overseas regions (subject to changes depending on updated data) to three levels with varying quarantine restrictions, with Level 3 regions having the highest risk of infection. Residents that have returned from Levels 1 and 2 regions are required to self-monitor for flu-like symptoms, while those from Level 3 regions are placed under a mandatory 14-day home quarantine. Furthermore, foreigners with recent travels to Level 3 regions are temporarily prohibited from entering Taiwan, and most flights from mainland China are grounded.
To keep healthcare providers updated on the travel history of each resident, information from the immigration database is incorporated into the integrated circuit (IC) chip embedded in the health insurance identification cards, which are issued by the National Health Insurance Administration (NHI) and available to over 99% of the population. Additionally, distribution of personal protective equipment (PPE) is under government supervision to avoid hoarding and assure availability.

3. Risk control strategies in hospitals

Hospitals throughout Taiwan have taken steps to minimize the virus spread. Figure 1 illustrates a typical hospital screening workflow. People that have returned from Level 3 regions such as mainland China, Iran, Italy, South Korea, and certain European countries in the last 14 days are prohibited from entering hospitals, unless they need to be seen in clinic for non-COVID-19-related illnesses or have suspected infection. The NHI IC Card, which is connected to the immigration database and contains its card holder’s travel and contact history, is verified by the medical staff before the card holder can enter a hospital for medical services; furthermore, everyone needing to enter a hospital, including patients, visitors, and staff members, is required to wear a disposable or cloth mask. Infrared thermal cameras are placed at hospital entrances, and individuals with abnormal thermal signals are rechecked for body temperature; those with an elevated temperature (forehead temperature ≥ 37.5°C or tympanic temperature ≥ 38.0°C) are prohibited from entering and subsequently referred to either the emergency department (travel history to Level 3 regions) or the special epidemic clinic (including travel history to areas other than Level 3 regions or suspicious travel/occupation/contact/cluster [TOCC] history) located outside the hospital building for further evaluations by infectious disease (ID) specialists. In addition, only up to two guests per
patient are allowed to visit the clinic/inpatient floor for one hour per day to avoid overcrowding the hospital and minimize further spread outside the hospital.

4. Precautionary measures in radiation oncology departments

Cancer patients are more vulnerable to infection due to their compromised immune system, and active cancer therapy such as chemotherapy and radiotherapy (RT) may lead to further immunocompromised status. Hence, precautionary measures are necessary especially in radiation oncology departments where patients are present for daily or fractionated treatment (Figure 2). Common policies of radiation oncology departments in Taiwan for patients with reported or confirmed COVID-19 include postponing the simulation and scheduling RT after completing the isolation and infection control requirements. The simulation and initiation of RT for patients arriving from Level 3 regions and without COVID-19 symptoms are postponed for 14 days from their entry to Taiwan. In case of urgent medical necessity before completing the 14-day quarantine requirement, patients need to contact Taiwan’s Centers for Disease Control for approval to enter hospital following specific protocols. The quarantine restrictions also apply to scheduled follow-up and new consult patient. For patients coming from Levels 1 and 2 regions in the last 14 days prior to their hospital appointment, the simulation or treatment, with the attending oncologists’ approval, can be scheduled for the end of the day after disinfection of the room. Patients continue to be screened daily, and those with new onset of fever, other flu-like symptoms, or new TOCC history during RT course are referred to the onsite screening station for SARS-CoV-2 tests. Each patient is tested every 24 hours for three consecutive times, with a testing result turnaround of 24 hours. Those with three consecutive negative tests are allowed to resume RT. Some centers may consider hypofractionated regimens for infected individuals in order to finish RT faster, per treating physicians’ discretion. Surgical masks for medical staff in the department are supplied on at least a daily basis and
more frequently as needed. Notably, each patient undergoing RT is provided with a new surgical mask daily and is encouraged to wear it in public spaces outside the hospital. The treatment machines and equipment are disinfected between each patient, and treatment facilities are cleaned by trained staff in compliance with recommendations from the hospital’s infection control team.

At some medical centers, the medical staff, including physicians, therapists, and nurses, are divided into mutually exclusive subgroups. Direct contact between members from each subgroup is prohibited. If any member of the subgroup encountered a suspicious COVID-19 case, the whole subgroup undergoes a 14-day quarantine. Meanwhile, other subgroups can still operate the department with the least amount of impact on medical service. Hospital meetings and tumor board conferences are either canceled, reduced in frequency, or take place via online video discussions. With the proactive preventive approaches outline above, there has been no need to reduce clinical staff availability as a way to further reduce human contact and increase social distancing. All hospitals are able to maintain normal workforce to assist patients and provide cross coverage when needed, and there has been no SARS-CoV-2 transmission in the radiation oncology departments in Taiwan.

5. Challenges impacting radiation oncology patients and clinical staff

With initial success in containing COVID-19 spread in Taiwan, impact on RT service is minimal. For example, at the Department of Radiation Oncology at National Taiwan University Hospital, which maintains a daily treatment volume of 300-350 patients in two shifts, the rate of postponing or canceling RT simulations for all causes was 16.9% (73/431) from February 15 to March 15, 2020, comparable to 16.4% (77/471) in the same period in 2019. By providing adequate screening and preventive measures for the patients and staff, there was no need for rationing RT or treatment delay in otherwise uninfected/non-quarantined individuals. Sixty-
one inpatient RT consultations were seen from February 15 to March 15, 2020, similar to 57 in the same period in 2019. Two patients were referred to the epidemic screening process and had subsequent negative COVID-19 test results, and no patient undergoing RT had COVID-19. Despite this achievement, there have been unavoidable influences on patients and healthcare professionals. Patients who are concerned about acquiring the infection may choose to postpone clinic visits, despite not having a departmental policy to recommend the delay. In addition, patients who were planned for RT may decide to defer the recommended therapy, especially with palliative or elective treatment. The shortage of medical supplies for PPE and fear of getting infected inside hospital buildings make it stressful for both patients and healthcare professionals. All these impacts might affect the interaction between patients and healthcare professionals, influence important decision-making processes, and potentially determine cancer therapy outcome. As COVID-19 evolves into a global pandemic, the risk of community spread in Taiwan could continue to increase. A proposed modified workflow that separates RT patients into different physical waiting/treatment space and “zones” in case of increased community spread is presented in Figure 3. In addition, the government is considering nationwide screening of all healthcare professionals for SARS-CoV-2 antibodies to detected past infection as well as current asymptomatic infections to better triage frontline healthcare workers.


Taiwan went through the severe acute respiratory syndrome (SARS) epidemic in 2013, with 181 deaths of 668 probable infected patients. Because of its high nosocomial infection and mortality rates, SARS led to the closure of medical units and isolation of many healthcare professionals in Taiwan, resulting in over 20% of RT treatment volume reduction. With lessons learned from the SARS outbreak and concerns for other seasonal infections in a densely
populated country as well as air pollution, Taiwanese residents, regardless of their health status, developed the habit of wearing masks in public. Taking all the information into consideration, hospitals have adapted an updated policy to screen high-risk individuals by isolating them in designated areas outside hospital buildings to protect uninfected people and healthcare professionals,\(^{11}\) taking highly hygienic steps by mandating mask-wearing for everyone inside hospital buildings, and disinfecting waiting areas and treatment units between patients. The different strategies between SARS and COVID-19 make the current workflow of fractionated RT cautiously maintained.

### 7. Conclusion

With experiences gained from the SARS epidemic, the Taiwanese government’s efficient policies as well as strategies, and a multitude of precautionary steps implemented by hospitals, departments of radiation oncology in Taiwan have been able to provide uninterrupted radiation treatment for most cancer patients amid the current COVID-19 pandemic. Taiwan’s strategic plans for limiting the spread could be a useful resource for other regions facing this serious public health threat.
Reference


Figure 1. Screening workflow for patients entering hospitals and daily radiation treatments.

*Designated by the government and subject to modification. **Forehead temperature $\geq$ 37.5°C or tympanic temperature $\geq$ 38.0°C. Abbreviation: NHI-IC, National Health Insurance Integrated Circuit (IC) chip; RT, radiotherapy; TOCC, travel/occupation/contact/cluster history.

Figure 2. Picture of radiation therapists and an uninfected/low-risk/asymptomatic routine patient wearing PPE during a RT session.

Figure 3. Conceptual risk stratification strategy for patients requiring RT service during the community spread of COVID-19. Abbreviation: RT, radiotherapy; URT, upper respiratory tract; TOCC, travel/occupation/contact/cluster history
Travel history to Level 3 regions* after 14-day quarantine
Travel history to Levels 1-2 regions* and TOCC screening with
linkage to NHI-IC Cards (mandatory mask-wearing for all)

Yes  No

Have a scheduled or urgent appointment

No

Deny entry

Yes

Elevated body temperature** or flu-like symptoms

No

Special epidemic clinic outside of hospital building for further triage/testing

Proceed to RT clinic but decision of simulation and treatment is made by radiation oncologist

Elevated body temperature** or flu-like symptoms

Yes  No

Special epidemic clinic outside of hospital building for further triage/testing

Proceed to RT clinic, simulation, and treatment

Daily screening

Yes

Elevated temperature and new TOCC history

No

Continue RT
Risk Assessment

Green Zone
Afebrile/No URT symptoms/No TOCC risks

Yellow Zone
Febrile/Pneumonia/URT symptoms/TOCC risks

Red Zone
Reported/Confirmed COVID-19

SARS-CoV-2 Test

Negative

Continue RT

Positive

Hold/Postpone RT
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