

Supplemental Material S1

RART-Bronchiolitis – HFNC Co-Design Meeting 2: HFNC Process Mapping

Patient Journey & Decision Points

Think of a typical infant (<12 months) presenting with bronchiolitis in your ED.

Please consider what usually happens from arrival to HFNC decision-making. Some examples have been provided

Step	Is this followed by your site?	What happens?	Who is involved? / Who makes the decisions? (Role)	When does it happen (timing)?	What criteria / triggers used	What influences the decisions made?	Documentation practices
Oxygen assessment / SpO ₂ monitoring							
Low-flow O ₂ trial and monitoring		Often skipped in mild/moderate cases; varies by clinician			SpO ₂ < 92% or persistent distress		
Decision to escalate to HFNC - initiation decisions		Nursing setup, consult senior; initiate at site protocol settings	Made by doctor or senior nurse, often influenced by parental concern		Failure to improve after low-flow or severe distress		EHR note, variable detail
HFNC stopping decisions							
Escalation for severe respiratory distress							

Barriers

Barrier category	Examples	Relevant at your site? (Y/ N)	Details
Knowledge and understanding	Unaware of criteria / new guideline changes		
	Knowledge gaps around when to start/ stop HFNC		
	Fear of deterioration without HFNC		
Skills and confidence	Variable ability to assess severity and decide on escalation		
	Anxiety and lack of confidence in ‘doing nothing’		
Environment and resources	HFNC is readily available so often started by default		
	Busy ED environment may encourage ‘quick fixes’ to manage patient flow		
	Logistical pressures and convenience bias		
	Lack of prompts/ decision aids		
Culture and team dynamics	More junior staff feel pressure to act		
	Lack of shared understanding across the team about safe conservative care		
	Peer influence favouring intervention		
Patient and family pressures	Parents expect an intervention ("something to be done")		
	Clinicians worry about family dissatisfaction if treatment is withheld		
Other (not in examples provided)			

Solutions co-design -What would help in your setting?

Evidence based strategies	Examples	Relevant/ helpful at your site? (Y/ N)	Example
Education & training	Regular updates on bronchiolitis guidelines Education sessions Online modules Case studies		
Protocol implementation	HFNC initiation and stopping protocols Decision aids		Poster at bedside with HFNC initiation criteria
Organisational	Champions Daily huddles Leadership support		
Audit and feedback	Monthly reports Benchmarking Clinician-specific feedback		
Family education and communication scripts	Parent leaflets/scripts with standardised messaging		
Decision support	Visual prompts EMR alerts Protocols		

Supplemental Material S2

HFNC implementation synthesis

Table 1: Barriers and Enablers to HFNC Use -CFIR Domains

CFIR Domain	Barriers	Enablers	Source
Intervention Characteristics	Perceived benefit despite weak evidence	Structured initiation/weaning protocols; clearly documented criteria	Gupta (2022), O'Brien (2023), Byrd (2024), Treasure (2023), Jo (2022)
Inner Setting	Unstructured initiation; availability without clear guidance; variability in practice	Protocolized initiation ('Pause'), multidisciplinary huddles; standardized documentation	Byrd (2024), Siraj (2021), Treasure (2023), Jo (2022), O'Brien (2023)
Characteristics of Individuals	Clinician preference for HFNC initiation; nurses' proactive initiation for non-hypoxic moderate illness driven by perceived comfort, safety, and deterioration prevention	Experienced clinicians who trust clinical judgment; assertive nurses influencing management	Gupta (2022), O'Brien (2023), Felsinger (2025)
Process	Poor documentation, lack of accountability	Structured protocols, multidisciplinary meetings, real-time feedback and EHR templates	Byrd (2024), Siraj (2021), Treasure (2023)
Implementation Climate	Lack of shared understanding and collaboration; normalisation of HFNC use beyond guideline indications, particularly in moderate illness without hypoxia	Shared understanding, multidisciplinary culture of 'safely doing less'	Gupta (2022), Byrd (2024), O'Brien (2023), Felsinger (2025)
Networks & Communication	Departmental silos and poor interdisciplinary communication; misalignment between nursing and medical staff regarding triggers, goals, and expected benefits of HFNC	Facilitated multidisciplinary discussions, nursing and medical collaboration	Gupta (2022), O'Brien (2023), Byrd (2024), Felsinger (2025)
Patient Needs & Resources	Parental expectation for intervention	Family education to support conservative management	Treasure (2023), Jo (2022)

Table 2: Barriers and Enablers to HFNC Use -TDF Domains

TDF Domain	Barriers	Enablers	Source
Knowledge	Gaps in knowledge about evidence-based use of HFNC	Structured education, modules, clinical guidelines and reinforcement	Gupta (2022), Siraj (2021), Byrd (2024), O'Brien (2023)
Skills	Inconsistent assessment skills and HFNC setup	Training and competency in respiratory assessment, familiarity with equipment	Byrd (2024), Treasure (2023), Jo (2022)
Beliefs about Consequences	Fear of patient deterioration without HFNC; belief that HFNC prevents worsening; belief that HFNC reduces work of breathing, tachypnoea, illness duration, and prevents deterioration even in non-hypoxic infants	Evidence-based reassurance, clear data showing no harm	Gupta (2022), O'Brien (2023), Treasure (2023), Felsinger (2025)
Environmental	Easy availability, logistical	Structured protocols limiting	Siraj (2021), Byrd (2024),

Context & Resources	pressures, and convenience leading to initiation	availability, defined logistic workflows	Treasure (2023)
Social/Professional Role & Identity	Nurses' assertiveness pushing for HFNC; clinician identity tied to proactive intervention; distinct professional roles with nurses prioritising continuous monitoring and early escalation and doctors aligning more closely with hypoxia-based guideline thresholds	Experienced clinicians' trust in nurses; clarity of roles and shared understanding	O'Brien (2023), Felsinger (2025)
Behavioural Regulation	Lack of structured decision-making tools	Standardised HFNC decision-support algorithms, guidelines, EHR documentation	Byrd (2024), Treasure (2023), Jo (2022)
Social Influences	Pressure from nurses and peers; influence from specialists advocating HFNC use; strong nursing advocacy influencing escalation decisions in moderate illness	Structured interprofessional dialogue, strong team culture, multidisciplinary discussions	Gupta (2022), O'Brien (2023), Byrd (2024), Felsinger (2025)
Emotion	Anxiety about doing nothing, 'need to do something'; use of HFNC in response to visible distress despite absence of hypoxia	Emotional reassurance, cultural change messaging	Gupta (2022), O'Brien (2023), Felsinger (2025)

Table 3: Key Implementation Strategies

Strategy	Details	Impact on HFNC use	Source
Protocol Implementation ('pause' and 'holiday')	Structured protocols for initiation (clinical pause) and weaning (structured trial off therapy)	Reduction in HFNC initiation and duration; decreased hospital length of stay	Byrd (2024), Treasure (2023), Jo (2022), Siraj (2021)
Multidisciplinary Team Huddles	Discussions between nurses, respiratory therapists, physicians for HFNC decisions	Reduced inappropriate initiation; increased team consensus and guideline adherence	Byrd (2024), O'Brien (2023), Felsinger (2025)
Audit & Feedback	Real-time monitoring with statistical process control charts and clinician-specific feedback	Improved adherence to protocols; reduced unnecessary HFNC use through accountability	Byrd (2024), Siraj (2021)
Interprofessional Education	Education sessions, coaching, online modules	Increased clinician knowledge and alignment with evidence-based practices	Byrd (2024), Treasure (2023), O'Brien (2023), Gupta (2022), Felsinger (2025)
Family Education & Communication Scripts	Standardised messaging to manage parental expectations and clearly communicate the care plan	Reduced parental demand for HFNC initiation through improved understanding	Treasure (2023), Jo
EHR Integration & Documentation	Integrated decision-support tools and structured documentation within electronic health records	Enhanced guideline adherence; reduced unnecessary initiation through structured prompts	Byrd (2024)
Coaching and Peer Support	Regular multidisciplinary coaching sessions, small group discussions, and peer-to-peer support	Sustained practice change; improved confidence and reduced clinician anxiety around conservative management	Byrd (2024), Gupta (2022)

Table 4: Recommended Content for Education

Component	Key Messages/Resources	Source
Evidence summary	Clearly explained evidence showing limited benefit of routine HFNC; explicit clarification that HFNC does not reduce LOS or illness duration in non-hypoxic infants despite common clinician belief	Gupta (2022), Byrd (2024), Siraj (2021), Felsinger (2025)
Structured Protocol Training	'Pause' initiation and 'Holiday' weaning	Byrd (2024), Siraj (2021)
Clinical Assessment Skills	Standardised respiratory scoring, clinical assessment methods	Byrd (2024), Treasure (2023)
Cost-Benefit Education	Education about resource optimization, healthcare costs related to HFNC	Siraj (2021), Byrd (2024), Felsinger (2025)
Family Communication Skills	Structured scripts on illness course, managing expectations	Treasure (2023), Jo (2022)
Behavioural/Cultural Alignment	Messaging to mitigate clinician anxiety; 'doing less safely'; addressing interprofessional differences in perceived goals of HFNC (comfort vs oxygenation vs escalation prevention)	Gupta (2022), O'Brien (2023), Felsinger (2025)
EHR & Documentation Training	Templates, standard notes, flowcharts	Byrd (2024)
Emotional Regulation and Team Dynamics	Reassurance, normalising conservative care, role modelling	Gupta (2022), O'Brien (2023), Felsinger (2025)

(1-8)

References

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