Research Square

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A nationwide survey on the use of Heated Humidified High Flow Oxygen therapy on the paediatric wards in the UK: current practice and research priorities

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Research article

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Abstract

Background

Heated Humidified High Flow Nasal Cannula Oxygen Therapy (HHFNC) is increasingly used on the paediatric wards and High Dependency Units (HDU) for different types of pathologies and different age groups. We aimed to describe current practice related to the use of HHFNC on the paediatric wards and HDUs, weaning practices and preferred outcome measures for future research.

Methods

We carried out a cross-sectional online survey of UK paediatric consultants or their delegates working on the paediatric wards. Descriptive analysis of the their geographical, and organizational characteristics, their specialties, and their level of experience was investigated. Reasons for HHFNC initiation, weaning criteria, patients' characteristics and their primary pathologies were also analysed.

Results

Participation of 218 paediatricians from 81 hospitals (Median: 2.7, Range: 1-11) was registered. HHFNC was provided in most of the surveyed hospitals (93%, 75/81). A High Dependency Unit (HDU) was available in 47 hospitals (58%); less than a third of those have a dedicated paediatrician. Decisions around HHFNC were made solely by paediatricians in (75%) of the cases, mostly at hospitals with no HDU compared to those with dedicated HDUs (70.3% VS 36.6%, 95%CI:22.6%-50.4%, P< .001). Most respondents (72%) agreed that HHFNC is either the same or superior to nasal Continuous Positive Airway Pressure therapy (nCPAP). Failure rate while on HHFNC was identified as the most important outcome measure in any future research followed by the length of need for HHFNC support (37.1%, and 28% respectively).

Conclusion

This survey showed support for developing a paediatric-specific national guidance on the use of HHFNC on the wards. Our list of defined research priorities may help guide further collaborative research efforts in this field.

Background

Heated Humidified High Flow Nasal Cannula Oxygen Therapy (HHFNC) has been widely accepted as an option for non-invasive respiratory support of infants and children in critical care.(1) More recently, HHFNC has also been introduced into paediatric wards in the United Kingdom (UK), mainly for the management of bronchiolitis.(2) Although high-quality evidence has begun to emerge on the clinical effectiveness of HHFNC compared to standard oxygen therapy, these trials are bronchiolitis-focused;(3)

therefore, current use of HHFNC in infants and children is still largely based on individual experience with a clear lack of national and international guidance.

HHFNC has many mechanisms of action by which it reduces the work of breathing and improves efficiency of ventilation(4, 5) such as washout of nasopharyngeal dead space leading to improved alveolar ventilation, reduction in the inspiratory resistance associated with the nasopharynx, improvement in conductance and pulmonary compliance by supplying adequately warmed and humidified gas, and provision of positive distending pressure for lung recruitment.(6, 7) Despite widespread use, there are several unanswered questions regarding HHFNC therapy such as the optimal starting flow rate, strategies for weaning, feeding while on HHFNC, and use of adjunctive therapy such as nebuliser therapy.(8) Moreover, its use for diseases other than bronchiolitis,(9) and during transport is still being explored.(10) Regarding HHFNC flow rates, there are no national or international guidelines in infants and child,(11, 12) and although a range of 1.5 - 2 L/kg/min has been widely adopted in current pediatric practice and in previous clinical trials, experimental data suggest that higher flows might provide greater airway pressures.(7, 11, 13) We expect that there is a wide spectrum of maximum HHFNC flow rates that are currently being practiced in the UK. In critical care units, HHFNC therapy has been primarily regarded as a method for weaning from nCPAP; however, there are no clear protocols for weaning HHFNC on paediatric wards, which may prolong length of hospital stay.(9, 14, 15) Therefore, variability in weaning strategies is expected in the absence of robust evidence. There are also a limited number of observational studies describing the supportive care of patients receiving HHFNC (i.e. nasogastric (NGT) or nasojejunal tubes (NJT) VS. oral feeding, aerosol delivery techniques for inhalational drug delivery, and use of sedation while on HHFNC).(8, 9)

In view of the uncertainty surrounding the use of HHFNC in paediatric practice, we aimed to survey UK paediatricians with the following aims: a) to describe current practice related to the use of HHFNC on the paediatric wards and HDUs for different age groups and different pathologies; b) to describe weaning practices and supportive practice during HHFNC; and c) to define research priorities and preferred outcome measures for any future randomised controlled trials.

Methods

We carried out a cross-sectional online survey of UK paediatric consultants using the Online Survey Software (formerly BOS, onlinesurveys.ac.uk, Jisc software, UK) to elicit their responses regarding practice related to HHFNC and their perceptions regarding research priorities. The survey covered four main domains:

1. general information about the respondents,
2. their wards and their patients' characteristics including their primary illnesses,
3. information about the use of HHFNC in practice including responses to two case scenarios, and
4. finally, the respondents' opinion of future trials on HHFNC and the key priorities in any further research.

An initial version of the survey was piloted (by 7 paediatric consultants) in three regions across the UK and these responses were used to inform the final questionnaire used in this survey (Additional File 1). Questions were directed to paediatric consultants (or their delegates such as a senior registrar or a nurse practitioner) who spend more than 50% of their clinical time in their specialty within the UK. Completion of the survey was voluntary, and consent was implied through completion and submission of the survey. The survey link was initially distributed by the Royal College of Paediatrics and Child Health (RCPCH) e-bulletin, and by the British Paediatric Respiratory Society (BPRS) through their mailing lists. We also requested the 12 regional Paediatric Intensive Care retrieval services to forward the survey link to the acute hospitals in their geographical area. Phone calls to the paediatric wards and HDUs were also made where their regions were noticed to be underrepresented in the survey. Data was collected between September 2018 and June 2019.

Data about the number of hospitals with paediatric services and the number of registered paediatric consultants in the UK were obtained from the RCPCH Medical Force Census 2015.(16) The classification of hospital size was based on the number of admissions/year (small, medium, and large) and the definitions HDU/HDC (High Dependency Care) were also based on the RCPCH Medical Force Census 2015 to filter the responses accordingly (High Dependency Care for Children, Time to Move On, RCPCH).(17)

We primarily used the respondent as the unit of analysis other than for questions relating to hospital characteristics. Results are reported as proportions and/or means as appropriate. Significance testing for differences in proportions were performed using the chi-square test, and for differences in means for normally distributed data using the Student t-test. Data analyses were performed using Stata v16 (Stata Corporation, College Station, USA) and Microsoft Excel 2016 (Microsoft Corporation, USA).

Results

A total of 218 respondents participated in the survey, representing 81 hospitals with acute paediatric inpatient services in the UK, a median of 2.7 (range: 1-11) responses per hospital. Majority of the participants were paediatric consultants (213/218, 97.7%) with a wide range of clinical experience in their field (table 1).

Forty-seven out of 81 hospitals (58%) had dedicated HDUs compared to 34 hospitals with no HDU (42%). Majority of HDUs were managed by the paediatrician on-call in (17/47,36%) of the cases while (7/47, »15%) had a dedicated paediatrician and (12/47, 25%) HDUs were solely managed by the intensive care team. The majority of HDUs provided all types of non-invasive ventilation (including Bilevel Positive pressure ventilation, BiPAP) and long-term invasive ventilation (LTV) (43/47, 91.5%). A variety of patient categories were generally managed on hospital wards (table 2).

Use of HHFNC:

Respondents reported using HHFNC in a variety of illnesses on their wards particularly where HDU and intensive care facilities are not readily available (such as respiratory, cardiac, and neuromuscular

diseases). Respiratory diseases collectively accounted for more than 75% of the reasons to start HHFNC (figure 1).

The most common clinical indication for HHFNC initiation was hypoxia (oxygen saturation <92%) not responding to low flow oxygen (LF) (figure 2).

Paediatric wards were the primary location to start HHFNC according to the majority of respondents (167/218, 76.6%). Other locations such as the emergency department were also considered an option when a ward bed was not immediately available. Six respondents representing 5 cardiology wards from 4 different regions reported using HHFNC for cardiac patients with different pathologies (pre- and post-heart surgery). Some respondents with respiratory background (26/218, 11.9%) considered their respiratory wards as HDU-acuity level therefore HHFNC became a standard therapy on these wards. HDU and PICU were the primary locations to start HHFNC therapy in 8/218 responses (3.6%).

According to respondents, the most popular HHFNC device used on the wards was the Fisher and Paykel Optiflow system (37.9%), Fisher and Paykel Airvo2 system (33.5%) and Vapotherm (21.2%). Respondents also indicated using HHFNC for different age groups on the paediatric wards, including older age groups (pre-school ages, and teenagers).

Starting HHFNC therapy on the ward was overall a paediatric team-led decision, and similarly modification and weaning off HHFNC (paediatric consultant, respiratory consultant, registrar, senior nurse, or nurse practitioner) particularly in hospitals with no HDU compared to hospitals with dedicated HDUs í24/34 (70.3%) VS 17/47 (36.6%), 95%CI: 22.6%-50.4%, P: .002ý.

Relevant guidance on HHFNC was more available in hospitals with HDUs compared to hospitals with no HDU í36/47, (77%) VS 17/34 (50%), 95%CI: 5.9-45.6, P: .012ý (Table 3):

We presented 2 clinical vignettes in our survey in terms of application of HHFNC on the wards based on age and weight: findings to these scenarios are summarized in figure 3.

Clinical parameters by which the respondents assessed failure of HHFNC included significant work of

breathing, worsening respiratory acidosis, apnoea needing stimulation, significant tachypnoea and tachycardia, deterioration on the local assessment scores (i.e. PEWS).

Weaning off HHFNC was managed variably by respondents with the majority opting to wean the FiO2 to a certain value (most commonly 0.40, indicated by 62.2% of respondents) and then gradually weaning the flow rate afterwards (75.7% of respondents).

Respondents were asked to compare between nCPAP and HHFNC on the wards. More than two thirds of them said HHFNC is either the same or superior to nCPAP with fewer complications (table 4).

Research priorities on the use of HHFNC was an important focus that we tried to explore in this survey. Clinicians were asked to rank the three most important outcome measures in any future research looking

at the effect of HHFNC therapy in paediatric patients (figure 4).

Failure rate of HHFNC was the first most important concern amongst the respondents followed by the length of need for HHFNC support as second most important and cost effectiveness as third (37.1%, 28%, and 28.8% respectively).

Overall, 187 clinicians (85.8%) supported the idea of developing national guidance on the use of HHFNC in general paediatric practice. A small number of clinicians thought that such a guidance is not necessary (12/218, 5.7%) and the remaining respondents were not sure if such guidelines might change current practice.

Discussion

This study is the first and the largest national survey to review the current practice around HHFNC on the paediatric wards in terms of the number of responses, the geographical areas that have been covered across the UK and the use of HHFNC in many paediatric illnesses other than bronchiolitis, in addition to discussion about the supportive therapy while on HHFNC.

The study period was intentionally meant to span as many seasonal variations as possible to reflect practice and to minimize recall bias when HHFNC is at its lowest use in the summer.

In this survey, we noticed many areas of controversy and variation in clinical practice around HHFNC. As a non-invasive therapy, HHFNC is easy to use and set-up for different age groups on the paediatric wards from infancy up to teenagers. When compared to LF oxygen therapy, high oxygen concentration (FiO2 of up to 1.0) can be delivered and is well tolerated.(18, 19) There is an extensive literature that supports the role of HHFNC in neonates (beyond the preterm age group) to prevent intubation and invasive ventilation.(20) The reported literature is however very limited when it comes to the use of HHFNC in the population beyond infancy and in diseases other than bronchiolitis.(21) Its role for prevention of intubation or as a step-down after extubation is yet to be tested.(22) Although majority of the patients who used HHFNC in this survey were with primary respiratory problems (75%), HHFNC was used for cardiac patients (such as cardiac failure and post cardiac surgery)(23, 24) and patients with neuromuscular-type diseases.

Determining the initial HHFNC rate and the escalation strategy is still controversial as shown in this survey. While most respondents focused on 2L/kg/min as a start-up flow, others tried a range of 3-4L/kg/min in cases of bronchiolitis and pneumonia. Using the actual patient's weight is a useful guide that most units have agreed on, however it is worth mentioning though that most devices that deliver HHFNC are capped at < 2 L/kg/min for larger children with a maximum flow of 60 L/min.

It was also interesting in this survey to observe that majority of the units have criteria to determine HHFNC failure and an escalation strategy to an appropriate level of support demonstrated in the two case scenarios.

Another area of controversy was the use of Aerosol therapy via HHFNC. The delivery of nebulized medicines is generally affected by flow, type of system used, cannula size, and type of nebulizer used.(25) Respondents didn't specify whether certain nebulizing devices are used on their wards while connected to HHFNC.

We acknowledge that the total response rate in this survey is not large enough to make firm suggestions, however we believe that this survey has served its purpose of highlighting the real need of further consolidated research and probably start developing a national guidance on the use of HHFNC on the paediatric wards similar to other countries.(26)

Conclusion

HHFNC is a rapidly evolving therapy with little data that supports its use in many of the paediatric diseases that have been discussed in this survey. Considering its ease of use, comfort, and the growing body of confidence amongst paediatricians in HHFNC justifies its clinical equivalence and maybe superiority to other non-invasive ventilation modalities.

Key research priorities that have been identified by our respondents may help guide future studies to answer these concerns and support their clinical decisions.

Abbreviations

HHFNC: Heated Humidified High Flow Nasal Cannula Oxygen Therapy

HDU: High Dependency Unit

PICU: Paediatric Intensive Care Unit

nCPAP: nasal continuous positive airway pressure

FiO2: Fraction inspired of O2

Declarations

Ethics approval and consent to participate:

We confirm that this study complies with the national guidelines (HRA Decision Tool attached). Due to the nature of this study, completion of the survey was voluntary, and no ethical approval was required.

Consent for publication: not applicable.

Availability of data and materials:

The datasets used and/or analysed during this study are available from the corresponding author on reasonable request.

Competing interests:

None

Funding:

None

Authors' contributions:

OH designed the survey, carried out the data analyses, drafted the initial manuscript. CE helped designed, piloted, and distributed the survey. PR conceptualised the study, reviewed and revised the draft manuscript. All authors read and approved the final manuscript.

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References

1. Ojha S, Gridley E, Dorling J. Use of Heated Humidified High Flow Nasal Cannula Oxygen in neonates: a U.K wide survey. Acta paediatrica (Oslo, Norway : 1992). 2012;102.
2. Turnham H, Agbeko RS, Furness J, Pappachan J, Sutcliffe AG, Ramnarayan P. Non-invasive respiratory support for infants with bronchiolitis: a national survey of practice. BMC pediatrics. 2017;17(1):20.
3. Milesi C, Essouri S, Pouyau R, Liet JM, Afanetti M, Portefaix A, et al. High flow nasal cannula (HFNC) versus nasal continuous positive airway pressure (nCPAP) for the initial respiratory management of acute viral bronchiolitis in young infants: a multicenter randomized controlled trial (TRAMONTANE study). Intensive care medicine. 2017;43(2):209-16.

4. Dysart K, Miller TL, Wolfson MR, Shaffer TH. Research in high flow therapy: mechanisms of action. Respir Med. 2009;103(10):1400-5.
5. Hutchings FA, Hilliard TN, Davis PJ. Heated humidified high-flow nasal cannula therapy in children. Archives of disease in childhood. 2015;100(6):571-5.
6. Ramnarayan P, Schibler A. Glass half empty or half full? The story of high-flow nasal cannula therapy in critically ill children. Intensive care medicine. 2017;43(2):246-9.
7. Ejiofor BD, Carroll RW, Bortcosh W, Kacmarek RM. PEEP Generated by High-Flow Nasal Cannula in a Pediatric Model. Respiratory Care. 2019:respcare.06470.
8. Al-Subu AM, Hagen S, Eldridge M, Boriosi J. Aerosol therapy through high flow nasal cannula in pediatric patients. Expert review of respiratory medicine. 2017;11(12):945-53.
9. Slain KN, Shein SL, Rotta AT. The use of high-flow nasal cannula in the pediatric emergency department. Jornal de pediatria. 2017;93 Suppl 1:36-45.
10. Jones AJ, Mathew S, Wong SW, Patel M, Equi A, Sukhani S, et al. A regional audit of high-flow nasal cannula therapy use for bronchiolitis in London district general hospitals. Archives of disease in childhood. 2017;102(3):296-7.
11. Milesi C, Boubal M, Jacquot A, Baleine J, Durand S, Odena MP, et al. High-flow nasal cannula: recommendations for daily practice in pediatrics. Annals of intensive care. 2014;4:29.
12. Mikalsen IB, Davis P, Oymar K. High flow nasal cannula in children: a literature review. Scandinavian journal of trauma, resuscitation and emergency medicine. 2016;24:93.
13. Dries DJ, McGonigal MD, Malian MS, Bor BJ, Sullivan C. Protocol-driven ventilator weaning reduces use of mechanical ventilation, rate of early reintubation, and ventilator-associated pneumonia. J Trauma. 2004;56(5):943-51; discussion 51-2.
14. Badiee Z, Eshghi A, Mohammadizadeh M. High flow nasal cannula as a method for rapid weaning from nasal continuous positive airway pressure. International journal of preventive medicine. 2015;6:33.
15. Betters KA, Hebbar KB, McCracken C, Heitz D, Sparacino S, Petrillo T. A Novel Weaning Protocol for High-Flow Nasal Cannula in the PICU. Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies. 2017;18(7):e274-e80.
16. <2015_rcpch_workforce_census_v1.1.pdf>.
17. <high_dependency_care_for_children_-_time_to_move_on.pdf>.
18. Ward JJ. High-Flow Oxygen Administration by Nasal Cannula for Adult and Perinatal Patients. Respiratory Care. 2013;58(1):98-122.
19. Tiruvoipati R, Lewis D, Haji K, Botha J. High-flow nasal oxygen vs high-flow face mask: a randomized crossover trial in extubated patients. J Crit Care. 2010;25(3):463-8.
20. Manley BJ, Owen L, Doyle LW, Davis PG. High-flow nasal cannulae and nasal continuous positive airway pressure use in non-tertiary special care nurseries in Australia and New Zealand. Journal of

paediatrics and child health. 2012;48(1):16-21.

21. Mikalsen IB, Davis P, Øymar K. High flow nasal cannula in children: a literature review. Scandinavian journal of trauma, resuscitation and emergency medicine. 2016;24:93.
22. Ramnarayan P, Lister P, Dominguez T, Habibi P, Edmonds N, Canter RR, et al. FIRST-line support for Assistance in Breathing in Children (FIRST-ABC): a multicentre pilot randomised controlled trial of high-flow nasal cannula therapy versus continuous positive airway pressure in paediatric critical care. Critical care (London, England). 2018;22(1):144.
23. Carratala JM, Diaz Lobato S, Brouzet B, Mas-Serrano P, Espinosa B, Llorens P. Efficacy and safety of high-flow nasal cannula oxygen therapy in patients with acute heart failure. Emergencias. 2018;30(6):395-9.
24. Testa G, Iodice F, Ricci Z, Vitale V, De Razza F, Haiberger R, et al. Comparative evaluation of high-flow nasal cannula and conventional oxygen therapy in paediatric cardiac surgical patients: a randomized controlled trial. Interact Cardiovasc Thorac Surg. 2014;19(3):456-61.
25. Berlinski A. Pediatric Aerosol Therapy. Respir Care. 2017;62(6):662-77.
26. <Use of high-flow nasal cannula oxygen therapy in infants and childrenUse of high-flow nasal cannula oxygen therapy in infants and children | Canadian Paediatric Society.pdf>.

Tables

Table 1: Characteristics of the respondents by specialty and experience:

	Working in hospitals with HDU (n=164, %)*	Working in hospitals with no HDU (n=54, %)*	p value
Main Specialty (>50% clinical time)			
General Paediatrics	119 (72.6)	48 (89)	.0137
PEM[1]	5 (3)	1 (1.8)	.63
PICM[2]	4 (2.4)	0	
Cardiology	5 (3)	1 (1.8)	.63
Respiratory	25 (15.2)	1 (1.8)	.008
Neonates	2 (1.2)	2 (3.7)	.23
Others (HDU consultant, nurse practitioner)	4 (2.4)	1 (1.8)	.79
Clinical Experience			
< 1 Year	10 (6)	2 (3.7)	.5
1-5 Years	60 (36.6)	20 (37)	.95
6-10 Years	54 (32.9)	14 (8.5)	.0005
>10 Years	40 (24.4)	18 (10.9)	.035

[1]Paediatric Emergency Medicine, [2]Paediatric Intensive Care Medicine. *Rounded percentages where possible.

Table 2. Categories of paediatric patients admitted to the wards/HDU in 81 hospitals:

Patient Categories on the Ward/HDU	Per respondent (n[1], %)	Per hospital (n[1], %)
Medical	207 (95)	78 (96)
Respiratory	188 (86.2)	76 (94)
Surgical	162 (74.3)	65 (80)
Neonates <28 days	150 (68.8)	61 (75)
Neurology/Neurosurgery	126 (57.8)	51 (63)
Trauma	121 (55.5)	49 (60)
Cardiac/Cardiac Surgical	55 (25.2)	26 (32)
Others (ENT, Plastics, Burns, Gastro)	18 (8.3)	12 (15)

[1]Based on 218 responses, and 81 hospitals

Table 3. Reponses in terms of HHFNC guidelines, options for respiratory support and application of supportive therapy on the wards:

	Working in hospitals with HDU (n=164)	Working in hospitals with no HDU (n=54)	p value
Decisions to start HHFNC by Paediatricians, n (%)	60 (36.6)	38 (70.3)	.0001
Availability of guidelines for HHFNC, n (%)	127 (77.4)	27 (50)	.0001
Proportion of patients using HHFNC on the ward, n (%)			
<1%	21 (12.8)	14 (6)	.17
1-5%	47 (28.6)	22 (40.7)	.12
6-10%	34 (20.7)	1 (1.8)	.001
11-20%	12 (7.3)	1 (1.8)	.14
>20%	2 (1.2)	9 (16.7)	.0001
HHFNC not used on my ward	9 (5.5)	6 (11.1)	.16
Don't know	39 (23.7)	1 (1.8)	.0001
Available options for respiratory support on the ward (including HDU), n (%)			
Low Flow O2	164 (100)	54 (100)	N/A
HHFNC	155 (95)	47 (87)	.067
CPAP and/or BiPAP	152 (92.7)[1]	15 (27.7)[2]	<.05
Established LTV	111 (67.7)[3]	0	
Supportive Therapy			
Aerosol therapy, n (%)			
MDI therapy without stopping HHFNC	13 (7.9)	4 (7.4)	
MDI therapy, HHFNC is temporarily stopped	12 (7.3)	4 (7.4)	
Nebulised therapy without stopping HHFNC	101 (61.6)	31 (57.4)	.58
Nebulised therapy, HHFNC is temporarily stopped	5 (3)	0	
I don't know	15 (9.1)	7 (12.9)	.40
NGT insertion, n (%)			
Always	26 (15.8)	6 (11.1)	.38
Most of the times	84 (51.2)	22 (40.7)	.22
Sometimes	23 (14)	11 (20.3)	.67
Rarely/Never	7 (4)	4 (7.4)	
Feeding while on HHFNC, n (%)			
Strictly NBM	5 (3)	6 (11.1)	
May start NG feed	108 (65.9)	24 (44.4)	.005
May start NJ feed	6 (3.6)	1 (1.8)	
May start oral feed	17 (10.3)	12 (22.2)	.02
Sedation[4], n (%)			
Never	74 (45.1)	33 61.1)	.04
Sometimes	65 (39.6)	10 (18.5)	.005
Most of the times	3 (1.8)	0	
Always	0	0	

[1] Bubble CPAP on the ward and BiPAP on HDU,

[2]CPAP only,

[3]HDU only,

[4]Chloral hydrate was the most commonly used sedative.

Table 4: Respondents comparison between HHFNC and nCPAP on the wards:

HHFNC	Efficacy and Clinical Effectiveness (%, 95%CI)	p value	Failure and Complications	P Value
Superior to nCPAP	30.6 (24.56-37.18)	<.0001	44.3 (37.59-51.16)	<.0001
Same as nCPAP	37.3 (30.86-44.09)	<.0001	27.1 (21.32-33.52)	<.0001
Inferior to nCPAP	7.2 (4.15-11.48)	<.0001	3.8 (1.68-7.27)	<.0001
I don't know	19.1 (14.11-24.96)	<.0001	22.9 (17.50-29.06)	<.0001

Figures

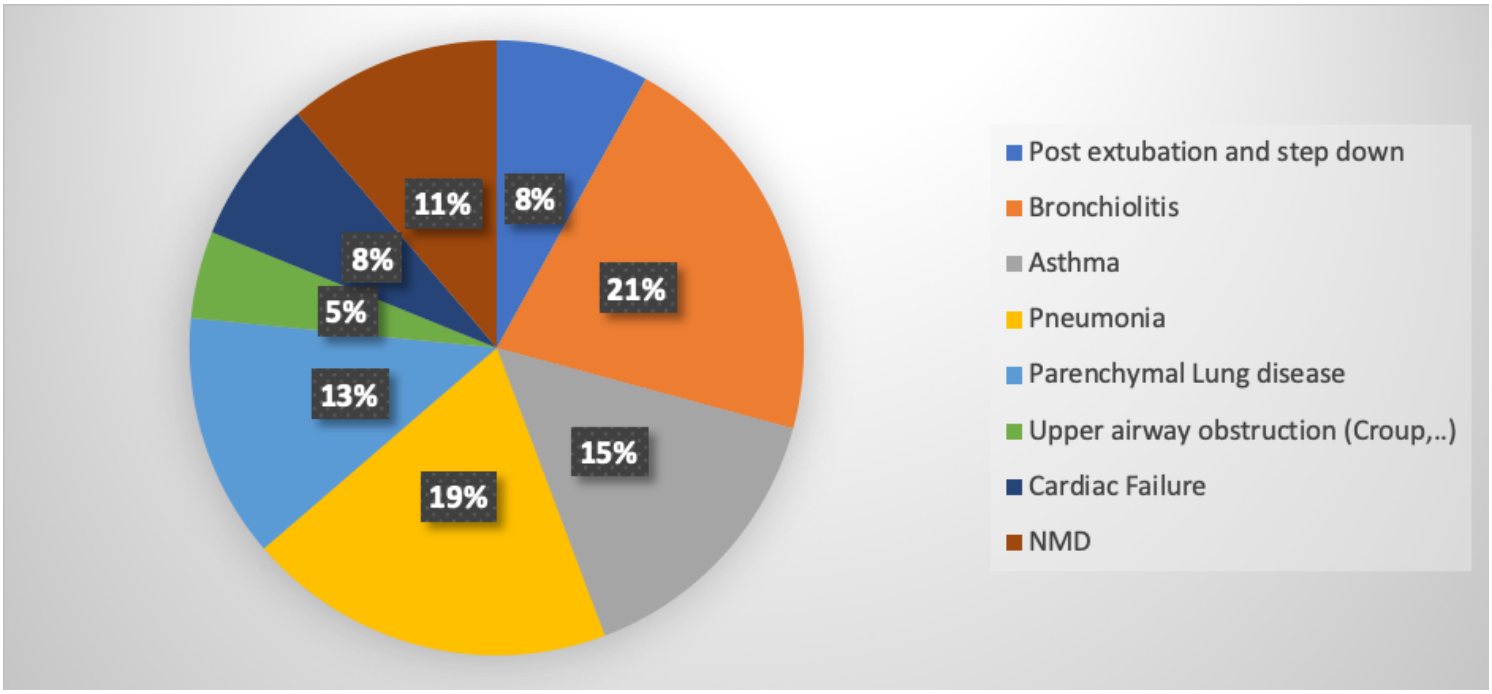

Figure 1

Initiation of HHFNC and modification

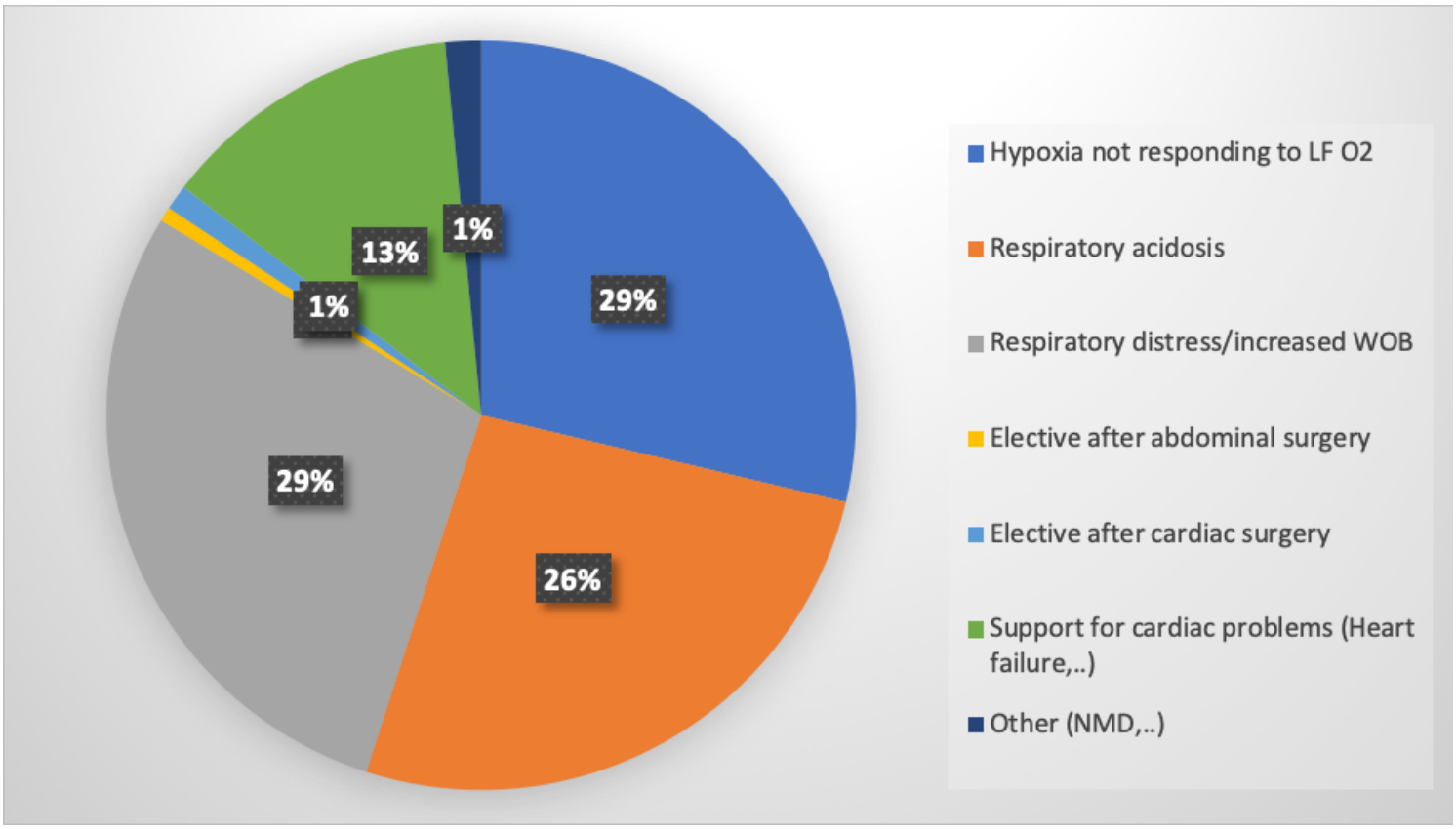

Figure 2

Indications for HHFNC on the ward.

Scenario	*1- an infant (<10 kg) with moderate respiratory distress:*	*2- A child (> 10 kg) with moderate respiratory distress:*
A: What is the Start-up flow rate?	Most respondents indicated a starting flow rate for HHFNC at 2L/kg/min (76.6%)	68.9% of the respondents said they would start at 2L/kg/min
B: What is the HHFNC maximum flow rate?	35% of the respondents indicated keeping the HHFNC flow rate at 2L/kg/min, while around 40% said they could go up to 3-4 L/kg/min.	Responses were almost equal (one third each) in terms of either staying at 2L/kg/min, trying 3L/kg/min or considering the Manufacturer's recommendations if available.
C: What is the action plan if no clinical improvement while on HHFNC?	More than 70% said they will refer to the intensive care/retrieval team for further advice.	More than 70% said they will discuss the case with the intensive care/retrieval team for further advice.
Comments:	A few respondents stated an individualized protocol such as fixed flow rate regardless of the weight, or a flow range based on the weight (e.g. < 4kg: 5-8L/min, 4-10 Kg: 8-12L/min).	A few responses suggested an individualized protocol starting at 2L/Kg/min for the 1st 10 kg followed by 0.5 L/kg/min thereafter.

Figure 3

HHFNC in clinical practice on paediatric wards based on age and weight

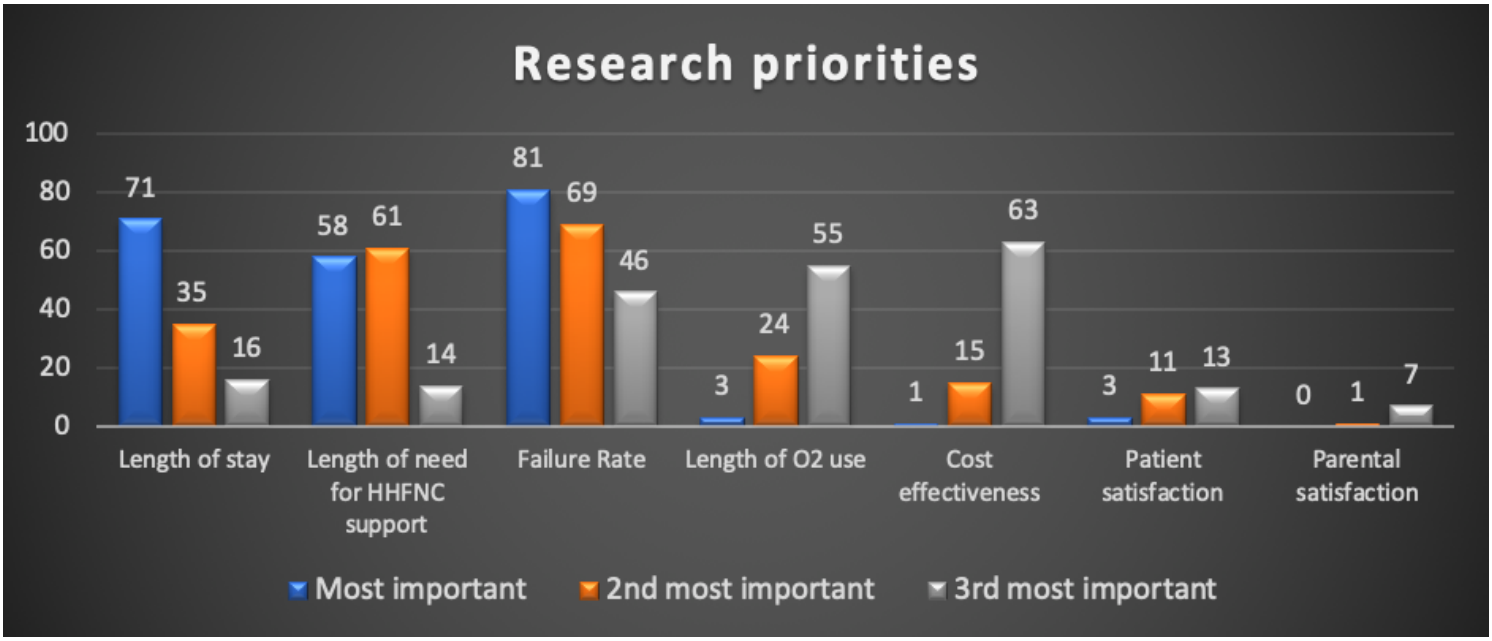

Figure 4

Identified Research Priorities (numbers represent responses of total 218)

Supplementary Files

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