Factors Associated With Re-Intubation Within 14 Days After Ventilator Liberation

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BACKGROUND: According to Taiwan's integrated delivery system policy, ventilator-dependent patients are successfully liberated from mechanical ventilation in accordance with step-down care. However, premature discharge affects the 14-d readmission quality index. Therefore, we explored the risk and related factors of subjects liberated from mechanical ventilation who were re-intubated within 14 d. METHODS: This retrospective study analyzed a cohort of ventilator-dependent subjects 17 y of age and older using a population-based database from the Taiwan National Health Research Institutes Database from 2006 to 2010. Chi-square test and logistic regression analyses were used to explore whether subjects liberated from mechanical ventilation were re-intubated within 14 d and to investigate the related factors. RESULTS: A total of 15,840 ventilator-dependent subjects were liberated from mechanical ventilation, and 449 subjects were re-intubated within 14 d; the total re-intubation rate was 2.83%. The factors related to a higher risk of re-intubation were also the reasons for ventilator use, including complications, hospital accreditation level, and the ventilator weaning care stage. A higher risk of re-intubation was identified in subjects with COPD (odds ratio [OR] 1.32, 95% CI 1.02–1.7, *P* = .035) or pneumonia (OR 1.4, 95% CI 1.07–1.86, *P* = .02) and in subjects who stayed at a district hospital (OR 3.53, 95% CI 2.48–5.01, *P* < .001). Liberation from mechanical ventilation in the respiratory care ward and home respiratory care were associated with the highest risk of re-intubation, which was 2.32 times that of ICU subjects (*P* < .001). CONCLUSIONS: Factors associated with re-intubation within 14 d after ventilator liberation are related to the level and quality of the care setting; thus, to prevent re-intubation, more attention should be paid to higher-risk ventilator-dependent subjects after they are liberated from mechanical ventilation. *Key words: ventilator-dependent subject; re-intubation; integrated delivery system.* [Respir Care 2017;62(12):1557–1564.

Introduction

Mechanical ventilation is required by 33–40% of patients admitted to ICUs.[1,2] In the United States, patients receiving mechanical ventilation for ≥ 21 d have been estimated to incur health-care costs of $423,596/person an-

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nually.[3] Zilberberg et al[4] have projected that the number of patients in the United States requiring ≥ 4 d of mechanical ventilation will reach 605,898 in 2020, more than double the number in 2005. Ventilator-dependent patients' long-term occupation of high-cost ICU beds imposes a heavy financial burden on the health-care system and can crowd out other patients in need of acute care. Transferring ventilator-dependent patients out of ICUs into long-term care facilities has been shown to be a more cost-effective approach.[5-7]

The majority of ventilator-dependent patients are male[8] and elderly,[9,10] and whether a patient will be successfully liberated from mechanical ventilation has been associated with numerous factors, such as the patient's sex,[11] age,[12] and health status;[12] the type or level of the treating health-care organization[13]; and the reason for ventilator use.[11] Patients with neuromuscular/chest wall conditions[11] or more comorbid conditions, as well as older patients,[12] were shown to have more difficulty weaning off ventilator use, whereas patients who were female, had COPD,[11] or were being treated at a medical center[13] were associated with successful liberation from mechanical ventilation. A study in the United States reported that the rate of successful liberation from mechanical ventilation was 50.3%.[14]

In Taiwan, as of April 2014, there were 12,521 patients with respiratory failure who required long-term mechanical ventilation,[15] and that number is increasing annually. Respiratory failure accounted for 10.2% of Taiwan's total national health-care expenditure in 2013.[16] Increasing the ventilator liberation rate of ventilator-dependent patients and decreasing the re-intubation rate are important indicators of health-care quality for acute/ICU care. In 2000, Taiwan launched an integrated delivery system with a prospective payment demonstration program for ventilator-dependent patients. This program established a 4-stage respiratory care system for these patients based on the number of days receiving mechanical ventilation and their clinical stability. Mechanically ventilated patients with acute, unstable medical conditions are treated in an ICU for 1–21 d and then transferred from the ICU to a respiratory care center. After 63 d of ventilator use, 42 d of respiratory care center treatment, or a thoracic specialist's assessment that ventilator liberation is not achievable in the short term, patients are transferred to a respiratory care ward. After their conditions are stabilized, patients are transitioned to home respiratory care. This integrated delivery care system is intended to reduce ventilator-dependent patients' stay in ICUs, reduce health-care costs, and improve the quality of care.

Previous research has assessed some of the effects of Taiwan's integrated delivery care program. Among the findings, the average length of ICU stay has decreased from 34.4 to 30.5 d; ventilator liberation rates in respiratory care centers and respiratory care wards have steadily increased in successive years[17]; the mortality rate of ventilator-dependent patients in respiratory care centers has decreased; and total in-patient expenditures were significantly reduced.[18] In this study, we examined the relative risk and associated factors of re-intubation within 14 d after successful liberation from mechanical ventilation.

QUICK LOOK

Current knowledge

According to integrated delivery system policy, ventilator-dependent patients achieve successful liberation from mechanical ventilation in accordance with step-down care, but premature discharge affects the 14-d readmission quality index. The factors leading to re-intubation of ventilator-dependent patients following successful liberation from mechanical ventilation in accordance with step-down care have not been well described.

What this paper contributes to our knowledge

The factors related to risk of re-intubation in ventilator-dependent subjects who were liberated from mechanical ventilator within 14 d were the reason for ventilator use, complications, hospital accreditation level, and the location of care. These factors might be used to determine the optimal time for liberation from mechanical ventilation and to prevent re-intubation through early intervention.

Methods

Data Source and Study Subjects

Secondary data (from January 1, 2006 to December 31, 2010) from the National Health Insurance Research Database, which is maintained by Taiwan's National Health Research Institutes, were used for a retrospective analysis of ventilator-dependent subjects 17 y of age and older, who were successfully liberated from mechanical ventilation and then re-intubated within 14 d (N = 15,840).

Ventilator-dependent subjects were defined as having received mechanical ventilation support for ≥ 21 consecutive days and had not been discontinued long enough to meet the criteria for successful weaning. (According to the regulations of Taiwan's National Health Insurance Administration for claims payment, successful ventilator weaning is defined as discontinuation of mechanical ventilation for ≥ 5 d, during which the patient is ventilator-independent.) Ventilator-dependent subjects included those using invasive and noninvasive ventilation.

Description of Variables

The dependent variables analyzed were whether re-intubation was performed within 14 d after successful ventilator weaning. The independent variables analyzed included the subjects' personal characteristics (sex, age, and monthly salary), reasons for ventilator use, health status (Charlson comorbidity index and ventilator complications), characteristics of the health-care organization (level and ownership), and ventilator weaning care stage (ICU, respiratory care center, respiratory care ward, or home respiratory care).

The following additional information on the variables was obtained. (1) The reasons for ventilator use, as defined by the primary and secondary diagnosis codes, according to the International Classification of Diseases, Ninth Revision, Clinical Modification, at the initial use of mechanical ventilation, included pneumonia, septicemia, stroke, COPD, heart failure, trauma, coronary artery disease, lung cancer, and other diseases (eg, polio syndrome, spinal cord injury, muscular dystrophy, spinal lateral sclerosis, and multiple sclerosis). (2) The Charlson comorbidity index was used as a measure of comorbidity.[19] The Charlson comorbidity index scores were categorized as ≤3, 4–6, 7–9, or ≥10, with a high score indicating high comorbidity severity. (3) Complications included pneumonia, pneumothorax, pulmonary edema, and other diseases (eg, laryngeal edema, subcutaneous emphysema, oxygen toxicity, and pulmonary embolism) that were recorded as the primary or secondary diagnosis for 2 out-patient visits or one hospitalization. (4) The characteristics of the health-care organization were the level and ownership of the health-care organization where a subject's successful liberation from mechanical ventilation was observed, or where a subject who was not successfully liberated from mechanical ventilation last stayed as of the end of the observation period. (5) The ventilator weaning care stage was the level of care (eg, ICU, respiratory care center, respiratory care ward, or home respiratory care) at which a subject's successful weaning was observed, or at which a subject who was not successfully liberated from mechanical ventilation was last placed as of the end of the observation period. (6) Successful weaning was defined as the discontinuation of mechanical ventilation for ≥5 d. (7) Re-intubation within 14 d after successful weaning was defined as reinstitution of mechanical ventilation within 14 d of successful weaning. (8) A low-income household designation was made if the subject belonged to a household in which the average per-person monthly income was < 60% of the median per-person disposable income in the household's local area in the previous year.[20] This study was approved by the institutional review board of Yuan's General Hospital in southern Taiwan (approval 20130603C).

Statistical Analysis

This study applied the SAS 9.3 software suite (SAS Institute, Cary, North Carolina) for database processing and statistical analysis, used frequency distributions and percentages for describing various variable distributions, and employed the means and SD values to present the distributions of continuous variables.

First, the chi-square test was used to assess the association of re-intubation within 14 d of weaning with each independent variable. Next, logistic regression analysis was then performed to examine the risk and associated factors of re-intubation within 14 d of weaning in successfully weaned subjects. In this study, a $P < .05$ was considered to be statistically significant.

Results

Subject Demographics

There were 15,840 ventilator-dependent subjects who were 17 y of age or older and had successful liberation from a mechanical ventilator from the National Health Research Institutes from January 1, 2006 to December 31, 2010, and whose records were obtained from National Health Research Institutes secondary database. These subjects were predominantly men (58.5% males and 41.5% females) and primarily in the 65–84-y-old age group (56.9%). The $566–747 monthly salary group (40.3%) represented the largest percentage of these subjects, followed by the $747–943 monthly salary group (34.1%). A total of 449 subjects were re-intubated within 14 d after being liberated from mechanical ventilation (2.8%). This group had more men than women (60.4% vs 39.6%), and most of the subjects were in the 65–84-y-old age group (60.6%). The $747–943 monthly salary group represented the largest percentage of these subjects (41%), followed by the $566–747 monthly salary group (34.3%) (Table 1).

Health-Care Organization Characteristics

Based on the number and proportions of re-intubated subjects, the health-care organization level was ranked as follows: district hospital (39.2%, 176 subjects), regional hospital (35.6%, 160 subjects), and medical center (25.2%, 113 subjects). Regarding hospital ownership, more of the subjects who were re-intubated within 14 d after being liberated from mechanical ventilation were treated at non-public hospitals than at public hospitals (79.7% vs 20.3%). The most common clinical locations were ranked in the following order: respiratory care wards (47%, 211 subjects), respiratory care centers (41.9%, 188 subjects), and ICUs (11.1%, 50 subjects) (see Table 1).

Table 1. Demographic Characteristics and Clinical Location of Subjects

Variables	Total (N = 15,840) n (%)	Re-Intubation Within 14 d (n = 449) n (%)
Sex		
Female	6,567 (41.5)	178 (39.6)
Male	9,273 (58.5)	271 (60.4)
Age		
≤24	224 (1.4)	4 (0.9)
25–44	968 (6.1)	14 (3.1)
45–64	3,400 (21.5)	71 (15.8)
65–84	9,016 (56.9)	272 (60.6)
≥85	2,232 (14.1)	88 (19.6)
Monthly salary (USD)		
LIH	509 (3.2)	16 (3.6)
≤566	616 (3.9)	15 (3.3)
566–747	6,381 (40.3)	154 (34.3)
747–943	5,401 (34.1)	184 (41)
943–1,189	880 (5.6)	14 (3.1)
1,189–1,500	888 (5.6)	22 (4.9)
1,500–1,893	445 (2.8)	20 (4.5)
≥1,893	720 (4.5)	24 (5.3)
Level of health-care organization		
Medical center	7,165 (45.2)	113 (25.2)
Regional hospital	6,978 (44.1)	160 (35.6)
District hospital	1,697 (10.7)	176 (39.2)
Ownership of organization		
Public hospital	3,714 (23.4)	91 (20.3)
Non-public hospital	12,126 (76.6)	358 (79.7)
Location of care		
ICU	3,639 (23)	50 (11.1)
RCC	9,453 (59.7)	188 (41.9)
RCW and HRC	2,748 (17.3)	211 (47)

Subjects include those weaned from mechanical ventilation and re-intubated within 14 d.
LIH = low-income household
RCC = respiratory care center
RCW = respiratory care ward
HRC = home respiratory care

Relevant Factors Influencing Re-Intubation

This study used the chi-square test to determine whether the variables of subject demographics, health status, hospital characteristics, and type of care facility demonstrated statistically significant correlations ($P < .05$) with the re-intubation of subjects within 14 d after liberation from mechanical ventilation (Table 2).

Regarding the sex variable, the rate of re-intubation for male subjects was slightly higher than that for female subjects (2.9% vs 2.7%). For the age variable, the rate of re-intubation was highest for the 85-y and older group (3.9%), followed by that for the 65–84-y-old age group (3%). The high-age groups showed increasing numbers of re-intubated subjects; thus, the rate of re-intubation was positively correlated with age. Regarding the monthly salary variable, the re-intubation rate was highest for the NT$ 45,801–57,800 group (4.5%), followed by the NT$ 22,801–28,800 group (3.4%).

Subjects who had been placed on a ventilator due to COPD exhibited significantly higher re-intubation rates within 14 days after liberation from mechanical ventilation compared with other subjects ($P < .001$). In terms of the severity of the subjects' comorbidities (measured using the Charlson comorbidity index), the re-intubation rate was the highest for the Charlson comorbidity index ≤ 3 group (2.9%), followed by the Charlson comorbidity index 4–6 group (2.6%). Subjects who had ventilator complications due to pneumonia exhibited significantly higher rates of re-intubation within 14 d after liberation from mechanical ventilation than did the other subjects ($P < .001$).

Regarding levels of health-care organization, district hospitals (10.4%) had the highest re-intubation rates, followed by the regional hospitals (2.3%). Concerning ownership, the re-intubation rate at non-public hospitals was higher than that at public hospitals (3% vs 2.5%). Finally, regarding the location of care, the re-intubation rate was highest for the respiratory care wards (7.7%), followed by the respiratory care centers (2%) (see Table 2).

Analysis of the Risks of Re-Intubation

This study used logistic regression analysis to investigate the risks of re-intubation within 14 d after liberation from mechanical ventilation. Regarding age, we used the 24-y and younger age group as a reference and determined that the risk of re-intubation was highest in the 85-y and older group (odds ratio [OR] = 1.5, 95% CI 0.54–4.33, $P = .43$), followed by the 65–84-y-old group (OR = 1.3, 95% CI 0.45–3.52, $P = .66$). Furthermore, male subjects exhibited a risk of re-intubation 1.1 times that of female subjects. Concerning the severity of comorbidity, the risk of re-intubation was the highest for the group with a Charlson comorbidity index score of 4–6, which was 1.1 times that of the group with a Charlson comorbidity index score of ≦3. Regarding monthly salaries, this study used the low-income household group as a reference and found that the risk of re-intubation was the highest in the $1,500–1,893 monthly salary group (OR = 1.8, 95% CI 0.89–3.55, $P > .99$), followed by the ≥ $1,893 monthly salary group (OR = 1.3, 95% CI 0.66–2.49, $P = .47$).

The subjects who use ventilator without any reason as the reference group; the primary cause of mechanical ventilation was COPD that was the only identified risk factor for re-intubation (OR 1.32, 95% CI 1.02–1.7, $P = .035$). Regarding the health-care organization levels, the risk of re-intubation was the highest at district hospitals (ie, 3.5 times greater than the medical centers), followed by re-

Table 2. Key Factors Determining Whether Were Re-Intubated Within 14 Days After Weaning From Mechanical Ventilation

Variables	Total (N = 15,840)	Re-Intubation Within 14 d		P	Adjusted OR	95% CI	P
		No (n = 15,391)	Yes (n = 449)				
	n (%)	n (%)	n (%)				
Sex				.46			
Female	6,567 (41.5)	6,389 (97.3)	178 (2.7)		1		
Male	9,273 (58.5)	9,002 (97.1)	271 (2.9)		1.1	0.89–1.34	.40
Age, y				<.001			
≤24	224 (1.4)	220 (98.2)	4 (1.8)		1		
25–44	968 (6.1)	954 (98.6)	14 (1.4)		0.8	0.26–2.58	.74
45–64	3,400 (21.5)	3,329 (97.9)	71 (2.1)		1	0.35–2.82	.99
65–84	9,016 (56.9)	8,744 (97)	272 (3)		1.3	0.45–3.52	.66
≥85	2,232 (14.1)	2,144 (96.1)	88 (3.9)		1.5	0.54–4.33	.43
Monthly salary, USD				.003			
LIH	509 (3.2)	493 (96.9)	16 (3.1)		1		
≤566	616 (3.9)	601 (97.6)	15 (2.4)		1.0	0.49–2.12	.96
566–747	6,381 (40.3)	6,227 (97.6)	154 (2.4)		0.9	0.52–1.54	.69
747–943	5,401 (34.1)	5,217 (96.6)	184 (3.4)		1.2	0.72–2.11	.44
943–1,189	880 (5.6)	866 (98.4)	14 (1.6)		0.6	0.29–1.29	.19
1,189–1,500	888 (5.6)	866 (97.5)	22 (2.5)		1.0	0.52–1.99	.97
1,500–1,893	445 (2.8)	425 (95.5)	20 (4.5)		1.8	0.89–3.55	.10
≥1,893	720 (4.5)	696 (96.7)	24 (3.3)		1.3	0.66–2.49	.47
Reasons for ventilator use							
Pneumonia				.035			
No	8,482 (53.5)	8,264 (97.4)	218 (2.6)		1		
Yes	7,358 (46.5)	7,127 (96.9)	231 (3.1)		0.9	0.71–1.13	.34
Septicemia				.59			
No	11,983 (75.7)	11,638 (97.1)	345 (2.9)		1		
Yes	3,857 (24.3)	3,753 (97.3)	104 (2.7)		1.0	0.76–1.22	.77
Stroke				.52			
No	12,849 (81.1)	12,479 (97.1)	370 (2.9)		1		
Yes	2,991 (18.9)	2,912 (97.4)	79 (2.6)		1.1	0.86–1.47	.40
COPD				<.001			
No	13,968 (88.2)	13,611 (97.4)	357 (2.6)		1		
Yes	1,872 (11.8)	1,780 (95.1)	92 (4.9)		1.3	1.02–1.7	.035
Heart failure				.004			
No	14,246 (89.9)	13,861 (97.3)	385 (2.7)		1		
Yes	1,594 (10.1)	1,530 (96.0)	64 (4.0)		1.3	0.98–1.75	.07
Accident				.038			
No	14,273 (90.1)	13,855 (97.1)	418 (2.9)		1		
Yes	1,567 (9.9)	1,536 (98)	31 (2)		0.8	0.55–1.18	.26
Coronary artery disease				.08			
No	15,017 (94.8)	14,600 (97.2)	417 (2.8)		1		
Yes	823 (5.2)	791 (96.1)	32 (3.9)		1.4	0.94–2.03	.10
Lung cancer				.43			
No	15,571 (98.3)	15,127 (97.1)	444 (2.9)		1		
Yes	269 (1.7)	264 (98.1)	5 (1.9)		0.7	0.28–1.8	.47
Others				.07			
No	14,994 (94.7)	14,578 (97.2)	416 (2.8)		1		
Yes	846 (5.3)	813 (96.1)	33 (3.9)		1.3	0.88–1.88	.20
Charlson comorbidity index score				.52			
≤3	14,142 (89.3)	13,734 (97.1)	408 (2.9)		1		
4–6	1,181 (7.5)	1,150 (97.4)	31 (2.6)		1.1	0.72–1.59	.75
7–9	104 (0.7)	103 (99)	1 (1)		0.5	0.06–3.45	.46
≥10	413 (2.5)	404 (97.8)	9 (2.2)		1.1	0.51–2.18	.88

Table 2. Continued

Variables	Total (*N* = 15,840)	Re-Intubation Within 14 d: No (*n* = 15,391)	Re-Intubation Within 14 d: Yes (*n* = 449)	*P*	Adjusted OR	95% CI	*P*
	n (%)	*n* (%)	*n* (%)				
Ventilator complications							
Pneumonia				<.001			
No	5,198 (32.8)	5,099 (98.1)	99 (1.9)		1		
Yes	10,642 (67.2)	10,292 (96.7)	350 (3.3)		1.4	1.07–1.86	.02
Pneumothorax				.56			
No	15,267 (96.4)	14,837 (97.2)	430 (2.8)		1		
Yes	573 (3.6)	554 (96.7)	19 (3.3)		1.2	0.74–1.95	.46
Pulmonary edema				.61			
No	15,370 (97)	14,932 (97.2)	438 (2.8)		1		
Yes	470 (3)	459 (97.7)	11 (2.3)		0.7	0.39–1.34	.30
Others				.81			
No	15,700 (99.1)	15,254 (97.2)	446 (2.8)		1		
Yes	140 (0.9)	137 (97.9)	3 (2.1)		0.8	0.25–2.61	.72
Level of health-care organization				<.001			
Medical center	7,165 (45.2)	7,052 (98.4)	113 (1.6)		1		
Regional	6,978 (44.1)	6,818 (97.7)	160 (2.3)		1.2	0.96–1.59	.11
District	1,697 (10.7)	1,521 (89.6)	176 (10.4)		3.5	2.48–5.01	<.001
Ownership of organization				.12			
Public	3,714 (23.4)	3,623 (97.5)	91 (2.5)		1		
Non-public	12,126 (76.6)	11,768 (97)	358 (3)		1.2	0.95–1.55	.13
Location of care				<.001			
ICU	3,639 (23)	3,589 (98.6)	50 (1.4)		1		
RCC	9,453 (59.7)	9,265 (98)	188 (2)		1.3	0.93–1.81	.13
RCW and HRC	2,748 (17.3)	2,537 (92.3)	211 (7.7)		2.3	1.59–3.41	<.001

OR = odds ratio
LIH = low-income household
RCC = respiratory care center
RCW = respiratory care ward
HRC = home respiratory care

gional hospitals, where the risk of re-intubation was 1.2 times that of the medical centers. Regarding organization ownership, the risk of re-intubation at non-public hospitals was higher than that at public hospitals (OR = 1.2, 95% CI 0.95–1.55, *P* = .13). Regarding the location of care, respiratory care wards exhibited the highest risk of re-intubation, which was 2.2 times that of ICUs, followed by respiratory care centers, which had a risk of re-intubation that was 1.3 times that of ICUs (see Table 2).

Discussion

Our analysis showed that the probability of successful ventilator weaning decreased with increases in subject age and the Charlson comorbidity index scores of the ventilator-dependent subjects (see Table 2). Older and sicker subjects tended to have greater deterioration of organ function and, thus, may be more difficult to wean from mechanical ventilation. This result is the same as that reported by Yang et al[21] and Tu et al[22] (71% of subjects older than 64 y vs 69.9 ± 14.3% and 68.7 ± 15.1%) for a respiratory care center of a medical center in southern Taiwan. This study used a secondary database, so we can only use the comorbidity index to indirectly measure the patient's disease severity, whereas Yang et al[21] and Tu et al[22] measured the disease severity with the APACHE II score.

The re-intubation rate ranged from 3 to 19% (total 13%) in an International Consensus Conference article[23-28] and was 45.4% for the longer weaning group in the WIND study[29]; most of these subjects received mechanical ventilation for < 21 d, and re-intubation after successful liberation from mechanical ventilation was not defined.

For individual hospital respiratory care center subjects, previous studies have reported a 19% re-intubation rate within 14 d after ventilator liberation.[22] In the present study, the re-intubation rates within 14 d for subjects liberated from ventilator use were 1.37, 1.99, and 7.68% for ICUs, respiratory care centers and respiratory care wards, and home respiratory care, respectively. The managed care method for strengthening management models applied by the National Health Insurance Administration of the Ministry of Health and Welfare has achieved the expected medical quality improvements.

In the Epstein and Ciubotaru study,[30] intubated subjects were treated within 72 h after extubation, and the mortality rate increased with prolonged re-intubation; therefore, re-intubation within 14 d after successful liberation from mechanical ventilation presents a higher risk. The use of ventilators due to pneumonia complications is an important factor in re-intubation, which also demonstrated significance in this study (OR 1.4, 95% CI 1.07–1.86, $P = .02$).

Criner[12] reported that COPD and pneumonia are possible reasons for long-term ventilator use. In this study, it was shown that COPD was associated with an increased risk of re-intubation after ventilator use.

We also found that subjects in regional hospitals and district hospitals were at higher risk of re-intubation within 14 d after successful liberation from mechanical ventilation than subjects at medical centers, which is likely related to the quality and experience of different hospital grades. Chiang et al[13] have observed greater success among medical center subjects, which aligns with Criner's findings.[12]

In the list of persistent monitoring indicators for Taiwan hospitals, admitted patients discharged within 14 d due to the same disease or a related disease (ie, non-planned re-hospitalization rate indicators) was an indicator of integrated acute care.[31] Therefore, we propose that patients who undergo re-intubation within 14 d after successful liberation from mechanical ventilation should be returned to intensive care, because patients who undergo re-intubation after failed extubation have a poor prognosis, with a hospital mortality rate exceeding 30–40%, although the reasons remain unclear.[32] This finding reminds respiratory therapists to more closely monitor the condition of these 2 types of patients during and after the ventilator-dependent patient's ventilator liberation.

Conclusions

The risk and related factors of re-intubation in ventilator-dependent subjects 17 y and older who were liberated from mechanical ventilation within the past 14 d include the reason for ventilator use, complications, hospital accreditation level, and the location of care. The above factors were related to the care setting level and quality; thus, higher risk patients should receive more attention and be assessed after being liberation from mechanical ventilation to prevent re-intubation.

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