BMJ Paediatrics Open

National survey of feasibility of NIV trials for management of children with bronchiolitis

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To cite: Rosala-Hallas A, Jones AP, Bedson E, *et al*. National survey of feasibility of NIV trials for management of children with bronchiolitis. *BMJ Paediatrics Open* 2020;**4**:e000780. doi:10.1136/bmjpo-2020-000780

Received 26 June 2020
Revised 7 August 2020
Accepted 25 August 2020

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ABSTRACT

Background Bronchiolitis is a major cause of admission to hospital in children. Non-invasive ventilation (NIV) support with continuous positive airway pressure (CPAP) or high-flow nasal cannula (HFNC) oxygen is routinely used for infants in the UK with bronchiolitis.

Objective To establish UK paediatric practice regarding management of bronchiolitis, and to explore issues pertinent to the design of a potential future randomised controlled trial of NIV.

Design Screening logs were completed in hospitals in England capturing information on paediatric bronchiolitis admissions. An online national survey of clinical practice was disseminated to healthcare professionals (HCPs) across the UK to ascertain current management strategies.

Results Screening logs captured data on 393 infants from 8 hospitals. Reasons for admission were most commonly respiratory distress and/or poor fluid intake. Oxygen was administered for 54% of admissions. Respiratory (CPAP and HFNC) and non-respiratory support administered varied considerably. The national survey was completed by 111 HCPs from 76 hospitals. Data were obtained on criteria used to commence and wean NIV, responsibilities for altering NIV settings, minimum training requirements for staff managing a child on NIV, and numbers of trained staff. Most centres were interested in and capable of running a trial of NIV, even out of normal office hours.

Conclusions Respiratory and non-respiratory management of bronchiolitis in UK centres varies widely. A trial of HFNC oxygen therapy in this group of patients is feasible and HCPs would be willing to randomise patients into such a trial. Future work should focus on defining trial eligibility criteria.

What is known about the subject?

- Bronchiolitis is one of the the most common causes of hospitalisation in infancy.
- Non-invasive ventilation and specifically high-flow nasal cannula oxygen therapy is increasingly used for children with bronchiolitis based on limited evidence in the UK.
- There is widespread support among paediatricians in the UK for a trial of non-invasive ventilation to guide UK practice.

What this study adds?

- Respiratory and non-respiratory management of bronchiolitis in UK centres varies widely.
- A trial of high-flow nasal cannula oxygen therapy is feasible and healthcare professionals would be willing to randomise patients into such a trial.

INTRODUCTION

Bronchiolitis is a major cause of admission to hospital in children.[1 2] Between 2004 and 2012, 8172 children under the age of 1 year were admitted to a paediatric intensive care unit (PICU) for bronchiolitis in England.[3] From 2004 to 2011, the overall average PICU admission rate increased by 1.8% each year.[3]

Bronchiolitis management is centred on oxygen therapy for hypoxia, respiratory support and good hydration. Early use of non-invasive ventilation (NIV), such as continuous positive airway pressure (CPAP) or heated humidified high-flow nasal (HFNC) oxygen (O_2), may have an impact on outcome by avoiding disease progression.[4] There has been an increase in the use of HFNC in routine clinical practice for moderate-to-severe bronchiolitis; however, until recently, there has been little evidence to guide practice, and there have been no studies using NHS patients from the UK.[5 6] Recently, a number of reports have raised concerns regarding its cost effectiveness in bronchiolitis.[7]

The objectives of this study were to assess current UK practice regarding bronchiolitis management in terms of the type of NIV methods used and the criteria for commencing and weaning NIV. We also wished to explore issues pertinent to the design of a potential future randomised controlled trial (RCT) of NIV. This study formed part of a larger research project (Non-Invasive Ventilation

for the Management of Children with Bronchiolitis: a feasibility study (NOVEMBR)).[8]

METHODS

A point-prevalence study, using paper screening logs of paediatric hospital admissions with bronchiolitis, was prospectively completed, by research nurses from district general hospitals and paediatric tertiary centres hospitals across England. The logs gave guidelines for completion and captured: patient age, referral route, demographic and clinical risk factors, reasons for admission, treatment interventions during admission, method of O_2 delivery and amount of O_2 (if any), and length of hospital stay. In total, 14 hospitals were approached for participation of which eight responded (five district general hospitals and three paediatric hospitals; see online supplemental list 1 for a list of the hospitals). The logs were circulated in two waves: the first wave included five hospitals and ran from 12 December 2016 to 12 January 2017; the second wave included three different hospitals from 11 December 2017 to 13 January 2018. The same log was used for all hospitals; repeat sampling was not used. Data on all patients admitted with a diagnosis of bronchiolitis during these time periods to these hospitals were captured.

In addition, an online national survey (online supplemental material) was developed by the study management group to explore current practices of HCPs when managing bronchiolitis. The survey was piloted among clinical members of the Study Management Group, which comprised PICU, respiratory and general paediatricians, paediatric nurses and research nurses. Amendments made from the piloting process were improvements to the clarity and understanding of the survey by changes to some of the language. The survey was disseminated to lead paediatricians at all paediatric centres in the UK through the National Institute for Health Research Clinical Research Network (CRN) Coordinating Centre to Specialty Cluster Office for Children and Local CRNs, and through the General and Adolescent Paediatric Research Collaborative UK and Ireland. The lead paediatricians were asked to complete the survey themselves or to pass it on to whoever they considered most appropriate. It was conducted online between 29 September 2017 and 31 January 2018. Respondents were asked to report their job title and give information about their hospital including: the number of estimated paediatric bronchiolitis admissions, type of NIV interventions used and who administers them, criteria for initiating and weaning CPAP and HFNC, availability of local bronchiolitis care pathways and lastly, questions to determine the acceptability to HCPs of running a clinical trial. Completion of the survey was deemed consent to participate.

Data from both the screening logs and the online national survey were summarised using descriptive statistics. Where questions were missed or responses 'Not known', percentages were derived using denominators for those who gave an answer only.

Advice from the HRA was sought and it was confirmed that ethical approval was not required for the online survey. Approval was not required for the screening exercise as only anonymous data were collected.

Patient and Public Involvement (PPI) was not included forthis component of the NOVEMBR study since the aim was to ascertain currentpractice amongst HCPs.

RESULTS

Screening logs

Table 1 gives a summary of the screening data. Three hundred and ninety-three patients were screened at eight hospitals across England (online supplemental list 1). Data by hospital are presented in online supplemental table 1. The greatest proportion (139/357, 39%) were admitted in the afternoon and early evening (14:00–20:00). Median age at admission was 14 weeks (IQR: 8–29) and median length of hospital stay was 2 days (IQR: 1–3). Most referrals were via emergency departments (246/391, 63%) or from general practitioners (99/391, 25%). It was possible for multiple reasons for admission to be selected for each patient; among the most frequent, over half (203/392, 52%) reported difficulty with breast feeding/inadequate oral fluid intake, 36% (142/392) other respiratory problems, including cough and increased work of breathing, 31% (121/392) severe respiratory distress and 27% (106/392) of children looked seriously unwell to a HCP. Commonly reported risk factors for hospital admission included age less than 3 months (165/357, 46%) and/or prematurity (89/357, 25%); 34% (120/357) reported no risk factors. Non-respiratory interventions included: nasogastric fluids (157/354, 44%), antibiotics (87/354, 25%), nebulised treatments (52/354, 15%) and intravenous fluids (37/354, 10%); 38% (134/354) reported no treatment intervention. There was considerable variation across hospitals: nasogastric fluids use ranged from 17% to 77% of infants, antibiotics from 9% to 67%, nebulisers from 7% to 55% and intravenous fluids from 1% to 37% (figure 1). Oxygen was delivered to 191 (54%) patients. Multiple methods for O_2 delivery could be selected; methods reported were low-flow nasal cannula (103/191, 54%), rebreathe mask (42/191, 22%), head box with humidified O_2 (25/191, 13%), HFNC (52/191, 27%), CPAP (18/191, 9%) and intubation and ventilation (21/191, 11%).

National online survey of current practice

The survey was accessed by 123 individuals. Twelve (9%) completed demographic details only and were excluded from the summaries; the remaining 111 (91%) responders were from 76 hospitals (online supplemental list 2). The majority (83/111, 75%) of respondents were from district general hospitals; 25% (28/111) were from paediatric tertiary centres. According to the Royal College of Paediatrics and Child Health workforce document published in 2019, there are 189 paediatric centres with inpatient facilities in the UK of which 35 are considered specialist

Table 1 Screening data

	N (%)
Patient age (weeks)	
N	378
Mean (SD)	20.0 (15.9)
Median (IQR)	14.2 (7.5–29.1)
Min, Max	1.3–82.4
Missing	15
Length of stay in hospital (days)	
N	390
Mean (SD)	2.7 (3.0)
Median (IQR)	2 (1.3)
Min, max	0–24
Missing	3
Time of presentation	
N	357
02:00–08:00	36 (10%)
08:00–14:00	81 (23%)
14:00–20:00	139 (39%)
20:00–02:00	101 (28%)
Missing	36
Referral route	
N	391
Accident and emergency	246 (63%)
District general hospital	16 (4%)
General practitioner	99 (25%)
Open access	17 (4%)
Other hospital	10 (3%)
Readmission	1 (0.3%)
Walk-in	2 (0.5%)
Not known	2
Risk factors*	
N	357
Baby born prematurely	89 (25%)
Congenital heart defect	7 (2%)
Neuromuscular disease	1 (<1%)
Immunodeficiency disorders	2 (1%)
Chronic lung disease	8 (2%)
Young age (≤3 months)	165 (46%)
Other	24 (7%)
No risk factors	120 (34%)
Not known	1
Missing	35
Reason for admission*	
N	392
Apnoea (reported or observed)	21 (5%)
Child looks seriously unwell to a HCP	106 (27%)
Severe respiratory distress	121 (31%)
Central cyanosis	3 (1%)
Persistent O_2 saturation <92% when breathing air	30 (8%)
Difficulty with breast feeding/ inadequate oral fluid intake	203 (52%)
Social circumstances	2 (1%)
Other respiratory	142 (36%)
Other	50 (13%)
Missing	1
Method* of O_2 delivery	
N	191
Nasal Cannula	103 (54%)
Headbox with humidified O_2	25 (13%)
Heated humidified high-flow nasal O_2	52 (27%)
Rebreathe mask	42 (22%)
CPAP	18 (9%)
Intubation and ventilation	21 (11%)
Other	13 (7%)
No O_2 used	162
Not known	3
Missing	37

*Multiple responses could be selected.
CPAP, continuous positive airway pressure; HCP, healthcare professional.

(tertiary) centres.[9] Respondents were either consultants (92/109, 84%) or nurses (12/109, 11%, table 2).

Almost half (47%, 38/81) of respondents stated that the estimated annual number of paediatric bronchiolitis admissions to their hospital with a length of stay of at least 1 day, was between 101 and 200, and 30% (24/81) estimated between 51 and 100. The majority (71/84, 85%) of respondents stated local bronchiolitis care pathways and/or guidance were available to them; 86% (75/87) reported the criteria for starting O_2 was SpO_2 <92%. Six respondents (6/88, 7%), from separate hospitals, reported the ability to send home children with bronchiolitis on O_2.

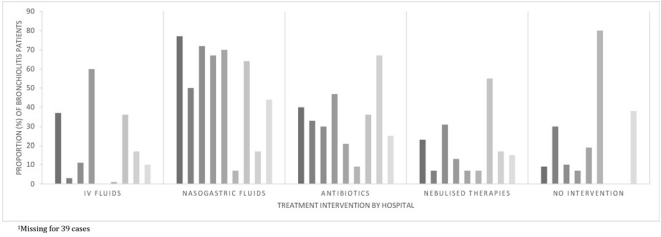

Figure 1 Screening responses—treatment interventions across hospitals.

Table 2 Survey participant/hospital demographics

Participant and hospital demographics	Number of respondents (%)
Job title/role	
N	109
Consultant	92 (84%)
Nurse	12 (11%)
Other	5 (5%)
Missing	2
Number of children with bronchiolitis admitted to hospital (with ≥1 day length of stay) per year	
N	81
<50	5 (6%)
51–100	24 (30%)
101–200	38 (47%)
201–300	9 (11%)
301–400	2 (2%)
>401	3 (4%)
Not known	28
Missing	2
Local bronchiolitis care pathways and/or guidance available	
N	84
Yes	71 (85%)
No	13 (15%)
Not known	6
Missing	21
Criteria for starting O_2	
N	87
SpO_2 <92%	75 (86%)
Other	12 (14%)
Not known	2
Missing	22
Do you send otherwise well children with bronchiolitis who are improving, home on O_2?	
N	88
Yes	6 (7%)
No	82 (93%)
Not known	3
Missing	20
Methods to deliver O_2: therapy on the general medical practice ward*	
N	86
Nasal cannula	84 (98%)
Heated humidified high-flow nasal O_2	73 (85%)
Rebreathe mask	50 (58%)
Non-invasive CPAP	49 (57%)
Headbox with humidified O_2	29 (34%)
Missing	25
Methods to deliver O_2: therapy on the High Dependency Unit*	
N	73
Heated humidified high-flow nasal O_2	70 (96%)
Non-invasive CPAP	64 (88%)
Nasal cannula	56 (77%)
Rebreathe mask	39 (53%)
Headbox with humidified O_2	19 (26%)
Missing	38

*Multiple responses could be select.
CPAP, continuous positive airway pressure.

CPAP/HFNC

More respondents reported being able to deliver O_2 on paediatric wards by HFNC (73/86, 85%) than CPAP (49/86, 57%); 55% reported the ability to deliver O_2 using both treatment modalities. On High Dependency Units (HDU), the ability to deliver O_2 using either was similar (HFNC, 70/73, 96%; CPAP, 64/73, 88%).

The modal estimate of infants with bronchiolitis that did not require O_2 on admission reported by respondents was 11%–20%, whereas the estimate of infants that did require O_2 was 61%–70%. Although the modal estimate of infants treated with CPAP or HFNC was similar (0%–10%), the variation was more marked for HFNC, with some respondents estimating that up to 80% of patients requiring NIV in their centres would be treated with HFNC, compared with a maximum of 40% estimated to be treated with CPAP (online supplemental table 5).

Apnoea, type 2 respiratory failure, exhaustion and the child not improving on alternate therapies (mostly HFNC) were more commonly cited as criteria to start CPAP compared with HFNC (figure 2, online

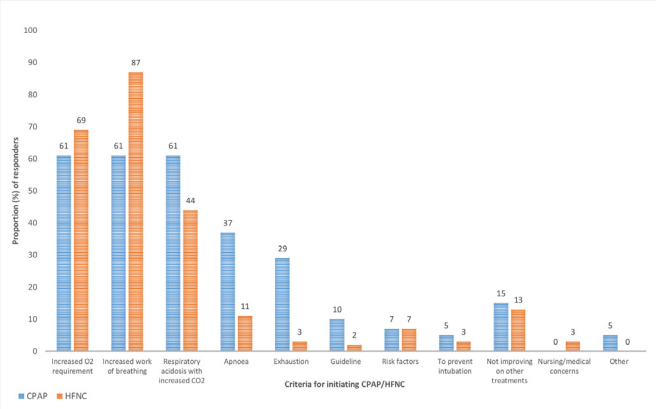

Figure 2 Survey responses—criteria for initiating continuous positive airway pressure (CPAP) compared to high-flow nasal cannula (HFNC).

supplemental table 3); HFNC was started for increased work of breathing more often than CPAP. Correspondingly, resolved apnoea, and improved C02/respiratory acidosis were more commonly cited as criteria for weaning CPAP compared with HFNC. Responsibilities for altering CPAP/HFNC settings lay predominantly with the nursing staff, who were responsible in 40% (23/57) of cases on CPAP compared with 77% (46/60) of cases on HFNC. Minimum training requirements for staff to manage a child on CPAP/HFNC were similar for both methods and included: annual attendance of in-house training packages with and without clinical competency assessments, attendance to ad hoc training sessions run by equipment manufacturers and high dependency courses.

Acceptability of a trial

Most respondents (34/41, 83%) reported that it would be possible to run a clinical trial evaluating NIV treatment approaches in bronchiolitis even out-of-hours at their hospitals (online supplemental table 4). Forty respondents suggested at least one barrier to undertaking such a trial. Barriers included: current medical/nursing staff workload (15/40, 38%), availability of equipment (7/40, 18%), lack of research nurse support (4/40, 10%) and lack of adequately trained staff to undertake a trial (3/40, 8%). Correspondingly, 47 respondents suggested at least one enabler to undertaking a trial: having adequate medical, nursing and research nurse support (24/47, 51%), good training and education about any trial (8/47, 17%) and importantly, having access to extra equipment (8/47, 17%). Sixty per cent (47/78) estimated that 1–5 HDU beds would be available in winter.

Respondents at 72% of sites reported always having one or more GCP trained doctor on every shift. Similarly, respondents at 45% of sites reported that their site had one or more GCP trained nurse on every shift.

DISCUSSION

In this prospective observational study of bronchiolitis admissions, large numbers of children (particularly young infants approximately 3 months of age) were hospitalised with this condition but generally for only a few days. Many (46%) did not require oxygen during their admission, but in those who did, the method by which it was administered varied widely; this was particularly so for those requiring NIV. Despite publication of The National Institute for Health and Care Excellence (NICE) guidelines on bronchiolitis in 2015,[3] there remains considerable variation in other aspects of management.

This study provided the opportunity to compare survey responses from a large number of UK paediatric HCPs with screening log data on actual bronchiolitis admissions to secondary and tertiary centres. Survey responses overestimated the proportion of children requiring O_2 on admission compared with screening log data, and although modal estimates of CPAP usage were broadly in line with actual usage, estimates of HFNC usage underestimated actual usage. In interpreting these results, it should be acknowledged that the screening log data were based on admissions to only eight paediatric centres, and that there was a wide range of estimates of percentages of children treated with O_2 and with NIV (particularly HFNC). It may also be the case that the screening results differ between district general hospitals and paediatric tertiary centres; however, our sample size did not permit such a comparison.

We compared reasons for starting and weaning NIV. Apnoea, type 2 respiratory failure, exhaustion and the child not improving on alternate therapies (mostly HFNC) were more commonly cited as criteria to start CPAP. Correspondingly, resolved apnoea, and improved $C0_2$/respiratory acidosis were more commonly cited as weaning criteria for CPAP than HFNC. The overall consistency of approach to starting and weaning NIV suggests the need for a consensus-based clinically pragmatic protocol for any future trial, and that agreeing criteria and a protocol to initiate and wean NIV across sites in a future trial is feasible. Furthermore, such criteria have already been adopted for a UK-based pragmatic trial in critically ill children on both stepping up and stepping down non-invasive respiratory support.[10]

Based on our findings, we would question whether it is currently feasible for a HFNC versus CPAP trial to be undertaken outside of PICUs and high-dependency units in the UK. This is primarily for reasons of capacity/capability, with many centres unable to support the use of CPAP on general paediatric wards and also given the recent funding and start of the FIRST-ABC (First-line support for Assistance in Breathing in Children) trial which is examining the non-inferiority of HFNC compared with CPAP.[10] However, a trial to assess the clinical effectiveness of HFNC versus standard oxygen therapy ('standard' agreed a priori) is feasible and one which many general paediatricians would likely support. A key issue for any such trial would be eligibility criteria. NOVEMBR and recently published RCTs of NIV for bronchiolitis suggest that eligibility cannot be based solely on the need for oxygen.[5 6] We have shown here that although over half children hospitalised with bronchiolitis are hypoxic on admission, most do not require O_2 for long (under 24 hours), do not deteriorate that frequently, and do not have prolonged inpatient admissions. Even for those hypoxic children at high risk of severe bronchiolitis (ie, those less than 3 months of age or born prematurely), the median (IQR) length of stay in hospital was only 2 (1–3) days. Key eligibility criteria for any future trial will likely have to include both need for O_2 and increased work of breathing, and take into account risk factors such as young age/prematurity. It is these infants for whom HFNC likely has the biggest potential to demonstrate clinical and cost effectiveness. A retrospective cohort study published in 2018 identified predictors of escalated care in bronchiolitis and used these to derive a risk score to outline higher risk patients; validation of such a score would be beneficial.[11]

The screening logs highlighted a large variation in the frequency with which various non-respiratory interventions were used in children with bronchiolitis. Variation on this scale has previously been reported between countries, but not to our knowledge within the UK.[12] When designing potentially large multicentre trials of NIV for children with bronchiolitis, an appreciation of this sort of variation in practice may be needed when planning patient recruitment per site and trial acceptability.

There were two limitations of note, the first being that in the survey multiple responses from the same hospital could have inflated the proportions for certain responses. To check the validity of our results, we looked at the results with each hospital included only once for each response level (online supplemental tables 2-4) and found that the proportions were similar. The second limitation was that participants from the same hospital occasionally reported different answers, which is likely due to different perspectives depending on the job roles of the respondents; however, sample sizes prevented us from exploring differences between HCP subgroups (ie, nurses from general paediatric wards and those from HDU).

We have established that there is a wide variety of practice across the UK in the respiratory and non-respiratory treatments given to infants with bronchiolitis. Our results also suggest that a trial of NIV is feasible and that HCPs would be willing to randomise patients into an NIV trial. Future work should now focus on defining the eligibility criteria for such a trial.

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Acknowledgements The authors would like to acknowledge the healthcare professionals who participated in the screening log and survey of national practice. They also would like to thank the funder, the NIHR Research for Patient Benefit Programme.

Contributors CvM and PM conceived the study. CvM, PM, RF and KW designed the study. EB, MP, KT, VC and DL were members of the study management group. AR-H analysed the data. AJ supervised data analysis. AR-H, APJ and PM drafted the manuscript. All authors reviewed and provided comments on the manuscript.

Funding This research was funded by the National Institute for Health Research (NIHR), Research for Patient Benefit (RfPB) Programme (Grant Reference Number PB-PG-1014-35081).

Disclaimer Views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

Competing interests CvM was an invited speaker at a meeting sponsored by Fisher & Paykel. PM sits on an independent data monitoring and safety committee of an early phase trial of an antiviral treatment for bronchiolitis funded by Pulmocide and as an advisor for antiviral trials for bronchiolitis funded by Janssen and Alios. RF has served on independent data monitoring and safety committees of early phase trials in bronchiolitis funded by Ablynx and on a clinical endpoint committee for an RSV vaccine trial funded by Janssen.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The datasets generated are available from the corresponding author on reasonable request.

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REFERENCES

1 Florin TA, Plint AC, Zorc JJ. Viral bronchiolitis. *Lancet* 2017;389:211–24.
2 Reeves RM, Hardelid P, Gilbert R, *et al*. Estimating the burden of respiratory syncytial virus (RSV) on respiratory hospital admissions in children less than five years of age in England, 2007-2012. *Influenza Other Respi Viruses* 2017;11:122–9.
3 Green CA, Yeates D, Goldacre A, *et al*. Admission to hospital for bronchiolitis in England: trends over five decades, geographical variation and association with perinatal characteristics and subsequent asthma. *Arch Dis Child* 2016;101:140–6.
4 Nice bronchiolitis guideline, 2016. Available: https://www.nice.org.uk/guidance/ng9 [Accessed Feb 2020].
5 Franklin D, Babl FE, Schlapbach LJ, *et al*. A randomized trial of high-flow oxygen therapy in infants with bronchiolitis. *N Engl J Med Overseas Ed* 2018;378:1121–31.
6 Kepreotes E, Whitehead B, Attia J, *et al*. High-Flow warm humidified oxygen versus standard low-flow nasal cannula oxygen for moderate bronchiolitis (HFWHO RCT): an open, phase 4, randomised controlled trial. *Lancet* 2017;389:930–9.
7 Ralston SL. High-Flow nasal cannula therapy for pediatric patients with bronchiolitis: time to put the horse back in the barn. *JAMA Pediatr* 2020;174:635–6.
8 van Miert C, Fernandes RM, Eccleson H, *et al*. Non-invasive ventilation for the management of children with bronchiolitis (NOVEMBR): a feasibility study and core outcome set development protocol. *Trials* 2018;19:627.
9 Royal College of paediatrics and child health. workforce census: UK overview report, 2019. Available: https://www.rcpch.ac.uk/resources/workforce-census-uk-overview-report-2019 [Accessed July 2020].
10 NIHR research award. FIRST-ABC. Available: https://fundingawards.nihr.ac.uk/award/17/94/28 [Accessed Feb 2020].
11 Freire G, Kuppermann N, Zemek R, *et al*. Predicting Escalated care in infants with bronchiolitis. *Pediatrics* 2018;142:e20174253.

12 Schuh S, Babl FE, Dalziel SR, *et al*. Practice variation in acute bronchiolitis: a pediatric emergency research networks study. *Pediatrics* 2017;140:e20170842.

Non-Invasive Ventilation for the Management of Children with Bronchiolitis Survey - Supplementary Material

List 1: Hospitals included in the screening exercise

- Alder Hey Children's NHS Foundation Trust
- Brighton and Sussex University Hospitals NHS Trust
- Cambridge University Hospitals NHS Foundation Trust
- Countess of Chester NHS Foundation Trust
- County Durham and Darlington NHS Foundation Trust
- Derby Teaching Hospitals NHS Foundation Trust
- Macclesfield Foundation Trust
- Wolverhampton Foundation Trust

List 2: Hospitals included in the survey exercise

- Airedale General Hospital
- Altnagelvin Area Hospital
- Birmingham Women and Children's Hospital
- Blackpool Victoria Teaching Hospital
- Bradford Teaching Hospital
- Burton Hospitals NHS Foundation Trust
- Calderdale Royal Hospital
- Chesterfield Royal Hospital NHS Foundation Trust
- Children's Hospital for Wales
- Countess of Chester NHS Foundation Trust Hospital
- Craigavon Area Hospital, Northern Ireland
- Cumberland Infirmary, Carlisle
- Daisy Hill Hospital, Newry
- Darlington Memorial Hospital
- Diana Princess of Wales Hospital, Grimsby
- Dorset County Hospital
- Durham and Darlington NHS Trust
- East Cheshire NHS Trust
- Gloucestershire Hospitals NHS Trust
- Great North Children's Hospital Newcastle upon Tyne
- Great Western Hospital, Swindon
- Hampshire Hospitals NHS Trust
- Heart of England NHS Foundation Trust
- Hereford County Hospital
- Hillingdon Hospital
- James Cook University Hospital
- King's Mill Hospital
- Kingston Hospital NHS Foundation Trust
- Leeds Children's Hospital
- Leicester Royal Infirmary
- Leighton Hospital, Crewe
- Musgrove Park Hospital
- Norfolk and Norwich University Hospital
- North Devon District Hospital
- North Middlesex Hospital
- Northumbria Specialist Emergency Care Hospital
- Nottingham Children's Hospital
- Ormskirk District General Hospital
- Oxford University Hospitals NHS Trust
- Poole Hospital NHS Foundation Trust
- Princess Alexandra Hospital NHS Trust
- Queen Alexandra Hospital, Portsmouth
- Raigmore Hospital - NHS Highland
- Royal Aberdeen Children's Hospital
- Royal Belfast Hospital for Sick Children
- Royal Derby Hospital
- Royal Devon and Exeter Hospital
- Royal Free London NHS Foundation Trust
- Royal Hospital for Sick Children, Edinburgh

- Royal Hospital for Sick Children, Glasgow
- Royal Lancaster Infirmary
- Royal London Hospital
- Royal Manchester Children's Hospital
- Royal United Hospital, Bath
- Royal Victoria Infirmary, Newcastle
- Royal Wolverhampton Hospital
- Russells Hall Hospital
- Salisbury District Hospital
- Sheffield Children's Hospital
- St Helens and Knowsley Teaching Hospitals NHS Trust
- St Helier's Hospital
- Stockport NHS Foundation Trust
- The Royal Wolverhampton NHS Trust Hospitals (New Cross)
- Torbay and South Devon NHS Foundation Trust
- University Hospital Crosshouse
- University Hospital of North Durham
- University Hospital of North Tees
- University Hospital Southampton
- University Hospitals Leicester
- University Hospitals of North Staffordshire
- Warrington and Halton Hospitals NHS Trust
- West Cumberland Hospital
- Whittonton Health, London
- Wye Valley NHS Trust
- Yeovil District Hospital

Supplementary Table 1: Screening data by hospital

	H1	H2	H3	H4	H5	H6	H7	H8	Overall
Patient age (weeks)									
N	35	62	61	28	43	123	26	0	378
Mean (SD)	21.3 (16.0)	20.7 (21.0)	21.9 (17.3)	16.0 (12.4)	16.3 (13.0)	21.0 (14.6)	17.0 (11.6)	-	20.0 (15.9)
Median (IQR)	18.0 (7.0, 35.0)	12.6 (6.3, 29.1)	14.0 (8.0, 33.0)	13.0 (7.0, 22.0)	10.0 (6.0, 25.0)	15.0 (10 ,30.0)	15.5 (7.5, 23.0)	-	14.2 (7.5, 29.1)
Min, Max	3.0, 56.0	1.3, 82.4	3.0, 76.0	4.0, 59.0	2.0, 44.0	2.0, 57.0	2.0, 38.0	-	1.3, 82.4
Missing	0	0	0	0	0	0	0	15	15
Length of stay in hospital (days)									
N	35	59	61	28	43	123	26	15	390
Mean (SD)	4.54 (2.90)	4.09 (3.78)	2.93 (2.21)	2.14 (1.48)	2.02 (2.36)	1.98 (2.96)	2.12 (2.53)	1.87 (3.09)	2.7 (3.0)
Median (IQR)	4 (2, 7)	3 (2, 5)	2 (2, 4)	1 (1, 4)	1 (1, 2)	1 (1, 1)	1 (0, 3)	1 (1, 1)	2 (1.3)
Min, Max	1, 12	0.78, 22	1, 14	1, 5	0, 13	1, 24	0, 7	1, 13	0, 24
Missing	0	3	0	0	0	0	0	0	3
Time of presentation									
N	35	62	61	28	43	113	0	15	357
2am-8am	1 (3%)	9 (15%)	7 (11%)	2 (7%)	5 (12%)	11 (10%)	-	1 (7%)	36 (10%)
8am-2pm	12 (34%)	13 (21%)	3 (5%)	5 (18%)	11 (26%)	33 (29%)	-	7 (47%)	81 (23%)
2pm-8pm	11 (31%)	16 (26%)	29 (54%)	15 (54%)	17 (40%)	44 (39%)	-	4 (27%)	139 (39%)
8pm-2am	11 (31%)	24 (39%)	22 (36%)	6 (21%)	10 (23%)	25 (22%)	-	3 (20%)	101 (28%)
Missing	0	0	0	0	0	10	26	0	36
Referral Route									
N	35	62	61	28	43	121	26	15	391
Accident and Emergency	24 (69%)	58 (94%)	56 (92%)	13 (46%)	36 (84%)	41 (34%)	7 (27%)	11 (73%)	246 (63%)
District General Hospital	11 (31%)	3 (5%)	0 (0%)	1 (4%)	0 (0%)	0 (0%)	1 (4%)	0 (0%)	16 (4%)
General Practitioner	0 (0%)	0 (0%)	0 (0%)	9 (32%)	6 (14%)	64 (53%)	18 (69%)	2 (13%)	99 (25%)
Open Access	0 (0%)	0 (0%)	0 (0%)	2 (7%)	0 (0%)	13 (11%)	0 (0%)	2 (13%)	17 (4%)
Other hospital	0 (0%)	1 (2%)	5 (8%)	1 (4%)	0 (0%)	3 (2%)	0 (0%)	0 (0%)	10 (3%)
Readmission	0 (0%)	0 (0%)	0 (0%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)
Walk-in	0 (0%)	0 (0%)	0 (0%)	1 (4%)	1 (2%)	0 (0%)	0 (0%)	0 (0%)	2 (0.5%)
Not known	0	0	0	0	0	2	0	0	2
Risk Factors*									
N	35	61	61	17	43	123	11	6	357
Baby born prematurely	9 (26%)	18 (30%)	14 (23%)	3 (18%)	11 (26%)	29 (24%)	0 (0%)	5 (83%)	89 (25%)
Congenital Heart Defect	0 (0%)	2 (3%)	3 (5%)	0 (0%)	2 (5%)	0 (0%)	0 (0%)	0 (0%)	7 (2%)
Neuromuscular Disease	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	1 (<1%)
Immunodeficiency disorders	0 (0%)	0 (0%)	2 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (1%)

	H1	H2	H3	H4	H5	H6	H7	H8	Overall
Chronic lung disease	0 (0%)	2 (3%)	2 (3%)	1 (6%)	1 (2%)	2 (2%)	0 (0%)	0 (0%)	8 (2%)
Young Age (≤3 months)	15 (43%)	28 (46%)	27 (44%)	15 (88%)	23 (53%)	46 (37%)	11 (100%)	0 (0%)	165 (46%)
Other	1 (3%)	5 (8%)	15 (25%)	1 (6%)	2 (5%)	0 (0%)	0 (0%)	0 (0%)	24 (7%)
No risk factors	14 (40%)	17 (28%)	20 (33%)	0 (0%)	13 (30%)	56 (46%)	0 (0%)	0 (0%)	120 (34%)
Not known	0	1	0	0	0	0	0	0	1
Missing	0	0	0	11	0	0	15	9	35
Reason for admission*									
N	35	62	61	27	43	123	26	15	392
Apnoea (reported or observed)	4 (11%)	4 (6%)	2 (3%)	3 (11%)	6 (14%)	2 (2%)	0 (0%)	0 (0%)	21 (5%)
Child looks seriously unwell to a healthcare professional	22 (63%)	2 (3%)	2 (3%)	5 (19%)	6 (14%)	58 (47%)	11 (42%)	0 (0%)	106 (27%)
Severe respiratory distress	18 (51%)	26 (42%)	44 (72%)	3 (11%)	10 (23%)	0 (0%)	18 (69%)	2 (13%)	121 (31%)
Central cyanosis	0 (0%)	0 (0%)	0 (0%)	2 (7%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	3 (1%)
Persistent O_2 saturation <92% when breathing air	7 (20%)	3 (5%)	5 (8%)	4 (14%)	7 (16%)	0 (0%)	3 (12%)	1 (7%)	30 (8%)
Difficulty with breastfeeding/inadequate oral fluid intake	19 (54%)	29 (47%)	40 (66%)	15 (56%)	40 (93%)	42 (34%)	12 (46%)	6 (40%)	203 (52%)
Social circumstances	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (5%)	0 (0%)	0 (0%)	0 (0%)	2 (1%)
Other respiratory	0 (0%)	47 (76%)	10 (16%)	5 (19%)	16 (37%)	53 (43%)	0 (0%)	11 (73%)	142 (36%)
Other	0 (0%)	6 (10%)	11 (18%)	3 (11%)	9 (21%)	13 (11%)	7 (27%)	1 (7%)	50 (13%)
Missing	0	0	0	1	0	0	0	0	1
Method* of O_2 delivery									
N	24	40	47	21	21	23	10	5	191
Nasal Cannula	16 (67%)	30 (75%)	3 (6%)	4 (19%)	18 (86%)	21 (91%)	8 (80%)	3 (60%)	103 (54%)
Head box with cold humidified O_2	1 (4%)	0 (0%)	20 (43%)	0 (0%)	4 (19%)	0 (0%)	0 (0%)	0 (0%)	25 (13%)
Heated humidified high flow nasal O_2	8 (33%)	12 (30%)	18 (38%)	6 (29%)	1 (5%)	3 (13%)	4 (40%)	0 (0%)	52 (27%)
Rebreathe mask	3 (13%)	12 (30%)	19 (40%)	2 (10%)	2 (10%)	3 (13%)	0 (0%)	1 (20%)	42 (22%)
CPAP	3 (13%)	3 (8%)	2 (4%)	5 (24%)	4 (19%)	1 (4%)	0 (0%)	0 (0%)	18 (9%)
Intubation and ventilation	10 (42%)	5 (13%)	1 (2%)	0 (0%)	1 (5%)	2 (9%)	0 (0%)	2 (40%)	21 (11%)
Other	1 (4%)	0 (0%)	1 (2%)	10 (48%)	0 (0%)	1 (4%)	0 (0%)	0 (0%)	13 (7%)
No O_2 used	11	16	14	0	22	99	0	0	162
Not known	0	3	0	0	0	0	0	0	3
Missing	0	3	0	7	0	1	16	10	37

*Multiple responses could be selected.

Supplementary Table 2: Participant and hospital demographics of survey respondents

Participant and hospital demographics	Number of respondents (%)	Number of hospitals (%)
Job title/role		
Consultant	92 (84%)	70 (93%)
Nurse	12 (11%)	9 (12%)
Other	5 (5%)	5 (7%)
Missing	2	1
Number of children with bronchiolitis admitted to hospital (with ≥1 day length of stay) per year		
<50	5 (6%)	5 (8%)
51-100	24 (30%)	21 (34%)
101-200	38 (47%)	30 (48%)
201-300	9 (11%)	9 (15%)
301-400	2 (2%)	2 (3%)
>401	3 (4%)	3 (5%)
Not known	28	26
Missing	2	1
Local bronchiolitis care pathways and/or guidance available		
Yes	71 (85%)	56 (85%)
No	13 (15%)	12 (18%)
Not known	6	6
Missing	21	20
Criteria for starting O_2		
Sp02 < 92%	75 (86%)	59 (88%)
Other	12 (14%)	11 (16%)
Not known	2	2
Missing	22	20
Do you send otherwise well children with bronchiolitis who are improving, home on O_2?		
Yes	6 (7%)	6 (9%)
No	82 (93%)	63 (94%)
Not known	3	3
Missing	20	19
Methods to deliver O_2: therapy on the general medical practice ward		
Nasal Cannula	84 (98%)	67 (100%)
Heated humidified high flow nasal O_2	73 (85%)	61 (91%)
Non-rebreathe mask	50 (58%)	44 (66%)
Non-invasive CPAP	49 (57%)	39 (58%)
Head Box with cold humidity	29 (34%)	23 (34%)
Missing	25	24
Methods to deliver O_2: therapy on the HDU		
Heated humidified high flow nasal O_2	70 (96%)	56 (100%)
Non-invasive CPAP	64 (88%)	50 (89%)
Nasal Cannula	56 (77%)	47 (84%)
Non-rebreathe mask	39 (53%)	34 (61%)
Head box with cold humidity	19 (26%)	16 (29%)

Participant and hospital demographics	Number of respondents (%)	Number of hospitals (%)
Missing	38	35

Supplementary Table 3: Survey responses on CPAP/HFNC use

	Individual respondents		**Hospitals** *(Participants from the same hospital may have given different answers)*	
	CPAP N (%)	**HFNC N (%)**	**CPAP N (%)**	**HFNC N (%)**
Do you currently use a CPAP/HFNC machine for children with bronchiolitis at your hospital?				
N	81	73	65	61
Yes	64 (79%)	68 (93%)	52 (80%)	58 (95%)
No	17 (21%)	5 (7%)	17 (26%)	3 (5%)
Not known	1	2	1	2
Missing	29	36	28	30
Criteria for initiating CPAP/HFNC*				
N	59	61	47	52
Increased O_2 requirement	36 (61%)	42 (69%)	31 (66%)	35 (67%)
Increased work of breathing	36 (61%)	53 (87%)	28 (60%)	37 (71%)
Respiratory acidosis with increased CO_2 (type 2 respiratory failure)	36 (61%)	27 (44%)	28 (60%)	23 (44%)
Apnoea	22 (37%)	7 (11%)	20 (43%)	7 (13%)
Not improving on HF NC O_2	17 (29%)	N/A	16 (34%)	2 (4%)
Exhaustion	6 (10%)	1 (2%)	6 (13%)	1 (2%)
Guideline	4 (7%)	4 (7%)	4 (9%)	4 (8%)
Risk factors	3 (5%)	2 (3%)	3 (6%)	2 (4%)
To prevent intubation	3 (5%)	0 (0%)	3 (6%)	0 (0%)
Other	9 (15%)	8 (13%)	31 (66%)	7 (13%)
Not improving on other treatments	-	2 (3%)	-	2 (4%)
Nursing/medical concerns	0 (0%)	2 (3%)	0 (%)	2 (4%)
Missing	5	7	5	7
Criteria for weaning CPAP/HFNC*				
N	53	56	45	51
Improving Oxygenation (reduced O_2 requirement, O_2 saturations being maintained)	41 (77%)	39 (70%)	34 (76%)	33 (65%)
Decreased work of breathing	23 (43%)	22 (39%)	20 (44%)	21 (41%)

	Individual respondents		**Hospitals** *(Participants from the same hospital may have given different answers)*	
	CPAP N (%)	**HFNC N (%)**	**CPAP N (%)**	**HFNC N (%)**
Clinical improvement/stability	21 (40%)	22 (39%)	16 (36%)	19 (37%)
Improving Carbon dioxide, reducing respiratory acidosis	20 (38%)	15 (27%)	18 (40%)	10 (20%)
Resolved apnoeas	7 (13%)	3 (5%)	7 (16%)	3 (6%)
Tolerating feeds	2 (4%)	3 (5%)	2 (4%)	3 (6%)
Other	7 (13%)	10 (18%)	6 (13%)	8 (16%)
Missing	11	12	7	12
Who is responsible for altering CPAP/HFNC settings?*				
N	57	60	47	53
Medical Staff	55 (96%)	53 (88%)	45 (96%)	47 (89%)
Nursing Staff	23 (40%)	46 (77%)	22 (47%)	41 (77%)
Respiratory Physiotherapist	1 (2%)	1 (2%)	1 (2%)	1 (2%)
Not known	1	1	1	1
Missing	6	7	6	7
Minimum training requirement(s) for staff to manage a child on CPAP/HFNC*				
N	48	51	40	44
Annual attendance of an in-house training package with clinical competency assessment	23 (48%)	19 (37%)	20 (50%)	17 (39%)
Annual attendance of an in-house training package without clinical competency assessment	14 (29%)	16 (31%)	13 (33%)	14 (32%)
Attendance on an ad hoc training session run by manufacturer	10 (21%)	22 (43%)	9 (23%)	20 (45%)
High dependency course	10 (20%)	4 (8%)	10 (25%)	4 (9%)
Other	14 (29%)	13 (25%)	13 (33%)	13 (30%)
None	3 (6%)	1 (2%)	3 (8%)	1 (2%)
Not known	12	12	11	12
Missing	4	5	4	5

*Multiple responses could be selected.

Supplementary Table 4: Survey responses for acceptability for a trial

Participant and hospital demographics	Number of respondents (%)	Number of hospitals (%)
Number of HDU beds in winter		
0	12 (15%)	12 (19%)
1-5	47 (60%)	37 (60%)
6-10	15 (19%)	14 (23%)
10+	4 (5%)	4 (6%)
Not known	9	9
Missing	24	23
Number of whole-time equivalent paediatric research nurses working at hospital		
0	9 (19%)	9 (20%)
>0 & <1	9 (19%)	8 (17%)
≥1	30 (63%)	29 (63%)
Not known	18	14
Missing	45	38
Number of Good Clinical Practice trained ward nurses on an average shift		
0	13 (57%)	12 (55%)
>0 & <1	0 (0%)	0 (0%)
≥1	10 (43%)	10 (45%)
Not known	39	32
Missing	49	38
Number of Good Clinical Practice trained doctors on an average shift		
0	3 (11%)	3 (12%)
>0 & <1	4 (15%)	4 (16%)
≥1	20 (74%)	18 (72%)
Not known	36	33
Missing	48	40
Ability to run a clinical trial on how best to provide non-invasive ventilation in children with bronchiolitis out-of-hours[1]		
Yes	34 (83%)	31 (84%)
No	7 (17%)	7 (19%)
Not known	29	26
Missing	41	34

[1]Monday - Friday 17:00 - 08:00 or weekends

Supplementary Table 5: Estimated percentage of children[1] admitted to hospital for bronchiolitis receiving the following treatments (excluding A&E short stay patients)

Percentage of children	Number (%) of respondents				
	No O_2	**O_2**	**CPAP**	**Heat**	**Intubation**
0%-10%	20 (26%)	1 (1%)	47 (59%)	25 (31%)	74 (93%)
>10%-20%	24 (31%)	2 (2%)	25 (32%)	15 (19%)	4 (5%)
>20%-30%	21 (27%)	5 (6%)	5 (6%)	16 (20%)	2 (3%)
>30%-40%	8 (10%)	3 (4%)	2 (3%)	9 (11%)	0 (0%)
>40%-50%	4 (5%)	9 (11%)	0 (0%)	6 (8%)	0 (0%)
>50%-60%	0 (0%)	9 (11%)	0 (0%)	5 (6%)	0 (0%)
>60%-70%	0 (0%)	20 (25%)	0 (0%)	2 (3%)	0 (0%)
>70%-80%	1 (1%)	13 (16%)	0 (0%)	2 (3%)	0 (0%)
>80%-90%	0 (0%)	12 (15%)	0 (0%)	0 (0%)	0 (0%)
>90%-100	0 (0%)	7 (9%)	0 (0%)	0 (0%)	0 (0%)

[1]Respondents could choose one percentage category for each treatment.

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

Dear Colleague,

RE: Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR): A feasibility study

NIHR have asked us to undertake a feasibility study with a view to designing a trial on how best to provide non-invasive ventilation (NIV) for children in hospital with bronchiolitis. As part of this study, we are surveying paediatricians in the UK to find out how these children are currently managed. The questions in this survey will cover the number of children admitted to your hospital with bronchiolitis, the type of NIV intervention(s) used at your hospital and who administers them, and the number of paediatric research staff at your hospital.

We would be very grateful if you (or whoever you consider most appropriate within your hospital) could complete the following short survey. If there are any questions that you are unable to answer, there is an option at the end of the survey to suggest who could provide answers on your behalf.

Kind Regards

Professor Paul McNamara

On behalf of the NOVEMBR study team

Email: Novembr.study@liverpool.ac.uk
Telephone: 0151 252 5573 / 0151 794 9838

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

* 1. Please indicate the name of the hospital where you work

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2. Please provide your job title/role

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* 3. Is your hospital...

- a District General Hospital
- a Paediatric Tertiary Hospital
- Other (please specify)

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4. **Approximately**, how many children with bronchiolitis are admitted to your hospital (with a minimum one day length of stay) per year?

- ◯ <50
- ◯ 51-100
- ◯ 101-200
- ◯ 201-300
- ◯ 301-400
- ◯ >401
- ◯ Don't know

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

5. **Approximately**, what percentage of children admitted to your hospital for bronchiolitis receive the following treatments (total for the five options may add up to >100%). Please exclude A&E short stay patients:

	Percentage
No Oxygen	
Oxygen	
Non-invasive CPAP	
Heated humidified high flow nasal oxygen	
Intubation and ventilation	

Other (please specify; if not known, enter NK)

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6. Do you have any local bronchiolitis care pathways and/or guidance?

- Yes **(Please email a copy to novembr@liverpool.ac.uk)**
- No
- Don't know

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7. What criteria do you use for starting oxygen?

- ○ Sp02 <92%
- ○ Other (please specify; if not known, enter NK)

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8. Do you send otherwise well children with bronchiolitis who are improving, home on oxygen?

- ○ Yes
- ○ No
- ○ Don't know

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9. Which of the following do you currently use to deliver oxygen therapy on the **general medical** paediatric wards? (please select all that apply)

- ☐ Nasal Cannula
- ☐ Head Box with cold humidity
- ☐ Non-rebreathe mask
- ☐ Heated humidified high flow nasal oxygen
- ☐ Non-invasive CPAP
- ☐ Other (please specify; if not known, enter NK)

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10. How many HDU beds do you have in winter? (If not known, enter NK)

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11. Which of the following do you currently use to deliver oxygen therapy on the **HDU**? (Please select all the apply)

- [ ] Nasal Cannula
- [ ] Head box with cold humidity
- [ ] Non-rebreathe mask
- [ ] Heated humidified high flow nasal oxygen
- [ ] Non-invasive CPAP
- [ ] Not Applicable (no HDU beds)
- [ ] Other (please specify; if not known, enter NK)

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

12. Do you currently use a CPAP machine for children with bronchiolitis at your hospital?

- ○ Yes
- ○ No
- ○ Don't know

13. If answered 'yes' to previous question, what type of CPAP machine do you currently use for children with bronchiolitis, and how many do you have available at your hospital? (please select the number available for each option below)

Fisher & Paykel bubble nCPAP	
Phillips NeoPAP	
Infant flow SiPAP	

Other (please specify; if not known, enter NK)

14. What criteria do you use for **initiating** CPAP?

Criteria 1.	
Criteria 2.	
Criteria 3.	
Criteria 4.	
Criteria 5.	
Any others (please specify; if not known, enter NK)	

15. What criteria do you use for **weaning** CPAP?

Criteria 1.	
Criteria 2.	
Criteria 3.	
Criteria 4.	
Criteria 5.	
Any others (please specify; if not known, enter NK):	

16. Who is responsible for altering CPAP settings?

- [ ] Nursing Staff
- [ ] Medical Staff
- [ ] Respiratory Physiotherapist
- [ ] Don't know
- [ ] Other (please specify)

17. What are the minimum training requirements for staff to manage a child on CPAP?

- [ ] Attendance on an ad hoc training session run by manufacturer
- [ ] Annual attendance on an in-house training package without clinical competency assessment
- [ ] Annual attendance of an in-house training package with clinical competency assessment
- [ ] High dependency course
- [ ] None
- [ ] Don't know
- [ ] Other (please specify)

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

18. Do you currently use heated humidified high flow nasal oxygen for children with bronchiolitis at your hospital?

- ○ Yes
- ○ No
- ○ Don't know

19. If answered 'yes' to previous question, what type of heated humidified high flow nasal oxygen machine do you currently use for children with bronchiolitis, and how many do you have available at your hospital? (please select the number available for each option below).

Fisher & Paykel Optiflow Junior	
Fisher & Paykel Airvo	
Vapotherm Precision Flow	
We do not use a heated humidified high flow nasal oxygen machine	

Other (please specify type and number of machines at your hospital; if not known, please enter 'NK')

20. What criteria do you use for **initiating** heated humidified high flow nasal oxygen machine?

Criteria 1.	
Criteria 2.	
Criteria 3.	
Criteria 4.	
Criteria 5.	
Any others (please specify; if not known, enter NK):	

21. What criteria do you use for **weaning** heated humidified high flow nasal oxygen?

Criteria 1.	
Criteria 2.	
Criteria 3.	
Criteria 4.	
Criteria 5.	
Any others (please specify; if not known, enter NK):	

22. Who is responsible for altering heated humidified high flow nasal oxygen settings?

- [ ] Nursing staff
- [ ] Medical Staff
- [ ] Respiratory Physiotherapist
- [ ] Other (please specify; if not known, enter NK)

23. What are the minimum training requirements for staff to manage a child on heated humidified high flow nasal oxygen?

- [ ] Attendance on an ad hoc training session run by manufacturer
- [ ] Annual attendance on an in-house training package without clinical competency assessment
- [ ] Annual attendance of an in-house training package with clinical competency assessment
- [ ] High dependency course
- [ ] None
- [ ] Don't know
- [ ] Other (please specify)

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24. How many whole time equivalent (WTE) paediatric **research** nurses work at your hospital? (If not known, enter NK)

25. On an average shift, how many ward nurses are GCP (Good Clinical Practice) trained? (If not known, enter NK)

26. On an average shift, how many doctors are GCP (Good Clinical Practice) trained? (If not known, enter NK)

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

27. We are considering designing a clinical trial on how best to provide non-invasive ventilation in children with bronchiolitis. Would you be able to run such a trial out-of-hours (Monday - Friday 17:00 -08:00 or weekends), at your hospital?

- ○ Yes
- ○ No
- ○ Don't know

Please provide a reason for your response.

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28. Could you foresee any barriers to undertaking a trial on non-invasive ventilation at your hospital?

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29. What would enable you to participate in the study at your hospital? (If not known, enter NK)

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

30. As part of the NOVEMBR feasibility study, we will be conducting a Delphi survey to identify important outcomes for use in future clinical trials. We would greatly appreciate your input. If you are interested in completing the survey, please enter your email address into the comments box below:

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Reminder: If you answered 'yes' to question 6. 'Do you have any local bronchiolitis care pathways and/or guidance?', please email a copy to novembr.study@liverpool.ac.uk.

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

31. If there are any questions that you have been unable to answer, we would be grateful if you could provide details (name and email address) of anyone who might be able to provide this information.

Name:	
Email address:	
Name:	
Email address:	

Non-invasive ventilation in the management of children with bronchiolitis (NOVEMBR); National Survey of Current Practice

Many thanks for taking part in this survey, we greatly appreciate your input!

Best wishes,

The NOVEMBR team