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Impact of COVID-19 on Nuclear Medicine in Asia

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Coronavirus disease 2019 (COVID-19) was first detected in China in late 2019 and rapidly spread to nearby Asian countries in early 2020. Outbreaks occurred differently in each country and affected nuclear medicine (NM) practice significantly even before the COVID-19 pandemic. The Asian NM community has worked together from the beginning of the pandemic. Fortunately, the Asian Regional Cooperative Council for Nuclear Medicine annual general meeting and Asia Nuclear Medicine Board examination was held in Manila from January 28 to February 2, 2020; these were the last face-to-face events of these organizations to date. Members shared information about COVID-19 at the conference, and through online means afterwards. Web-based surveys performed from March to April 2020 for the Asian Regional Cooperative Council for Nuclear Medicine and Asia Nuclear Medicine Board communities showed a significant reduction of NM practice and supply of radioisotopes (RI) at the beginning of the COVID-19 pandemic. A follow-up survey in March to April 2021 clearly showed the recovery of both NM practice and RI supplies. The pattern of recovery is variable according to institutions and countries. Herein, we have reported the case-in-point operational histories of four representative institutions in the East, Southeast, South, and West Asia. The second outbreak in India is ongoing on a worrisome scale. Various communications and educational sessions were actively performed online in the Asian NM community during the pandemic.

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Introduction

Coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China in December 2019. It initially spread to East and Southeast Asian countries and later to West Asia. These Asian countries, which detected the first cases of COVID-19 in January 2020, include Japan, Thailand, South

Korea, Taiwan, Macau, Nepal, Singapore, Vietnam, Malaysia, Cambodia, Sri Lanka, UAE, India, and the Philippines, in order of occurrence.¹ The World Health Organization eventually declared a COVID-19 pandemic in March 11, 2020.²

The COVID-19 pandemic has made health care the topic of concern globally. The strengths and vulnerabilities of health care systems in each region and country became visible. Nuclear medicine (NM) is not an exception. The International Atomic Energy Agency (IAEA) human health division underwent several webinars entitled “COVID-19 pandemic: challenges for the NM departments”.³ The results of these discussions were published as guidance.⁴ They also surveyed and published the global impact of COVID-19 on NM departments. The impact of COVID-19 on global cardiovascular diagnostic procedural volumes and safety practices including nuclear cardiology study was also assessed and published by a group of IAEA Noninvasive Cardiology Protocols Study.⁵

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The practice of NM was reduced significantly as countries worldwide being affected by the COVID-19 pandemic. Many NM professionals were experienced and even dead by COVID-19 infections.⁶

The Asian community of NM has worked together from the beginning of the COVID-19 pandemic. Fortunately, the Asian Regional Cooperative Council for Nuclear Medicine (ARCCNM) annual general meeting with the Asia Nuclear Medicine Board (ANMB) coaching and examination programs were held in Manila, Philippines, in conjunction with the 35th Philippine Society of Nuclear Medicine convention from January 28 to February 2, 2020; these were the last face-to-face conference of these organizations to date. Members shared information about COVID-19 at the conference, and through online means thereafter.

Online Survey: NM Practice & RI Supply

Questionnaires were designed by one of the authors of this paper (H.H.B.) and disseminated in March to April 2020 and in the same period in 2021. The first questionnaire included two questions: (1) How was the NM practice of your department in February to March 2020 as compared to that in the same period in 2019? Please choose among the five categories: increased (more than 5% increase), no change (less than 5% change), mildly (5%-30%) decreased, markedly (more than 30%) decreased, and shutdown and (2) How has the supply of radioisotopes (RI) changed between last year and this year? Please choose among the five categories: new items, same, reduced by 1–2 items, reduced by three or more items, and no supply. The second questionnaire included similar questions with the same answer choices: (1) How was your practice this year during January to February 2021 as compared to the same period in 2020? and (2) How was the supply of RI? Questionnaires were answered within a few days after being disseminated through a social network service (Whatsapp) and emails. The comparison of NM practice and RI supply between time periods was done using a Chi-square test. *P*-value less than 0.05 were regarded as significant.

Forty NM departments from 13 countries throughout Asia (Bangladesh, China, India, Indonesia, Iran, Japan, Jordan, South Korea, Malaysia, Pakistan, the Philippines, Singapore, and Thailand) answered the first questionnaire in March to April 2020. Of these departments, 80% had significant difficulties. A quarter of NM clinics shut down for three reasons: (1) loss of RI supply, (2) the NM ward was converted into a COVID-19 ward, and (3) doctors and paramedics were being deployed to assist in the management of COVID-19 cases. The RI supply were absent in 25% of these departments and was significantly reduced in 50%. The RI supply was maintained in only 25% of these institutions, which could continue providing services. (Fig. 1A)

Fifty-two NM departments from 12 countries in Asia (Bangladesh, China, India, Indonesia, Jordan, South Korea, Kuwait, Malaysia, Oman, Pakistan, the Philippines, and Thailand) completed the second questionnaire in March to April 2021. Both practice of NM and supply of RI showed recovering trends in 2021. (Fig. 1B) The practice of NM had increased in 41% and decreased in 41% of these departments, compared to that in

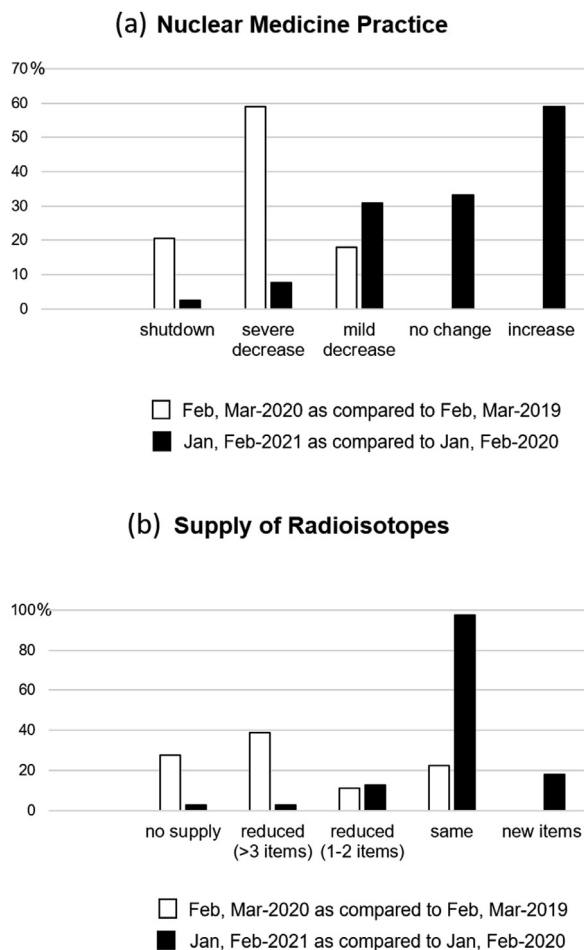


Figure 1 Change of nuclear medicine practice and radioisotope supply in Asia surveyed in March to April 2020, and similar period in 2021. They are significantly reduced in 2020, but partly recovered in 2021.

the previous year. One NM department in Myanmar was shut down; however, this was not because of COVID-19 but owing to a national political issue. The RI supply was maintained in 86% and reduced in 12% of these departments.

Cases in Point

The case-in-point operational histories are introduced here with each author's insight. They represent the East, South-east, South, and West Asia. Situations and activities of NM departments during COVID-19 pandemic in the Chonnam National University Hospital of South Korea (East Asia), four hospitals in the southern region of the Philippines (Southeast Asia), Rajiv Gandhi Cancer Institute and Research Centre in India (South Asia), and King Hussein Cancer Center in Jordan (West Asia) are described.

Chonnam National University Hospital, Gwangju, South Korea

The NM procedure volume including imaging studies, in vitro tests, and radionuclide therapy, gradually decreased

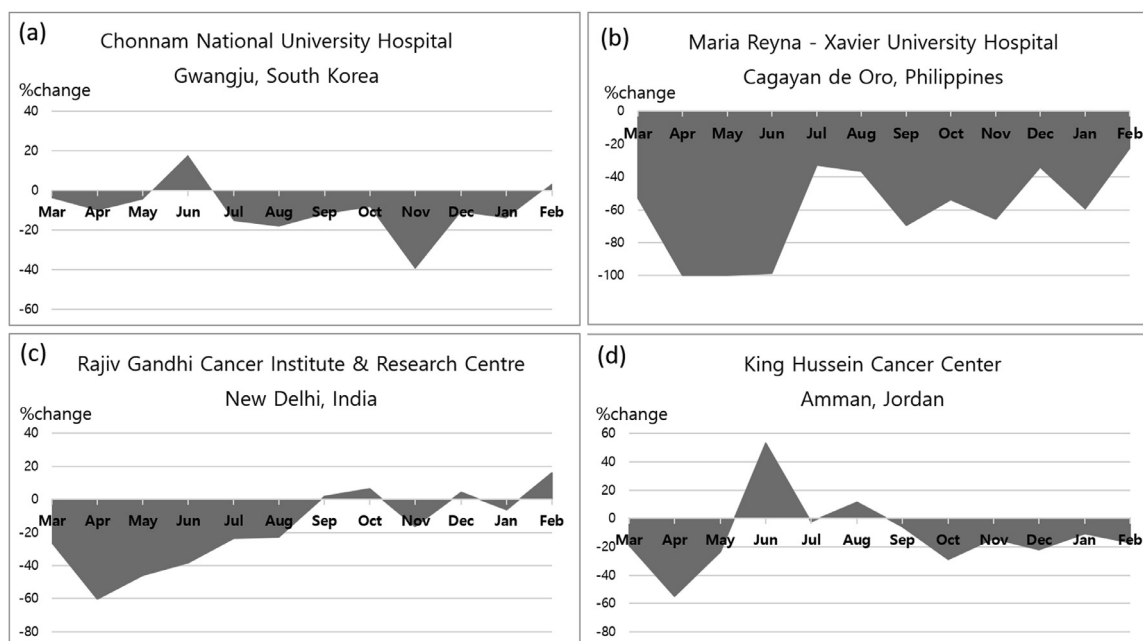


Figure 2 Percent change of nuclear medicine practice in four case-in-point hospitals. (A) Chonnam National University Hospital, Gwangju, South Korea, (B) Maria Reyna-Xavier University Hospital, Cagayan de Oro, Philippines, (C) Rajiv Gandhi Cancer Institute and Research Centre, New Delhi, India, and (D) King Hussein Cancer Center, Amman, Jordan. Percent change indicates percent of nuclear medicine procedures including both imaging and therapy compared to the same period of the previous year.

after the first case of COVID-19 was detected in South Korea on January 20, 2020, and the first large outbreak occurred in Daegu in late February 2020. The reduction of NM practice was mainly because patients canceled their reservations owing to mass anxiety. It was around this time that the Korean government implemented the test, trace, and treat policy also known as the 3T policy. Various real time reverse transcription polymerase chain reaction (RT-PCR) test kits that were developed by Korean companies made mass screening possible. An epidemic investigation support system for tracing confirmed cases was widely applied. It traced mobile phones, credit cards, public transportation, hospital visits, and closed circuit television data. Patients infected by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) were isolated in a residential treatment center when they had no symptoms and in negative pressure isolation rooms when they had respiratory symptoms. The world's first drive-through COVID-19 testing site began operating from late February 2020 and soon expanded to 50 locations. The number of confirmed COVID-19 cases began to decrease from March 2020. However, when the Korean government relaxed regulations during the summer in an effort to stimulate the economy, the cases soon began to rise. The second and third outbreaks occurred in August and November 2020, respectively. Several staff and patients of the Chonnam National University Hospital (CNUH) were infected by SARS-COV-2 in November 2020, which led the closure of several wards in CNUH. The practice volume of the NM department sharply decreased accordingly. It recovered slowly in 2021 despite some NM staff members volunteering to be deployed to COVID-19 screening centers. (Fig. 2a)

New standard operating procedures (SOPs) were prepared initially by the staff of the NM department of CNUH. These were replaced by a guideline provided by the Korean Society of NM.⁷ No COVID-19 patients have been examined at the NM department of CNUH and no NM staff members have developed COVID-19 to date. Vaccination for NM staff members began in March 2021.

South of the Philippines

Like other NM facilities in the Philippines, the COVID-19 pandemic significantly affected the operations of four hospitals located in Cagayan de Oro, a city located on the island of Mindanao, South of the Philippines: Maria Reyna-Xavier University Hospital, Cagayan de Oro Medical Center, Capitol University Medical center and Zamboanga City Medical Center. Figure 2b shows the percent change of NM practice volume in the Maria Reyna-Xavier University Hospital. The rising cases of COVID-19 infections nationwide prompted government sanctions resulting in forced NM service shutdown due to the following primary factors:

1. Movement restriction of the people as imposed by extreme community quarantine
2. Government and commercial restriction on land and air transport hubs which stopped the supply of critical radiopharmaceuticals
3. General fear of the people to go out and resume pre-pandemic activities resulting in a postponement of non-emergency health conditions, including NM procedures

A. Community Quarantine

The imposition of the community quarantine resulted in a minimal movement of the general population outside their homes to essential tasks, such as food acquisition and emergency medical care. There was a drastic reduction of patients for imaging and therapy in the NM departments. Radioimmunoassay procedures continued until kits were available again. The hospital staff was put on a skeletal workforce, and some NM services were shut down, or staff members were reassigned to different areas such as logistics and triage areas in the case of government hospitals. Hospital protocols were updated for COVID-19 precautions, and new guidelines were drafted for NM procedures. Even with updated infectious disease protocols, some NM staff were infected with COVID-19, resulting in further reduction of the workforce to the point of the temporary shutdown of NM practice until such time that adequate quantity of healthy personnel was available. This situation stretched from March 2020 to September 2020, and only minimal procedures were done due to limited radiopharmaceuticals. The general NM census for imaging and therapy showed an overall reduction of at least 50%-90%.

B. NM Practice During COVID-19 Pandemic

In the early days of the pandemic, the government implemented a nationwide public transportation freeze in the National Capital Region. Since the lockdown on March 16, 2020, all NM center operations were halted. Personnel was placed either on the skeletal workforce or reassigned to triage areas in the respective hospitals. The dynamic development of COVID-19 protocols occurred over time. The supply of RI, including Tc-99m, stopped. The radioimmunoassay laboratory, which had limited kits, was the only section running up to the end of June 2020. As the months unfolded, in late May, the hospitals started receiving radioactive materials in trickles. Private hospitals at that time insisted on catering only to non-COVID cases, while the government hospital catered to COVID-19 patients. Radionuclide therapy began late on June 29, 2020, because of the general fear of patients coming to hospitals, and elective procedures were discouraged.

Rajiv Gandhi Cancer Institute and Research Centre, New Delhi, India

After the first COVID-19-positive case in India was reported in February 2020, guidelines and protocols about the health sector were put forward by the Indian Council of Medical Research, which is the apex body for research in such situations. Rajiv Gandhi Cancer Institute and Research Centre (RGCIRC) is a state-of-the-art tertiary cancer facility for service, education, and research located in New Delhi, the capital city of India. A flu corner was created at the main entrance of the hospital where all persons wishing to enter the hospital had to undergo body temperature checking, and were asked to report any symptoms indicative of COVID-19. At that point of time N-95 masks were not readily available, and even the routine surgical masks started becoming short

in supply. Foot-operated hand sanitizer dispensing systems were put in public areas, and people were counseled and encouraged to use the same. Cleaning and disinfection were done at regular intervals in public areas, offices, and wards to cover all the blocks in the hospital. Cancer patients clinically suspected to have COVID-19 were initially admitted to an isolation facility and shifted to a regular ward if they were found negative for infection by RT-PCR testing. The patients found to be positive for infection were shifted to a dedicated COVID-19 ward. All patients needing admission for various surgeries and other interventional procedures, such as biopsies and endoscopies had to have a negative RT-PCR report before admission. The first COVID-positive case was detected on April 24, 2020 at RGCIRC.

The infection was contracted for the first time by a RGCIRC staff on June 9, 2020, and until February 2021, a total of 367 staff members had been infected. The total staff infection rate was 23.3%, out of which the infection rate among doctors and nurses were 21.6 and 26.5%, respectively. A total of 123 staff members needed hospitalization, and the rest were managed at home isolation. There was one death among the staff who worked in administration. At the NM department, two physicians, one technologist, and one support staff contracted the COVID-19 at different times during the pandemic.

The general guidelines applicable to the other departments of the hospital were also applied to the NM department. In addition to these, certain other SOPs were implemented after approval from the administration and the quality assurance department of the institution. Patients undergoing NM procedures were asked the history of international travel in the past 2 week, any COVID-19-related symptoms, contact with any known COVID-19 patient. A mobile application named "Arogya Setu" installed on smartphones of all Indian citizens were used for patient's risk stratification. The application uses contact tracing to record details of all the people who might have contacted about doing his normal activities. If any of them, at a later point in time, tests positive for COVID-19 infection, one is immediately informed, and his/her risk stratification is notified in the downloaded mobile application—this second-tier screening in the NM department after the initial screening at the entrance to the hospital. Any of the patients who were deemed to be at intermediate risk were sent for consultation to the infectious disease team, and high-risk patients were sent for RT-PCR testing, while the scan appointment was kept on hold.

Patients with lung cancer, or oral cancer, and post-chemotherapy patients were challenging to risk-stratify. Another challenge was that some of the patients became COVID-19 positive at different intervals after the NM procedure was performed. The facility was sanitized depending on the time elapsed, and contact tracing was done. We formed two NM teams with 50% of our workforce in each team, working on alternate days on-site. The team consisted of 50% of the total capacity of physicians, technologists, nurses, and other support staff members. We adapted the "as low as reasonably achievable" principle of radiation protection. A Perspex barrier was installed at the reception and at all possible places

where physical interaction with a patient or caregiver, including visualizing the patient's other relevant reports, was allowed. In the NM department, no known COVID-19-positive patients were taken up for imaging or therapy. A negative RT-PCR report was mandatory for patients who were previously infected. The number of NM procedures notably dropped during the initial months of the pandemic due to our strict screening and testing protocols and the strict lockdown imposed by the government, and restriction on movements. (Fig. 2c) Radionuclide therapy volume was most affected due to the non-availability of RI within the country as well as from overseas due to the ban of commercial international flights in the country except the ones under the travel bubble agreement and repatriation purposes.

The government of India has been proactive regarding the vaccination of its citizens, which was implemented in a phased manner for different groups. The vaccination program started successfully on January 16, 2021 all over the country. Unfortunately, a second wave began in March 2021 that was much larger than the first and led to shortages of vaccines, hospital beds, oxygen cylinders, and other medicines in parts of India.¹

King Hussein Cancer Center, Amman, Jordan

The first case of COVID-19 in Jordan was detected in March 2020. As a leading tertiary center for treating cancer patients in Jordan, King Hussein Cancer Center (KHCC) promptly implemented umbrella procedures directed primarily to lessening the transmission of the virus and to reduce the risk of infection to patients, staff, and family members. A floor in the Nizar Naqeeb building of KHCC was dedicated to suspected cases, and a new triage area was established at the emergency unit. Home delivery of refill medications was initiated, and a hospital visits were limited to 4-7 PM. The staff was discouraged from traveling, and grand rounds and educational lectures were done virtually. In September, wearing masks was made mandatory for patients and companions, and both were screened for COVID-19 before admission. Easy access to COVID-19 testing was available to all staffs. All employees were encouraged to register for vaccination; at the beginning of 2021, when the vaccines became available in Jordan, the medical staff was prioritized to get vaccinated.

The NM department strictly implemented the KHCC umbrella procedures and implemented specific measures tailored to the NM procedures. These measures included rescheduling routine elective appointments to manage the workflow better and continuing to provide priority procedures. Granting virtual private networking access to NM staff facilitated two NM teams; on-ground frontline teams and a backup support work-from-home team, with interchanging weekly rotations. A checklist was implemented to monitor the status of each patient one day before their NM procedure appointment; a note in the hospital information system was documented by a NM nurse for each patient accordingly. All staff members began changing to scrub while in the department, wearing surgical masks, gloves, and closed lab coats as protective gear. Full protective gear recommended by the

infection control program was implemented in the case of suspected or proven COVID-19 patients. This recommendation was implemented with continuous monitoring of protective gear compliance. Hands sterility and equipment sterility before and after each procedure were also strictly implemented. The NM therapeutic clinic was being conducted virtually unless the patient's physical presence was needed. Moreover, social distancing was implemented in all forms with proper psychological support for the staff. These measures were strict at the beginning of the pandemic in Jordan and when the first and second waves hit the country, but sensibly and cautiously eased when the pandemic situation improved in the second half of 2020 and when the lockdowns was lifted. However, the administration of the NM department and KHCC were mindful that these measures needed to be vigilantly revised as the pandemic situation changes.

The number of performed NM procedures reduced significantly in 2020 compared to those in preceding years, and dropped considerably at the beginning of the pandemic in Jordan in the second quarter of 2020 (Fig. 2d) as a direct result of the national lockdown, public anxiety about the pandemic, interrupted supply of radiopharmaceuticals, and uncertainties among healthcare providers about the best health care approach during the pandemic. However, this uncertainty was mitigated gradually as practitioners learned more about the disease and as their experience of working during this pandemic rationalized their thoughts; moreover, as most of the NM staff have either been vaccinated or gained immunity after getting infected, they are now comfortable working in such conditions. This was apparent as the number of NM procedures in the department revolutionized in 2021, compared to the same period in 2020 despite the tremendous surge in the burden of COVID-19 in the country, compared to the previous year at the beginning of the pandemic when there were only a few COVID-19 cases recorded in Jordan.

Discussion

The practice of NM in Asia was significantly affected from the beginning of the COVID-19 pandemic. Entire NM procedures, including imaging studies and therapies, were affected. The insufficient supply of Mo-99/Tc-99m generators affected 60% of the NM centers in Asia, but more than 80% in India and Pakistan. The supply of I-131 was insufficient in 55% of the NM centers in Asia. This interruption of the supply chain was due to lockdowns, closure of borders, and cancellation of flights. Asia was more severely affected than Europe, Oceania, and North America. While South Korea and Singapore experienced the smallest reduction of NM procedures.^{5,6}

The NM communities in Asia actively moved to solve these problems. As the first case of COVID-19 occurred in Wuhan, China, the Chinese Society of Nuclear Medicine and the editorial board of the Chinese Journal of Nuclear Medicine and Molecular Imaging organized a group of professionals to formulate an expert consensus on the safety management of NM diagnosis and treatment during the

outbreak of COVID-19. It was published in the journal February 24, 2020,⁸ and was soon translated into English and published in the European Journal of Nuclear Medicine and Molecular Imaging.⁹ The ARCCNM held a conference in conjunction with the Philippine Society of Nuclear Medicine in early February 2020 in Manila, Philippines. The ANMB examination was held at the same time. Fellows of ANMB kept communicating through social network services and emails, and the ANMB committee provided an online lecture series. eLearning modules were provided by ARCCNM in conjunction with the Regional Cooperation Agreement regional office (RCARO). They were freely available at the website of RCARO,¹⁰ and covers brain diseases including brain tumor, cerebral ischemia, epilepsy, dementia, and movement disorders; Endocrine diseases include thyrotoxicosis, thyroiditis, thyroid nodules, thyroid cancer, and parathyroid adenoma; Cardiopulmonary diseases include stable angina, cardiomyopathy, pulmonary embolism; Oncology diseases includes head and neck cancer, esophageal cancer, lung cancer, breast cancer, colorectal cancer, lymphoma, gynecologic cancer, prostate cancer, neuroblastoma; Malignant and inflammatory bone diseases. eLearning modules on reporting bone scan, renal scan, and myocardial perfusion imaging were also included. Physics and chemistry modules included PET/CT instrumentation, image artifacts, quality control, dosimetry, and cyclotron radiochemistry.

Living in the COVID-19 pandemic has become the new normal. Governments throughout the world have implemented many strategies to contain the spread of the disease and to mitigate the impact of COVID-19. The success of these measures is significantly heterogeneous, varying among countries and communities of different social and economic statuses. International leaders, including IAEA officers, suggested a plan to return to “business as usual” in NM.¹¹ Online surveys clearly showed that both practice of NM and supply of RI in Asia was recovering. Uncertainty of the situation was mitigated as NM practitioners learned more about COVID-19 and their thoughts were rationalized by experience of working.

This review article has some limitations. First, we could not cover all institutions and countries in Asia. We had no information on NM practice in central Asia. It is clear that the situation is heterogeneous and differed according to countries and regions. Second, our data do not show the situation in detail. However, we could show a changing trend of NM practice in Asia.

In conclusion, despite restrictions and difficulties, many NM departments in Asia are returning to their pre-COVID-19 practices.

Conflict of interest

Authors have no conflict of interest.

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References

1. COVID-19 pandemic in Asia. Wikipedia. https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Asia accessed in 9th May, 2021
2. WHO Director-General's opening remarks at the media briefing on COVID-19. March 11, 2020.
3. IAEA webinar 'coronavirus disease (COVID-19) pandemic: challenges for the nuclear medicine departments' <https://humanhealth.iaea.org/HHW/covid19/webinars.html> accessed in 9th May, 2021
4. Paez D, Gnanasegaran G, Fanti S, et al: COVID-19 pandemic: Guidance for nuclear medicine departments. *Eur J Nucl Med Mol Imaging* 47:1615-1619, 2020
5. Einstein AJ, Shaw LJ, Hirschfeld C, et al: International Impact of COVID-19 on the diagnosis of heart disease. *J Am Coll Cardiol* 77:173-185, 2021. <https://doi.org/10.1016/j.jacc.2020.10.054>. Jan 19 Published online 2021 Jan 11
6. Freudenberg LS, Paez D, Giammarile F, et al: Global impact of COVID-19 on nuclear medicine departments: An international survey. *J Nucl Med* 2020 61:1278-1283, 2020
7. Bang JI, Lee HY, Cho YS, et al: KSNM/KSID/KOSHIC guidance for nuclear medicine department against the Coronavirus Disease 2019 (COVID-19) pandemic. *Nucl Med Mol Imag* 54:163-167, 2020
8. Chinese Society of Nuclear Medicine: Editorial Board of the Chinese Journal of Nuclear Medicine and Molecular Imaging. 2019 New coronavirus infection outbreak during the nuclear medicine diagnosis and treatment safety prevention and control expert consensus. *Chin J Nucl Med Mol Imaging* 40, 2020. DOI <https://doi.org/10.3760/cma.j.cn321828-20200222-00062>, URL <http://rs.yiigle.com/yufabiao/1182642.htm>. accessed in 9th May, 2021
9. Lan X, Long Y, Shar F, et al: Expert consensus on the safety prevention and control of nuclear medicine diagnosis and treatment during the outbreak of COVID-19 (1st edition): (translated from Chinese version). *Eur J Nucl Med Mol Imag* 2020
10. RCA e-Learning Campus. <https://rcaro.org/elearning/> accessed in 9th May, 2021.
11. Huang HL, Gnanasegaran G, Paez D, et al: Nuclear medicine services after COVID-19: gearing up back to normality. *Eur J Nucl Med Mol Imag* 47:2048-2053, 2020