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Predictors of early hospital readmission in patients receiving home mechanical ventilation

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ABSTRACT

Background: Although the proportion of patients with chronic respiratory failure requiring home mechanical ventilation (HMV) is increasing, hospital readmissions in these patients are also increasing.
Objective: We investigated the factors for early readmission in patients receiving HMV.
Methods: We retrospectively analyzed the data of adult patients readmitted to the hospital within a year who first received HMV and were discharged from the Asan Medical Center between March 2014 and February 2019. We compared the clinical characteristics at discharge before readmission between the early (readmission within 30 days) and late readmission groups (readmission between day 31 and 1 year) and investigated the clinical characteristics and outcomes at readmission.
Results: Of the 116 patients identified, 36.2% had been readmitted early. The patients who received invasive HMV had a higher rate of early readmission than those who received non-invasive HMV. Pneumonia was the most common reason of readmission in the two groups. The rate of aspiration was significantly higher in the early readmission group (28.6% vs. 8.1%; P = .003). In multivariate logistic regression analysis, nasogastric tube feeding, sequelae of pneumonia or acute respiratory distress syndrome, and central nervous system disorders as causes for HMV were significantly associated with early readmission.
Conclusion: Feeding methods and causes for HMV were associated with early readmission. Educating caregivers on respiratory care (suction and feeding methods) is important for preventing early readmission.

Introduction

Recent technical developments in respiratory therapy have resulted in an increase in home mechanical ventilation (HMV) use in patients with chronic respiratory failure discharged to their homes or long-term care hospitals.[1] HMV enables patients who require long-term mechanical ventilation to be discharged from the intensive care unit (ICU) and continue the treatment in their home environments; thus, HMV has led to positive outcomes such as an improved quality of life, reduction in hospital costs, lower risk of hospital infections, and an increased survival rate.[2]

However, it is noteworthy that unplanned readmissions among patients receiving HMV increase hospital costs and higher psychological burden on the whole health care team.[3-5] The average readmission time for long-term ventilator patients was 39.2 days, and pneumonia was the main cause of readmission.[6,7] The incidence of pneumonia in patients receiving HMV is 59.6%, which is higher than that reported in acute care hospitals.[8] According to the American Association for Respiratory Care practice guidelines, readmissions or deaths associated with HMV typically occur due to aggravation of the underlying disease, respiratory infections, side effects related to airways, and ventilation failure.[9] In a previous study on children, unplanned readmissions occurred within a short period of approximately 1–3 months after starting HMV in 40–70% of the discharged patients. In addition, the causes of these unplanned readmissions were principally pneumonia and airway-related problems, which are preventable.[10,11]

Unplanned hospital readmissions have been reported in various disease groups and have a significant cost burden.[12] A shortfall in medical care prior to discharge is commonly regarded as the cause of early readmission (i.e., within 30 days); therefore, many medical institutions are making efforts to reduce this incidence. Therefore, studies on the clinical characteristics, causes, and possible prevention strategies related to the unplanned early readmission in these patients are required. Hence, we analyzed the clinical characteristics and causes of readmission in adult patients starting HMV and evaluated possible mitigation approaches.

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Methods

Study design and patient population

We retrospectively evaluated data of patients (>18 years old) who first received HMV and were discharged from the Asan Medical Center between March 2014 and February 2019, and were readmitted to the hospital within a year. We included those cases who were inpatients or who were discharged or transferred after initial resuscitation in the emergency room. For patients who experienced more than one readmission, we included only the first readmission. We excluded patients transferred to other hospitals, had discontinued treatment, or had died. Also, we excluded the patients who were readmitted for a planned procedure or rehabilitation. Patients who were readmitted within 30 days were assigned to the early readmission group and those readmitted within a year from the 31st day were assigned to the late readmission group (Fig. 1).

This study was approved by the Ethics Committee of the Asan Medical Center (No. 2020-1036). The requirement for informed consent was waived because of the retrospective nature of the analysis.

Data collection

In the present study, HMV was defined as the daily use of non-invasive or invasive ventilation at home or in a long-term care facility. We excluded patients with only obstructive sleep apnea and used continuous positive airway pressure ventilation.

We used the Deyo–Charlson score to standardize the value of any underlying disease. This score was calculated by summing the scores of the differential effects of 17 different chronic diseases on mortality.[13] A Deyo–Charlson score of ≥3 was considered significant in terms of the readmission risk.[14] ICU management was defined as management involving the use of a conventional ventilator for more than 96 h through an artificial airway in the ICU. Problems with devices were defined as cases of readmission for replacement due to dysfunction of the devices maintained for treatment, such as tracheostomy tubes, feeding tubes, HMV devices, and other drainage tubes.

Patient data were collected from electronic medical records. We investigated the clinical characteristics of patients, cause for HMV application, and equipment (HMV) characteristics at the time of discharge. Factors related to early readmission were analyzed by comparing the clinical characteristics, cause for HMV application, and equipment (HMV) characteristics before discharge, between the early and late readmission groups. In addition, we investigated the clinical characteristics and outcomes of patients at the time of readmission.

At discharge, the following clinical characteristics were analyzed: age, sex, comorbidities (solid cancer, hematologic malignancy, chronic renal disease on hemodialysis, chronic liver disease), Deyo-Charlson score, intensive care treatments, functional status (bedridden), unresponsive mental status, feeding methods (oral, gastrostomy tube, and nasogastric tube), length of hospital stay, the type of HMV used (i.e., non-invasive ventilation [NIV] or invasive ventilation [IV]), and place of residence after discharge (i.e., home or long-term care hospital).

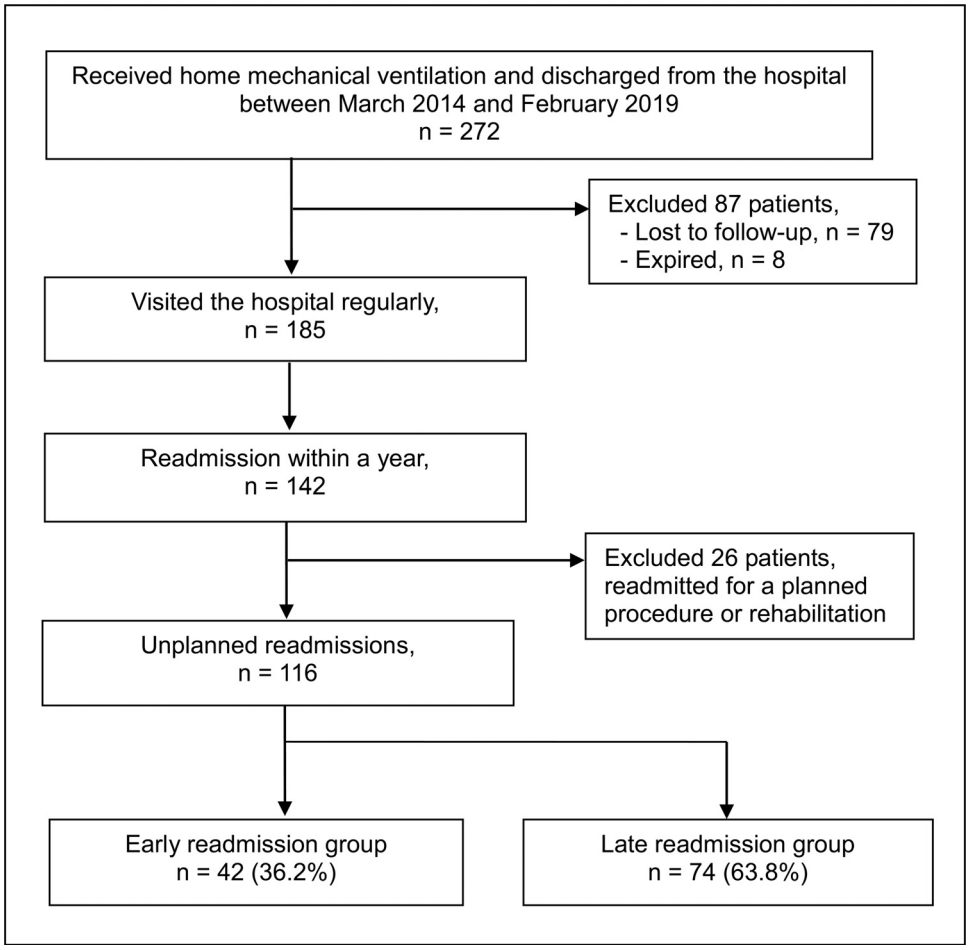

Fig. 1. Flowchart of patient selection.

We investigated the cause for HMV application (i.e., progression of chronic lung disease, neuromuscular disease, sequelae of pneumonia or acute respiratory distress syndrome, central nervous system disorder, congestive heart failure, and others).

To better understand the equipment (HMV) characteristics at the time of discharge, the inspiratory pressure, oxygen supply, support schedule (i.e., night time, night time and as-needed, all day, and as-needed), and length of mechanical ventilation were evaluated.

To determine the clinical characteristics and outcomes at the time of unplanned readmission, we investigated the period from discharge to readmission, the causes of readmission (i.e., an acute exacerbation of the initial cause for HMV, occurrence of the new problems, problems with devices), the route of readmission (ER), hospital unit for treatment (ER, ICU, or GW), and survival to discharge.

Statistical analysis

All the data were expressed as median and interquartile range or number of patients (n; %). Normally distributed variables were compared using the chi-square or Fisher's exact test, and the mean values of the two readmission groups were compared using the Student's *t*-test. Non-normally distributed, continuous variables were compared using the Mann–Whitney U test. To identify preventable factors of early readmission, independent variables that showed a significant difference in univariate analysis were included in multivariate logistic regression. Variables included in univariate analysis were clinical characteristics of patient and equipment (HMV) characteristics. Variables with a *P* value of ≤.10 in univariate analysis were included in the multivariable logistic regression analysis. The variables for the multivariate analysis were calculated using bootstrapping, a nonparametric method that takes 1000 samples of the data. Backward elimination was performed using the likelihood ratio method. Model adequacy was assessed using the Hosmer–Lemeshow goodness-of-fit test. Data are presented as odds ratios with 95% confidence intervals. A 2-sided *P* value of <.05 was considered significant.

Statistical analyses were conducted using SPSS version 21.0 for Windows (SPSS, Chicago, IL, USA).

Results

One hundred sixteen patients with unplanned readmission within a year from discharge were enrolled. Clinical characteristics at discharge before readmission were described in Table 1. Forty-two (36.2%) patients were assigned to the early readmission group and 74 (64.8%) to the late readmission group. The mean age was 68.5 years and 60.3% of the patients were male. Solid cancers as comorbidities were significantly higher in the early readmission group (19.0% vs. 5.4%; *P* = .020). Sixty-four (55.2%) patients had a Deyo–Charlson score of ≥3. The Deyo–Charlson scores (≥3 points) were not different between the early and late readmission groups (64.3% vs. 50.0%; *P* = .137). ICU management (66.7% vs. 37.8%; *P* = .003) and an unresponsive mental status (16.7% vs. 5.4%; *P* = .047) were significantly higher in the early readmission group. However, oral feeding (40.5% vs. 68.9%; *P* = .003) and home discharge (50.0% vs. 74.3%; *P* = .008) were significantly higher in the late readmission group. Regarding the type of HMV, IV was more common than NIV in the early readmission group (61.9% vs. 27.0%; *P* < .001).

A comparison of the reasons for HMV application in the early and late readmission groups is presented in Table 2. The progression of chronic lung disease was significantly higher in the late readmission group (31.0% vs. 51.4%; *P* = .033), whereas the sequelae of pneumonia or ARDS (26.2% vs. 8.1%; *P* = .008) and central nervous system disorders (21.4% vs. 5.4%; *P* = .009) were significantly higher in the early readmission group.

HMV equipment characteristics in the early and late readmission groups at the time of discharge are presented in Table 3. Regarding the HMV support time, all-day support was significantly more frequent in the early readmission group (47.6% vs. 21.6%; *P* = .004). The length of mechanical ventilation in the early readmission group was significantly longer than in the late readmission group (26.5 days vs. 14 days; *P* = .005).

The clinical characteristics and outcomes at the time of the unplanned readmission are presented in Table 4. For the 116 patients, the mean time from discharge to readmission was 53.5 [19–123] days; for the early readmission group, it was 11 [6.8–22.3] days and for the late readmission group, it was 92 [54–174.5] days (*P* < .001). The route of admission commenced at the emergency room in 90.5% of the patients. Hospital units where patients received treatment at

Table 1
Clinical characteristics of patients at the time of discharge.

Variables	Total (*n* = 116)	Late readmission group (*n* = 74)	Early readmission group (*n* = 42)	*P* value
Age, years	68.5(57–75)	65(56–74)	70(61–77.3)	.622
Sex, male	70(60.3)	46(62.2)	24(57.1)	0.595
Comorbidities				
Solid cancer	12(10.3)	4(5.4)	8(19.0)	0.020
Hematologic malignancy	11(9.5)	7(9.5)	4(9.5)	0.991
Chronic renal disease on HD	7(6.0)	4(5.4)	3(7.1)	0.703
Chronic liver disease	4(3.4)	2(2.7)	2(4.8)	0.620
Deyo–Charlson score (≥3)	64(55.2)	37(50.0)	27(64.3)	0.137
ICU management	56(48.3)	28(37.8)	28(66.7)	0.003
Bed ridden status	51(44.0)	29(39.2)	22(52.4)	0.169
Unresponsive mental status	11(9.5)	4(5.4)	7(16.7)	0.047
Feeding method				
Oral	68(58.6)	51(68.9)	17(40.5)	0.003
Gastrostomy tube	32(27.6)	18(24.3)	14(33.3)	0.297
Nasogastric tube	16(13.8)	5(6.8)	11(26.2)	0.004
Length of hospital stay, days	18.5(11–51.5)	15.5(10–35)	29(13.8–66)	0.008
Place of residence after discharge				0.008
Home	76(65.5)	55(74.3)	21(50.0)	
Long-term care hospital	40(34.5)	19(25.7)	21(50.0)	
Type of HMV				<0.001
Non-invasive ventilation	70(60.3)	54(73.0)	16(38.1)	
Invasive ventilation	46(39.7)	20(27.0)	26(61.9)	

Note: Data are presented as median and interquartile range or frequency (%). *P* value was between the early readmission group and late readmission group.
Abbreviations: HD, hemodialysis; ICU, intensive care unit; HMV, home mechanical ventilation.

Table 2
Cause for HMV application in the early and late readmission groups at the time of discharge.

Variables	Total (n = 116)	Late readmission group (n = 74)	Early readmission group (n = 42)	P value
Progression of chronic lung disease	51(44.0)	38(51.4)	13(31.0)	0.033
COPD	19(16.4)	14(18.9)	5(11.9)	
Tuberculosis destroyed lung	8(6.9)	7(9.5)	1(2.4)	
Bronchiectasis	7(6.0)	6(8.1)	1(2.4)	
Bronchiolitis obliterans	7(6.0)	5(6.8)	2(4.8)	
Interstitial lung disease	7(6.0)	5(6.8)	2(4.8)	
Advanced lung cancer	2(1.7)	1(1.4)	1(2.4)	
Asthma	1(0.9)	0(0.0)	1(2.4)	
Neuro muscular disease	21(18.1)	15(20.3)	6(14.3)	0.421
Amyotrophic lateral sclerosis	19(16.4)	13(17.6)	6(14.3)	
Neuromuscular junction disease	2(1.7)	2(2.7)	0(0.0)	
Sequelae of pneumonia or ARDS	17(14.7)	6(8.1)	11(26.2)	0.008
Central nervous system disorder	13(11.2)	4(5.4)	9(21.4)	0.009
Brain tumor	5(4.3)	2(2.7)	3(7.1)	
Stroke	4(3.4)	2(2.7)	2(4.8)	
Neurodegenerative disorder	3(2.6)	0(0.0)	3(7.1)	
Hypoxic brain injury	1(0.9)	0(0.0)	1(2.4)	
Congestive heart failure	8(6.9)	6(8.1)	2(4.8)	0.494
Others	6(5.2)	5(6.8)	1(2.4)	0.415
Restrictive thoracic cage disorder	5(4.3)	4(5.4)	1(2.4)	
Obesity hypoventilation syndrome	1(0.9)	1(1.4)	0(0.0)	

Note: Data are presented as frequency (%). P value was between the early readmission group and late readmission group.
Abbreviations: HMV, home mechanical ventilation; COPD, chronic obstructive pulmonary disease; ARDS, acute respiratory distress syndrome.

readmission were the general ward (62.1%), emergency room (21.5%), and ICU (16.4%). Pneumonia was the most common reason of readmission in the study population (36.2%). There was no significant difference in the occurrence of pneumonia between the early and late readmission groups (26.2% vs. 41.9%; P = .091). However, aspiration (28.6% vs. 8.1%; P = .003) and acute exacerbation of sequelae of pneumonia or ARDS (11.9% vs. 1.4%; P = .023) were significantly higher in the early readmission group. Survival to discharge was 81.0% in the early readmission group and 91.9% in the late readmission group; the difference was not statistically significant.

Using a multivariate logistic regression model, three variables were independently associated with unplanned early readmission: using a nasogastric tube, experiencing the sequelae of pneumonia or ARDS, and central nervous system disorders (Table 5).

The main study group (116 patients) was divided into an NIV group (70 patients) and IV group (46 patients) and analyzed by comparing clinical characteristics at the time of discharge and readmission. The results are presented in Supplemental Table 1. On comparing the NIV and IV groups, the rates of solid cancer (4.3% vs. 19.6%; P = .008), bed ridden status (18.6% vs. 82.6%; P < .001), length of hospital stay (12.5 days vs. 51 days; P < .001), and sequelae of pneumonia or ARDS (5.7% vs. 28.3%; P = .001) due to HMV application were significantly higher in the IV group. The rates of oral feeding (92.9 vs. 6.5%; P < .001) and progression of chronic lung disease due to HMV application (67.1% vs. 8.7%; P < .001) were significantly higher in the NIV group. The mean time from discharge to readmission was 59 [34.3–152] days in the NIV group and 23 [8.8–78.5] days in the IV group (P = .002). The rate of readmission due to pneumonia was significantly higher in the NIV group (52.9% vs. 10.9%; P < .001).

Next, the IV group (46 patients) were divided into an early readmission group (26 patients) and a late readmission group (20 patients), and their clinical characteristics and outcomes at discharge and readmission were compared. The results are presented in Supplemental Table 2. On comparing early and late readmission groups, the rate of readmission due to acute exacerbation of the sequelae of pneumonia or ARDS was significantly higher in the early readmission group (19.2% vs. 0%; P = .038), whereas problems with devices (feeding tube) were significantly higher in the late readmission group (0% vs. 45%; P < .001). The rate of aspiration was higher in the early readmission group but not significantly (38.5% vs. 20%; P = .177). Survival to discharge after readmission was significantly lower in the early readmission group (80.8% vs. 100%; P = .038).

Discussion

Fragile patients starting HMV at discharge are at risk of unplanned readmission because of several factors such as chronic respiratory failure, issues with the application of complex medical devices, and insufficient support for home care. In this present study, we evaluated clinical characteristics and risk factors of readmission. The

Table 3
HMV equipment characteristics in the early and late readmission groups at the time of discharge.

Variables	Total (n = 116)	Late readmission group (n = 74)	Early readmission group (n = 42)	P value
Inspiratory pressure, cm H_2O	14(12–16)	16(14–18)	15(12–18)	0.297
Need for oxygen	84(72.4)	54(73.0)	30(71.4)	0.858
Support schedule				
Night-time	42(36.2)	30(40.5)	12(28.6)	0.157
Night-time and as-needed	36(31.0)	27(36.5)	9(21.4)	0.092
All day	36(31.0)	16(21.6)	20(47.6)	0.004
As-needed	2(1.7)	1(1.4)	1(2.4)	1.000
Length of MV, days	17.5(10.3–40)	14(9–29)	26.5(13–50)	0.005
Length of MV (>30 days)	35(30.2)	17(23.0)	18(42.9)	0.025

Note: Data are presented as median and interquartile range or frequency (%). P value was between the early readmission group and late readmission group.
Abbreviations: HMV, home mechanical ventilation; MV, mechanical ventilation.

Table 4
Clinical characteristics and outcomes at the time of readmission.

Variables	Total (n = 116)	Late readmission group (n = 74)	Early readmission group (n = 42)	P value
Time from discharge to readmission, days	53.5(19–123)	92(54–174.5)	11(6.8–22.3)	< 0.001
Cause of readmission				
AE of the initial cause for HMV	26(22.5)	17(23.0)	9(21.4)	
Chronic lung disease	11(9.5)	8(10.8)	3(7.1)	0.517
Neuromuscular disease	3(2.6)	2(2.7)	1(2.4)	.000
Sequelae of pneumonia or ARDS	6(5.2)	1(1.4)	5(11.9)	0.023
Central nervous system disorders	1(0.9)	1(1.4)	0(0.0)	1.000
Congestive heart failure	2(1.7)	2(2.7)	0(0)	0.534
Others	3(2.6)	3(4.0)	0(0.0)	0.552
Occurrence of the new problem	71(61.2)	45(60.8)	26(61.9)	
Pneumonia	42(36.2)	31(41.9)	11(26.2)	0.091
Aspiration	18(15.5)	6(8.1)	12(28.6)	0.003
Others	11(9.5)	8(10.8)	3(7.1)	0.517
Devices problem	19(16.3)	12(16.2)	7(16.7)	
Tracheostomy tube	4(3.4)	1(1.4)	3(7.1)	0.134
Feeding tube	10(8.6)	10(13.5)	0(0.0)	.013
HMV devices	3(2.6)	1(1.4)	2(4.8)	0.297
Drainage tube	2(1.7)	0(0.0)	2(4.8)	0.129
Route of admission, ER	105(90.5)	67(90.5)	38(90.5)	1.000
Hospital unit for treatment				0.470
GW	72(62.1)	49(66.2)	23(54.8)	
ER	25(21.5)	14(18.9)	11(26.2)	
ICU	19(16.4)	11(14.9)	8(19.0)	
Survival to discharge	102(87.9)	68(91.9)	34(81.0)	0.082

Note: Data are presented as median and interquartile range or frequency (%). P value was between the early readmission group and late readmission group.
Abbreviations: AE, acute exacerbation; HMV, home mechanical ventilation; ARDS, acute respiratory distress syndrome; ER, emergency room; GW, general ward; ICU, intensive care unit.

patients who received invasive HMV had a higher rate of early readmission than those who received non-invasive HMV. When performing subgroup analysis of patients who received invasive HMV, acute exacerbations of sequelae of pneumonia or ARDS was associated with early readmission. Pneumonia was the most common reason of readmission in a year. The rate of aspiration was significantly higher in the early readmission group. In this multivariate analysis, nasogastric tube feeding and sequelae of pneumonia or ARDS and CNS disorder as a cause for HMV were independently associated with early readmission after the commencement of HMV.

According to Aston et al., the 1-month readmission rate of patients with chronic disease was approximately 5–10%.[12] Another study reported that 21.1% of the patients who were on the ventilator in the ICU for more than 96 hours were readmitted within 30 days after discharge.[6] In addition, a study found that 40.6% of the patients who had been admitted to the ICU for more than 1 week were readmitted within a year and 22.9% were readmitted within 30 days.[15] Compared to previous studies, in this present study, 64.8% of the patients were readmitted within a year, with 36.2% of them being readmitted within 30 days, showing a high unplanned readmission rate. This difference may be due to the inclusion of only HMV-applied patients in this study. In this present study, 66.7% of the early readmission group patients had received ICU management, and 41.4% needed tube feeding (i.e., gastrostomy tube or nasogastric tube). In addition, sequelae of pneumonia or ARDS and CNS disorders as causes for HMV application, mechanical ventilation via tracheostomy tube, and prolonged mechanical ventilation were high in the early readmission group.

Ventilator associated pneumonia (VAP) is caused by contamination in the airways due to long-term application of a ventilator, invasion of microorganisms through a tracheostomy tube, and insufficient adherence to aseptic technique during endotracheal suction.[16] The incidence rate of VAP is 8–28% in patients on ventilators and 59.6% in patients on invasive HMV.[16,17] The incidence of pneumonia in patients on HMV is higher than that in acute care hospitals. In this present study, pneumonia was also the most frequent reason of readmission in both groups. This suggests that long-term use of a ventilator might increase the risk of pneumonia regardless of the

Table 5
Prognostic factors for early readmission identified by univariate and multivariate logistic regression analyses.

Variables	Univariate logistic regression analysis		Multivariate logistic regression analysis	
	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
Comorbidities, solid cancer	2.59(0.26–12.05)	0.03		
ICU management	1.88(0.58–6.14)	<0.01		
Unresponsive mental state	1.38(0.21–9.21)	0.06		
Feeding method, nasogastric tube	2.62(0.59–11.54)	<0.01	3.74(1.11–12.62)	0.03
Discharge to long-term care hospital	1.10(0.36–3.34)	<0.01		
Cause for HMV application				
CLD	1.85(0.56–6.14)	0.04		
Sequelae of pneumonia or ARDS	5.22(1.23–22.23)	0.01	4.81(1.55–14.96)	<0.01
CNS disorder	3.99(0.59–26.92)	0.01	5.48(1.48–20.36)	0.01
Type of HMV, invasive ventilation	2.04(0.30–13.93)	<0.01		
Support schedule, all day	0.83(0.14–5.05)	<0.01		
Length of MV (>30 days)	0.58(0.17–1.99)	0.03		

Abbreviations: CI, confidence interval; ICU, intensive care unit; HMV, home mechanical ventilation; CLD, chronic lung disease; ARDS, acute respiratory distress syndrome; CNS, central nervous system; MV, mechanical ventilation.

underlying disease. The aspiration rate was higher in the early readmission group. Aspiration was associated with a higher rate of readmission and recurrent pneumonia.[18] Aspiration is one of the problems due to improper care by a nursing provider. Ahn et al.[7] indicated that inadequate feeding methods such as tube feeding in the supine position can contribute to a higher aspiration rate. Nasogastric tube feeding is another known cause of aspiration pneumonia,[19] which is due to bacterial colonization in the upper gastrointestinal tract and aspiration of gastric contents.[20,21] In this present study, compared to the use of oral and gastrostomy feeding tubes, the nasogastric feeding tube was significantly more common in the early readmission group, suggesting that nasogastric tube feeding may increase the incidence of aspiration. Therefore, proper education for suctioning, including preventing contamination of the suction catheter and increasing the frequency of oral suction to prevent aspiration into the lungs, should be provided to caregivers prior to discharge. In addition, education on feeding methods such as the appropriate head elevation and proper feeding speed control is advisable.[22]

The sequelae of pneumonia or ARDS and central nervous system disorders as cause for HMV application, and nasogastric tube feeding were the factors influencing early readmission. In addition, subgroup analysis of patients on invasive HMV showed that the patients who were received HMV due to the sequelae of pneumonia or ARDS were readmitted early because their symptoms worsened again after discharge. Considering the characteristics of this disease, most of these patients require a conventional ventilator in the ICU and change to a home ventilator because of difficult weaning. The recent development of respiratory therapy has encouraged patients who are critically ill to survive and be discharged from the ICU. However, these patients may subsequently develop post-intensive care syndromes such as critical illness polyneuromyopathy, cachexia, weakness, organ dysfunction, and cognitive impairment and these problems lead to prolonged HMV. Therefore, a multidisciplinary approach such as rehabilitation and disease status monitoring is required to improve patient outcomes.[23]

In hypercapnic respiratory failure, lowering the level of partial pressure of carbon dioxide is the key goal of HMV when it is first employed; hence, most patients apply non-invasive mechanical ventilation during sleep. It has been reported that the use of non-invasive ventilation at night reduces the rate of readmission by lowering the risk of acute exacerbation of chronic lung disease and improves the quality of life of patients.[6,24] A previous study reported that 20.4% of patients with chronic obstructive pulmonary disease had to be readmitted within 30 days.[25] In this present study, the rate of applying a home ventilator for chronic lung disease was 44%. However, among them, 10.8% were readmitted within a year and 7.1% were readmitted within 30 days because of acute exacerbation. These results suggest that HMV helps reduce the frequency of acute exacerbations in patients with chronic lung disease.

Srinivasan et al.[5] reported that 39% of the patients who were visited at home by the vendor for ventilator dysfunction had operational problems; however, most issues were resolved at home without any side effects. Only two patients required hospitalization because of care-related patient factors not due to a defect in the equipment. In this present study, 16.3% of the patients were readmitted within a year due to problems with the devices, and only 2.6% of them had ventilator problems. This means that it is more likely to be a functional problem of an artificial airway or feeding tube or drainage tube for disease treatment than a mechanical problem. Problem with home mechanical ventilator equipment may not be a major issue for readmission.

This study has some limitations. The current investigation was a single institutional study, limiting the general applicability of the data. In addition, we may have underestimated the readmission rates because 32% of patients did not revisit this hospital and we could not evaluate whether they did unplanned readmission at another institution. We did not evaluate the quality of home care or long-term care hospitals in-depth. Care liaison services must be in place to evaluate the reasons of readmission. Given the medical state of patients undergoing HMV, home care services such as home medical services, home nursing services, and telemedicine are required.

Conclusions

The sequelae of pneumonia or ARDS and CNS disorder as a cause for HMV and nasogastric tube feeding method were independently associated with early readmission. Respiratory events, such as aspiration, were associated with early readmission. Providing education focusing on respiratory care (suctioning and feeding methods) to caregivers is important for preventing early readmission.

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Conflict of interest

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

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.hrtlng.2022.10.004.

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