

The Impact of COVID-19 on First-Year Undergraduate Nuclear Medicine Students' Practical Skills Training

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Clinical placement is an important component of any undergraduate nuclear medicine program. For first-year students, it is an introduction to clinical nuclear medicine, which helps them better understand the profession as well as consolidate their learning to date. Clinical placements for first-year students usually take the form of 2 wk of full-time attendance at a nuclear medicine site. At the University of Newcastle, in Australia, part of the clinical placement course includes radiopharmacy laboratory sessions in a simulated environment to develop necessary skills and confidence. Because of the coronavirus disease 2019 (COVID-19) pandemic, restrictions were put in place that meant cancelling clinical placements for first-year students and reducing time in the radiopharmacy laboratory from 2 h to 1 h per session. The aim of this study was to evaluate whether a clinical alternative portfolio in lieu of clinical placement was effective in increasing the students' knowledge and skills in nuclear medicine practice and whether specifically developed instructional videos for preparation of the radiopharmacy laboratory sessions compensated for the reduced time. **Methods:** A paper-based survey was given to the 50 students enrolled in the first-year professional practice course. This survey, containing 56 questions, consisted of both open questions and closed Likert-scale questions about the changes to the radiopharmacy laboratory sessions and the clinical alternative portfolio in 2 separate sections. Quantitative and qualitative analysis was performed on the resulting data. **Results:** There was a 94% response rate to the survey. Most students watched the preparatory radiopharmacy videos at least once and strongly agreed that each video adequately prepared them for the associated laboratory session. Just over half (51%) the students thought the reduced time in the laboratory was sufficient to complete the required tasks. Most students agreed that the modules included in the clinical alternative portfolio increased their knowledge of nuclear medicine practice. **Conclusion:** Despite the restrictions put in place because of COVID-19, the learning outcomes of the first-year nuclear medicine professional practice course were met. The preparatory videos for the radiopharmacy laboratory sessions and the clinical alternative portfolio were positively received and gave the students a good introduction to clinical nuclear medicine.

Key Words: nuclear medicine practice; students; COVID-19; clinical placement

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Clinical education for any health-care student has long been used to develop the student's practical skills and knowledge and reinforce the theoretic knowledge taught at the university (1). Experiencing actual patients in a real clinical situation gives the student a unique learning experience not achieved in the classroom (2). For first-year nuclear medicine students, their first clinical placement is their initial foray into clinical nuclear medicine. As well as consolidating their learning, it gives the students a better understanding of the profession as a whole, helping them realize whether this is the correct career choice for them (1).

As part of the Bachelor of Medical Radiation Science (Nuclear Medicine) (honors) program at the University of Newcastle, Australia, students complete 43 wk of clinical placement over 4 y. Clinical placements for first-year students usually take the form of 2 wk of full-time attendance at a nuclear medicine site. The emphasis of this clinical placement is to develop communication skills among themselves and patients and staff, develop technical skills (e.g., using the γ -camera), and put into practice any theory learned. They are assessed on their clinical competence by a clinical supervisor who is a practicing nuclear medicine technologist working at the clinical site. There are also written assessments for the student to complete, including a case study and reflective report.

To develop the crucial technical skills needed for their first placement, students are educated in radiopharmacy techniques in a specifically designed radiopharmacy within the University of Newcastle. The radiopharmacy laboratory has 10 student benches and an instructor's bench, each fitted with a commercial L-block and all the necessary equipment to maintain radiation safety in the workplace (e.g., lead pots and syringe shields). For first-year students, time in the radiopharmacy involves learning about radiation safety, needle skills, $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator elution, and quality control testing of the eluate. Students also learn how to draw up doses and basic methods for reconstituting a kit. In the simulated environment, there is no radioactivity involved, the generator systems are preused and over 6 mo old, and saline is used to practice drawing up doses. In this way, the student can develop the necessary skills and confidence without contaminating themselves and their environment. The advantages of using this simulation-based education includes protecting the

TABLE 1
Description of Preradiopharmacy Laboratory Videos

Video no.	Description	Length (min)
1	Laboratory introduction	5
2	Needle skills and dose calibrator	11
3	Generator elution and quality control	10
4	Point source and dose dispensing	7
5	Technegas	8
6	Radiopharmaceutical kit	4

student, the clinical supervisor, and ultimately the patient from unnecessary risks (in this instance, unnecessary ionizing radiation exposure) and offering the opportunity to practice high-risk events while receiving feedback in a safe environment (3,4).

The radiopharmacy laboratory sessions and the 2-wk clinical attendance are combined into the course “MRSC1330: Nuclear Medicine Professional Practice IB,” which takes place during semester 2, year 1, of the program for a Bachelor of Medical Radiation Science (honors) (nuclear medicine).

The COVID-19 pandemic imposed several restrictions on the delivery of MRSC1330. This necessitated a change in the course to adapt to the restrictions while still providing a quality learning experience for students. Radiopharmacy laboratory sessions, which were conducted on campus face-to-face, were allowed to continue during 2020; however, strict social distancing rules applied, and the amount of time students and staff were in the same room was regulated. All persons not living together were instructed to stay 1.5 m away from each other, and there was a limit of 1 person per 4 m² allowed within a room; this meant that a maximum of 6 students and the instructor were allowed in the radiopharmacy laboratory for each session, instead of the usual 10. Each session was repeated 9 times to accommodate the 50 students enrolled in the course. Each session also needed to be limited to 1 h instead of the usual 2 h, reducing the time available to demonstrate the learning task each week. To combat this time constraint, a set of 6 instructional videos was made by the course coordinator for each learning task (Table 1).

The 2 wk of clinical placement were also cancelled. In their place, a clinical alternative portfolio consisting of 4 modules was created to offer another learning experience for the student. Details of the clinical alternative portfolio are provided in Table 2. The portfolio was designed to be closely aligned to existing clinical placement learning outcomes. The portfolio constituted 80% of the total marks for the course, with the other 20% coming from a radiopharmacy skills assessment task.

The students were instructed to watch the prerecorded videos and read the laboratory notes before attending their radiopharmacy session each week. These were designed to familiarize the students, in advance, with the material to be covered each week because of the reduced time frame of the laboratory sessions. The prerecorded videos and the laboratory notes for the course were available on Blackboard Learn, a learning management system, making them suitable for viewing online from home.

The “Communication” module consisted of a set of pre-readings and a workshop. The pre-readings contained information on communication techniques and the importance of effective communication. To accommodate COVID-19 restrictions, 4 communication workshops were held on campus, with 3 workshops having 12 students in attendance and the fourth having 14. Each workshop was broken into two 2-h blocks over 2 d. In the first block, students had interactive discussions about why introductions are important, whom they might need to communicate with while on placement as a student technologist, what some of the issues facing their patients might be, and how to become more aware of nonverbal communication and cultural sensitivities. The students were also shown videos of nuclear medicine technologists interacting with patients. In the second block, students were divided into groups of 2 and were required to perform scenario-based exercises to develop their communication skills. The activities included students role-playing being either a technologist or a patient for various medical conditions, including being a patient with vision impairment, cancer, dementia, or pain. For assessment, students were required to write a reflective report. The report was designed to help students increase their understanding of effective

TABLE 2
Clinical Alternative Portfolio

Module	Description/summary of learning	Assessment
“Communication”	Effective communication techniques; types of people technologists need to communicate with; hands-on communication workshop	Reflective report (20%)
“Work, Health, and Safety”	Health and safety in workplace; risk assessment	“Hazard Identification Risk Assessment and Control” worksheet (20%)
“Case Study”	Methods for writing a case study	Bone scan case study (20%)
“Introduction to Nuclear Medicine Practice”	Patient identification, consent, and privacy; typical procedure for 3-phase bone scan; γ -camera operations	Audio recording of bone scan explanation (20%)

communication and to help inform their future experiences when communicating with patients and clinical staff (2).

The “Work, Health, and Safety” module was developed to inform students of the protocol and processes in place to maximize safety in the workplace. As well as being a key capability for nuclear medicine technologists (workplace safety forms part of the Medical Radiation Board of Australia’s professional capabilities document) (5), young workers may be less aware of work, health, and safety risks and responsibilities and therefore at more risk of workplace injury (6). As an assessment, students were required to complete a “Hazard Identification Risk Assessment and Control” worksheet on an area of their choice (e.g., workplace or shopping center). The worksheet was developed by a work, health, and safety academic from the university, with input from the course coordinator.

The “Case Study” module was developed because the writing of case studies is an integral part of the assessment of clinical placements within the nuclear medicine program at the University of Newcastle. In this module, students were required to choose a pathologic condition commonly imaged using bone scans and then write it up in the style of a case study.

As part of the “Introduction to Nuclear Medicine Practice” module, the students were given short videos on the operation of γ -cameras (supplied by GE Healthcare and Siemens) and a video of a bone scan. For the assessment, students were required to make a short audio recording explaining a bone scan to a patient. This task simulated what they would have been doing while on clinical placement but also tied together the knowledge learned in the “Communication” module. They needed to be able to correctly identify the patient as well as communicate information about a bone scan at a level a typical patient would understand.

The aim of this study was to evaluate whether the radiopharmacy instructional videos provided sufficient information to allow the student to confidently complete the laboratory sessions in the reduced time and whether the clinical alternative portfolio was effective in increasing the students’ knowledge and skills in nuclear medicine practice.

MATERIALS AND METHODS

Study Participants

The participants were all 50 students enrolled in the first-year “Nuclear Medicine Professional Practice 1B” course in 2020. Ethics approval was granted by the University of Newcastle’s Human Research Ethics Committee under its quality assurance scheme (QA242). Written consent was not obtained because this was an anonymous survey and consent was implied through completion and submission of the survey.

Survey

A paper-based survey was given to the students, as well as a participant information statement explaining the details of the study. The survey was administered after the final course assessment. The students were informed that participation was entirely their choice and nonparticipation would have no bearing on their marks or

progression in the course. The survey consisted of 2 main sections. Section A contained 33 questions relating to the radiopharmacy laboratory sessions and the 6 instructional videos; section B contained 23 questions about the clinical alternative portfolio. The questions were a combination of closed questions using 5-point Likert scales and open-ended questions for written comments.

Analysis of Results

Quantitative data from the survey were analyzed using weighted sum averages (WSA) of the Likert scale scores. The WSA analysis allowed comparison of the usefulness of each preradiopharmacy video and the clinical alternative tasks.

To determine whether the restructured radiopharmacy laboratory sessions had any effect on student learning, the results from the 2020 (COVID-19-restricted) radiopharmacy skills assessment were compared with the results from students who took the assessment in 2019. The 2020 cohort completed its first clinical placement in April 2021, and the effect of the clinical alternative portfolio was assessed by comparing the results from the 2021 clinical placement with the results from the 2019 cohort after completion of the same (though their second) clinical placement block. A 1-tailed *t* test was used to assess the statistical difference in the results of students between corresponding years.

The written comments from the survey were independently analyzed using thematic analysis by the authors. A range of themes and subthemes was derived and reviewed for agreement. Any disagreement was resolved through discussion.

RESULTS

In total, 47 of 50 students (94% response rate) completed the evaluation survey. Although 3 papers were incomplete, the completed parts of the survey have been included in the analysis.

Quantitative Analysis

Radiopharmacy Laboratory Sessions. Most students (98% [45/46]) watched each video at least once, with students watching most videos at least twice (Table 3). The exception was the “Radiopharmaceutical” video, with 34% (16/46) of students watching it more than 3 times. Students strongly agreed that each video was easy to understand, with the WSA ranging from 4.61/5 for the “Point Source and Dose Dispensing” video to 4.79/5 for the “Laboratory Introduction” video (Fig. 1).

When asked if each video adequately prepared them to participate in the associated radiopharmacy laboratory session, again most students strongly agreed (Table 4). The lowest ranked was the “Technegas” (Cyclomedica) video, and the highest ranked video was the “Radiopharmaceutical” video.

In response to questions about whether the laboratory sessions were long enough, 19% (9/47) of students strongly agreed (“plenty of time”) and 32% (15/47) agreed (“just enough time”) (Fig. 2). Thirty-six percent of students (17/47) disagreed (“some sessions could have been longer”) or strongly disagreed (“all sessions could have been longer”). Overall, the WSA was just over neutral, at 3.19.

Clinical Alternative Portfolio. Students were asked if they believed that the clinical alternative portfolio increased

TABLE 3
Number of Times That Students Watched Each Radiopharmacy Preparation Video ($n = 46$)

Video no.	Description	0 times	1 time	2 times	3 times	>3 times
1	Laboratory introduction	0%	43%	51%	4%	2%
2	Needle skills and dose calibrator	0%	27%	47%	16%	11%
3	Generator elution and quality control	0%	40%	33%	14%	14%
4	Point source and dose dispensing	2%	24%	46%	13%	15%
5	Technegas	0%	55%	30%	11%	4%
6	Radiopharmaceutical kit	2%	17%	28%	19%	34%

their knowledge of nuclear medicine practice (Fig. 3). Most students either strongly agreed or agreed with this, with the WSA ranging from 4.11 for the “Risk Assessment” module to 4.37 for the “Introduction to Nuclear Medicine Practice” module. Although a couple of students disagreed that some parts of the portfolio increased their knowledge (“Case Study” and “Communication” modules), no student strongly disagreed.

Most students agreed that the communication workshop was effective in increasing their awareness of communicating with both patients and people in general (Table 5). Only 1 student disagreed. That student thought that the workshop was “helpful in parts.”

Of the 3 videos that students were instructed to watch as part of the “Introduction to Nuclear Medicine Practice” module, most students watched them at least once (Table 6). Although all 3 videos ranked well, the GE Healthcare video on the operation of the γ -camera scored slightly higher than the Siemens video both in ease of understanding (WSA, 4.53 vs. 4.42) (Fig. 4) and in supporting student learning (WSA, 4.65 vs. 4.45) (Fig. 5).

Comparison of Results with Previous Cohorts. Marks were compared between this COVID-19-affected 2020 cohort and the 2019 cohort (not affected by COVID-19 restrictions). There was no statistical difference ($t = 1.23$, $P = 0.11$)

between the 2019 and 2020 radiopharmacy results, despite the fact that students in 2020 obtained slightly higher results (average, 94.5%; SD, 5.84) than students in 2019 (average, 92.5%; SD, 8.09).

Similarly, there was no statistical difference ($t = 1.89$, $P = 0.12$) between the 2019 and 2021 (COVID-19-affected) clinical placement results, despite the fact that students in 2021 obtained higher results (average, 78.6%; SD, 13.82) than students in 2019 (average, 74.64%; SD, 14.06).

Qualitative Analysis

Radiopharmacy Laboratory Sessions. The written comments from the open-ended questions concerning the radiopharmacy laboratory sessions uncovered

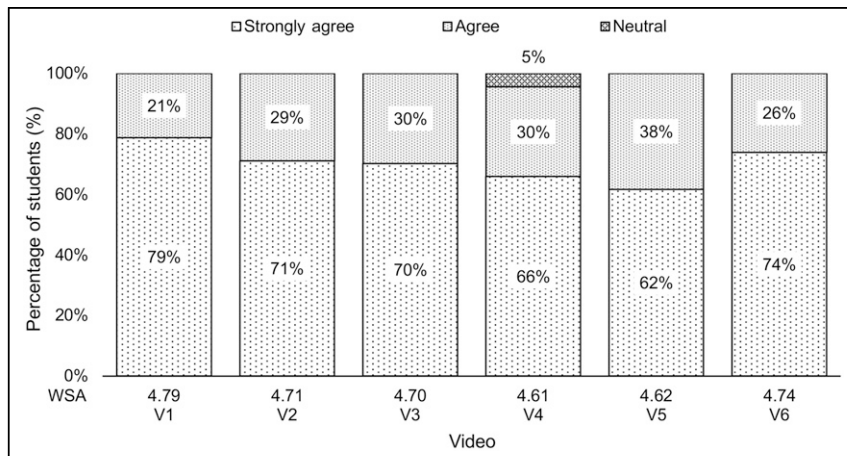


FIGURE 1. Percentage of students indicating that video was easy to understand. Video descriptions are provided in Table 1.

TABLE 4
Percentage of Students Indicating That Videos Adequately Prepared Them to Participate in Associated Radiopharmacy Laboratory

Parameter	Adequately prepared					WSA
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	
Laboratory introduction	68%	28%	4%	0%	0%	4.64
Needle skills and dose calibrator	67%	29%	2%	2%	0%	4.60
Generator elution and quality control	64%	32%	4%	0%	0%	4.60
Point source and dose dispensing	70%	26%	4%	0%	0%	4.65
Technegas	64%	30%	6%	0%	0%	4.57
Radiopharmaceutical kit	72%	26%	2%	0%	0%	4.70

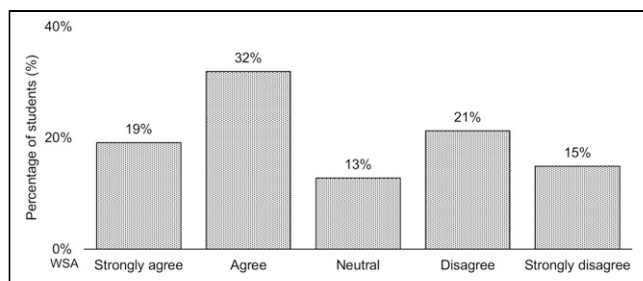


FIGURE 2. Percentage of students indicating that laboratory sessions were long enough to complete each task.

4 major themes: timing of the laboratory sessions; delivery of the laboratory sessions; content of the videos; and student learning, understanding, and confidence.

Regarding timing of the sessions, just over 50% of the students indicated that there was enough time in the laboratory each week to finish their specific tasks and that “any longer than 1 h and I feel it would drag on for too long” (participant [P] 44) or “we always had enough time and also to ask questions if we needed to” (P 10). However, some students felt that the laboratory time was too short, and they felt rushed: “by the time you get organized and put gloves/gowns on its not enough time to have multiple goes at eluting the generator and practicing getting doses” (P 25) and “I would have liked more time, a lot of our labs were cut short and rushed” (P 15). One student who indicated that there was sufficient time in the laboratory commented that “more practice to help

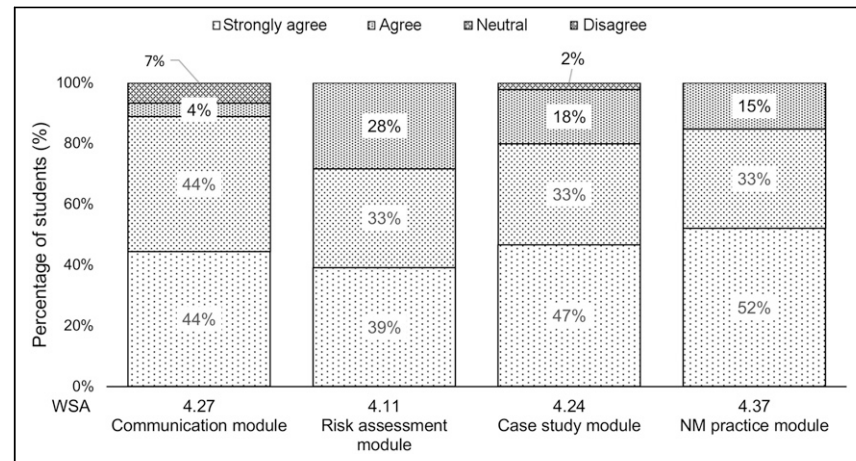


FIGURE 3. Percentage of students indicating that module increased their knowledge of nuclear medicine practice. NM = nuclear medicine.

TABLE 6

Number of Times That Students Watched Each “Introduction to Nuclear Medicine Practice” Video ($n = 46$)

Parameter	0 times	1 time	2 times	3 times	>3 times
Bone scan video	11%	46%	33%	9%	2%
GE Healthcare video	24%	50%	20%	7%	0%
Siemens video	28%	54%	13%	4%	0%

understand the method” (P 5) was needed. Students also commented that it “would have been better if we had more individual time with the lab instructor” (P 13) and that there was “not enough time to check everyone individually” (P 27).

Regarding delivery of the sessions, some students felt that the sessions needed to be delivered more than once a week: “the labs were good, however it would have been more efficient if we did them twice a week” (P 23) and “it is also hard to solidify skills 1 h a wk, as after a week has passed I felt I had forgotten everything” (P 33). It was also felt that another review laboratory session was needed: “maybe 2 labs before the test would have been more beneficial than one” (P 20). The smaller group size was felt to be a positive consequence of the COVID-19 restrictions, as “smaller groups allow for a better group dynamic” (P 47).

Regarding the content of the videos, the preparatory radio-pharmacy videos were well received by all students: “They were very clear and extremely helpful” (P 1). Students felt that the content within the videos was extremely helpful for their preparation each week: “the intro video alongside the in-class video helped me understand the lab thoroughly” (P 9); “all the videos were great as a hands-on learner watching them made it easier to grasp before heading in” (P 45); and “they matched what we were expected to do” (P 27). However, some students were looking for some more specific content to be added to the videos: “however a top down... camera angle could have helped with organizing [and] arranging the materials” (P 28); “a little more detailed” (P 34); “high camera view on generator” (P 40); and “adding some ‘tips and tricks’ would be great for example, how to remove a tricky needle cap” (P 16).

TABLE 5

Percentage of Students Indicating That Communication Workshop Increased Their Awareness of How to Better Communicate with Patients and with People in General

Parameter	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	WSA
With patients	66%	30%	2%	2%	0%	4.6
Generally with people	52%	35%	11%	2%	0%	4.4

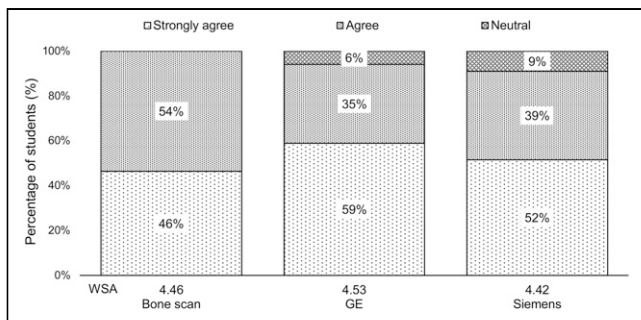


FIGURE 4. Percentage of students indicating that “Introduction to Nuclear Medicine Practice” video was easy to understand.

Regarding student learning, understanding, and confidence, the students felt that, overall, the videos added to their learning experience: “really great for reviewing what we have learnt. I watched them multiple times.” (P 27); “I believe that every subsequent year after this should have them as they provide a great source of study and reassurance” (P 28); and “I think every year they should be done. I know they were only done for COVID-19 but I think they are very beneficial.” (P 33). Specific videos also helped students understand health and safety aspects of the laboratory: “this video helped me avoid a needle stick injury” (P 42). Students were able to watch the videos at any time during the semester, which also made them useful for their assessment: “good tool to revise for practical exam” (P 16) and “I loved having them there to look back on” (P 10). However, other students felt that the videos helped with their understanding: “they were really good for my understanding” (P 17) and “the ... video helped me understand the lab thoroughly” (P 9). The videos also helped with students’ confidence: “they really helped reduce some of the anxiety and stress of the labs because you know what you’re in for before you get there” (P 16).

Clinical Alternative Portfolio. The written answers to the clinical alternative portfolio open-ended questions revealed 4 major themes: preparation for future clinical placement, communication skills, increased understanding and skills, and content of modules.

Regarding preparation for future clinical placement, students felt that the clinical alternative portfolio prepared them for

future clinical placements, especially the “Communication,” “Introduction to Nuclear Medicine Practice,” and “Case Study” modules. The modules “gave us a real insight into clinical situations. How to prepare for placement, what to expect, how to talk to patients” (P 21); “case studies will be done throughout my career—this gives me experience” (P 42); and “good to organize thoughts on how things work in a practice” (P 16).

Regarding communication skills, learning how to communicate in a nuclear medicine setting was helpful for students: “communication in a clinical setting is very different from everyday settings, and this is not something you realize without exposure. It made me aware of what I did not know and provided skills that will make adjusting to clinical practice less of a shock” (P 16). Having different scenarios meant that the students could experience a diverse range of clinical situations: “the workshop helped me understand how to communicate with all different patients with different needs. I gained a better understanding about communication toward patients, and how important it is” (P 24) and “it made me more aware of how to communicate effectively with a wide range of professionals and patients” (P 46).

Regarding achieving a better understanding and an increase in skills, for some students the clinical alternative portfolio gave them a better understanding of nuclear medicine because it “helped me to better understand what scans are for, what other images need to be done and how they are done” (P 37). Because of the extra reading required to complete some assessment tasks, “I noticeably gained knowledge of [nuclear medicine] in general due to extensively researching” (P 1). The clinical alternative portfolio also built on the basic skills and knowledge the students had acquired from courses delivered in semester 1: “refreshed my memory and helped” (P 43) and “allowed us to put into practice what we learnt in previous modules” (P 36).

Regarding the content of the modules, some students felt that simulating the clinical setting in the communication workshops made the learning easier: “I didn’t understand how daunting communication could be and I’m glad I learnt before placement” (P 15) and “able to interact without the pressure of a patient” (P 44). The γ -camera operation videos were also well received, as “in some ways it could possibly be even more helpful than work placements. Such as the videos of the cameras that we can revisit and pause—allowing us to learn at our own pace” (P 47). The risk assessment module, although helpful to some students—“made me aware as to just how many risks there could be in a workplace” (P 25) and “it was able to bring my attention to things I may not have thought about” (P 26)—lost some importance to others as it was not specifically focused on a health-care setting: “it did not add to my knowledge about the workplace” (P 28) and “didn’t necessarily provide insight into safety hazards within a hospital setting” (P 32).

Overall, the clinical alternative portfolio was seen to be an excellent alternative to attending clinical placement for some students: “I believe this was the best possible alternative to a clinical practice” (P 14); “it was helpful and an

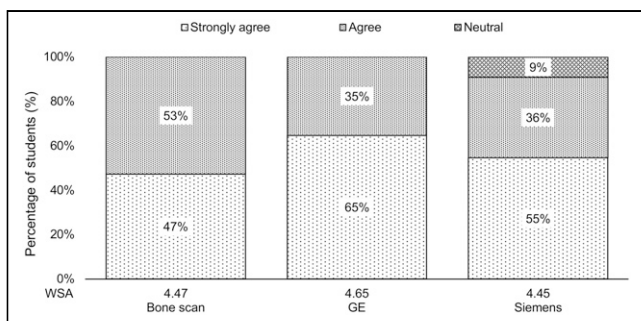


FIGURE 5. Percentage of students indicating that “Introduction to Nuclear Medicine Practice” video supported their learning.

impressive solution to missing work placement” (P 47); “I thought it provided us with the knowledge needed to take us into placement next year” (P 3); and “the portfolio was a great assessment that helped due to the cancellation of placement” (P 8). However, some students did not feel there was much benefit in completing the alternative tasks: “As we weren’t able to use the machines or deal with patients it was hard to understand the normal practice” (P 36). When asked what they would change about the clinical alternative portfolio, some students simply answered, “go on placement.”

DISCUSSION

Both the radiopharmacy instructional videos and the clinical alternative portfolio, put in place because of COVID-19 restrictions, were successful in terms of student learning. The radiopharmacy instructional videos provided sufficient information for the student to confidently complete the laboratory sessions, given the reduced time spent in the laboratory each week. Similarly, the clinical alternative portfolio increased the first-year students’ knowledge and skills in nuclear medicine practice despite cancellation of their clinical placement.

Radiopharmacy Laboratory Sessions

Most students strongly agreed that the instructional videos adequately prepared them for the weekly radiopharmacy laboratory session, with most students watching each video at least twice and finding them easy to understand. However, only half the students thought that the amount of time spent in the laboratory each week was sufficient for their learning. At the time, the videos were made in response to a reduced amount of time spent in the laboratory each week, allowing for a briefing on the learning objective to be done before entering the laboratory. However, this study has shown that the videos were much more than that. The videos helped students with various learning styles prepare for the laboratory session each week. It is the role of the health science educator to accommodate the different learning styles of students (7), which include concrete experience (feeling), reflective observation (watching), abstract conceptualization (thinking), and active experimentation (doing) (7). In this instance, the students are provided videos and written instructions (watching and thinking) and then given the opportunity to practice what they have learned (doing). The videos added to the learning experience provided by the simulation-based radiopharmacy laboratory sessions, providing essential knowledge and the chance to rewatch for review purposes. The laboratory sessions provided first-year nuclear medicine students with a realistic and relevant learning experience, an essential element of simulation-based education (4,8). Although their time in the laboratory was reduced, each student received the same level of training, which is sometimes not afforded in clinical practice because of the inconsistent teaching styles of supervisors (1,4,9).

Clinical Alternative Portfolio

The decision to cancel the clinical placement was not taken lightly, as there are many known advantages to exposing the student to the profession at such an early stage in their studies (1). Most students either agreed or strongly agreed that all 4 modules of the portfolio increased their knowledge of nuclear medicine practice and safety in the workplace and prepared them for future clinical placements. This agreement was backed up by similar clinical placement results when comparing this cohort with the previous cohort.

Preparation for Future Clinical Placement

As with the radiopharmacy laboratory sessions, all students received the same educational experience, therefore eliminating the inequality in learning due to varying clinical placement encounters (1,4,9). A recent study by Ketterer et al. (9) stated that participation in simulated placement activities did not disadvantage the therapeutic radiography (radiation therapy) student and that simulated placement activities “should play a major role” in the training of students. However, the lack of patient interaction and the inability of students to immerse themselves in the profession will ensure that this portfolio is used as a preparation tool and not a replacement for clinical placement.

Communication Skills

Effective communication within any medical setting is imperative; it reduces patient anxiety, addresses any concerns the patient may have, and educates the patient about the procedure (10). The first-year nuclear medicine cohort had varying levels of experience with communication, ranging from having no experience to having communication experience through retail work to already being a health professional (some students in this cohort were trained dental hygienists and nursing assistants); however, most students agreed or strongly agreed that the module increased their awareness of how to communicate with patients or people in general. The inclusion of communication skills training in the clinical alternative portfolio provided examples of effective communication within the workplace, as well as patient–technologist interactions, within a safe learning environment. This environment allowed students to practice their evolving communication skills and make errors without the fear of reprisal (4,10).

Content of Modules

The modules in the clinical alternative portfolio were designed to be equivalent to the learning outcomes of clinical placement. Although, on placement, previous first-year students were assessed on their communication skills with both staff and patients and were required to complete a risk assessment task and a bone scan case study, they also needed to write a reflection based on a personal interaction with a person from a culturally diverse or indigenous background. By aligning the set tasks in the clinical alternative portfolio with the traditional placement learning outcomes, the students in this study were provided with the same

learning opportunities as previous students in an attempt to increase their understanding of nuclear medicine practice. A mixture of teaching methods was used in the portfolio, including face-to-face teaching, prerecorded lectures, self-directed learning, and industry-recorded videos. As well as catering to different learning styles, this mix gave students the flexibility of blended learning (11,12).

Limitations

A limitation of this study was the relatively small sample size ($n = 47$), though this represented 94% of the eligible participants. Another limitation was the lack of generalizability due to the research's being conducted for a single course at a single Australian university.

CONCLUSION

During 2020, in the midst of a worldwide pandemic, first-year nuclear medicine students at the University of Newcastle were provided with a safe environment to develop their radiopharmacy skills and be introduced to clinical nuclear medicine practice. The learning outcomes of the radiopharmacy laboratory sessions were still met, despite the time restrictions put in place, and the student learning experience was enhanced by the preparatory videos. With the loosening of COVID-19 restrictions—and because of the student feedback—the students will return to 2-h radiopharmacy laboratory sessions in 2021. The videos will also be used as part of the prelab preparation. The clinical alternative portfolio enabled students to acquire a basic understanding of clinical nuclear medicine without the need to attend nuclear medicine practice sessions. Although the clinical alternative portfolio was positively received, it should not replace clinical placement for first-year students. Instead, it should be

used as a method of preparation for students about to embark on their first clinical placement in a nuclear medicine department.

DISCLOSURE

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

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