

# Changing Methods of Education During a Pandemic: Questionnaire Survey about Examinations for Nuclear Medicine Technology at Educational Institutions in Japan

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Coronavirus disease 2019 (COVID-19) has spread around the world. Its effects go far beyond health care: education has to be conducted so as to prevent infection among students and faculty. Accordingly, changes have occurred in Japan's educational institutions, including methods of preparing students for examinations for nuclear medicine. To assess the quality of training for radiologic technologists, we investigated the related changes undertaken at educational institutions. We investigated the lecture format for teaching nuclear medicine technology at Japanese institutions during COVID-19 and efforts to ensure the quality of conventional education. **Methods:** We sent a questionnaire to 19 Japanese institutions. It addressed the lecture format and initiatives in examinations for nuclear medicine technology in the first and second semesters of 2020. **Results:** We obtained responses from 17 institutions. In the first semester of 2020, the lecture format for nuclear medicine technology included remote, hybrid (combination of remote and face-to-face), and video-on-demand lectures. To reinforce the effect of the new teaching formats, institutions adopted various methods, such as enhancing the possibility of allowing students to ask questions, increasing the number of quizzes during lectures, delivering lectures to YouTube, and introducing an e-learning system. In the second semester of 2020, the lecture format included face-to-face, remote, hybrid, and video-on-demand lectures. In that second semester, the number of institutions providing face-to-face lectures while taking thorough measures against infection showed a marked increase. **Conclusion:** The institutions introduced various educational techniques and initiatives. They prioritized students' understanding of lecture content and applied what they considered the best teaching methods. Sharing information about the changes adopted at different institutions should help promote good radiologic technologists—even during a pandemic.

**Key Words:** lecture format; infection control; initiatives; new approaches; student education, COVID-19

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Coronavirus disease 2019 (COVID-19) has had an impact on medicine and education. In many educational institutions, lectures have changed from a traditional face-to-face format to a remote or hybrid format (a hybrid format is a combination of face-to-face and remote lectures to hinder COVID-19 infection) (1–5). Teaching has to be undertaken in such a way as to prevent infection among students and faculty. Accordingly, changes have taken place in teaching at Japan's educational institutions, including teaching related to examinations for nuclear medicine technology. The examinations for nuclear medicine technology at universities in Japan have traditionally been based on a face-to-face lecture. Face-to-face lectures are adopted because teachers can proceed with the lecture while visually observing the level of understanding and satisfaction of students. However, because of the spread of COVID-19, Suzuka University of Medical Science shifted from face-to-face lectures to remote and hybrid formats in 2020. The usefulness of remote lectures has been cited (2,5–7). It has also been reported that remote lectures are becoming the standard for lectures in the future (8).

In a previous study, we obtained information from students using a questionnaire survey about their degree of understanding and satisfaction with remote lectures related to examinations for nuclear medicine technology. In that study, we reported very high levels of understanding and satisfaction with that remote format (1). To ensure the ongoing quality of training for radiologic technologists, we determined in the present study the changes that had taken place in educational methods at different institutions. We wanted to share information about the educational methods adopted by the institutions and investigate efforts toward infection control (during the lecture as a useful tool for training) for promoting high-quality medical personnel. We investigated the lecture format for teaching nuclear medicine technology at Japanese institutions during COVID-19, and we investigated efforts to ensure the quality of conventional education.

## MATERIALS AND METHODS

### Questionnaire Requests

We asked the lecturers responsible for proctoring examinations for nuclear medicine technology at 19 educational institutions in Japan to complete the questionnaire. We randomly selected 19 institutions from among all educational institutions teaching nuclear medicine technology in Japan. We asked that the questionnaire be completed between December 2020 and February 2021.

### Questionnaire Content

For the first and second semesters of 2020, we asked lecturers about the lecture format they use before examinations for nuclear medicine technology and their assessment method for assigning grades. We asked the participants to provide free descriptions of initiatives and methods for preventing infection. We inquired about the lecture formats participants found most appropriate during COVID-19 and their reasons for choosing them. In Japan, the first semester is from April to September and the second from October to March.

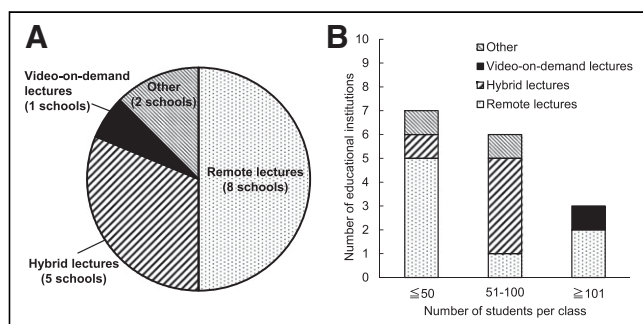
## RESULTS

### Questionnaire Response Rate

In all, 17 institutions completed the questionnaire; 2 did not.

### Lecture Format in First Semester of 2020

Figure 1 shows the results regarding lecture format for the first semester of 2020. Figure 1A indicates the lecture format for that first semester, and Figure 1B presents the results according to the number of students in each class. One participant was not responsible for teaching nuclear medicine in that first semester; thus, Figure 1 displays the data for the other 16 institutions. For the same reason with later results, Figures 2–4 show data from 16 institutions. Figure 1A indicates that the numbers of institutions that provided the lectures in remote, hybrid, video-on-demand, and other formats were 8, 5, 1, and 2, respectively. The other formats were a mixture of face-to-face, remote, and video-on-demand lectures (1 institution) or a mixture of face-to-face and video-on-demand lectures (1 institution). No institutions held only face-to-face lectures. Figure 1B indicates that many remote lectures were held at institutions where the number of students in each



**FIGURE 1.** Lecture format in first semester of 2020: aggregation (A) and number of students per class (B). Other = combination of face-to-face, remote, and video-on-demand lectures (1 institution) and face-to-face and video-on-demand lectures (1 institution).

class was either small or large. Most of the institutions with classes of 51–100 students offered hybrid lectures.

### Regular Examinations in First Semester of 2020

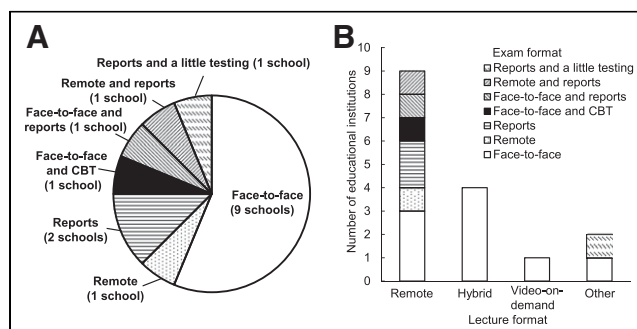
Figure 2 shows the results regarding the methods for regular examinations (assessment methods that evaluate the comprehension of a lecture and for assigning grades) in the first semester of 2020. Figure 2A presents details of the regular examination methods for that semester, and Figure 2B indicates the regular examination methods classified by lecture format. Figure 2A shows that the numbers of institutions that held regular examination in face-to-face, remote, reports, face-to-face-plus-computer-based, face-to-face-plus-reports, remote-plus-reports, and reports-plus-a-little-testing formats were 9, 1, 2, 1, 1, 1, and 1, respectively. Figure 2B indicates that when the lectures were held remotely, various examination methods were adopted to prevent infection.

### Lecture Format in Second Semester of 2020

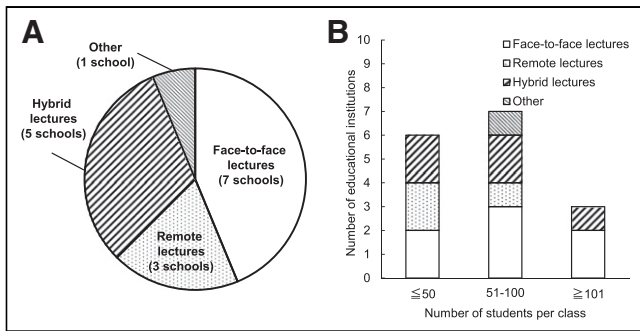
Figure 3 shows the results regarding the lecture format in the second semester of 2020. Figure 3A presents details of the format in that semester, and Figure 3B shows the results according to number of students per class. Figure 3A indicates that the numbers of institutions that held face-to-face, remote, hybrid, and other lecture formats were 7, 3, 5, and 1, respectively. The other lecture format, adopted by 1 institution, was a mixture of face-to-face and video-on-demand. Figure 3B shows that there was no difference in the lecture format according to the number of students. Some institutions held face-to-face lectures regardless of the number of students.

### Regular Examination in Second Semester of 2020

Figure 4 shows the results for regular examinations (assessment method for assigning grades) for the second semester of 2020. Figure 4A presents the findings for regular examination methods in that semester, and Figure 4B shows the results for regular examination methods according to lecture format. Figure 4A shows that the numbers of institutions adopting face-to-face, remote, remote-plus-reports, and reports-plus-a-little-testing formats were 13, 1, 1, and 1, respectively. There was a clear increase in the number of face-to-face examinations.



**FIGURE 2.** Regular examinations in first semester of 2020 (assessment method for assigning grades): aggregation (A) and categorization by lecture format (B). CBT = computer-based testing.



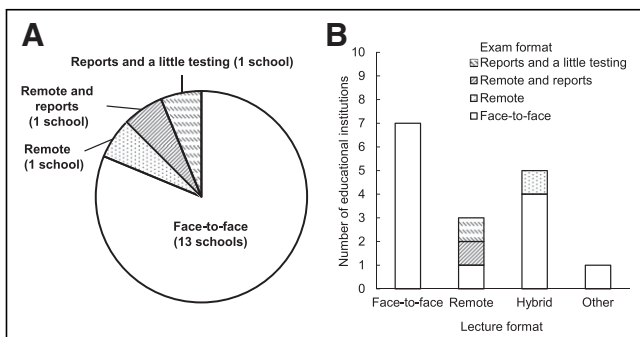
**FIGURE 3.** Lecture format in second semester of 2020: aggregation (A) and categorization by number of students per class (B). Other = combination of face-to-face and video-on-demand lectures (1 institution).

### Free Descriptions of Initiatives and Approaches

Table 1 presents the results related to initiatives and new approaches at the institutions. The comments relate to free descriptions obtained in the questionnaire responses. We obtained many comments about new approaches to infection control. Regarding remote and video-on-demand lectures, there were many comments about improving student understanding. With respect to hybrid lectures, many comments related to reducing the number of class days.

### Most Suitable Lecture Format During COVID-19

Figure 5 shows the results related to the optimal lecture format during the pandemic. The numbers of institutions that chose face-to-face, remote, and hybrid lectures were 7, 4, and 6, respectively. Some of the reasons for selecting face-to-face lectures were as follows: they facilitate confirmation of students' understanding; the risk of infection is higher off than on campus; and by attending lectures while taking measures against infection, students become more aware of such measures. Some of the reasons for choosing remote lectures were as follows: they prevent infection among faculty and students, and the quality of conventional education can be guaranteed when designing the content of remote lectures. One of the reasons for selecting hybrid lectures was that face-to-face lectures are also necessary because remote lectures may not monitor student achievement in real time.



**FIGURE 4.** Regular examination in second semester of 2020 (assessment method for assigning grades): aggregation (A) and categorization by lecture format (B). Other = combination of face-to-face and video-on-demand lectures.

## DISCUSSION

In this study, we investigated the lecture format with respect to teaching nuclear medicine technology before examinations at Japanese educational institutions during COVID-19. We also examined novel efforts to ensure the quality of conventional educational approaches and measures to achieve infection control.

We found that the methods adopted by the surveyed institutions changed significantly as a result of the pandemic. In the first semester of 2020, none of the institutions undertook face-to-face lectures: they switched to such formats as remote or hybrid lectures. The spread of COVID-19 caused the Japanese government to declare a state of emergency during April and May 2020. As a result, Japan's residents were asked to avoid unnecessary outings and maintain social distance (9).

In the first semester of 2020, remote and hybrid lecture formats were introduced toward controlling the infection. We observed that educational institutions with few students in classes tended to opt for remote lectures. Accordingly, the small class sizes meant that students could communicate and interact with lecturers remotely. In that way, lecturers were able to assess the learning levels of each student, which supported the remote lecture strategy.

Institutions with many students in each class provided remote and video-on-demand lectures, which meant that students did not have attend in person. To prevent clustering in the case of large classes, the studied institutions adopted a lecture format such that students did not come into close contact with one another.

By contrast, most of the educational institutions with classes of 51–100 students offered hybrid lectures. With the hybrid format, students who wished to take lectures remotely were able to do so, reducing the number attending face-to-face lectures. That format allowed lecturers to monitor students' understanding and satisfaction and teach accordingly. The hybrid format allowed adequate measures against infection.

In the first semester of 2020, the face-to-face format was the most frequently applied method for conducting regular examinations. However, some institutions that used remote lectures in the first semester adopted various test formats to prevent infection. Some institutions conducted testing remotely. Among the comments received from institutions that conducted remote testing were comments indicating that such tests did not allow confirmation that students were relying solely on their academic ability. When taking such tests, students showed their own face on the computer monitor. However, it would have been possible to browse study materials and cheat in such a way that it could not be seen on the monitor. Remote testing can prevent students from being infected, but the biggest disadvantage is that it cannot exclude such fraudulent activities. We received many comments stating that face-to-face testing was the best approach.

In the second semester of 2020, the number of institutions offering face-to-face lectures increased significantly. The reason for the increase was that COVID-19 infection control had

**TABLE 1**  
Free Description of Suggested Initiatives and Approaches During Pandemic

Face-to-face lectures	Remote lectures	Hybrid lectures	Video-on-demand lectures
<p>Distribute COVID-19–related information all at once so that students, faculty, and staff can keep up with latest information on COVID-19. Strengthen infection control.</p> <p>Distribute health observation cards, and require students to measure their temperature and check their symptoms every morning. Stagger start time of lectures in each major so that student traffic will not be dense.</p> <p>Give lectures in classrooms that can accommodate more than twice actual number of participants. Maintain distance between students, and secure social distance. Always open window.</p> <p>Install acrylic dividers, students always wear masks, disinfect microphones, disinfect hands before entering room, disinfect desks after lectures, and always ventilate.</p>	<p>Always administer quizzes online (e-learning system). Remote lectures provided more assignments than face-to-face lectures assignments, giving more time to review.</p> <p>Post videos and lesson materials online, and distribute all slides in PDF format. Provide increased explanations and figures in handouts.</p> <p>Take questions in real time using chat. Communicate with students via chat or email to eliminate points of confusion.</p> <p>Remote lectures eliminate time it takes to travel to school, allowing more time for studying.</p>	<p>Video distribution of board-style lectures with Keynote presentation software. Record lecture for day, and distribute it on YouTube.</p> <p>For small classrooms, capacity of classroom is set to 50%, and lectures are given in 2 classrooms (teachers move between 2 classrooms). For large classrooms, capacity will be 50%, and lectures are given in classroom.</p> <p>Limit school days by study year. Reduce school days. Divide class in half and alternate between face-to-face and remote lectures every other week.</p> <p>For students who do not have remote study environment, we have established a style that allows students to attend school by setting up listening area on campus.</p>	<p>Two videos of 40-min recorded lectures are screened in 90-min lecture. At end of each video, 10 review questions are prepared, and answers are submitted.</p> <p>Recorded video can be reviewed many times later.</p>

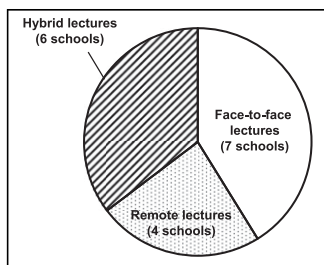
begun to be established. Around March of 2020, the Prime Minister’s Office of Japan announced that the “Three Cs” should be avoided: closed spaces, crowd places, and close-contact settings. The notification was introduced because of the increased risk of COVID-19 infection (1,10). Educational institutions that considered face-to-face lectures more effective could conduct teaching in that manner while avoiding the Three Cs. With face-to-face lectures, it is necessary to implement adequate infection control measures throughout the university. In the first half of 2020, there was no way of providing lectures while avoiding the Three Cs. Therefore, no educational institutions gave face-to-face lectures in the first semester.

In the second semester of 2020, the face-to-face format for regular examinations had also increased markedly. In

that semester, the institutions had become accustomed to face-to-face infection control. Accordingly, regular examinations were often held in face-to-face format. But some institutions continued with remote or other examination formats because of the infection risk.

Regular examinations are essential for assessing student comprehension. In the regular examination for the lecture held in the second semester, infection control measures were taken, and face-to-face methods were adopted by many educational institutions. However, it cannot be denied that there is a risk of infection. Therefore, we would like to examine the methods used by some educational institutions in the regular examinations in the first semester of 2020. Some educational institutions have adopted the face-to-face-plus-reports format for regular examinations. By adopting this method, it is possible to reduce the risk of infection and evaluate the level of understanding of students in a short time. In the future, we would like to incorporate this type of regular examination into our lectures.

In the free description portion of the questionnaire, we received many comments related to methods of infection control. All institutions that held face-to-face lectures took thorough infection control measures. Many comments related to remote lectures addressed methods of improving student understanding. Unlike face-to-face lectures, the



**FIGURE 5.** Optimal lecture format during COVID-19.

remote format does not permit real-time evaluation of students' comprehension and satisfaction. Further, with the remote format, the lecturer is not physically present; the comments therefore indicated concern about the decline in concentration level with such teaching. This finding has been reported in previous studies (1). Accordingly, lecturers at institutions that conducted remote lectures devised methods that could obtain the same level of student understanding and satisfaction as did the face-to-face format.

The free descriptions of hybrid lectures included methods of reducing the number of class days. Lecturers wished to have direct contact with students to determine whether they understood the lecture content. Thus, institutions provided hybrid lectures and devised ways to reduce the number of attendance days.

Regarding video-on-demand lectures, the free descriptions mentioned ways of improving student understanding. Few institutions offered video-on-demand. However, there were comments about its merits because it allows multiple reviews of a lecture. It was evident from the free description that educational methods have changed completely to prevent COVID-19 infection. Each institution offered ways to prevent infection and improve understanding.

In the questionnaire, we asked about the optimal lecture format for COVID-19. Evidently, there were no clear differences in a comparison of face-to-face, remote, and hybrid lectures in terms of educational suitability; each institution held different views in this regard. All the institutions made efforts to prevent infection and improve understanding: they believed it was possible to teach in a way that ensured the quality of conventional education in any lecture format.

We investigated various lecture formats and initiatives undertaken by educational institutions under COVID-19. COVID-19 has completely changed all institutions, and they have moved away from conventional education. All the institutions we examined had addressed new educational challenges as a result of COVID-19. We wish to share these initiatives and methods adopted, thereby contributing to the promotion of medical education in society—even during a pandemic. In 2021 and 2022, we will continue to give the same lectures as in 2020. Now, mutant strains of COVID-19 are also prevalent, and lectures are given with strict infection control measures. If education policy in Japan changes in the future as a result of COVID-19, it will be necessary to prepare for such changes using the findings of this study.

Finally, we would like to talk about future prospects. It is unclear whether the new initiatives and lecture formats in COVID-19 investigated here will be used permanently. We would like to continue this survey to see what kinds of changes will be brought about in the future. In addition, we would like to investigate changes in student attitude ratings and satisfaction levels and student board examination scores in lectures at each educational institution. Each educational institution may make a difference by instituting these changes. In previous research, remote lectures were found

to give students the same level of satisfaction and understanding as the conventional face-to-face lectures (1). Therefore, we believe that by designing lectures that satisfy students in any lecture format, we can provide lectures with a high degree of understanding and satisfaction in any lecture format. Moreover, regarding employment, the chances of getting hands-on training with radiation equipment are decreasing at all educational institutions to prevent infection, and many students are worried about whether they will be able to do their jobs well after finding employment. We would also like to investigate changes in methods of hands-on training that have resulted from COVID-19.

## CONCLUSION

We investigated the lecture formats in nuclear medicine technology at educational institutions in Japan during COVID-19; we also examined new efforts to maintain the quality of education and ideas for infection control. We wish to share the related initiatives and ideas among teaching staff and to promote education of medical personnel who can contribute to society.

## DISCLOSURE

No potential conflict of interest relevant to this article was reported.

## ACKNOWLEDGMENTS

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## KEY POINTS

**QUESTION:** During the time of COVID-19, what changes have been made to lecture formats for teaching nuclear medicine technology at Japanese educational institutions, and what efforts are being made to ensure the quality of conventional education?

**PERTINENT FINDINGS:** In case-control studies of 17 educational institutions in Japan, the lecture format during COVID-19 was not the conventional one; various school-specific methods were adopted to prevent infection. Associations between lecture styles were not observed in 17 institutional case-control studies.

**IMPLICATIONS FOR PATIENT CARE:** By sharing the results of this survey with each educational institution, it is possible to strengthen infection control measures and provide a high-quality conventional education.

## REFERENCES

1. Nakaya K, Yasuda E, Muto H, et al. Educational effect of remote lectures for students aiming to become radiologic technologists: questionnaire on nuclear medicine examinations. *J Nucl Med Technol.* 2021;49:164–169.

2. Al-Balas M, Al-Balas HI, Jaber KM, et al. Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives. *BMC Med Educ.* 2020;20:341.
3. Shah M, Hameed BZ, Naik N, et al. The history and evolution of ‘webinars’ and their role in urology: the modern way of training, education and communication. *Cent European J Urol.* 2021;74:128–130.
4. Potra S, Pugna A, Pop MD, et al. Facing COVID-19 challenges: 1st-year students’ experience with the Romanian hybrid higher educational system. *Int J Environ Res Public Health.* 2021;18:3058.
5. Patchoros G, Wenzler G. Satisfying program-level outcomes by integrating primary literature into the online classroom. *J Nucl Med Technol.* 2021;49:170–174.
6. Letterie GS. Medical education as a science: the quality of evidence for computer-assisted instruction. *Am J Obstet Gynecol.* 2003;188:849–853.
7. Rotimi O, Orah N, Shaaban A, et al. Remote teaching of histopathology using scanned slides via Skype between the United Kingdom and Nigeria. *Arch Pathol Lab Med.* 2017;141:298–300.
8. Wijesooriya NR, Mishra V, Brand PLP, et al. COVID-19 and telehealth, education, and research adaptations. *Paediatr Respir Rev.* 2020;35:38–42.
9. Isumi A, Doi S, Yamaoka Y, et al. Do suicide rates in children and adolescents change during school closure in Japan? The acute effect of the first wave of COVID-19 pandemic on child and adolescent mental health. *Child Abuse Negl.* 2020;110:104680.
10. Information related to COVID-19. Prime Minister of Japan and His Cabinet website. <https://japan.kantei.go.jp/>. Accessed January 24, 2022.