

## Oxygen Saturation Target in the Management of Infants Admitted with Viral Bronchiolitis and its Effect on Duration of Hospital Stay in Hong Kong

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### Abstract

We aim to assess whether a use of target oxygen saturation of  $\geq 90\%$  reduces duration of hospital stay for infants admitted to hospital with viral bronchiolitis.

**Keywords:** Bronchiolitis; Oxygen therapy; Duration of hospital stay; Oxygen saturation (SpO<sub>2</sub>) target

### Introduction

Viral bronchiolitis is a common reason for hospital admission for infants under 24 months of age and has significant morbidity and mortality in many countries worldwide [1]. Traditionally, oxygen therapy is prescribed to maintain peripheral capillary oxygen saturation (SpO<sub>2</sub>) at the normoxaemic range of  $\geq 94\%$  [2]. However, Cunningham, *et al.* led a randomized controlled trial published in Lancet 2015 which showed that allowing a target oxygen saturation of  $\geq 90\%$  in management of infants with bronchiolitis is as safe and clinically effective as a target of  $\geq 94\%$  [3]. Nevertheless, the use of oxygen target of SpO<sub>2</sub>  $\geq 94\%$  is still common and widespread from our observation. NICE guideline for children with bronchiolitis published in 2015 suggests discharge consideration when child is taking adequate oral fluids and has maintained a SpO<sub>2</sub>  $\geq 92\%$  in air [4]. However, there are few publications directly studying the benefit of a lower oxygen saturation target in children with bronchiolitis. There are no studies on this topic for the infant population in Hong Kong.

### Methods

We retrospectively analysed hospital records for all infants aged 1 to 24 months admitted to paediatrics ward in Kwong Wah Hospital with bronchiolitis. Kwong Wah Hospital is a medium sized hospital based in urban Hong Kong. A final principle diagnosis was given on discharge by the child's attending paediatrician. We excluded children who were referred for bronchiolitis but the final diagnosis was not bronchiolitis. All children who had the final diagnosis of bronchiolitis and were aged between 1 to 24 months admitted within the study period were included. The study period was a 3-month duration from 1st July to 30th September in 2016.

### Patient and public involvement

Infants were admitted to general paediatrics ward and their progress was recorded in the usual patient notes. Patient records were retrieved retrospectively from hospital records department. We reviewed all children's hospital records in details anomalously.

We recorded if each patient required oxygen therapy during their admission and their respective duration of hospital stay. For patients requiring oxygen therapy, we collected data on the lowest oxygen saturation before starting oxygen therapy, the target oxygen saturation, the mode of oxygen delivery and the amount or concentration of oxygen supplementation given. In addition, the modified-Clinical Asthma

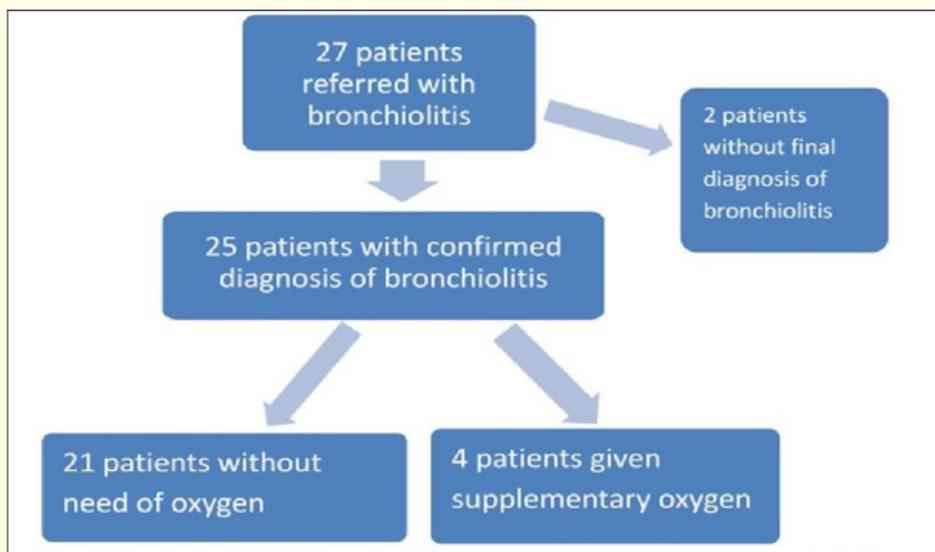
Score (m-CAS) and the information on the feeding status of the child during his or her hospital stay were also collected. The m-CAS is an objective assessment of the child’s overall clinical status using five criteria: oxygen saturation, the presence of wheeze, the use of accessory muscle, breath sounds, and the mental state (Table 1). Each criterion is scored 0, 1 or 2 points based on the severity, with a total maximum score of 10. The score was routinely calculated for all children with bronchiolitis in our unit, assessed every 4 hours by our trained nursing team. A score of 1 - 2 is indicative of mild disease, a score of 3 - 5 is moderate disease, whereas a score > 5 is indicative of severe disease. Patients and the public were not directly involved in this research.

Score Points	SpO <sub>2</sub>	Wheezing	Accessory Muscle Use	Expiratory Breath Sound	Mental status
0	≥ 95% in room air	None/end expiratory	None	Normal	Normal
1	< 95% in room air	Entire expiratory phase	Subcostal, substernal, intercostal, nasal flaring	Unequal	Altered mental status/agitated
2	<95% with FiO <sub>2</sub> 30%	Inspiratory and expiratory	Supraclavicular, paradoxical respiration	Decreased bilaterally	Depressed

**Table 1:** Modified- Child Asthma Score. There are 5 criteria (SpO<sub>2</sub>, Wheezing, Accessory muscle use, Expiratory breath sound and mental status), each scored 0 - 2 points. Total score ranges from 0 to 10.

### Case Report and Results

There was a total of 27 children admitted with bronchiolitis. 25 out of 27 children were confirmed to have a principle diagnosis of bronchiolitis on discharge. Of these 25 children, 21 did not require any oxygen supplementation during their hospital stay. Four children required oxygen supplementation during the hospital stay with an age range of 9 - 23 months (Figure 1).



**Figure 1:** Flow Diagram of 27 children referred with bronchiolitis, of which 25 were included for analysis. 4 of the 25 children were given supplementary oxygen.

The children were prescribed a target SpO<sub>2</sub> of ≥ 94%. The mean duration of hospital stay for infants who received oxygen therapy was 5.3 days compare to 3.4 days for infants who did not receive oxygen therapy (Figure 2). For children who required oxygen supplementation, the lowest SpO<sub>2</sub> was 88-90% in room air (two children had lowest SpO<sub>2</sub> of 88%, and the other two children had lowest SpO<sub>2</sub> of 90%). The duration of oxygen therapy ranged from one to five days. Two children had oxygen delivered via a humidified high flow device, with a fraction of inspired oxygen (FiO<sub>2</sub>) of 0.22 to 0.30. The other two children had oxygen delivered via nasal cannula with a flow rate of 0 - 2 L/min.



Figure 2: Duration of hospital stay for children with and without oxygen therapy given.

In order to analysis whether the use of lower SpO<sub>2</sub> target can reduce duration of hospital stay, we also included detailed data on the clinical condition of the children with oxygen given (See Appendix 1). In the 24 hours immediately before oxygen was stopped, the four children had lowest oxygen saturation of 90% - 95%. All of them also had satisfactory feeding status (they were all fully oral fed, with no vomiting, and passed urine 5 - 10 times in 24 hours) the day before their oxygen supplementation was weaned off.

Finally, the children who required oxygen therapy had an initial m-CAS of 2 - 5 on admission, indicating mild to moderate disease. Of note, in the day before the oxygen therapy was stopped, 3 patients had a m-CAS of 0 - 1, and 1 patient had m-CAS of 2, all indicative of mild disease.

### Discussion

Bronchiolitis is a frequent cause of admission to general paediatrics. Only four out of twenty- five children with bronchiolitis required oxygen therapy, with a lowest oxygen saturation of 88% in room air for 2 children. Another two children had lowest SpO<sub>2</sub> of 90%, suggesting that they may not have required oxygen at all if new SpO<sub>2</sub> threshold of ≥90% was used. In the day before the discontinuation of oxygen therapy, all children had mild disease severity as demonstrated by the m-CAS of 0 - 2 out of 10. All children also had satisfactory oral feeding. They would have been considered for discharge if not for their prescription of oxygen supplement to maintain ≥ 94%.

### Conclusion

In conclusion, all infants who required oxygen in our cohort were clinically stable with satisfactory oral feeding and SpO<sub>2</sub> of ≥ 90% at least 1 day before discontinuation of oxygen. The use of oxygen supplementation to maintain SpO<sub>2</sub> of ≥ 94% had prolonged their hospital duration of stay. We recommend that the equally safe and effective target SpO<sub>2</sub> of ≥90% be used instead to reduce the average length of patient stay in general paediatric wards.

## Key Messages

### What is known about the subject?

- Bronchiolitis is a common reason for admissions to general paediatric wards and presents a significant workload in many busy paediatric units worldwide.
- Oxygen supplementation is used to maintain adequate oxygen saturation in infants with bronchiolitis but there is no universal consensus regarding the target saturation in practice,
- A target oxygen saturation of 90% or higher is as clinically effective and safe as a target of 94% or higher.

### What this study adds:

- A target oxygen saturation of 90% would reduce the duration of hospital stay in infants with bronchiolitis.

## Competing Interest Statement

Dr Ng DYH has no competing interests. Dr Hau SF has no competing interests. Dr Chan YC has no competing interests.

## Contributorship Statement

Dr Chan YC provided guidance in planning of this study and methodology. Dr Ng DYH and Dr Hau SF are principle worker for conducting data collection, analysis, and the reporting of the work.

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