

# A Survey of Humidified High-flow Nasal Cannula Usage in Indian Pediatric Intensive Care Units

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Sir,

Humidified high-flow nasal cannula (HHFNC) has been increasingly used in the recent years.<sup>1-5</sup> It is being used as an option for noninvasive respiratory support in children in many pediatric intensive care units (PICU).<sup>1-4</sup> However, the current use of HHFNC in children is essentially based on individual hospital experience, as there are no existing national guidelines for the use of HHFNC in pediatric practice. Hence, our aim was to survey the Indian PICUs to identify the current practice of HHFNC usage.

We collected data by an online questionnaire (Google survey) that assessed current HHFNC practice in Indian PICUs. The survey questions are listed in the Appendix and included information about the hospital, application of HHFNC, indications, and complications experienced. A total of 100 Indian PICUs were invited to participate. Participation was anonymous and voluntary. Ethical clearance was not required for the study. The statistical analysis was performed by SPSS version 24.

Of the 100 surveys sent out, we received responses from 72 PICUs. Sixty-nine (96%) PICUs confirmed using HHFNC in their setting. The demographics of participating PICUs is summarized in Table 1. Of the 72 PICUs, 59 (82%) used AIRVO™ 2 system, and Optiflow™ (Fisher and Paykel Healthcare, Auckland, New Zealand) was used by 27 (38%). Clinical policies for the use of HHFNC were in place in 37 (51.4%) PICUs.

Respiratory distress due to bronchiolitis (97.2%) was the most common condition for using HHFNC, followed by pneumonia (87.5%), and asthma (63.9%). Sixty-eight (94.4%) PICUs frequently applied HHFNC as respiratory support when weaning from invasive ventilation. Table 1 illustrates other indications and parameters for application of HHFNC. In addition, HHFNC was considered by PICUs as an alternative to continuous positive airway pressure (CPAP) (69.4%) for escalating respiratory support from low flow oxygen (89%) and weaning from CPAP or non-invasive ventilation (NIV) (54.2%) (Table 1).

Nearly half (48%) of the PICUs reported no complications or problems due to HHFNC. Mechanical issues (e.g., circuit condensation, system error, flow obstruction) were encountered by 26 (36%) PICUs, whereas 25 (34%) of 72 PICUs reported patient complications such as nasal trauma, epistaxis, and air leaks (Table 1). Most PICUs used either invasive ventilation (57%) or NIV (43%) when patients failed HHFNC.

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The main aim of the survey was to ascertain the use of HHFNC in Indian PICUs. As previously known, HHFNC is safe, well-tolerated, and higher oxygen concentration can be delivered.<sup>5</sup> It is also easy to use and setup when compared to NIV.<sup>4,5</sup> Our survey has displayed that HHFNC is increasingly being used in Indian PICUs and is being considered for wider pediatric respiratory conditions, such as pneumonia, asthma, or as a respiratory support in patients being weaned from invasive or noninvasive ventilation. This observation is consistent with other publications on use of HHFNC.<sup>4-6</sup> Although most of the PICUs in our survey have used HHFNC for children with primary respiratory problems, some (40.3%) reported using it for children with underlying cardiac diseases or post cardiac surgery (Table 1), and a few (9%) have used for other conditions such as neuromuscular disorders, septic shock, and post-endoscopic procedures.

The most common benefits reported by PICUs for using HHFNC were the ease of use and improved tolerance as well as to reduce nasal trauma, which is similar to the other available surveys.<sup>2,4</sup> Complications associated with HHFNC are most frequently due to tubing rainout or circuit condensation that may be linked to the cooling of the HHFNC gas below its dew point.<sup>2,5</sup> Consistent with this, almost a third of our PICUs stated circuit condensation as a main problem (Table 1). The number of patient injury in our study has also been similar to the previous publications<sup>4-6</sup> (Table 1). Only 11 PICUs encountered side effects of nasal trauma, including bleeding of the nasal mucosa, and 14 PICUs reported air leak complications such as pneumothorax. The rate of patient-related injury due to HHFNC

**Table 1:** Respondent demographics and survey responses

HHFNC usage	n	(%)
Type of hospital		
Government	7	(9.7)
Private	56	(77.8)
Private non-profit	9	(12.5)
Type of PICU		
Pediatric medical	18	(25.0)
Neonatal and pediatric medical	38	(52.8)
Medical and surgical	42	(58.3)
Cardiac	14	(19.4)
Adult and pediatric medical and surgical	4	(5.6)
No of PICU beds		
<6	6	(8.3)
6–12	43	(59.7)
>12	23	(31.9)
Years since PICU functional		
<5 years	20	(27.8)
>5 years	52	(72.2)
Where HHFNC is used		
PICU	71	(100.0)
High dependency unit (HDU)	38	(53.5)
Wards	10	(14.1)
Emergency rooms	8	(11.3)
Operation theaters	1	(1.4)
Years of using HHFNC		
<2 years	18	(25.0)
2–4 years	35	(48.6)
>4 years	19	(26.4)
Indications for using HHFNC		
Bronchiolitis	70	(97.2)
Pneumonia	63	(87.5)
Post extubation	68	(94.4)
Asthma	46	(63.9)
Alternative to CPAP	50	(69.4)
Escalating respiratory support from low flow oxygen	64	(89)
Wean from CPAP or NIV	39	(54.2)
Wheezy lower respiratory infections (LRI)	54	(75)
Postoperative cardiac	29	(40.3)
Stridor	34	(47.2)
Other*	7	(9)
Complications due to HHFNC		
No complications	35	(48)
Nasal trauma	9	(12)
Air leak syndrome	14	(19)
Epistaxis	2	(3)
Mechanical issues with HHFNC	26	(36)

\*Other conditions like neuromuscular disorders, septic shock and post endoscopic procedures

HHFNC, humidified high-flow nasal cannula; PICU, pediatric intensive care units

is comparatively less than NIV,<sup>4</sup> and due to the ease of usage, it is increasingly becoming one of the preferred options for respiratory support in children.<sup>4,5</sup>

The main issue highlighted in our survey is the process of sterilizing and reusing the HHFNC circuit. Although the manufacturer of HHFNC does not recommend reusing the circuit, many (60%) PICUs in our survey were reusing the circuit. This could be attributed to the cost of HHFNC circuit which many patients and families may find challenging; hence, the hospitals choosing to sterilize and reuse them. The majority (79.2%) of our PICUs emphasized the need for more elaborate studies to validate the use of HHFNC, and nearly all (96%) would like to participate and contribute in clinical trials.

Our study is the first national survey to review the HHFNC usage in Indian PICUs as well as highlighting the prevalent issues related to its use. Our results suggest that despite limited evidence on efficacy of HHFNC and the limitations of cost, it is still widely used and is considered safe.

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**APPENDIX***Survey questions:*

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1	Name of hospital and city/town
2	What is your position in the hospital?
3	What kind of hospital?
4	Type of PICU.
5	Number of PICU beds
6	How long has the PICU been operational?
7	Do you currently use NIV?
8	Do you use HFNC?
9	How long has your unit been using HFNC
10	Which disease processes/situations is HFNC used.
11	When do you consider HFNC?
12	If HFNC fails - Which one of the following do you consider as the 1st option?
13	Do you have written unit guidelines/protocols for initiating, evaluating and stopping HFNC?
14	Where do you use HFNC? Tick all that are applicable
15	Which brand of HFNC do you use? Tick all that are applicable
16	Do you reuse HFNC circuits?
17	How do you sterilise HFNC circuits?
18	What problems with HFNC have you encountered on your unit?
19	Do you include HFNC as NIV for bed state/audit/data purposes?
20	Is your unit currently involved in clinical research into HFNC?
21	Would your unit consider joining clinical trials of HFNC?

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