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Duration of Home Oxygen Therapy in Young Children Enrolled in an Accountable Care Organization

To the Editor:

Home oxygen therapy has become a mainstay for children with chronic lung diseases, including but not limited to bronchopulmonary dysplasia. There are no uniform guidelines for discontinuing home oxygen therapy for children, with only 8% of pediatric pulmonologists using a standardized protocol to determine readiness for discontinuation (1). Nevertheless, a recent study of infants followed in a bronchopulmonary dysplasia clinic suggested that the median age of home oxygen weaning, i.e., the stepwise reduction of oxygen concentration for individual patients, was 10 months, with unsupervised cessation occurring in 32% of patients (2). With limited available data on home oxygen therapy discontinuation in younger children, we present a novel analysis of claims data from a pediatric accountable care organization to better characterize the duration and cessation of this therapy.

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Methods

After Institutional Review Board approval, we obtained claims data from Partners for Kids, an Ohio Medicaid managed care accountable care organization described in detail elsewhere (3). Children were included in the analysis if they started home oxygen therapy (Healthcare Common Procedure Coding System codes E0424–5, E0430–1, E0433–5, E0439–44, E0446, E1390–2, E1405–6, K0738) in 2008 to 2015, with follow-up through 2017. For infants younger than 1 year of age, the earliest claim was considered to signify therapy start. For children aged 1 to 3 years at the earliest claim, the earliest claim signified therapy start if the patient had already been enrolled in the accountable care organization plan for more than 30 days. Children for whom a date of therapy start could not be identified, and children with missing data at the time of the first claim, were excluded from the analysis.

Children were followed from therapy initiation until discontinuation, defined as 60 or more days of continuing accountable care organization enrollment without home oxygen claims. We considered this period as representing improvement in the disease process that permitted oxygen therapy discontinuation and verified that 97% of cases meeting this criterion did not have prolonged (>1 wk) hospitalization in the 60 days after the last home oxygen claim. Follow-up was censored at accountable care organization plan disenrollment, if applicable. Therapy discontinuation was evaluated using Kaplan-Meier curves and Cox proportional hazards models. Covariates were assessed at the initial claim and included age, sex, residence in central versus southeastern Ohio, diagnosis (congenital lung abnormalities [including bronchopulmonary dysplasia], apnea, congenital

cardiac disease, genetic syndromes, or other), and claims for tracheostomy or mechanical ventilation supplies. Monthly cost for home oxygen therapy was retrieved for January 2014 through November 2016. Data were analyzed using Stata/IC 14.2 (StataCorp, LP). Two-tailed $P < 0.05$ was considered statistically significant.

Results

Among 734 children with home oxygen therapy claims, 707 were determined to have started therapy between 2008 and 2015, and 18 were excluded for incomplete data on accountable care organization enrollment dates or demographic characteristics. The remaining 689 patients were followed up to 9 years after home oxygen therapy initiation. Median follow-up was 3 months (interquartile range, 1–6 mo) for patients continuing therapy until censoring, and 4 years (interquartile range, 2–6 yr) for those classified as discontinuing home oxygen therapy. Patient characteristics are summarized in Table 1, and therapy discontinuation is summarized by diagnosis in Figure 1. The crude rate of therapy discontinuation over the entire study period (i.e., up to 9 years after initiation) was 80%. Actuarial rates of therapy discontinuation at 1, 3, and 5 years, respectively, were 8%, 33%, and 61%, respectively. On multivariable Cox regression (Table 2), genetic syndromes were associated with twofold greater hazard of therapy discontinuation as compared with congenital lung abnormalities. Other covariates were not associated with the hazard of this outcome. The monthly cost per member for continuous oxygen ranged from $126 to $156.

Discussion

Our analysis of insurance claims data demonstrates that a majority of infants and children younger than 4 years of age when starting home supplemental oxygen no longer had insurance claims for home oxygen therapy after 5 years. These data establish an

Figure 1. Time to discontinuation of home oxygen therapy by primary diagnosis ($N = 689$).

anticipated duration for home oxygen therapy in infants and young children, to aid in cost containment in highly vulnerable pediatric populations.

Previous studies describing weaning of home oxygen therapy in younger children generally focus on specific diagnoses, especially bronchopulmonary dysplasia. Although bronchopulmonary dysplasia accounted for the majority of this study's cohort, the population of young children requiring home oxygen therapy supplementation includes children requiring home mechanical ventilation (4) or tracheostomies (5) and children with a variety of diagnoses that defy precise description. In the present data, the only differences seen in the hazard of home oxygen discontinuation were related to genetic syndromes diagnosed at therapy start. Such diagnoses were associated with increased hazard of therapy discontinuation, potentially related to early mortality. However, this group accounted for few of the patients in the study, and among the majority of patients, home oxygen therapy was eventually discontinued with no associated need for prolonged inpatient readmission.

With no previous research using insurance claims data to examine home oxygen therapy discontinuation, we designated two consecutive months without home oxygen claims as therapy discontinuation. Unlike tracheostomy decannulation, which is a discrete point in time, weaning of oxygen is more nuanced, with many children continuing to require supplemental oxygen during sleep or during periods of respiratory infection or pulmonary exacerbation. We were unable to quantify how long oxygen supplementation continued after the last claim payment. However, by tracking patients' plan enrollment, we were able to limit potential bias due to continuation of home oxygen therapy under a different payment mechanism.

The high crude rate of home oxygen therapy discontinuation (80%) suggests our data represent the complete course of home oxygen therapy for most children in the study. However, actuarial rates of therapy discontinuation may have been biased downward by early censoring of most patients classified to have continued this therapy (median follow-up of 3 mo). Furthermore, the analysis included only children enrolled in Medicaid, which is often associated with a higher disease burden (6).

Table 1. Characteristics of children initiating home oxygen therapy ($N = 689$)

Characteristic	No. (%)
Age	
<1 yr	635 (92)
1–3 yr	54 (8)
Sex	
Male	397 (58)
Female	292 (42)
Region of residence	
Southeastern Ohio	137 (20)
Central Ohio	552 (80)
Diagnosis	
Congenital lung abnormalities	530 (77)
Apnea	66 (10)
Congenital cardiac disease	53 (8)
Genetic syndromes	22 (3)
Other	18 (3)
Tracheostomy or mechanical ventilation supplies*	51 (7)
Therapy discontinued†	548 (80)

*Any claims paid within 60 days of home oxygen therapy initiation.
†Patient continued to be enrolled for at least 60 days in Medicaid managed care plan without further claims for home oxygen therapy.
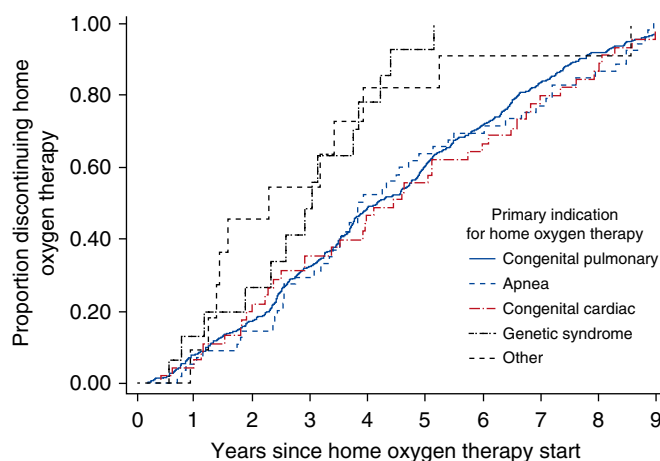
Table 2. Multivariable Cox proportional hazards model of discontinuing home oxygen therapy (N = 689)

Characteristic	HR	95% CI	P Value
Age			
<1 yr	Ref.		
1–3 yr	1.05	(0.76–1.45)	0.768
Sex			
Male	Ref.		
Female	1.03	(0.87–1.22)	0.743
Region of residence			
Southeastern Ohio	Ref.		
Central Ohio	0.83	(0.66–1.04)	0.113
Diagnosis			
Congenital lung abnormalities	Ref.		
Apnea	0.89	(0.66–1.12)	0.422
Congenital cardiac disease	0.89	(0.65–1.22)	0.460
Genetic syndromes	2.04	(1.17–3.58)	0.193
Other	1.43	(0.83–2.47)	0.193
Tracheostomy or mechanical ventilation supplies*	1.40	(0.93–2.10)	0.104

Definition of abbreviations: CI = confidence interval; HR = hazard ratio; Ref. = reference.
*Any claims paid within 60 days of home oxygen therapy initiation.

Nevertheless, with home oxygen therapy discontinuation occurring in a significant number of children without physician supervision (2), our analysis provides a real-world estimate of cessation of home oxygen therapy payment, proposing an area ripe for quality-improvement initiatives for reducing medical costs while providing high-quality, patient-oriented medical care for infants and children with chronic lung disease.

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Access to Supplemental Oxygen Therapy: A Crisis

To the Editor:

We read with great interest the publication by Jacobs and colleagues highlighting the perspectives of almost 2,000 patients on supplemental oxygen therapy (1). As practicing clinicians, we compliment Jacobs and colleagues for quantifying a problem we observe all too often. For example, we recently evaluated a patient with chronic obstructive pulmonary disease in our pulmonary clinic who was considering quitting her full-time job and applying for disability benefits after being prescribed supplemental oxygen. The compressed-oxygen cylinders delivered by her durable medical equipment provider were too heavy to carry and did not last for the duration of her workday. Her durable medical equipment provider did not offer her the option of a portable oxygen concentrator, and she could not afford to purchase one on her own. There are many such patients in our practice, and it is long past time we developed the evidence we need to revisit the Centers for Medicare and Medicaid Services Competitive Bidding Program and related policies.

More specifically, we need reliable evidence regarding the advantages and disadvantages of the different types of oxygen equipment (e.g., compressed-oxygen cylinders vs. portable oxygen concentrators vs. liquid oxygen). Studies are needed to quantify the effects of these various options for oxygen equipment on the physical, mental, and social health of patients and their caregivers, healthcare use, and costs. Much of the focus over the past decades has been evidence-based practice to guide clinicians. We now need evidence-based policies.

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