

Original Research

HMV exercise for nursing students

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Abstract

Home mechanical ventilation (HMV) exercise is incorporated into the current basic nursing education system to promote students' understanding of persons requiring home medical management. However, such exercise does not provide sufficient opportunities for them to actually manipulate related devices. With the cooperation of medical device manufacturers, we have been examining appropriate exercise contents to effectively promote students' understanding of this area for several years. This paper reports the outcomes of our approaches to further improve the quality of HMV exercise.

Key words: home mechanical ventilation (HMV), exercise, basic nursing education, students' levels of self-satisfaction

I. Introduction

Home mechanical ventilation (HMV) is a life-support system for persons requiring long-term home care and facing pulmonary ventilation difficulty due to disorders, such as neuromuscular or respiratory diseases. There are various types of HMV. As a recent trend, noninvasive positive pressure ventilation (NPPV) tends to be used more widely than tracheostomized positive pressure ventilation (TPPV) as the former has the merits of being easy to adopt, simple, and convenient, and, therefore, low-invasive (Ishihara, 2003).

According to a national survey conducted by Ishihara et al. in 2014, the number of persons requiring long-term care with mechanical ventilation (MV) was 17,190 in that year. In subsequent studies, an increased rate of living at home, improvements in the QOL and arterial blood gases, and a prolonged life expectancy were noted as long-term outcomes of NPPV (Ishihara, 2017).

To help persons requiring long-term home care with MV fulfill their lives, while preventing the acute deterioration of their conditions, HMV safety management is essential. In addition,

support systems, covering emergency measures, expertise, and device management by visiting nurses, as well as doctors, care workers, and device providers, should be established (Kawamura, 2000). As the number of such persons is increasing, it is also necessary to enhance students' insight into them through basic nursing education. For this purpose, this paper discusses appropriate learning contents and support for nursing students, focusing on HMV exercise.

II. Circumstances and current status of HMV

In Japan, HMV was initially adopted as part of nursing care for patients with intractable neurological diseases around 1975. The number of HMV users remained limited for many years, but it began to increase when the procedure became social insurance-covered in 1990, and the medical fee system was further revised in 1994.

Ishihara et al. conducted a survey on respiratory failure, and reported that the number of persons receiving long-term care rapidly increased from 1997, but stabilized around 2004. The number of HMV users was 17,190 in 2014, 11,350 of whom were NPPV users, accounting for

66%, while that of TPPV users was 5,840 (White Paper on Home Respiratory Care, 2010).

On examining the current status of HMV users based on the White Paper on Home Respiratory Care 2010, the 5 most frequent diseases among home NPPV users were: chronic obstructive pulmonary disease (COPD), sequelae of pulmonary tuberculosis, neuromuscular disease, sleep apnea syndrome, and kyphoscoliosis.

Among home TPPV users, neuromuscular disease accounted for approximately 70%, followed by COPD and sequelae of pulmonary tuberculosis.

Compared with TPPV, NPPV has the merits of being easy to adopt, simple, and convenient, and, therefore, low-invasive. (Ishihara, 2017)

On the other hand, TPPV is regarded as more appropriate for individuals showing aspiration or requiring airway maintenance due to difficulty in expectorating secretions such as sputum independently (Ishihara, 2017). In many patients after tracheostomy and requiring NPPV, secretions in the airway, such as sputum, should be continuously expectorated, making it difficult to close the tracheostomy aperture (Ishihara, 2017).

HMV users are forced to endure a state of artificial respiration permanently (Ishihara, 2017). Aiming to help persons who require long-term care, but do not need inpatient treatment, as well as their families, understand the significance and limitations of HMV, effectively use community-based healthcare, medical, and welfare services, and fulfill their home lives, activities to further improve support systems, enhance the quality of services for each disease, and establish backup systems are currently being promoted (Japan Visiting Nursing Foundation, 2003). Now that HMV use is increasing, as previously mentioned, basic nursing education is likely to play an important role in supporting persons requiring such care.

III. Outline of HMV-related learning

1. Summary of the target population [A2]

The study subjects were 116 third-year nursing university students taking a home-based nursing seminar.

2. Ethical considerations

The present study was conducted with the approval of the university ethical committee. The subjects were told that participation/non-participation in the study would not affect their grades and that the results of the study would be published at academic conferences. They were

also informed of the study objectives before providing oral and written consent. The subjects' anonymity was preserved, and the study data were dealt with in a manner so that the subjects could not be identified.

3. HMV in the curriculum for nursing education

In our university, home nursing education is provided through the following programs: 〈Introduction to Home Nursing〉 during the second year, 〈Home Nursing Exercise〉 and 〈Clinical Home Nursing〉 during the third year, and 〈Home Nursing Training〉 during the fourth year. Students learn about MV through 〈Clinical Home Nursing〉 and 〈Home Nursing Exercise〉; as the latter replaced 〈Theory of Home Nursing Support〉 that had previously been provided, one of our current major challenges is re-organizing programs related to home nursing theories. Setting clear goals, adopting comprehensive and long-term perspectives, is also essential to nurture professionals through nursing education (Tajima, 2009).

4. HMV in the National Nursing Examination

On analyzing the level of understanding of HMV needed by students based on the questions adopted in the National Nursing Examination, these questions were shown to cover the following domains in each category: major: nursing for persons requiring medical management at home; intermediate: MV (noninvasive ventilation therapy); and minor: HMV users, the principles and structure of ventilators, airway purification, complication prevention, and safety management and support in home care (Table 1). All of these questions examine students' basic understanding of support for persons requiring MV. We also noted that MV is regarded as an area to be addressed in the domains of basic nursing skills, support for community-based long-term care, and medical safety; therefore, we had to confirm whether the definition of HMV in the curriculum and related learning contents were appropriate for the characteristics of the relevant course and the contents of subjects covered by it. Furthermore, as a large number of students obtain nursing licenses after graduation, we also needed to comprehensively examine the criteria to select questions for the National Nursing Examination.

Table 1 HMV in the National Nursing Examination

Major	Medium	Minor	Domains
Nursing for persons requiring medical management at home	MV (noninvasive ventilation therapy)	HMV users	Basic nursing skills Support for community-based long-term care
		The principles and structure of ventilators	Basic nursing skills Support for community-based long-term care
		Airway purification	Support for community-based long-term care
		Complication prevention	Support for community-based long-term care
		Safety management and support in home care	Support for community-based long-term care Medical safety

IV. Actual situation of HMV-related learning

1. Development of HMV exercise

It was necessary for us to determine learning contents to be incorporated into 〈Home Nursing Exercise〉 in consideration of the characteristics of the relevant course to cover all related areas based on students, own responsibilities, while avoiding duplication. We selected the following contents: 1) developing nursing processes, 2) playing the role of the facilitator in multi-professional collaboration, 3) performing role-plays in home-visit scenes, and 4) practicing MV.

Among the 15 sessions of 〈Home Nursing Exercise〉 (2 credits), 2 were allocated to MV exercise. The purposes of the exercise were defined as follows: 〈to acquire basic knowledge of home oxygen therapy (HOT) and HMV; and to enhance the understanding of persons requiring medical management at home〉. The instructional and behavioral objectives are listed in Table 2. The exercise was performed by 116 students divided into 4 groups under the guidance of 3 faculty members. To smoothly rotate activities, they were combined with other activities to be performed in this course (Table 3). During a pre-exercise orientation, the purposes of the exercise, goals to be achieved, contents, and self-evaluation were explained to the students. At the beginning of the exercise, all of them watched a DVD showing actual MV mask-fitting procedures as an introduction.

HOT-related learning goals included: understanding the purposes of oxygen therapy and the types of related devices, experiencing the use of oxygen tubes, and learning how to handle the devices safely.

The faculty members and device providers supported the students to experience the placement of oxygen tubes and transfer using portable oxygen cylinders, while confirming the contents of their previous learning Sessions (Photograph 1).

NPPV-related learning goals included: forming a pair and fitting masks for various types of ventilators to develop an interest in the significance of support and reason for its necessity (Photograph 2).

Table 2 Exercise Plan

I. Purposes
To acquire basic knowledge of HOT and HMV; and to Promote the understanding of persons requiring medical management at home.
II. Goals to be achieved
[Home oxygen therapy : HOT]
1. Able to accurately explain the purposes and methods of HOT
2. Able to accurately explain the types of HOT device
3. Able to appropriately attach oxygen tubes
4. Able to safely handle HOT devices
[Home mechanical ventilation : HMV]
1. Able to accurately explain the purposes and methods of HMV
2. Able to accurately explain the structure of HMV devices
3. Able to appropriately attach masks
4. Able to safely handle HMV devices
5. Understanding methods of airway purification
III. Preparation for learning
1. Orientation
1) Grouping and clarifying points to be noted during exercise
2) Determining the contents of previous learning
3) Allocating rooms and time for exercise
2. Specifying the purposes, goals to be achieved, and points to be noted
3. Expanding previous learning
4. Others

Table 3 Development of HMV exercise

	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes
30 students	DVD	HOT · NPPV	GW in home-visit scenes	GW in home-visit scenes	GW in home-visit scenes	Conclusion
30 students		GW in home-visit scenes	HOT · NPPV	GW in home-visit scenes	GW in home-visit scenes	
30 students		GW in home-visit scenes		HOT · NPPV	GW in home-visit scenes	
26 students		GW in home-visit scenes		GW in home-visit scenes	HOT · NPPV	



Photograph 1 experience of attaching oxygen tubes



Photograph 2 experience of fitting ventilator masks

While confirming the students' learning progress, the faculty members made arrangements for them to visualize HMV users and relate the contents of their learning to their experiences during the exercise ; for example, to promote their understanding of such users, the faculty members asked them questions regarding the ventilatory mode, type of mask, and points to be noted when fitting masks, such as <How do you feel?>, <Do

Table 4 Contents of previous learning Sessions

Home oxygen therapy (HOT)
1) Applicability of HOT
2) Points of HOT management and related guidance
3) Impact and screening of oxygen insufficiency
4) Diseases requiring HOT
5) Possible complications of oxygen therapy
6) Handling of HOT devices
Home mechanical ventilation (MV/NPPV)
1) Applicability of HMV
2) Characteristics of noninvasive positive (NPPV) and tracheostomized positive (TPPV) pressure ventilations
3) Points of MV management and related guidance
4) Diseases requiring MV
5) MV-related problems
6) Ventilatory modes and pressure levels
7) Types of mask
8) Points to be noted when attaching masks
9) What questions would you like to ask medical device providers to ensure medical safety for persons requiring home care?

you have a sense of pressure?>, and <Are you comfortable?>.

After the exercise, a questionnaire survey on self-satisfaction was conducted involving the 116 students to examine their awareness, which may have been enhanced through these experiences. The questionnaire consisted of questions covering 5 domains: <interest>, <difficulty>, <preparedness>, <motivation>, and <satisfaction>. Each question was answered on a 5-point scale from <Strongly agree> to <Agree>, <Neutral>, <Disagree>, and <Strongly disagree>. Responses were obtained from 98 students (response rate : 84.5%). Their answers tended to be positive in all domains, revealing their high levels of self-satisfaction (Table 5), and such a tendency was the most marked for the statement <The exercise was interesting>, as 90 (91.9%) answered it with <Strongly agree> or <Agree>, while 1 (1 %) [A4] negatively answered it with <Disagree> or <Strongly disagree [A5]>. To <I have prepared for each exercise session, and revised my learning after it>, 81 (82.6%) positively responded.

Table 5 Students' Levels of Self-satisfaction

		n=98 (%)				
Statement Answer	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	
1 The exercise was interesting.	58 (59.2%)	32 (32.7%)	7 (7.1%)	1 (1.0%)	0 (0.0%)	
2 The exercise tasks were neither too difficult nor too easy.	48 (49.0%)	36 (36.7%)	13 (13.2%)	1 (1.0%)	0 (0.0%)	
3 I have prepared for each exercise session, and revised my learning after it.	56 (57.1%)	25 (25.5%)	12 (12.2%)	4 (4.1%)	1 (1.0%)	
4 Overall, I have been highly motivated to participate in this exercise.	58 (59.2%)	29 (29.6%)	10 (10.2%)	1 (1.0%)	0 (0.0%)	
5 I am generally satisfied with this program.	55 (56.1%)	30 (30.6%)	11 (11.2%)	2 (2.0%)	0 (0.0%)	

V. Discussion

1. Necessity of confirming and coordinating learning contents to plan exercise

As shown in Table 1, H MV is regarded as an area to be understood in the contexts of basic nursing skills, support for community-based long-term care, and medical safety in the National Nursing Examination. To enable students to confirm what they have learned through creative and original exercise before practicing it, arrangements for such exercise and nursing skill acquisition should be made through interdisciplinary management, liaison, and collaboration (Sugimori, 2014). Therefore, when planning exercise as part of this course, we previously confirmed learning contents in the major category: <nursing for persons requiring medical management at home> and medium category: <MV>. Although each domain is systematically managed based on specialties in the current National Nursing Examination system, we could coordinate the contents of exercise sessions relatively easily.

The type of curriculum adopted in our university is progressive; thus, students systematically learn on a step-by-step basis (Sugimori, 2014). To ensure stable learning outcomes, we needed to confirm the contents of their previous learning Sessions.

2. Necessity of devising methods for productive learning

For persons requiring long-term care with H MV and their families, decision-making regarding ventilator use is an important event, as it is a matter of life or death for the former, and has a marked impact on the lives of the latter as caregivers. In order to promote the understanding of these people through the experience of attaching oxygen tubes and fitting ventilator masks during exercise, it may be crucial for faculty members to select appropriate activities to be experienced by students and guide them toward productive learning from educational perspectives (Sugimori, 2014).

The point of such guidance is leading students to develop insight into persons requiring long-term care using ventilators and their families, rather than simply learning how to handle and manage these devices.

The guidelines on home-visit nursing for ALS patients requiring long-term care with MV, established by a study group for improvement of the QOL of patients with intractable diseases in FY 1999, emphasize the necessity of multiface-

tedly supporting these patients, covering decision-making, ventilatory arrangements, medical service use, QOL improvement, the availability of social resources, and emergency management.

In our case, it was necessary to devise methods to make students' learning more productive, with the goals we set to promote their understanding of ventilator users: <to acquire basic knowledge of H OT and H MV; and to enhance the understanding of persons requiring medical management at home> as a basis for this.

3. Necessity of previous arrangements and a sufficient number of faculty members

To achieve sufficient learning outcomes within limited time frames, previous arrangements and a sufficient number of faculty members are indispensable. Without the faculty members' guidance, the exercise plan outlined in Table 3 Would not be feasible. To appropriately proceed with exercise sessions, a total of 3 meetings were held among the faculty members. They needed to make arrangements for each other in order for students to smoothly transition from the lecture to exercise room, and provide guidance for them during exercise sessions. Ensuring a sufficient number of faculty members is key to supporting students' active learning during exercise. Among the 3 faculty members, 1 and 2 were allocated to the lecture and exercise rooms, respectively, to establish a sufficient teaching system. In short, the sharing of preparatory plans among faculty members and a sufficient number of them may be necessary to achieve continuous learning effects.

4. Necessity of scales to objectively measure the level of self-satisfaction

For the self-satisfaction survey after the exercise, the students tended to positively answer in all 5 domains: <interest>, <difficulty>, <preparedness>, <motivation>, and <satisfaction>, revealing their high levels of self-satisfaction. As these students aimed to become medical professionals, it may have been natural for them to show high levels of interest in medical devices, such as ventilators and oxygen cylinders. At this point, active and satisfactory learning for students is likely to meet their learning needs and be productive. As nursing skill acquisition is the core of technical learning, a number of related programs are incorporated into nurse training courses. However, in clinical environments, learning activities tend to be restricted to meet safety requirements, consequently limiting the types of nursing skills students can experience

during clinical training. Now that the importance of in-school exercise and nursing skill acquisition is increasing, students are also expected to securely achieve their goals.

The domains of the self-satisfaction questionnaire were limited to: <interest>, <difficulty>, <preparedness>, <motivation>, and <satisfaction>. Therefore, the results only revealed students' tendencies, but they demonstrated the outcomes of an exercise plan developed by faculty members, in addition to presenting a learning model for students. Scales to objectively measure students' levels of self-satisfaction may be needed in the future.

References

- Ishihara H, Sakatani M, Inoue Y, et al.: Current Status and Challenges of Home Respiratory Care — Report of the National Survey 2007 -Ministry of Health, Labour and Welfare (MHLW) Grants for Intractable Disease Research: A Study on Respiratory Failure, 2007 (in Japanese)
- Ishihara H: Home Mechanical Ventilation — Its Current Status and Community-based Medical Liaison Systems in Japan — A Textbook for the Home Mechanical Ventilation Seminar 2016, Japan Association for the Advancement of Medical Equipment 1-2, 2017 (in Japanese)
- Ministry of Health, Labour and Welfare, A Study Group on Respiratory Failure, White Paper on Home Respiratory Care, 3-5, 2010(in Japanese)
- Ministry of Health, Labour and Welfare (MHLW) Grants for the Promotion of Elderly Health, FY 2012: The research report on 24 hours home care support system to the medical treatment person long term of which medical dependence such as the respirator mounting are high. Japan Visiting Nursing Foundation, 2003 (in Japanese)
- Supervised by Kawamura S: Nursing Protocols for the Management of Medical Procedures in Home Care, Japanese Nursing Association Publishing Company, 2000 (in Japanese)
- Sugimori M, Funashima N: Nursing Education Version 5, Igaku-Shoin Ltd., 79, 2014 (in Japanese)
- Tajima K: Basics and Actual Situation of Evaluation in Nursing Education — Approaches to Nurture Practical Nursing Skills. Igaku-Shoin Ltd.: 162-64, 2009 (in Japanese)