

Oxygen saturation thresholds in bronchiolitis: examining admissions

Tim J van Hasselt,¹ Bhavna Singham,² Eve Bassett,³ Ian D Wacogne,³ Paediatric Research Across the Midlands (PRAM) Network

¹Department of General Paediatrics, Walsall Manor Hospital, Walsall, UK
²Birmingham Children's Hospital NHS Foundation Trust, Birmingham, UK
³Department of General Paediatrics, Birmingham Children's Hospital NHS Foundation Trust, Birmingham, UK

Correspondence to

Dr Tim J van Hasselt, General Paediatrics, Walsall Manor Hospital, Walsall WS2 9PS, UK; t.vanhasselt@nhs.net

ABSTRACT

Objective Examine admissions for bronchiolitis, comparing centres with oxygen saturation thresholds for admission of 90% versus 92%.

Design Prospective multi-centre service evaluation, all admissions for bronchiolitis during 4-week period, November 2018.

Setting Paediatric departments across 12 hospitals in the West Midlands, UK.

Patients 320 patients aged 6 weeks–1 year, diagnosis of bronchiolitis, exclusions: chronic illness or high dependency/intensive care admission.

Main outcome measures Reason for admission, admission saturations and length of stay.

Results Inadequate feeding was the the most common reason for admission (80%). Only 20 patients were admitted solely because of low saturations. Median peripheral oxygen saturation in this group was 88%. Median length of stay in 90% centres was 41 hours, against 59 hours for 92% centres ($p=0.0074$).

Conclusions Few patients were admitted solely due to low oxygen saturations, only one had a potentially avoidable admission if thresholds were 90%. Length of stay was significantly reduced in the 90% threshold centres.

BACKGROUND

The Bronchiolitis of Infancy Discharge Study (BIDS) randomised controlled trial demonstrated that for patients admitted with bronchiolitis, a peripheral oxygen saturation (SpO₂) threshold of 90% is safe compared with 94%,¹ though admission thresholds were not examined.

Moreover, Schuh *et al* found that using falsely elevated SpO₂ displays led to a significant reduction in admissions for bronchiolitis in their randomised controlled trial.²

Following these studies, many paediatric centres have reduced their SpO₂ threshold for both admission and discharge for bronchiolitis from the 92% recommended by the National Institute for Health and Care Excellence (NICE)³ to 90%.

It is not known how this reduction in SpO₂ admission threshold has influenced the characteristics of patients admitted with bronchiolitis.

OBJECTIVE

We aimed to examine patients admitted with bronchiolitis, comparing centres with 90% SpO₂ threshold to those with 92% threshold.

What is already known?

- ▶ There is variation across centres in the admission threshold for oxygen saturations for patients with bronchiolitis.
- ▶ While patients with bronchiolitis are most often admitted due to poor feeding, many require oxygen and this impacts on the length of stay.

What this study adds?

- ▶ There are very few patients who have oxygen saturations of 90%–91% in air, admitted solely because of low saturations.
- ▶ There would be very few admissions prevented if there was a universal oxygen saturation threshold of 90%.
- ▶ Reduction of oxygen saturation discharge threshold from 92% to 90% is associated with a decreased length of stay.

DESIGN

Prospective multi-centre service evaluation, using standardised proformas and data collection spreadsheets. Routinely collected data were used, ethical approval was not required for this service evaluation; however, the project was registered with each centre's audit and clinical governance department.

SETTING

12 paediatric departments across the West Midlands region, UK; majority secondary care level, one tertiary children's hospital.

PATIENTS

All patients admitted under the care of the paediatric team, whether from primary care or emergency department, between 1 November 2018 and 30 November 2018, with admission diagnosis of bronchiolitis, including those admitted only for a short duration of observation, for instance to a paediatric assessment unit.

Exclusions were as per BIDS trial: <6 weeks and >1 year corrected gestational age; prematurity <37/40 with oxygen requirement in last 4 weeks; congenital heart disease with significant cardiovascular compromise; cyanotic congenital heart disease; cystic fibrosis; interstitial lung disease;



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Short report

immunodeficiency; direct admission to high dependency unit (HDU) or paediatric intensive care unit (PICU).

COMPARISON

Patients from all the 90% SpO₂ threshold centres were pooled, and then compared with pooled patients from all the 92% centres.

Analysis was performed using Excel (Microsoft, USA) and Graphpad Quickcalcs (GraphPad Software, USA). χ^2 was used for categorical data, Mann-Whitney U test for non-parametric data.

MAIN OUTCOME MEASURES

- ▶ Lowest SpO₂ in air at time of decision to admit.
- ▶ Reason(s) for admission: low SpO₂ in air, inadequate feeding, social concerns/anxiety, repeat attendance in same illness, clinical instability: tachycardia, tachypnoea, unwell/deteriorating, apnoea.
- ▶ Length of stay, calculated from admission time/date and discharge time/date.

RESULTS

Data were collected for 394 patients, 320 patients were included in analysis, after 74 exclusions; most common reasons: 34 <6 weeks of age, 10 >1 year of age and 9 HDU admissions. There were 162 patients admitted to the six centres with a 90% SpO₂ threshold for admission, which included the tertiary hospital, and 158 admitted to the six centres with a 92% threshold. The overall mean age was 22 weeks (range 42–363 days); 23 weeks in the 90% centres and 21 weeks in the 92% centres ($p=0.276$).

Individual patients could have multiple reasons given for admission, see table 1. 80% of all patients were admitted because of inadequate feeding, whereas 32% were admitted due to low SpO₂. In centres with 90% threshold, 27% were admitted for low SpO₂, against 37% in 92% threshold centres ($p=0.050$).

The overall median oxygen saturation was 94% (range 66%–100%). The median was 95% in the 90% centres, and 94% in the 92% centres ($p=0.085$).

There were 20 patients who were admitted solely because of low SpO₂. Eight were from 90% threshold centres and 12 from 92% centres. Median saturation in this subgroup was 88% (range 66%–90%) with only one patient having SpO₂ of 90%, who was admitted to a 92% threshold centre.

Table 1 Reasons given for admission, individual patients could have multiple reasons given, comparing patients admitted to centres with 90% SpO₂ threshold for admission with those admitted to 92% threshold centres

	Total—320 patients		90% centres—162 patients		92% centres—158 patients	
	n	%	n	%	n	%
Low SpO ₂	101	32	43	27	58	37
Inadequate feeding	255	80	129	80	126	80
Social concerns/anxiety	32	10	15	9	17	11
Repeat attendance	51	16	30	19	21	13
Tachycardia	53	17	32	20	21	13
Tachypnoea	95	30	47	29	48	30
Unwell/deteriorating	35	11	17	10	18	11
Apnoea	5	2	1	1	4	3

Table 2 Mean and median length of stay, comparing centres with a discharge SpO₂ threshold of 90% with those with a threshold of 92%

	Total	90% SpO ₂ discharge threshold centres	92% SpO ₂ discharge threshold centres
n	320	181	139
Mean length of stay (hours) (SD)	61 (65)	54 (54)	70 (77)
Median length of stay (hours) (IQR)	46 (18–86)	41(15–76)	59 (22–93)*

* $p<0.01$.

Mean length of stay for all patients was 61 hours (SD 65 hours), median 46 hours (IQR 18–86). In centres with 90% admission, SpO₂ threshold median length of stay was significantly shorter at 41 hours (IQR 13–72), against 59 hours (IQR 22–93) for 92% threshold centres ($p=0.0037$).

One centre which had an admission threshold of 92% but a discharge threshold of 90%, so analysis of length of stay was repeated with this centre included in the 90% threshold group, see table 2. Median length of stay in 90% discharge threshold centres was 41 hours (IQR 13–72) compared with 59 hours (IQR 22–93), ($p=0.0074$).

We examined the data to see whether the most senior decision-maker at the time of admission was a confounding factor. Tier 2 doctors ('registrar' equivalent) were the most common decision-makers, 77% of admissions. This was 73% in 90% threshold centres, and 82% in 92% threshold centres. The next most common decision-maker was a consultant at 17% of admissions, 18% in 90% threshold centres and 16% in 92% centres. Tier 1 doctors ('senior house officer' equivalent) were decision-makers in only 4% of admissions, 7% and 1% in 90% and 92% threshold centres, respectively.

While there was a significant difference in seniority between 90% and 92% SpO₂ centres when examining Tier 1 doctors, Tier 2 doctors and consultants ($p=0.020$), this was not significant when examining only Tier 2 doctors and consultants ($p=0.501$).

CONCLUSIONS

Our large multi-centre prospective service evaluation of patients admitted with bronchiolitis showed that reducing admission SpO₂ threshold affects few patients, though discharge SpO₂ threshold does affect length of stay.

We showed that poor feeding was the most common reason for admission, in line with previous evidence.⁴ Mean SpO₂ was not significantly different between the groups, and there were low numbers of patients admitted solely for hypoxia. Only one patient had saturations of 90%, in a 92% threshold centre, suggesting one patient of the 158 admitted to centres with a 92% threshold was a potentially avoidable admission, had the threshold been reduced to 90%. It may be at SpO₂ of 90%–92% patients will be struggling to complete feeds, or showing clinical signs, requiring admission regardless.

Although IQRs were high, length of stay was significantly shorter in centres with a discharge SpO₂ threshold of 90%, compared with 92%. The reduction in length of stay from reducing SpO₂ thresholds was similar to that seen in BIDS,¹ and supports previous evidence that oxygen requirement is a key determinant of length of stay in bronchiolitis.^{4,5}

Strengths of this study include it being a large multi-centre service evaluation across a whole region, with a subsequent reasonable size population. In addition, the prospective nature

could capture the actual reasons for admission, in real time, from the decision-maker.

However, the limitation of prospective studies is that there is a higher chance of missing data. Moreover, reasons given for admission may not be fully captured, influenced by subconscious reasoning or subjective interpretation of clinical signs. Though BIDS examined readmission rates, finding no increase with a reduction in SpO₂ thresholds, we did not examine this ourselves.

We examined seniority of decision-maker as a potential confounding factor; overall, the centres did not substantially differ. However, there will be other confounding factors not accounted for: socio-economic variation; differing geographical factors across rural and urban areas; and different arrangements in service provision both within hospitals and the community support outside hospitals.

Our study suggests that reducing SpO₂ admission thresholds from 92% to 90% does not affect admissions. However, reducing SpO₂ discharge thresholds does reduce length of stay, and further studies examining possible benefits in terms of bed capacity and cost would be helpful.

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Contributors TjvH was involved in project design, statistical analysis and manuscript. BS was involved in project design and liaison with local data collectors. EB was involved in project design. IW was involved with project design. All authors reviewed and approved final manuscript. BS, AT, VP, HS, JN, SG, HC, KF, IF, LF, PD, DC, KH, FH, NF and CC are PRAM affiliated local collaborators, led the project locally at each site: registered with governance, collected and reviewed local data.

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