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# Shortening the Length of In-Hospital Training is Associated with Increased **Re-admissions for Children Requiring Chronic Mechanical Ventilation** Michael Dettorre, DO, Robin Kingston, CRNP, Neal Thomas, MD, MSc, Robert Tamburro, MD, MS Penn State Children's Hospital, Milton S. Hershey Medical Center, Hershey, Pennsylvania

## ABSTRACT

**Introduction:** Children with severe pulmonary or neurologic disorders may require chronic mechanical ventilation, and undertaking this at home, is both cost effective and preferable from many perspectives. Paramount to the success of this process is appropriate caregiver training. We recently changed our practice to decrease rehabilitation in-hospital educational training from 6 weeks to 4 weeks, and then assessed the effect of this change on early hospital and emergency department re-admission rates.

**Methods:** A database review was conducted for patients requiring chronic mechanical ventilation from January 1997 through June 2005. Abstracted data included age, diagnosis non-surgical readmissions, length of caregiver training, and insurance carrier. For analysis, age was dichotomized to under or over 1 year and diagnosis to neurological or pulmonary. Re-admission to the hospital or to the emergency department within 30 days of discharge was the primary outcome variable. All categorical variables were assessed in univariate analysis using Fisher Exact Test. Variables significant in univariate analysis were assessed in multivariable analysis.

**Results:** 61 of 78 patients were available for analysis after excluding those who died prior to discharge, those discharged to an extended care facility or those transferred back to the acute hospital for > 15 days following their training. 17/61 patients required at least one readmission. 8/12 (67%) patients who received 4 week training required re-admission versus 9/49 (18%) who received 6 weeks (p = 0.002). A pulmonary diagnosis and age were the only other variables associated with re-admission in univariate analysis. In multivariable analysis, controlling for diagnosis and age, the length of training remained significant (p = 0.005).

Conclusions: Shortening of the caregiver training time resulted in a significant increase in short term re-admissions, suggesting 4 weeks may not be sufficient, particularly for children ventilated for pulmonary reasons.

## INTRODUCTION

- Many children with severe pulmonary or neurological disorders require chronic mechanical ventilation.
- These children may be cared for in a variety of settings including hospital wards, extended care facilities, or at home.
- The use of mechanical ventilation at home offers children with severe pulmonary or neurological disorders many potential benefits.
- It may also provide a substantial cost saving to society.
- However, paramount to the success of this process is the appropriate education of the primary caregiver.
- In an attempt to maintain healthcare costs, chronic ventilator programs must continually attempt to limit the time required for in-hospital caregiver training.
- We recently changed our practice to decrease our in-house educational training from six weeks to four weeks.
- This project assessed the effect of this change on early re-admission rates and emergency department visits.

### Penn State Children's Hospital Technology **Dependent Care Program**

- The primary goal of the Penn State Children's Technology Dependent Care Program for ventilator dependent patients is to discharge the children home in the care of their families.
- Children served in this program are either partially or completely dependent on life-sustaining equipment, and require rehabilitation services to address related problems such as nutritional status, oralmotor dysfunction, developmental skill acquisition, adaptive equipment needs, communication, play skills, and self-care.

- To achieve these goals, the children who are accepted into this program are discharged from the acute care hospital and transferred into the Pediatric Rehabilitation Hospital at the Penn State Milton S. Hershey Medical Center.
- Once admitted into the Pediatric Rehabilitation Hospital, these children receive services to provide support of normal growth and development and to identify equipment needs.
- Family education is an integral part of the plan of care. The goal is that the child will return home with his/her family as an active participant in family and community life.
- A structured care plan is written to guide the family and staff through the admission. This is a detailed, multiple page document that delineates weekly goals to be achieved by the caregivers. It begins with caregivers simply reviewing multi-media educational materials and observing staff members displaying essential care skills. It progresses with caregivers performing these tasks with assistance and guidance, and ultimately, independently on their own.
- At discharge, it is expected that the family will be an expert in the care of their child and support services will be in place to assure a smooth transition to the home.
- The Technology Dependent Care Service is led by a physician and nurse practitioner with expertise in pediatric intensive care.
- The program has provided care to nearly 100 patients covering a 34 county area since its inception ten years ago.
- Although patients maintain their own primary care physician, care coordination and respiratory care follow-up is routinely performed by the Technology Dependent Care Service.

## **SPECIFIC AIM**

To compare the effect of reducing in-house caregiver educational training time from six weeks to four weeks on re-admission rates among children requiring chronic mechanical ventilation.

### **HYPOTHESIS**

We hypothesized that this reduction of in-house caregiver educational training time would be associated with an increased need for readmission to the emergency department and/or to the hospital.

### **METHODS**

### **Inclusion criteria**

- All children requiring chronic mechanical ventilation admitted between January 1997 and June 2005 were initially included.
- These children were identified via a retrospective review of our Technology Dependent Care Program database.

### **Exclusion criteria**

- Patients who died prior to discharge (N = 4)
- Patients discharged to an extended care facility (N = 2)
- Patients transferred back to the acute care hospital for > 15 days following their training, but prior to discharge (N = 11)

### Abstracted data included:

- Age
- Gender
- Diagnoses
- Admissions to the hospital or emergency department within 30 days after discharge
- Admissions to the hospital or emergency department within the first year after discharge
- Length of caregiver training time
- Primary insurance carrier

### Statistical analysis:

- Age was dichotomized as less than or greater than one year.
- Diagnosis was dichotomized as either neurological or pulmonary.
- A variable "Winter" was created to identify discharges between November and March to assess the effect of the time of year on readmission rates.
- Emergency department visits that resulted in hospital admission were considered as only hospital admissions.
- Surgical re-admissions were excluded since these admissions were most often planned, elective, and unlikely to be influenced by inhospital training time.
- Re-admission to the hospital or emergency department within 30 days of discharge was the primary outcome variable.
- All categorical variables were assessed in univariate analysis using Fisher Exact Test.
- All numerical variables were assessed in univariate analysis using Wilcoxon Two Sample Test (non-parametric analysis).
- All variables with p value < 0.10 in univariate analysis were assessed in multivariable analysis using stepwise logistic regression.
- Age was attempted in the regression model as both a categorical and numerical variable.
- Only those variables with a p value < 0.05 were retained in the multivariable model.

The study was approved by the Institutional Review Board and the need for informed consent was waived.

### RESULTS

- 78 patients were initially identified.
- 61 patients were available for analysis after excluding those who met exclusion criteria.
- 17 of these 61 patients (28%) required re-admission to the emergency department and/or to the hospital within 30 days of discharge.
- Four weeks of in-hospital training was provided for 12 patients; six weeks for the remaining 49 patients (Table 1).
- As anticipated, there was a difference in the number of in-hospital training days for the two groups (Table 1).
- 8 of the 12 patients (67%) who received a four week in-hospital training period required re-admission within 30 days of discharge as compared to only 9 of the 49 patients (18%) who received six weeks of training (p = 0.002) (Figure 1).

- This difference in re-admission rates was due in large part to an increase in emergency department visits (Figure 2).
- However, there was also a strong trend towards increased hospital admission rates among those receiving only four weeks of training as well (Figure 2).
- There were also more re-admissions during the first year after discharge among those children whose caregivers received only four weeks of training. Again, this difference was due primarily to an increase in emergency department visits (Figure 3).
- In addition to the length of in-hospital training time, only a pulmonary diagnosis as the etiology for the need for chronic mechanical ventilation and age were associated with re-admission within 30 days in univariate analysis (Table 2, Figures 4 & 5).
- In multivariable analysis, the length of training remained significantly associated with re-admission within 30 days after controlling for diagnosis and for age (OR 8.7; 95% CI: 1.9-39.4, p value = 0.005). • In fact, only length of training remained significantly associated with
- re-admission within 30 days in multivariable analysis.

#### Table 1. Comparison of baseline characteristics of patients by length of training

Category	Four week	Six week	p value
Number	12	49	
Rehab training time (days)	$30.3 \pm 2.8$	40.1 ± 2.5	0.01
Age (years)	2.6 ± 1.5	$4.4 \pm 1.0$	0.38
Gender (% Male)	42%	67%	0.07
Pulmonary diagnosis	75%	51%	0.20
Discharged in winter	67%	47%	0.34
Private Insurance	75%	43%	0.06

#### Table 2. Comparison of children re-admitted within 30 days of discharge with those who were not re-admitted

Category	<b>Re-admitted</b>	Not Re-admitted	p value
Number	17	44	
Age (years)	$1.3 \pm 0.4$	5.2 ± 1.1	0.001
Gender (% Male)	53%	66%	0.39
Pulmonary Diagnosis	76%	48%	0.05
Discharged in winter	29%	27%	1.00
Four week training	47%	9%	0.002
Private insurance	47%	50%	1.00
Age < one year	71%	52%	0.25



Figure 1. Percentage of Patients Requiring Re-admission Within 30 Days of Discharge by Length of Training



Figure 2. Percentage of Patients Requiring Re-admission Within 30 Days by Type of Admission



Figure 3. Number of Admissions per Patient Within the First Year After Initial Discharge by Length of Training



Figure 4. Percentage of Patients Requiring Re-admission Within 30 Days of Discharge by Reason for Chronic Ventilation



Figure 5. Percentage of PULMONARY Patients Requiring Re-admission Within 30 days of Discharge by Length of Training



### **SUMMARY**

- The four week program was effective in reducing the number of days of in-hospital educational training.
- No serious permanent sequelae were identified with this abbreviated in-hospital training.
- However, the four week program was associated with an increase in the number of admissions within the first month after discharge, both to the emergency department and to the hospital.
- The four week program was also associated with an increase in the number of emergency department visits throughout the first year following discharge.
- Re-admission within the first 30 days following discharge was also associated with a younger age and a pulmonary diagnosis.
- However, in multivariable analysis, only the length of in-hospital training was associated with re-admission within 30 days following discharge.

### LIMITATIONS

- The retrospective study design
- The small sample size particularly in the four week arm
- The study included only re-admissions that occurred at Penn State Children's Hospital or its emergency department.
- The analysis did not consider the role and extent of home nursing support on re-admission rates.

### **SPECULATION**

- The four week training program needs further evaluation before a definitive recommendation may be offered.
- At a minimum, provisions must be made for anticipated emergency department visits during the first 30 days after discharge.
- Arguably, this training time should be initially implemented for caregivers of older children with neurological reasons for chronic ventilation since these patients are less likely to require re-admission.