

# Practice and the Efficiency of Simulation Training for Nurses in a Rural Mountainous Area

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## Abstract

**Objective:** In mountainous areas, often a shortage of human resources to provide medical care is prevalent, which compels the frontline nurses to play a major role in providing the same, especially in situations of sudden patient changes. Thus, a simulation training program for nurses in a hilly and mountainous area was conducted. It was unique to the area and suited to the medical needs of the region and examined its effectiveness.

**Materials & Methods:** A needs survey was conducted with 93 nurses working in local medical institutions regarding their weaknesses in dealing with sudden changes, and a hypothetical scenario program was created to match the actual situation in the community. Five minutes of practice and 10 minutes of debriefing per scenario were provided to the participants, and four scenarios were conducted in one training session. Five training sessions were conducted from February 2015 to May 2018 for 57 nurses. After the completion of the training, a questionnaire was sent to the participants. Descriptive statistics retrieved from the collected questionnaires were used for the 5-point rating, and qualitative inductive analysis was used for the free text.

**Results:** In the post-intervention questionnaire, 89% of the respondents were 'satisfied', 89% answered 'meets needs', and 94% responded with 'would recommend to others'. In the free comments, there were some insights such as awareness of what could not respond emergency, importance of observation from a broad perspective and calm response to an emergency, how to report and its importance, a good opportunity to reflect on oneself, and increased motivation, indicating that an experiential learning cycle was formed among the participants.

**Conclusion:** This training is extremely practical and focuses on local needs, so that both, nurses' satisfaction and learning efficiency is high. This type of simulation training might be useful in mountainous areas where learning opportunities are scarce.

**Keywords:** Nurses in mountainous areas; Initial response to sudden changes; Lifelong learning with learning efficiency; Simulation training.

## Objective

In mountainous areas, generally, there is a shortage of human

resources who are skilled to provide medical care. In many cases, it is difficult for doctors to rush to the scene of a sudden change in a patient's condition, especially if the patient suffers from cardiac arrest [1]. Furthermore, patients who cannot be treated at their hospitals need to be transported to higher-order medical institutions far away from the patient's residence, which requires rapid initial response and judgement. Thus, nurses in mountainous areas need to possess a wide range of skills, including advanced knowledge, ability to respond to sudden changes, and triage skills. In order for nurses or healthcare professionals to acquire and maintain these skills, it is desirable to regularly participate in relevant training to update their knowledge [2,3]. However, since training sessions are often held in urban areas, it is difficult for nurses working in mountainous areas to participate frequently [1,4,5]. Therefore, for the lifelong education and training of nurses working in mountainous areas, a highly efficient educational program aimed to impart the required lessons in a short time is necessary. In addition, although the training is intended for sudden patient changes, it is necessary to focus on the ability to respond without cardiac arrest and patient assessment skills.

Simulation training is a training method that provides a learning environment that simulates an actual workplace and allows learners to acquire knowledge and skills through practice. In recent years, it has been actively used in the field of medical education [6]. According to the 'learning pyramid', which describes the retention rate of learning, the retention rate of practical training is said to be 75%, while that of lectures is only 5% [7]. Previous studies have shown that simulation training with high field fidelity is more effective than other types of training [8]. Thus, it can be deduced that simulation training is one of the most efficient learning methods. With the belief that simulation training with high learning efficiency would be useful in mountainous areas where learning opportunities are scarce, a regional simulation training project was launched.

The first feature of this training project is that it is a 'community-generated training', in which the local university and government are proactively involved in the management, rather than acting like just an organisation such as a university hospital bringing the training to the community. The second is to create a program that 'meets the needs of the community' so that local nurses can apply the training to their actual clinical practice. Thus, this report includes details on the practice of simulation training in a mountainous region and examination of the impact of training on local nurses using a questionnaire survey.

## Materials & Methods

### Target area

The city of Niimi is located in a mountainous area in northern Okayama Prefecture in Japan, with a population of approximately 30,000 and population ageing (aging) rate is 40% [9]. There are only several small-and medium-sized hospitals adjacent to the city with around 100 beds, and it takes more than 1 h and 30 min by land to reach more well-equipped medical institutions. The number of doctors working in Niimi is 103.9 per 100,000 people, which is far below the national average (226.5 per 100,000 people), indicating that it is a region with a serious shortage of doctors [9]. In addition, the number of nurses in Niimi is 717 per 100,000 people, which is lower than the national average (796.6 per 100,000 people), which indicates a shortage of nurses [10].

### Maternal Project and Operation of this Training

The Niimi Satellite Office of the Career Center MUSCAT (MD and Undergraduates Support and Care Attractive Women's Team),

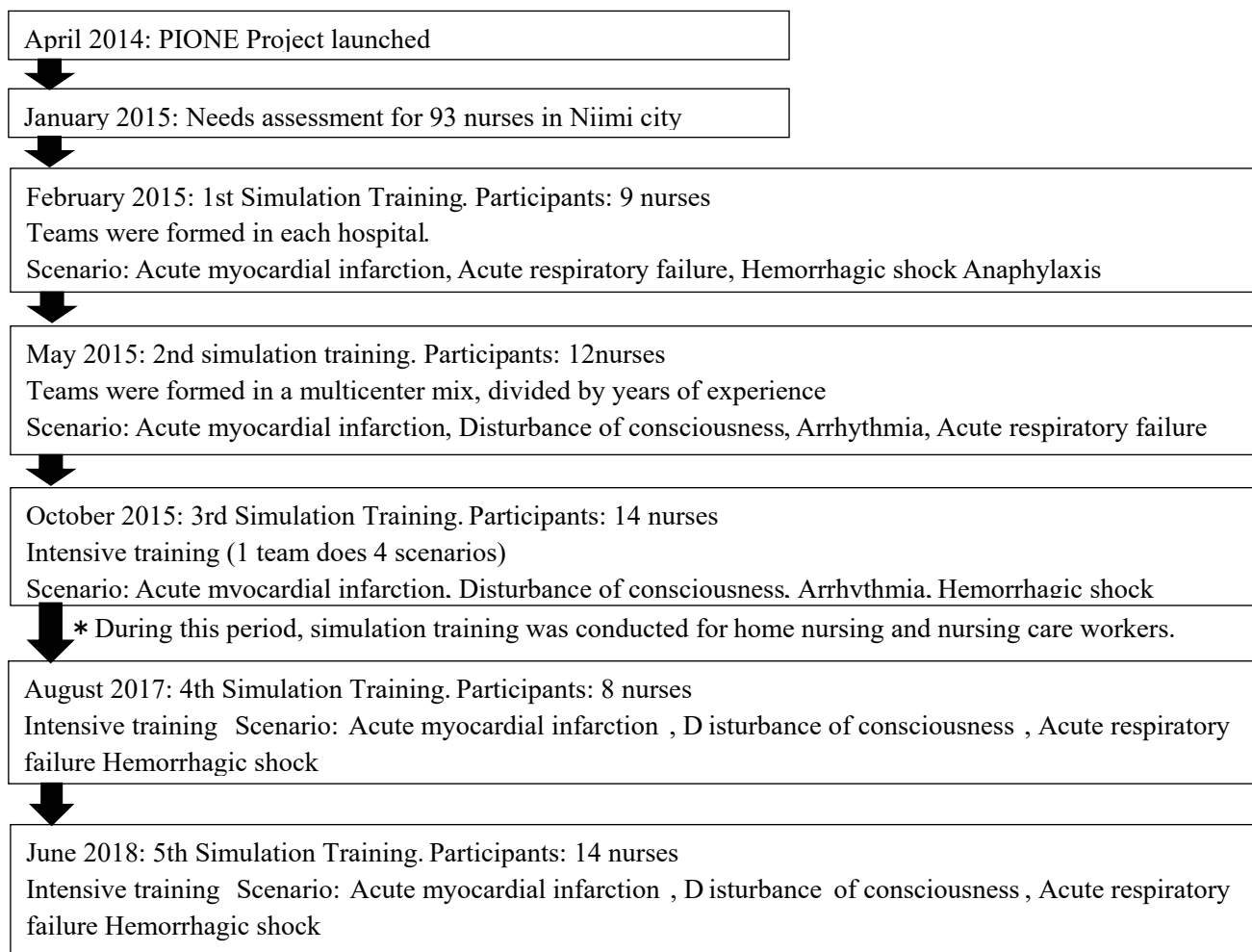
established in 2014, and PIONE (Productive Interactive Okayama Niimi Empowerment) Project, a project to support medical professionals in the northern region of Okayama Prefecture was launched. With the cooperation of Okayama University, doctors working at both Okayama University and Niimi City, Niimi City government, Niimi University, and medical organisations within the city worked together in this project. In this training, which is a part of the project, doctors from Okayama University, who are well-versed in medical education, instructed the project members in Niimi City on scenario creation, management know-how, and facilitation methods, and the members in Niimi City took the lead in managing the training. The flow from the launch of the PIONE project to the establishment of simulation training is shown in Table 1.

### Needs assessment

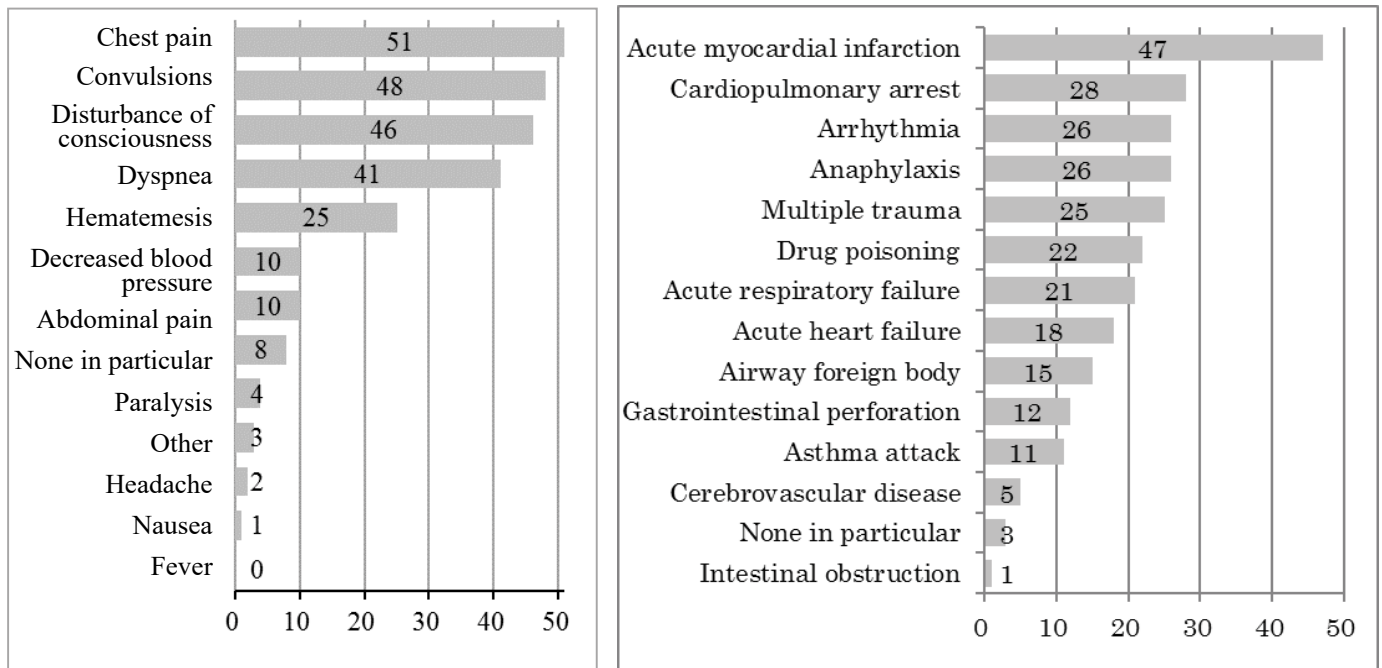
Since the target audience were local nurses, a needs assessment was done in January 2015. For this step, a questionnaire survey was conducted with nurses working at hospitals in Niimi city to determine in which diseases/conditions they lack knowledge and face difficulty in dealing during an emergency. In the needs assessment, 93 nurses who are working in hospitals in the city responded to the survey. The common signs they lacked expertise in were chest pain (51), convulsions (48), disturbance of consciousness (46), dyspnoea (41), and hematemesis (25), in that order. Acute myocardial infarction (47 patients) was by far the most common disease that they lacked expertise in, followed by cardiopulmonary arrest (28 patients), arrhythmia (26 patients), anaphylaxis (26 patients), and multiple trauma (25 patients) (Figure 1).

### Creating a scenario program

Based on the results of the needs survey, hypothetical scenario programs for diseases/conditions were created according to the needs of the target population. Each scenario program had its educational objectives and goals, which were set by discussing patient information and vital changes with nurses, nursing faculty, and physicians. The educational objectives and goals were set by the faculty of the Department of Nursing at Niimi Public University. In the mid-hills and mountainous areas, it takes more than 1 h and 30 min to transport a patient to a tertiary emergency medical institution in case of an emergency. Therefore, a quick response is necessary in such an emergency. In such scenarios, the night duty is performed by a part-time doctor; thus, nurses need to act independently and report appropriately as per the patient's condition. Considering these medical situations, the goals of the hypothetical scenario were 'to determine the urgency', 'to be able to take emergency measures', 'to be able to assess the condition', and 'to report appropriately to the doctor (medical institution)'. The scenario settings were kept faithful to actual clinical situations, such as a small number of people at night, a part-time doctor on duty, and a situation in which the doctor could not immediately rush to the scene. This training program was developed using a systematic approach based on the theory of instructional design [11]. By acquiring the know-how of the systematic approach, it is possible to apply it to a wide range of occupations and situations. Since the simulation training was for city nurses, the scope of the training can be expanded to include visiting nurses, nurses in outpatient clinics and dialysis clinics, multidisciplinary cooperation, and nursing home staff in response to requests from local medical professionals



**Table 1:** The flow from the launch of the PIONE project to the establishment of simulation training.



**Figure 1:** Results of the needs survey for nurses in Niimi City (n=93 Three options are available. The number in the graph is the number of people.

**Setup of the Venue and Actual Training**

For this training, patients were substituted with simulators and mock patients, and a high-fidelity simulator was borrowed from Okayama University for this purpose. The venue was the nursing practice room of Niimi Public University, and the beds, oxygen piping, and medical equipment in the practice room were used. The medical equipment necessary for hospitals, homes, and nursing homes were prepared, and the scene was reproduced as faithfully as possible. The facilitators of this training were doctors from Okayama University, who were well-versed in medical education, and doctors from the PIONE project. Before practicing the training, a briefing was given to all participants, followed by 5 minutes of practice and 10 minutes of debriefing. A specific scenario of acute myocardial infarction is shown as an example. The participants were presented with a setting of a night shift, two nurses working in the ward, and one doctor on duty in the hospital. The session started with an inpatient pressing the nurse’s call, saying “I have chest pain. The facilitator was in charge of the patient’s voice. The participants responded initially by calling out to the simulator as they would in an actual clinical setting. Checking vitals showed blood pressure of 130/80, pulse of 100, respiratory rate of 24 breaths per minute, and SPO2 of 80%. The nurse administered oxygen and the SPO2 increased. A 12-lead ECG was performed and showed an ST-segment elevation ECG. Checking vitals showed blood pressure of 130/80, pulse of 100, respiratory rate of 24 breaths per minute, and SPO2 of 80%. The nurse administered oxygen and the SPO2 increased; a 12-lead ECG was performed and showed an ST-segment elevation. The nurse reported the situation to the doctor on duty (the facilitator played the role of the doctor on duty), and the practice ended when the doctor arrived. Debriefing reflects on the aforementioned goals.

Five training sessions were conducted from February 2015 to May 2018 for 57 nurses working at hospitals and clinics in the city. The first round of the training was conducted by forming teams at each hospital. Based on the results of the needs assessment, one scenario was conducted for each disease at which each hospital was in-charge (‘acute myocardial infarction’, ‘acute respiratory failure’, ‘haemorrhagic shock’, and ‘anaphylaxis’). The second round was conducted by a multi-institutional mixed team categorised into years of experience (1-10, 11-20, 21-30, and 31 years or more). Based on the aforementioned

Time	Booth A (Simulated patients)	Booth B (simulator)
13:00	The first half Orientation	
13:15	A Hospital Disturbance of consciousness	B Hospital Acute myocardial infarction
13:30	A Hospital Hemorrhagic shock	B Hospital Arrhythmia
13:45	Movement	
13:50	B Hospital Disturbance of consciousness	A Hospital Acute myocardial infarction
14:05	B Hospital Hemorrhagic shock	A Hospital Arrhythmia
14:30	The second half Orientation	
14:45	C Hospital Disturbance of consciousness	D Hospital Acute myocardial infarction
15:00	C Hospital Hemorrhagic shock	D Hospital Arrhythmia
15:15	Movement	
15:20	D Hospital Disturbance of consciousness	C Hospital Acute myocardial infarction
15:35	D Hospital Hemorrhagic shock	C Hospital Arrhythmia
15:50	closure	

**Figure 2:** Program (4 groups to implement 4 scenarios).

needs assessment, one scenario was conducted for each disease in which each person with various years of experience faced difficulty. From the third time onward, the training was conducted intensively in which one team reacted and performed on four scenarios in a row, which were either ‘disturbance of consciousness’, ‘haemorrhagic shock’, ‘myocardial infarction’, ‘arrhythmia’, or ‘respiratory failure’. The current program is illustrated in Figure 2.

**Post Implementation Questionnaire**

After the training, a questionnaire survey was conducted among the participants and observers. The participants chose the answers in the questionnaires as per their liking from the following five options:

'satisfaction', 'does it meet your needs', 'can you use it in clinical practice', and 'would you recommend it to others' and a free column for 'honest impressions after the training'.

### Questionnaire Analysis Method

Descriptive statistics of frequency distribution and percentages were used to analyze the 5-point scale of the questionnaire. Microsoft® Excel (2010) was used to analyze the data. The free text was analyzed by inductive content analysis. Context of free text was extracted and coded. The similarities and differences of the codes were compared and examined, and those with common meanings were classified into categories and sub-categories. Three researchers worked together to analyze the data and examine the content of the categories.

### Ethical Considerations

This study was approved by the Niimi Public University Ethical Review Committee (Approval No.: 115).

### Results

Responses of post-event questionnaire were obtained from 57 nursing students who had taken the course so far, with a 100% response rate. Gender was all female. The mean years of nursing experience was 9.6 years (3 months-38 years). As for the level of satisfaction, 19 (34%) were very satisfied, 30 (55%) were satisfied, 4 (7%) were undecided, and 2 (4%) were dissatisfied. The percentage of very satisfied and satisfied was 89%. Regarding the question of whether it met their needs, 21 (37%) were very satisfied, 29 (52%) were satisfied, five (9%) were undecided, and one (2%) was unsatisfied, for a total of 89%. When asked if they would recommend the program to others, 31 (55%) responded that they would definitely recommend it, 22 (39%) would recommend it, and 3 (6%) were undecided, for a total of 94% (Figure 3).

As a result of analysing the frank opinions (free comments) of the participants after the training, focusing on their 'awareness', the following were categorised: (1) awareness of what cannot be done when responding to an emergency, (2) importance of observation from a broad perspective, (3) how to report and its importance, (4) importance of calm response to an emergency, (5) good opportunity to reflect on themselves, and (6) improvement of motivation. Each category was further divided into subcategories. (Figure 4).

#### Awareness of what cannot be done when responding to sudden changes

The awareness of the participants was gauged with questions like the following: 'Lack of study', 'Awareness of what I can't do', and 'Realization of what I could not actually do from a broad perspective in the given scenario.'

#### Importance of observation from a broad perspective

The participants realised that it is important to need to observe from a broader perspective to make informed judgments based on information such as medical history and findings, to 'Necessity of

improving my observation skill', and to 'Importance of examining the patient over time' by reconfirming the patient's response.

#### How to report and its importance

Generally, it is important to inform or report to the doctor of the urgency of the situation. In this training using hypothetical scenarios, the participants noticed that they 'I learned how to report', 'I realized how difficult it is to report', and 'I want to be able to report' about any emergency situation.

#### Importance of calm response in case of sudden changes

In emergency scenarios, it is important for the nurses to 'move with anticipation' and 'think and act calmly'. Furthermore, it is necessary to do 'What you can do as a nurse when there is an emergency', such as securing routes and providing mental support, in a qualified manner. In addition, post the training, there was an increase in motivation to 'be able to respond to sudden changes' in a calm and composed manner.

#### Good opportunity to reflect on oneself

In common with points (1) to (4), this training is a 'good opportunity to reflect on oneself'.

#### Increased motivation

In addition to the above points, the training also led to an increase in motivation, such as 'I want to use what I learned in the training in the future', 'To improve my skills', 'Challenge again', and 'Importance of accumulated training'.

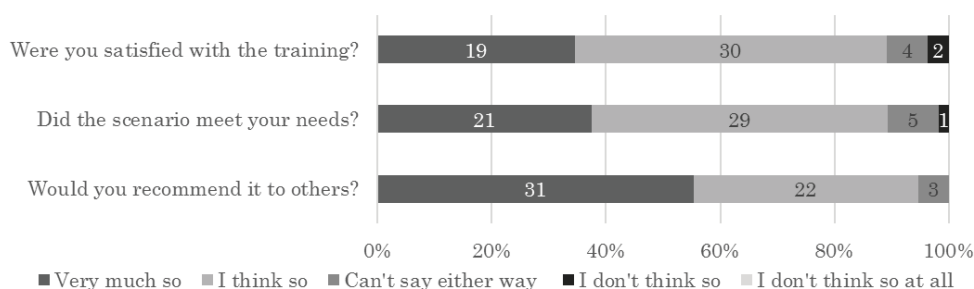
### Discussion

Simulation training is conducted by many universities and medical institutions. However, in most cases, it is conducted in special facilities such as simulation centres. There have been few reports of attempts to provide training to local healthcare professionals in a mountainous region with a population of about 30,000, such as ours, working at a facility run by the local university or government. One of the main reasons for this is the use of expensive simulators in such training. It is difficult for local government agencies or local medical institutions to purchase them, and this is a new approach that can be realised through collaboration with universities.

#### Needs and learning effects

As per the theory of adult education, learning according to the needs of the learner leads to a higher level of satisfaction and a higher learning effect [12]. Based on this theory, a needs assessment of nurses in mountainous regions was conducted. It was found that nurses were most uncomfortable with acute myocardial infarction, which requires immediate transport to a higher-order medical institution, and dealing with its characteristic symptom, chest pain. A stratified analysis was also conducted and it was found that needs differed depending on the type of facility and years of experience.

One of the points that was paid attention to when creating the actual



**Figure 3:** Post-survey of students (5-point scale) (Number of students is shown in the graph).

category	sub-category	code(summary)
(1)Awareness of what cannot be done when responding to sudden changes	Lack of study	I realized my lack of study.
	Awareness of what I can't do	I realized what areas I was weak in. I realized that I hadn't thought about what I needed to do.
	Realization of what I could not actually do	I realized that I could not actually take action even though I understood it in my head. I can't move in a hurry in reality.
(2)The importance of observation from a broad perspective	Need to observe from a broader perspective	I need to be able to think from a broader perspective. It is important to make judgments based on medical history and findings.
	Necessity of improving my observation skills	I need to improve my eye for observation.
	Importance of examining the patient over time	It is important to examine patients in succession. Observation at each time.
(3)How to report and the importance of reporting	I learned how to report.	I was able to learn how to make a report to move the doctor. I learned how to report urgency.
	I realized how difficult it is to report.	The importance and difficulty of accurately reporting the importance.
	I want to be able to report calmly.	I want to be able to observe and report calmly.
(4)The importance of responding calmly to an emergency situation	It is important to moving with anticipation	It is important to move with anticipation. Think about what to do next and act accordingly.
	It is important to think calmly and act calmly.	It is also important to think calmly and act calmly. Organize and respond to each situation one by one.
	What you can do as a nurse when there is an emergency	I learned what nurses can do (check vitals, etc.) before the doctor arrives. Mental support.
	I want to be able to respond to sudden changes.	I want to be able to respond calmly. I want to acquire the knowledge and ability to think so that I can respond calmly.
(5)Good opportunity to reflect on oneself	Good opportunity to reflect on oneself	Reflecting on my own actions. I was able to look back and see if I was actually able to do what I could do.
(6)Improvement of motivation	I want to use what I learned in the training in the future	I want to make use of it in the future. Definitely useful.
	To improve my skills	It will help me improve myself. I want to improve my skills.
	Challenge again	I want to be able to do it next time. I want to do the same scene again.
	Importance of accumulated training	It's important to accumulate experience. I want to gain experience in training and in the field.

**Figure 4:** Impressions immediately after training (free text).

scenario was the creation of a simulation setting with high fidelity to clinical practice in a mountainous region, rather than a large hospital setting. 'Fidelity' to actual clinical practice includes four elements: physical, technical, environmental, and spiritual; it varies depending on the purpose and the learner [13]. Regarding fidelity and learning effectiveness, the higher the fidelity, the higher was the learning effectiveness for veterans, while too much fidelity for first-time learners is considered inefficient for learning [14]. It was believed that the fidelity needed in training for nurses working in community healthcare settings is essentially technical and environmental. To reproduce fidelity, the following were used, a simulator to measure vitals, a simulated patient to realistically assess consciousness level and paralysis state, and an environmental setting that is often encountered in mountainous areas, such as 'a small number of people on the night shift, an unfamiliar part-time doctor on duty, and the need for hospital transfer'.

In this way, the needs of the community were surveyed and a scenario was reproduced and adapted to the characteristics of the community. As a result, it was believed that the participants felt that the scenario met their needs, as hypothesised, which led to a high level of satisfaction.

#### **Significance of the simulation training and learners' responses**

First, the characteristics of the region selected for this research are that the number of medical staff is smaller than in urban areas, resulting in fewer opportunities to go to urban areas for training and self-improvement, and fewer opportunities for on-site experience due to the small number of cases. In this situation, it was thought that it would be effective for nurses in the mountainous region to have a simulated experience of practice in a situation close to the actual

place. It is extremely burdensome for inexperienced learners to rely and reflect on their experiences in critical situations, and to connect them to the next time, which may be a cause of medical staff turnover. Miller pointed out that there is a gap between knowledge-centred skills acquired through learning in a calm environment and the ability to act in actual situations [15]. Simulation training, which reproduces actual workplaces scenarios, is considered to be an effective way to bridge the gap between knowledge and action [16]. According to the frank feedback after the training, about half of the participants felt that they could not actually move. In adult learning theory, experience, including failure, provides the basis for learning activities [17]. The fact that the students were able to experience the failure of 'not being able to move' in the mentally safe environment of the simulation is the first step toward effective learning, considering that they would feel unable to move in the field.

This research found that an even more important element of this training is to provide the learners more 'awareness' during debriefing and to take steps to connect the experience to learning. Kolb takes the four steps of 'concrete experience', 'reflective observation' (looking back), 'abstract conceptualisation', and 'active experimentation' (trying something new), and asks them to be repeated in simulated trainings [18]. This debriefing will encourage learners to reflect on the current situation of clinical practice in the mountainous regions and encourage them to take actual action in clinical practice. From the awareness, obtained from their frank feedback after this training, the learners felt that the 'awareness' enriched them with a concrete experience of responding to an emergency. Furthermore, they realised that 'awareness of what they could not do when responding to an emergency' due to the gap between their knowledge and actual actions created a major hindrance in serving the patients.

However, by looking back and reflecting on their actions, they were able to understand the abstract conceptualisation of 'the importance of observation from a broad perspective', 'the importance of responding calmly in the event of an emergency', 'how to report', and 'the importance of reporting'. The nurses reported that the training led to 'increased motivation' to apply these concepts in daily clinical practice and in honing and improving their own skills. Thus, it was believed that Kolb's experiential learning cycle was formed among the participants.

### Regional original simulation training

Since this training was mainly conducted by the local public university and the government, and in cooperation with various medical institutions and medical groups, it is easy to understand the needs of local medical professionals and to reproduce actual clinical situations. Particularly, the needs survey this time was able to obtain responses from almost all nurses working at hospitals in the city, making it highly reliable.

Furthermore, Okayama University was in a position to play a role in creating scenarios in cooperation with local medical professionals, while training instructors and providing full support to local communities so that they could operate their own training programs. To conduct the training independently, it is thus, necessary to train local facilitators. Therefore, a training course for facilitators was also held, and now local facilitators are playing an active role in imparting the training to relevant healthcare professionals.

### Future issues

According to the evaluation of studies using the Kirkpatrick model [19], this study was conducted at the reaction level. As the next step, it is necessary to evaluate whether the nursing skills of the participants in this training improved (Learning), whether the nursing level improved (Behaviour), and whether the level of medical care in the entire community improved (Organisation), which is a limitation of this

study. In future, the researchers plan to continue further verification of this training model and connect it to the field.

### Conclusion

Thus, it can be said that the simulation training conducted, was 'created by the community' and 'suited to the needs of the community' in the mountainous regions was highly satisfactory and showed a high learning effect. It was thought that simulation training with high learning efficiency would be useful in mountainous areas where learning opportunities are scarce. In addition, the construction of an independent simulation training environment in the community through collaboration between the university and local government seems to be an important initiative for effective learning in the future.

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