



Home oxygen for children with acute bronchiolitis

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► Additional supplemental fig 1 is published online only at <http://adc.bmj.com/content/vol94/issue8>

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ABSTRACT

A prospective randomised controlled pilot study was performed comparing home oxygen therapy with traditional inpatient hospitalisation for children with acute bronchiolitis. Children aged 3–24 months with acute bronchiolitis, still requiring oxygen supplementation 24 h after admission to hospital, were randomly assigned to receive oxygen supplementation at home with support from “hospital in the home” (HiTH) or to continue oxygen supplementation in hospital. 44 children (26 male, mean age 9.2 months) were recruited (HiTH n = 22) between 1 August and 30 November 2007. Only one child from each group was readmitted to hospital and there were no serious complications. Children in the HiTH group spent almost 2 days less in a hospital bed than those managed as traditional inpatients: HiTH 55.2 h (interquartile range (IQR) 40.3–88.9) versus in hospital 96.9 h (IQR 71.2–147.2) p = 0.001. Home oxygen therapy appears to be a feasible alternative to traditional hospital oxygen therapy in selected children with acute bronchiolitis.

Acute bronchiolitis is a common reason for hospitalisation in infants in developed countries,¹ with treatment being essentially supportive. Although the need for supplemental oxygen is generally considered to be an absolute indication for hospitalisation,² Bajaj *et al*³ recently demonstrated that children with acute bronchiolitis can be managed safely with home oxygen therapy. The broad application of this approach, however, has not been tested.

The development of nurse-led, home-based care has allowed children with a variety of illnesses to be managed safely at home rather than in hospital.^{4–5} Whereas managing children with acute illnesses at home is not a new strategy, it is an increasingly attractive alternative to traditional inpatient hospitalisation. Home oxygen therapy is a well-accepted option for children with chronic respiratory problems,⁶ but reports of home oxygen therapy for children with acute respiratory problems are limited. We sought to determine the feasibility and safety of home oxygen therapy for children with acute bronchiolitis compared with traditional inpatient hospitalisation.

METHODS

Setting and subjects

We conducted a prospective, randomised controlled pilot study comparing home oxygen therapy for children with acute bronchiolitis requiring oxygen supplementation with traditional inpatient hospitalisation. All children aged 3–24 months, admitted to Princess Margaret Hospital for Children (PMH), Perth, Western Australia, with a clinical diagnosis of acute bronchiolitis, who

required oxygen therapy and satisfied all inclusion and exclusion criteria (table 1) were eligible. Children were recruited over a single Australian bronchiolitis season, between 1 August 2007 and 30 November 2007.

Study protocol

Families of eligible children (table 1) were approached and following informed consent children were randomly assigned to continue traditional inpatient care (hospital group) or to continue oxygen therapy at home (hospital in the home (HiTH) group). Researchers were blinded and only following informed consent was the management allocation revealed.

Following randomisation children underwent a modified “safety in air test”, designed to provide some degree of reassurance that if oxygen supplementation were interrupted for an extended period the child would not develop sudden, life-threatening hypoxia.⁶ The test involved continuous monitoring of pulse oxygen saturation (SpO₂) levels and clinical status of the child, while in room air, over a period of 20 minutes. If SpO₂ remained at 80% or greater the child was considered to pass the test.

Children randomly assigned to the hospital group had their weaning of supplemental oxygen and the time of discharge from hospital managed by their paediatrician, independently of the study investigators. Standard management of children with acute bronchiolitis at our institution involves supportive care only, with supplemental oxygen therapy provided if SpO₂ levels are less than 93%.

Parents of children randomly assigned to the HiTH group were assessed for suitability and safety of providing care at home, were educated on home oxygen use and instructed on how to observe their children for signs of clinical deterioration. Children were reviewed by a HiTH nurse within 12 h of hospital discharge and received a minimum of two visits, in addition to one phone contact with the parents in every 24-h period. At each visit, if SpO₂ was greater than 92%, oxygen was reduced as follows: 1 to 0.75 l/minute, 0.75 to 0.5 l/minute, 0.5 to 0.25 l/minute, 0.25 to 0.125 l/minute and 0.125 to 0.06 l/minute and SpO₂ monitored for a further 15 minutes. If SpO₂ remained greater than 92% the child remained on this oxygen flow until the next visit. Once the child reached 0.06 l/minute a 15-minute trial in air was conducted and if SpO₂ remained greater than 92% the child was discharged.

Criteria for readmission to hospital were: (1) Oxygen requirement increased to more than 1 l/minute to maintain SpO₂ at greater than 92%; (2) apnoeic episode; (3) feeding less than 50% of

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
3–24 Months of age (corrected gestation)	Pre-existing cardiac, pulmonary (including chronic lung disease of infancy, cystic fibrosis and congenital or acquired airway anomalies) and neuromuscular disorders
Clinical diagnosis of acute bronchiolitis	History of apnoea
Adequate feeding ($\geq 50\%$ normal) and hydration	Prematurity < 34 weeks' gestation
Oxygen saturation $> 92\%$ on ≤ 1 l/minute nasal cannula oxygen.	
Observed and clinically stable for ≥ 24 h in hospital	
Pass modified "safety in air test"	
Caregivers must be counselled about risk of smoking around a child receiving oxygen supplementation	
Caregivers must be adequately educated about home oxygen	
HiTH nurses able to visit at home at least twice daily, in addition to daily phone call	
Paediatrician agrees that child is eligible for recruitment in study	
HiTH, hospital in the home.	

normal with clinical evidence of dehydration; (4) parents or treating paediatrician requested withdrawal of the child from the study.

The primary outcome measure was readmission to hospital within 7 days of discharge home and the secondary outcome measure was total days spent in a hospital bed. The study was approved by the Princess Margaret Hospital Ethics Committee.

Statistical analysis

A successful discharge was defined as not requiring readmission to hospital within 7 days and a 10% difference in readmission rates between groups was considered to be clinically significant. Using a minimum success rate of 100% for the hospital group and 90% for HiTH, we estimated that 180 children (90 in each group) would be needed to demonstrate a difference, with 80% power and 5% significance. Continuous data are expressed as median (interquartile range; IQR) and group differences compared with Wilcoxon rank sum test. Categorical data are shown as number (percentage) and compared with Fisher's exact tests.

RESULTS

Forty-four of 58 eligible children were enrolled (table 2). Seven families were not approached as the children met the inclusion criteria outside normal working hours, four lived outside the HiTH catchment area and three refused consent (see supplemental fig 1 available online only).

One child from each group (4.5%, 95% CI 0.1 to 22.8), required readmission to hospital. The child from the HiTH group was readmitted with dehydration secondary to viral gastroenteritis, with no change in respiratory status and was managed with nasogastric rehydration and oxygen supplementation. The child from the hospital group was readmitted

with bacterial pneumonia requiring oxygen supplementation and antibiotics. Both children made full and uneventful recoveries.

Children in the HiTH group spent significantly less time in a hospital bed (55.2 h, IQR 40.3–88.9) than those in the hospital group (96.9 h, IQR 71.2–147.2, $p = 0.001$). HiTH children received five (range four to 18) home visits from the time of hospital to HiTH discharge, with two (range one to six) phone contacts per patient.

DISCUSSION

This study suggests that home oxygen therapy is a feasible alternative to traditional hospital care in selected children with uncomplicated acute bronchiolitis.

No differences in readmission rates between the HiTH and hospital groups were noted, with only one of 22 ($< 5\%$) children in each group readmitted. The present study is limited by its small size, a result of funding and operational constraints. Whereas further studies with increased numbers are required, we believe that carefully selected children with acute bronchiolitis requiring oxygen therapy can be safely managed at home by their parents with HiTH support.

We demonstrated a significant reduction in the duration of hospital admission in the HiTH group compared with hospital-based care. This decreased length of stay may lead to improvements in service efficiency, including increased availability of hospital beds at a time when the demand for resources is at a peak.

In contrast to the study by Bajaj *et al.*,³ we admitted all children to hospital for at least 24 h to ensure that they were feeding adequately and were clinically stable, a policy felt to be more acceptable to paediatricians. Furthermore, in the study by Bajaj *et al.*,³ primary care physicians supervised the weaning of oxygen, whereas this study utilised a nurse-led home-based

Table 2 Demographic characteristics of each group

	Hospital group	HiTH group	p Value
No of children	22	22	
Median age, months (range)	8.7 (3.0–18.0)	8.5 (3.0–17.6)	0.83
Males, n (%)	10 (45.4%)	16 (72.7%)	0.12
Oxygen saturation on ED arrival (median)	93% (81–99)	94% (88–99)	0.70
RSV positive	16 (72.7%)	11 (50%)	0.12
Parental smoking, n (%)	7 (31.8%)	6 (27.3%)	0.28

ED, emergency department; HiTH, hospital in the home; RSV, respiratory syncytial virus.

service, a design more reflective of paediatric ambulatory care services available in Australia and the UK.

The lack of an effective treatment to change the natural history of acute bronchiolitis means innovative approaches are required to decrease the health and economic burden of the commonest cause of hospitalisation for infants in developed countries. Using carefully considered inclusion and exclusion criteria, home oxygen therapy is a feasible option in the management of children with acute bronchiolitis. This practice could potentially be established in any paediatric unit that is supported by a nurse-led HiTH programme.

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Competing interests: None.

Ethics approval: The study was approved by the Princess Margaret Hospital Ethics Committee.

Patient consent: Obtained.

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Images in paediatrics

A plethoric palm

A 5-year-old boy presented with a red hand since birth. On examination, his right palm was red, plethoric and slightly larger when compared with his left palm (fig 1). A diffuse capillary haemangioma of the right palm extending proximally to involve the entire upper limb and the right pectoral region was the cause for the marked plethora. Mild hypertrophy of the right upper limb and a few tortuous veins over the right pectoral region were noted (fig 2), and hence a diagnosis of Klippel–Trenaunay syndrome was considered. Klippel–Trenaunay syndrome is a rare, sporadic, complex malformation characterised by the clinical triad of (1) capillary malformations (port wine stain), (2) soft tissue and bone hypertrophy or, occasionally, hypotrophy of usually one lower limb and (3) atypical, mostly lateral varicosity.¹ Although lower-limb involvement is very common among the patients with this syndrome, upper-limb involvement has been observed.² The



Figure 1 Comparison of the patient's left and right hand.



Figure 2 Mild hypertrophy of the right upper limb and a few tortuous veins over the right pectoral region of the patient.

striking colour contrast of the palms and upper-limb involvement make this case interesting.

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