

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

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.¹ 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.² 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 isolation³, 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.³

1 To keep healthcare providers updated on the travel history of each resident, information
2 from the immigration database is incorporated into the integrated circuit (IC) chip embedded
3 in the health insurance identification cards, which are issued by the National Health Insurance
4 Administration (NHI) and available to over 99% of the population. Additionally, distribution
5 of personal protective equipment (PPE) is under government supervision to avoid hoarding and
6 assure availability.
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17 **3. Risk control strategies in hospitals**

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19 Hospitals throughout Taiwan have taken steps to minimize the virus spread.⁴ Figure 1
20 illustrates a typical hospital screening workflow. People that have returned from Level 3
21 regions such as mainland China, Iran, Italy, South Korea, and certain European countries in
22 the last 14 days are prohibited from entering hospitals, unless they need to be seen in clinic for
23 non-COVID-19-related illnesses or have suspected infection. The NHI IC Card, which is
24 connected to the immigration database and contains its card holder's travel and contact history,
25 is verified by the medical staff before the card holder can enter a hospital for medical services;
26 furthermore, everyone needing to enter a hospital, including patients, visitors, and staff
27 members, is required to wear a disposable or cloth mask . Infrared thermal cameras are placed
28 at hospital entrances, and individuals with abnormal thermal signals are rechecked for body
29 temperature; those with an elevated temperature (forehead temperature $\geq 37.5^{\circ}\text{C}$ or tympanic
30 temperature $\geq 38.0^{\circ}\text{C}$) are prohibited from entering and subsequently referred to either the
31 emergency department (travel history to Level 3 regions) or the special epidemic clinic
32 (including travel history to areas other than Level 3 regions or suspicious
33 travel/occupation/contact/cluster [TOCC] history) located outside the hospital building for
34 further evaluations by infectious disease (ID) specialists. In addition, only up to two guests per
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1 patient are allowed to visit the clinic/inpatient floor for one hour per day to avoid overcrowding
2 the hospital and minimize further spread outside the hospital.
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7 **4. Precautionary measures in radiation oncology departments**

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10 Cancer patients are more vulnerable to infection due to their compromised immune system,
11 and active cancer therapy such as chemotherapy and radiotherapy (RT) may lead to further
12 immunocompromised status. Hence, precautionary measures are necessary especially in
13 radiation oncology departments where patients are present for daily or fractionated treatment
14 (Figure 2). Common policies of radiation oncology departments in Taiwan for patients with
15 reported or confirmed COVID-19 include postponing the simulation and scheduling RT after
16 completing the isolation and infection control requirements. The simulation and initiation of
17 RT for patients arriving from Level 3 regions and without COVID-19 symptoms are postponed
18 for 14 days from their entry to Taiwan. In case of urgent medical necessity before completing
19 the 14-day quarantine requirement, patients need to contact Taiwan's Centers for Disease
20 Control for approval to enter hospital following specific protocols. The quarantine restrictions
21 also apply to scheduled follow-up and new consult patient. For patients coming from Levels 1
22 and 2 regions in the last 14 days prior to their hospital appointment, the simulation or treatment,
23 with the attending oncologists' approval, can be scheduled for the end of the day after
24 disinfection of the room. Patients continue to be screened daily, and those with new onset of
25 fever, other flu-like symptoms, or new TOCC history during RT course are referred to the
26 onsite screening station for SARS-CoV-2 tests. Each patient is tested every 24 hours for three
27 consecutive times, with a testing result turnaround of 24 hours. Those with three consecutive
28 negative tests are allowed to resume RT. Some centers may consider hypofractionated
29 regimens for infected individuals in order to finish RT faster, per treating physicians' discretion.
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31 Surgical masks for medical staff in the department are supplied on at least a daily basis and
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1 more frequently as needed. Notably, each patient undergoing RT is provided with a new
2 surgical mask daily and is encouraged to wear it in public spaces outside the hospital. The
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4 treatment machines and equipment are disinfected between each patient, and treatment
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6 facilities are cleaned by trained staff in compliance with recommendations from the hospital's
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8 infection control team.
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11 At some medical centers, the medical staff, including physicians, therapists, and nurses,
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13 are divided into mutually exclusive subgroups. Direct contact between members from each
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15 subgroup is prohibited. If any member of the subgroup encountered a suspicious COVID-19
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17 case, the whole subgroup undergoes a 14-day quarantine. Meanwhile, other subgroups can still
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19 operate the department with the least amount of impact on medical service. Hospital meetings
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21 and tumor board conferences are either canceled, reduced in frequency, or take place via online
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23 video discussions. With the proactive preventive approaches outline above, there has been no
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25 need to reduce clinical staff availability as a way to further reduce human contact and increase
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27 social distancing. All hospitals are able to maintain normal workforce to assist patients and
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29 provide cross coverage when needed, and there has been no SARS-CoV-2 transmission in the
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31 radiation oncology departments in Taiwan.
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41 **5. Challenges impacting radiation oncology patients and clinical staff**

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43 With initial success in containing COVID-19 spread in Taiwan, impact on RT service is
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45 minimal. For example, at the Department of Radiation Oncology at National Taiwan University
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47 Hospital, which maintains a daily treatment volume of 300-350 patients in two shifts, the rate
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49 of postponing or canceling RT simulations for all causes was 16.9% (73/431) from February
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51 15 to March 15, 2020, comparable to 16.4% (77/471) in the same period in 2019. By providing
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53 adequate screening and preventive measures for the patients and staff, there was no need for
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55 rationing RT or treatment delay in otherwise uninfected/non-quarantined individuals. Sixty-
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1 one inpatient RT consultations were seen from February 15 to March 15, 2020, similar to 57
2 in the same period in 2019. Two patients were referred to the epidemic screening process and
3 had subsequent negative COVID-19 test results, and no patient undergoing RT had COVID-
4 19. Despite this achievement, there have been unavoidable influences on patients and
5 healthcare professionals. Patients who are concerned about acquiring the infection may choose
6 to postpone clinic visits, despite not having a departmental policy to recommend the delay. In
7 addition, patients who were planned for RT may decide to defer the recommended therapy,
8 especially with palliative or elective treatment.⁵ The shortage of medical supplies for PPE and
9 fear of getting infected inside hospital buildings make it stressful for both patients and
10 healthcare professionals^{6,7}. All these impacts might affect the interaction between patients and
11 healthcare professionals,⁸ influence important decision-making processes, and potentially
12 determine cancer therapy outcome. As COVID-19 evolves into a global pandemic, the risk of
13 community spread in Taiwan could continue to increase. A proposed modified workflow that
14 separates RT patients into different physical waiting/treatment space and “zones” in case of
15 increased community spread is presented in Figure 3. In addition, the government is
16 considering nationwide screening of all healthcare professionals for SARS-CoV-2 antibodies
17 to detected past infection as well as current asymptomatic infections to better triage frontline
18 healthcare workers.

46 **6. Lessons of radiation oncology from SARS experiences for COVID-19**

48 Taiwan went through the severe acute respiratory syndrome (SARS) epidemic in 2013,
49 with 181 deaths of 668 probable infected patients.⁹ Because of its high nosocomial infection
50 and mortality rates, SARS led to the closure of medical units and isolation of many healthcare
51 professionals in Taiwan, resulting in over 20% of RT treatment volume reduction. With lessons
52 learned from the SARS outbreak and concerns for other seasonal infections in a densely
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1 populated country as well as air pollution, Taiwanese residents, regardless of their health status,
2 developed the habit of wearing masks in public. Taking all the information into consideration,
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4 hospitals have adapted an updated policy to screen high-risk individuals by isolating them in
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6 designated areas outside hospital buildings to protect uninfected people and healthcare
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8 professionals,¹¹ taking highly hygienic steps by mandating mask-wearing for everyone inside
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10 hospital buildings, and disinfecting waiting areas and treatment units between patients. The
11
12 different strategies between SARS and COVID-19 make the current workflow of fractionated
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14 RT cautiously maintained.
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21 **7. Conclusion**

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24 With experiences gained from the SARS epidemic, the Taiwanese government's
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26 efficient policies as well as strategies, and a multitude of precautionary steps implemented by
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28 hospitals, departments of radiation oncology in Taiwan have been able to provide uninterrupted
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30 radiation treatment for most cancer patients amid the current COVID-19 pandemic. Taiwan's
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32 strategic plans for limiting the spread could be a useful resource for other regions facing this
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34 serious public health threat.
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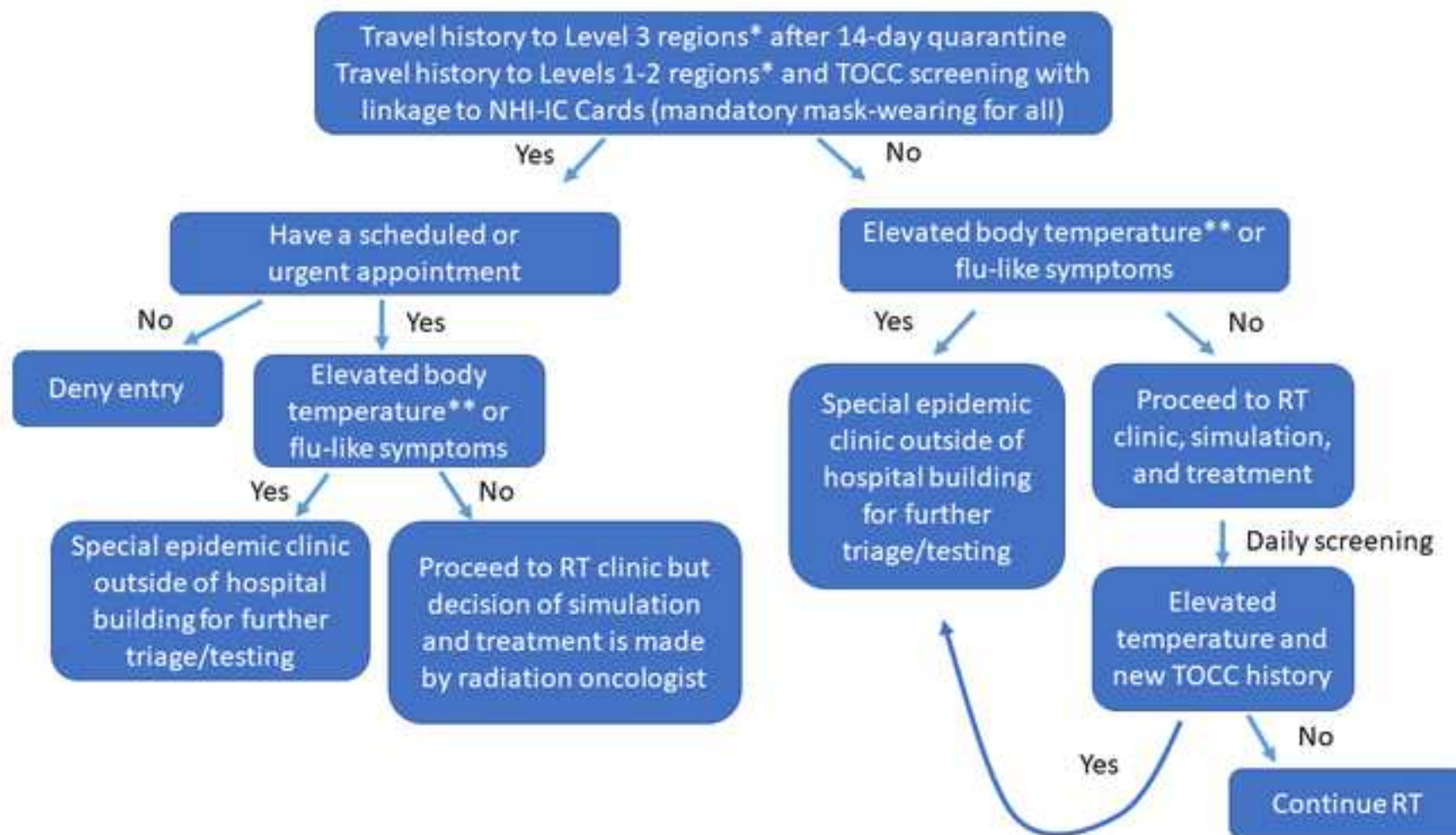
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1 Figure 1. Screening workflow for patients entering hospitals and daily radiation treatments.

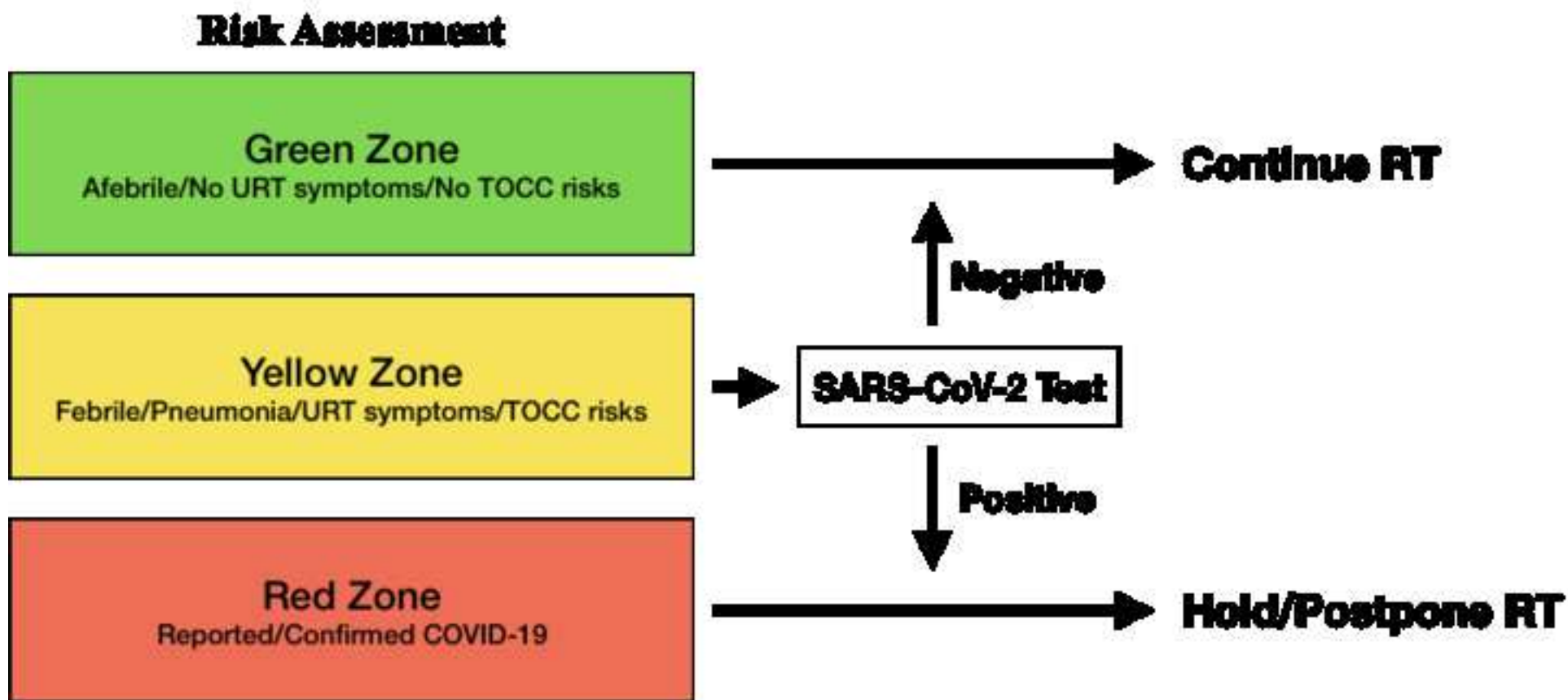
2 *Designated by the government and subject to modification. **Forehead temperature \geq
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4 37.5⁰C or tympanic temperature \geq 38.0⁰C. Abbreviation: NHI-IC, National Health Insurance
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6 Integrated Circuit (IC) chip; RT, radiotherapy; TOCC, travel/occupation/contact/cluster
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8 history.
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17 Figure 2. Picture of radiation therapists and an uninfected/low-risk/asymptomatic routine
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19 patient wearing PPE during a RT session.
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27 Figure 3. Conceptual risk stratification strategy for patients requiring RT service during the
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29 community spread of COVID-19. Abbreviation: RT, radiotherapy; URT, upper respiratory
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31 tract; TOCC, travel/occupation/contact/cluster history
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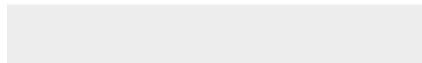


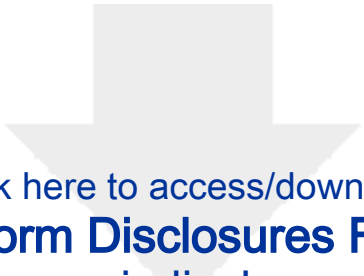
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