1-Year Survival of Subjects Discharged From a Long-Term Chronic Ventilator Unit

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INTRODUCTION: Among survivors of intensive care, many remain dependent on mechanical ventilation and are discharged to long-term chronic ventilator units or to skilled nursing facilities. Few long-term outcome data are available on patients transferred from long-term chronic ventilator units. METHODS: We retrospectively followed subjects discharged from a long-term chronic ventilator unit from 2010–2012. We determined where these subjects went, evaluating whether location of discharge had an effect on mortality. RESULTS: We followed 79 subjects who were 64.9 ± 15.9 y old. Average stay in the long-term chronic ventilator unit was 38.5 ± 20.1 d. Within the first year after discharge, 24 (30.3%) subjects died: 17 in a skilled nursing facility, 7 at home. Of those who survived the first year, 28 had been discharged to a skilled nursing facility and 27 to home. Survivors were younger (62.6 ± 12.4 vs 70.4 ± 13.1 y, *P* = .03), had shorter intensive care unit lengths of stay (10.4 ± 5.0 vs 16.4 ± 11.5 d, *P* = .03), and were more likely discharged home from long-term chronic ventilator unit (49.0% vs 29.1%, *P* = .040). CONCLUSIONS: Subjects discharged from an long-term chronic ventilator unit and were alive at 1 y had shorter stays in the ICU and were more likely to be discharged home. Further attention is warranted to assure the survival of critical care patients once they are discharged from intensive care units. *Key words: weaning; long term chronic ventilation; chronic critically ill* [Respir Care 2017;62(10):1284–1290. © 2017 Daedalus Enterprises]

Introduction

Millions of individuals have required the use of ICU resources over the past decades.[1,2] The growth in the number of ICU admissions is multifactorial, but the aging population with chronic medical conditions will likely play a significant role in the utilization of critical care resources.[3–6] Further, advances in intensive care have enabled more patients to survive a critical illness.[3,4] These survivors, however, will have sequelae from their acute critical illness that will continue well beyond their discharge from the ICU.[6,7] Further, a subgroup of these ICU survivors will remain dependent on mechanical ventilation due to the inability to fully recover from the initial acute period of their critical-care course.[8]

ICU survivors often utilize significant health resources due to lengthy hospital stays and post-discharge care that involves skilled nursing and long-term acute care facilities.[9,10] There are significant economic costs to surviving a critical illness, with hospital-related costs per year estimated to be $26 billion.[11] Linking acute and chronic care has become one of the greatest challenges for modern medicine and health policy.[12] Long-term acute care hospitals (LTACHs) are seen as a possible way to answer the challenge of lower health care costs and have become an important venue for patients with chronic acute care needs.

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However, there have been significant issues with LTACHs, from geographic availability to health costs,[13] thus raising the concern that the current health system may not be well designed for meeting the needs of ICU survivors with ongoing critical care issues.

The genesis of LTACHs dates back to the 1980s, when long-term chronic ventilator units were first introduced to offset the high costs of chronic critically ill patients requiring intensive care.[14] Skilled nursing facilities (SNFs) soon followed, attempting to offer management of these patients with less intensive care and lower costs. The Kindred Admission Screening Tool, developed in the 1990s, was implemented to help the timing and assess the safety of transfer from the ICU to a long-term chronic ventilator unit.[15] However, how patients fair after discharge from ICUs is not well understood.

We examined the outcomes of subjects discharged from one long-term chronic ventilator unit. There are few data discussing the mortality of patients receiving care in LTACHs, and even less after they are discharged to SNFs or home. To fill this gap, we examined patient outcomes regarding mortality at 1 y after transfer out of the long-term chronic ventilator unit. We also provide insight into areas where care for the chronic critically ill could be improved, ultimately benefiting the care of these patients.

QUICK LOOK

Current knowledge

Utilization of ICU care continues to grow, as does survival from an ICU. However, a subgroup of ICU survivors has ongoing critical care needs, such as mechanical ventilation. These patients are often discharged to a long-term chronic ventilator unit, but few long-term outcome data exist on the outcomes of these patients once they are discharged from the chronic ventilator unit.

What this paper contributes to our knowledge

We describe the survival of post-ICU subjects discharged from a long-term chronic ventilator unit. Subjects able to go home had an increased survival at 1 y compared to subjects transferred to other long-term facilities, raising the question of the need for proper resource allocation.

Methods

Study Design

We performed a retrospective cohort study using all patients admitted to the long-term chronic ventilator unit at Johns Hopkins Bayview Medical Center from 2010 to 2012. The subjects were followed for up to 5 y after discharge from our long-term chronic ventilator unit. The primary data sources were from the in-patient admission prior to the long-term chronic ventilator unit admission, our long-term chronic ventilator unit, and the SNF. If the subject was discharged home, we followed the subject by the contact information given by the subject. If subjects were lost to follow-up, death records were obtained using the Social Security Death Index through GenealogyBank (genealogybank.com). The Johns Hopkins University Institutional Review Board approved all methods and procedures for this study.

Study Population

Patients 18 y or older admitted to our long-term chronic ventilator unit from an ICU and subsequently discharged alive between 2010 and 2012 were eligible for inclusion. All diagnoses were identified using International Classification of Diseases, 9th Revision. Discharges were to one of three destinations: a SNF, home, or readmission to the hospital.

We chose to examine patients from 2010 to 2012 because of the implementation of the Nursing Home Transmittal 202 (NHT202) in the state of Maryland[16] 4 y earlier in 2008. This transmittal was meant to establish guidelines for determining medical eligibility for Medicaid-funded chronic hospital services for patients who are ventilator-dependent.[17] Specifically, they were an attempt to establish which patients could be eligible for less complex care and thus discharged from a chronic ventilator unit to a nursing home or a SNF. We have previously reported that, under these new standards, patients eligible for transfer of care and sent to SNFs had higher mortality rates than those patients who remained at a higher level of care before being discharged home.[18] However, because this was a small study with many unaddressed confounders, we sought to evaluate whether this trend continues to be true while taking into account other variables.

Variables and Outcomes

The primary exposure variable was the location to which subjects from our long-term chronic ventilator unit were discharged: SNF or home. We identified discharges from the electronic medical record. One-year mortality was addressed by direct telephone calls to the nursing facilities or contact numbers from subjects' charts.

The primary outcome was survival at 1 y after discharge. Secondary outcomes included an assessment of variables and their impact on transfer of care. These

Table 1. Characteristics for Subjects Transferred From a Long-Term Chronic Care Facility in 2010–2012

	Transferred to Skilled Nursing Facility (*n* = 45)	Transferred Home (*n* = 34)	*P*
Age, y ± SD	66.8 ± 12.7	63.1 ± 12.7	.16
Female, *n* (%)	19 (42)	23 (68)	
Charlson Comorbidity Index (± SD)*	3.7 ± 1.4	3.2 ± 1.6	.059
SOFA score on admission to ICU (± SD)	5.8 ± 2.4	5.7 ± 1.9	.32
Diagnosis on admission to ICU†			
Sepsis	8	7	
Pneumonia	8	9	
Intra-abdominal infection	5	4	
Respiratory failure	12	11	
Intracranial hemorrhage	3	1	
Acute renal failure	0	2	
Heart failure	5	4	
Burn	3	0	
Venous thromboembolism	1	0	
Trauma	1	0	

*Note that the Charlson Comorbidity Index was calculated on day 1 of the ICU admission.
†Subjects may have had more than one diagnosis that lead to an ICU admission.
SOFA = Sequential Organ Failure Assessment

variables included age, severity of illness on admission to the ICU as assessed using the Sequential Organ Failure Assessment (SOFA) score, length of stay in the ICU, and length of stay in the long-term chronic ventilator unit.

Statistical Analysis

Continuous values are reported as mean ± SD, unless otherwise stated. Categorical variables are presented as summations and percentages. Statistical comparisons between clinical parameters in various groups of patients were performed using non-parametric testing, specifically the Mann-Whitney *U* test, designating a $P < .05$ as statistically significant. For survival, we generated Kaplan-Meier survival curves for each group, with significance determined using a log-rank test. Analyses were conducted with SigmaPlot 11.0 (San Jose, California).

Results

A total of 141 subjects were admitted to the long-term chronic ventilator unit at Johns Hopkins Bayview Medical Center between 2010 and 2012. Four subjects were readmitted to the hospital, and 58 subjects died while in the long-term chronic ventilator unit. Readmission reasons included worsening hypoxemia,[2] hypotension,[1] and one case of atrial fibrillation with rapid ventricular response. The remaining 79 subjects constitute our study population, as they survived the long-term chronic ventilator unit and were discharged: 45 (57%) subjects were discharged to another LTACH setting, specifically a SNF, and 34 (43%) were discharged to home.

For the 79 subjects that made up the study population, the mean age was 64.9 ± 15.9 y (median age 69 y; range 21–93 y). Forty-three (53.1%) women made up the study group. The subjects spent an average 13.6 ± 9.2 d in the ICU (median 10 d; range 3–41 d). Their average SOFA score upon admission to the ICU was 5.9 ± 2.4 (range 0–13). The average Charlson Comorbidity Index was 3.8 ± 1.3 (range 0–10). The main diagnosis accounting for ICU admission was acute respiratory failure,[19] followed by pneumonia (17 subjects) and sepsis (15 subjects). For the diagnosis of sepsis, we did not further dichotomize the disease process by severe sepsis versus septic shock; these subjects were lumped together under sepsis. The mean length of stay in the long-term chronic ventilator unit was 38.5 ± 20.1 d (median 28 d; range 2–196 d). All 79 subjects had a tracheostomy at the time of admission to the long-term chronic ventilator unit, warranting some level of invasive ventilation.

Of the 79 subjects, 45 subjects were transferred to a SNF and 34 to home. Subjects discharged home were younger than subjects transferred to a SNF (63.1 ± 12.7 y vs 66.8 ± 12.7 y, respectively); however, this difference was not statistically significant ($P = .161$). Women made up the majority of subjects who left the long-term chronic ventilator unit for a home discharge (68%), but accounted for only 42% of the subjects who went to a SNF. Table 1 lists characteristics of subjects discharged to a SNF versus to home.

Table 2. Variables Affecting Site of Transfer From a Long-Term Chronic Ventilator Unit

	Transferred to Skilled Nursing Facility (*n* = 45)	Transferred to Skilled Home (*n* = 34)	*P*
Age, y ± SD	66.8 ± 12.7	63.1 ± 12.7	.16
SOFA score on admission to ICU (± SD)	5.8 ± 2.4	5.7 ± 1.9	.32
Length of stay in ICU, d ± SD	20.4 ± 8.7	8.6 ± 3.4	.009
Length of stay in long-term chronic ventilator unit, d ± SD	38.5 ± 14.3	38.6 ± 12.7	.47
Transferred with tracheostomy and ongoing mechanical ventilation need, *n* (%)	12 (27)	3 (9)	.008
Survival at 1 y, *n* (%)	28 (62)	27 (79)	.049
Survival with ongoing tracheostomies, *n* (%)	0 (0)	3 (100)	.002

SOFA = Sequential Organ Failure Assessment

Table 3. Characteristics for Survivors Versus Non-Survivors 1 y After Discharge From a Long-Term Chronic Care Facility

	Survivors (*n* = 55)	Non-survivors (*n* = 24)	*P*
Age, y ± SD	62.6 ± 12.4	70.4 ± 13.1	.03
Female, *n* (%)	29 (53)	13 (54)	.45
SOFA score on admission to ICU (± SD)	6.1 ± 1.4	5.6 ± 2.0	.21
Length of stay in ICU, d ± SD	10.4 ± 5.0	16.4 ± 11.5	.031
Length of stay in long-term chronic ventilator unit, d ± SD	36.1 ± 14.5	44.5 ± 8.8	.11
Discharged home, *n* (%)	27 (49)	7 (29)	.040

SOFA = Sequential Organ Failure Assessment

The primary exposure variable was the location upon discharge from the long-term chronic ventilator unit. We found that ICU stay was significantly associated with a discharge to a SNF. Those discharged to a SNF had a longer stay in an ICU than those discharged home (20.4 ± 8.7 d vs 8.6 ± 3.4 d, respectively; $P = .009$). However, stay in the long-term chronic ventilator unit did not predict place of discharge. The long-term chronic ventilator unit stay for subjects sent to a SNF (38.5 ± 14.3 d) was similar to the stay for subjects discharged home (38.6 ± 12.7 d; $P = .47$). Table 2 lists variables associated with discharges to a SNF versus home. Twenty-five subjects still had tracheostomies and ongoing mechanical ventilator needs at the time of transfer, with 3 subjects discharged to home and 12 to SNFs. There was a statistical difference in 1-y survival between those sent to a SNF versus home (62% vs 79%, respectively; $P = .049$). Furthermore, all 3 subjects with tracheostomies who went home were alive at 1 y, while all 12 who went to SNFs were deceased at 1 y.

Table 3 reviews variables associated with 1-y survival after discharge from the long-term chronic ventilator unit. Compared to non-survivors, survivors had shorter lengths of stay in the ICU (10.4 ± 5.0 d vs 16.4 ± 11.5 d; $P = .031$) and subjects were younger (62.6 ± 12.4 y vs 70.4 ± 13.1 y; $P = .03$). Length of stay in the long-term chronic ventilator unit did not predict survival ($P = .11$).

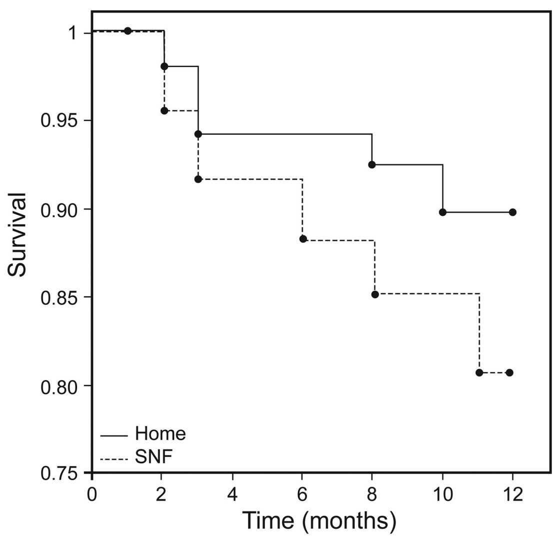

Fig. 1. Kaplan-Meier Curve demonstrating the 1-y survivability of discharged subjects from the chronic ventilator unit ($P = .040$). SNF = skilled nursing facility

However, being discharged home was associated with a 1-y survival: 49% of survivors were discharged home, whereas 29% of non-survivors were discharged home ($P = .040$). Figure 1 is the Kaplan-Meier curve showing survival > 1 y.

Discussion

We found that subjects discharged from our long-term chronic ventilator unit were most likely to be alive after 1 y if they had shorter stays in the ICU and were sent home versus to a SNF. Neither the subjects' initial severity of illness upon presentation to an ICU nor the length of stay at our long-term chronic ventilator unit were significant predictors of mortality after long-term chronic ventilator unit discharge.

The survival of an acute critical illness is often the beginning of a long medical journey for patients. For example, Lone and Walsh discussed the association of multi-organ failure on mortality 5 y after a critical illness.[20] They evaluated the status of organ systems according to the SOFA definition in 745 subjects during their ICU stay. Using a multi-variable analysis adjusting for each organ failure and confounders, they found that cardiovascular, hepatic, and respiratory failure carried the greatest risk of death within 5 y after discharge from the ICU (odds ratio 2.1–2.5). However, all individual organ failures were associated with a high 5-y mortality ($P < .001$), suggesting persistent negative effects from the acute illness on long-term health. Lone and Walsh did not describe where the ICU survivors received their post-ICU care or the many resources likely allocated to allow these subjects the chance to ultimately survive their acute illness.[20] Because the critical illness frequently extends beyond the initial ICU stay, it is logical to assume that the post-ICU care may have a significant impact on the final outcome of the original critical illness. As the management of chronic critically ill patients is fairly new, best practices for these patients are unclear; however, it appears from our study that if patients can be ultimately discharged home (with home discharge serving as a proxy for medical stability with or without significant recovery of physiological function), they will have an associated survival benefit.

The syndrome of chronic critical illness is complex. Most patients are older adults with underlying comorbid conditions who develop an acute illness requiring critical care (eg, sepsis, ARDS).[8,21] The hallmark of chronic critical illness is prolonged ventilation, but other characteristic clinical features include neuromuscular weakness, brain dysfunction, malnutrition, and complex wounds.[8,21] The prevalence of this complex syndrome is increasing. For example, in a retrospective cohort conducted between 2004 and 2009 from Massachusetts, North Carolina, Nebraska, New York, and Washington, the prevalence rate of chronic critical illness was 34.4 per 100,000 persons, with a steady increase in patients < 75 y (peaking at 82.1 per 100,000 persons for the 75–79 y age group).[22] Extrapolating these data to the United States as a whole, the 20% increase of chronic critical illness prevalence in the aforementioned time frame increased in-hospital costs from $15.6 billion in 2004 to $26.0 billion in 2009.[22] Novel ways to manage these patients in a cost-effective way must be seen as a priority for both physicians and policy makers.

The concept of the LTACH was developed to optimally manage patients with chronic critical illness. LTACHs are defined by the United States Centers for Medicare and Medicaid Services as acute care hospitals with an average stay $\geq$ 25 d.[14] As previously mentioned, LTACHs were established in the early 1980s when a shift toward prospective payment for United States hospitals began; ie, hospitals were paid a set amount for each patient rather than have payments determined by cost.[23] Over time, LTACHs evolved from purely respiratory-focused hospitals (such as a long-term chronic ventilator unit) to hospitals that provide care for patients with all types of chronic critical illnesses.[8,19] Moreover, the number of LTACHs has been on the rise, with a 33% increase from 2003 to 2007 associated with a doubling of Medicare spending toward these facilities from $2.7 billion to $5.2 billion. LTACHs were shown to utilize less health care cost while achieving similar survival in the management of chronic critically ill patients versus ongoing ICU management.[22] However, not all LTACHs are the same.[19,24] One type of LTACH is the SNF, which is seen as more cost-effective versus other LTACHs in the sense that less intensive care is offered, presumably for an ideal patient who needs less intensive care. Yet how to determine the ideal patient has not been well demonstrated in practice and warrants further evaluation in future trials.

In our cohort of subjects, the stay in our long-term chronic ventilator unit did not differ between survivors and non-survivors. However, the stay in our long-term chronic ventilator unit was likely influenced not by subjects demands and physiological parameters, but rather by the NHT202 policy in which emphasis was placed on sending stable patients to more cost-effective areas. As mentioned before, how to best define the ideal patient suitable for downgrade to other LTACHs is challenging because there are no ideal guidelines to suggest which patients are more prepared than others, or what step-down units need to specifically offer to help patients end their long medical journey at home. Furthermore, identifying patients who are clinically ready to be sent home may be more obvious than those who need more time with a higher level of care in LTACHs, which could thus impact survival if those patients are transferred prematurely. Therefore, while our study cannot speak to the safety of transfer from one LTACH to another, we strongly advocate that more attention be placed on patients requiring longer time in chronic care, specifically around resource allocation and best practices that ultimately have our ICU survivors return home.

Defining a longitudinal care model for post-ICU patients with ongoing intensive care needs must become a priority. Because these patients impact many aspects of medical care, family life, and health budget, and because they have a future that remains uncertain with regard to mortality and morbidity, a health model that in of itself is uncertain and unexplored will only add to anxiety, confusion, and cost to all parties involved. Furthermore, as noted previously, LTACHs are not all the same and have varying resources that may or may not be appropriate for certain patients. Prior publications that discuss the benefit of LTACHs are confounded in that the type of services they provide is not often clear (eg, ratio of physical therapists to patient; respiratory therapist to patient, etc).[17] However, as the field continues to build data with regard to the best care that LTACHs can provide, health care providers should be aware of current policies that may influence the management of LTACH patients. For instance, in 2006, the state of Maryland passed the NHT202 with the intention to facilitate access to ventilator care while guaranteeing that patients receive services that are most cost-effective.[16] With the NHT202, a utilization control agent performs periodic continued-stay reviews to determine whether chronic hospital services remain necessary and appropriate.[16] In other words, if a patient could receive a lower level of care, then the control agent would initiate the process for a transfer. While we advocate for more research to be allocated to these chronic critically ill patients managed in LTACHs, we wish to emphasize that physicians and health care providers become aware of policies that may affect the care of these patients. When the science is able to address the management of these patients in a more robust manner, such policies should be reassessed to assure they are in accordance with the data.

The creation of an effective longitudinal care model for critically ill survivors will take time. However, implementing certain interventions now may help create the background data necessary to better understand these patients' pathophysiology, needs, and prognosis. First, more research is necessary to better characterize these patients. The biochemical composition of these patients is complex, though may parallel other existing physiological profiles. For instance, the frailty phenotype encompasses malnutrition, deconditioning, and cardiovascular issues,[25] all of which are present in those who have chronic critical illness. Thus, collaborative efforts may expedite our understanding of post-ICU patients, which may lead to interventions. Second, education and awareness of these patients is variable. Specifically, critical care medicine is learning more and more of morbidity outcomes in its survivors, yet few interventions are known and well implemented that will positively affect patients beyond the ICU. Third, ownership of the care of the chronic critically ill is hard to define and likely does not constitute one profession. The difficulty in establishing one profession to be the champions of these patients is likely hindered by frequent transfers of care and the varying backgrounds of health providers at those facilities. Therefore, training to care for these patients must be a priority. Finally, there should be more open and honest discussions with the families of these patients, specifically during the ICU stay. The families often have poor insight into the journey they are about to embark on, especially because as their loved one is downgraded in care, the care will begin to appear less synchronized and organized. One variable that contributes to the poor insight of the families is likely the lack of knowledge from the critical care team and/or hospital team that cares for the patients before they leave the acute hospital setting. Thus, education and awareness of health providers who initially care for these patients is needed so that family meetings can be as informative as possible to discuss the medical expedition ahead.

Our study has several limitations. First, subjects who left our long-term chronic ventilator unit and were readmitted to the hospital were not further followed. This represents an important subgroup of patients who require repeat hospitalizations while still receiving intensive care therapy; future studies should explore these subjects further. Second, we identified diagnoses based on International Classification of Diseases, 9th Revision, which is subject to coding errors. Third, we only explored one long-term chronic ventilator unit and discharges within one state. We did this so we could address the health care policies of Maryland and its impact on post-ICU patient care. Thus, this investigation may serve to help initiate change in policy, in Maryland and in other states. Fourth, we only addressed mortality after discharge from long-term chronic ventilator unit and did not explore other morbidities (eg, mental health) that are known to be prevalent on post-ICU discharges and how they were addressed at home or at SNFs. Fifth, exploring family concerns for these patients should be a priority for future studies. For instance, the transition from one facility to another may have emotional and health consequences on family members that may negatively affect them; these were not explored. Families may also have reservations in allowing patients to come home (eg, economic barriers); these were also not explored, but both should be a focus of future studies. Sixth, there is no clinical score to evaluate the candidacy of a patient to be transferred from one LTACH to another (while there are scores to assess whether a patient needs an LTACH[23]); we did note whether subjects left the long-term chronic ventilator unit with a tracheostomy in place, but we did not have a formal way to assess the level of complex care patients needed in a manner similar to how a SOFA score implies level of severity for patients needing critical care. A formal scoring system should be explored for patients in an LTACH, especially if transfer of care is considered. Seventh, we did not review deaths in the long-term chronic ventilator unit; however, this should be investigated and better understood with regard to subjects who do not survive this initial transfer. Finally, we did not explore the medical resources available at the SNF (eg, how many respiratory therapists were there, nursing to patient ratio, frequency of physician visits). Addressing these in the future may provide better guidance for policy and institutional changes.

Conclusions

Survival at 1-y post discharge from a long-term chronic ventilator unit was associated with younger age, shorter ICU stays, and a home discharge. The long journey of patients with chronic critical illness is one that both health care providers and health policy makers are trying to understand. How to best allocate resources in a cost-effective way is crucial, and prospective studies as well as health care policies must consider the morbidity and mortality rates of all LTACHs and their patient populations. The prevalence of chronic critically ill patients will grow, demanding that we offer these patients the best medical care to assure their survival continues beyond the ICU.

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