

# Bronchiolitis – Less is More

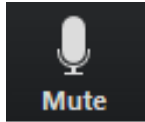
Marie-Pier Lirette (ED Fellow)

Maria Jose Conejero Muller (Paeds Fellow)

Diane Soares (RRT Clinical Educator/Specialist)

This document is property of The Hospital for Sick Children. The information in this document is not intended to be a complete or current statement of the subject-matter and should not be relied upon as such. If you place any reliance on this document, you do so solely at your own risk. You are responsible for confirming the accuracy and completeness of all information in this document before making any decision or permitting any decisions to be made related to any matters described herein. You are responsible for ensuring that this document complies with all applicable laws, statutes, and regulations. The Hospital for Sick Children is not responsible for any outcomes related to how this document will be used, interpreted, or changed by other parties outside The Hospital for Sick Children. No part of this document may be reproduced or published in a different format without the prior written permission of The Hospital for Sick Children

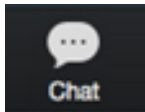
# Webinar Guidelines



Use mute when you are not speaking. Unmute anytime to ask questions.



Turn video on for a more personalized/engaging experience. If internet connection is low turn on when speaking.



Use the chat for additional comments/questions you'd like to share.  
Raise your virtual hand if you'd like to ask your question.

# Objectives

---

1

Discuss overutilization of resources, esp use Heated High Flow Nasal Cannula (HHFNC)

2

Describe QI initiatives to de-implement common interventions

3

Review respiratory management tips & tricks

# Bronchiolitis

---

- Viral bronchiolitis leading cause of hospitalization
- There is a need to '*do something*'. Continuously seeking interventions to improve outcomes.
- Past therapies (salbutamol, steroids, etc) rapidly adopted
  - De-implemented when RCT found no improvement
- Continue to order unnecessary interventions

## HOSPITALIZATIONS FACTS

- 15–17% of hospitalizations in children younger than 2 years
- 15% of ED presentations in infants
  - 3% bronchiolitis admitted to hospital
    - 2–6% requires admission to a PICU
    - 2–3% hospitalizations need invasive mechanical ventilation

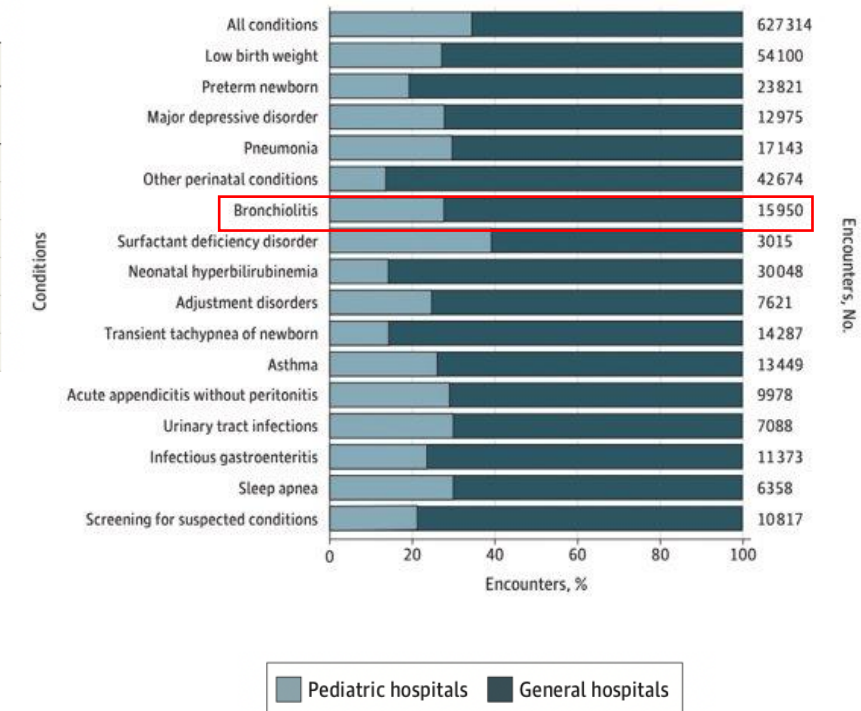
Importance of local  
practices!

# Leading causes of hospitalization in children

Table 2. Prevalence and Cost for the 50 Most Costly and 50 Most Prevalent Conditions Among Children With Inpatient Encounters in Ontario, Canada, From 2014 to 2019

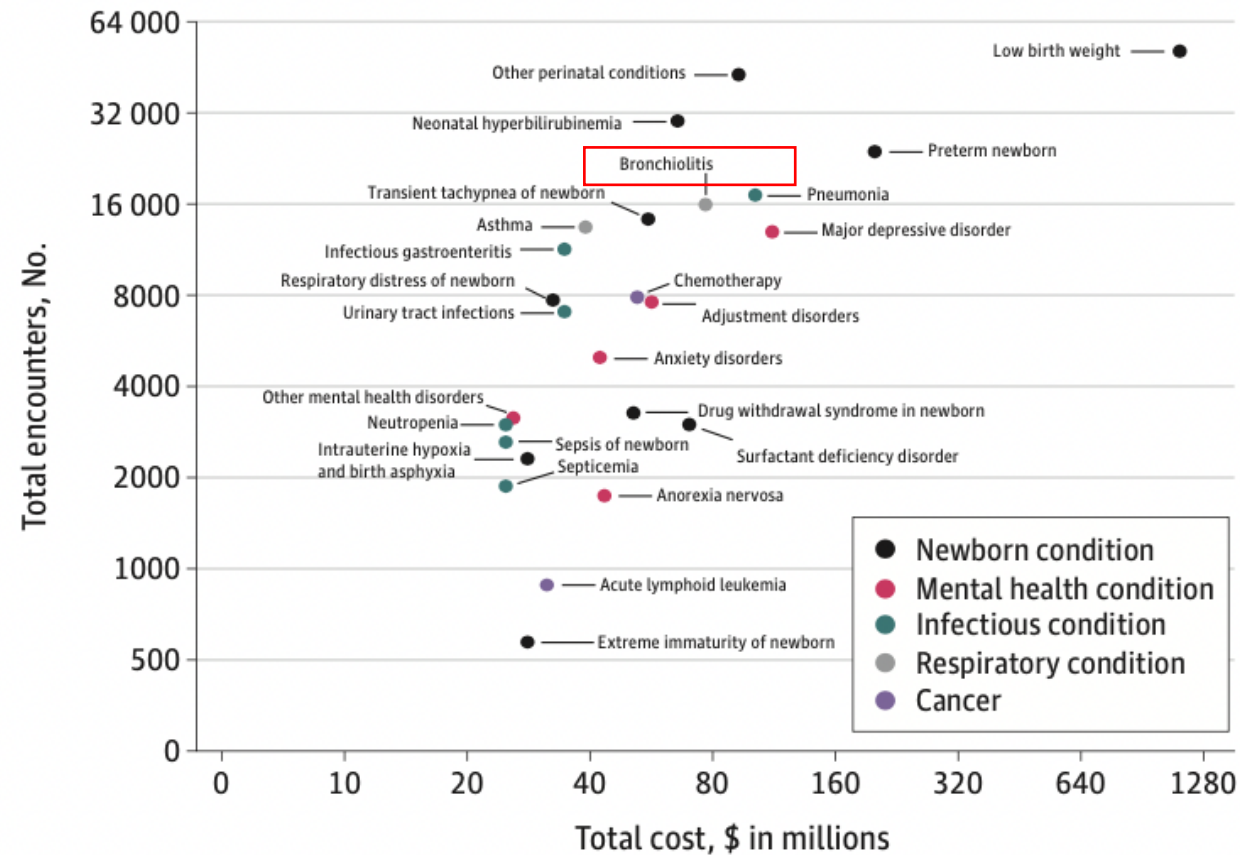
Condition <sup>a</sup>	Type of condition	Rank		Inpatient encounters, No.		Cost, \$ <sup>b</sup>	
		Based on total cost	Based on No. of encounters <sup>c</sup>	Total <sup>d</sup>	Prevalence <sup>e</sup>	Total	Per encounter, median (IQR)
Low birth weight	Medical	1	1	54 100	86.2	676 292 381	2924 (1236-13 777)
Preterm newborn	Medical	2	4	23 821	38.0	137 377 386	2468 (1255-6011)
Major depressive disorder	Medical	3	9	12 975	20.7	78 303 976	5780 (5306-6735)
Pneumonia	Medical	4	5	17 143	27.3	71 566 538	2929 (2709-4029)
Other perinatal conditions	Medical	5	2	42 674	68.0	65 791 674	1036 (1026-1236)
Bronchiolitis	Medical	6	6	15 950	25.4	54 581 261	2602 (2392-2700)

B Hospital encounters



\$\$\$\$\$\$\$\$

Figure 1. Volume and Cost of Encounters for the 25 Highest-Cost Medical Conditions Among Children With Inpatient Encounters in Ontario, Canada, From 2014 to 2019





# Guidelines – Investigations & Treatments



A home for paediatricians. A voice for children and youth.



POSITION STATEMENT

675  
Shares



## Bronchiolitis: Recommendations for diagnosis, monitoring and management of children one to 24 months of age

**Posted:** Nov 3, 2014 | **Updated:** Nov 30, 2021

The Canadian Paediatric Society gives permission to print single copies of this document from our website. For permission to reprint or reproduce multiple copies, please see our [copyright policy](#).

### Principal author(s)

Jeremy N Friedman, Michael J Rieder, Jennifer M Walton; Canadian Paediatric Society, [Acute Care Committee](#), [Drug Therapy and Hazardous Substances Committee](#)

Updated by Carolyn Beck, Kyle McKenzie and Laurel Chauvin-Kimoff

# SUMMARY OF CPS

**TABLE 6**

**Treating bronchiolitis**

<b>Recommended</b>	<b>Evidence equivocal</b>	<b>Not recommended</b>
Oxygen	Epinephrine nebulization	Salbutamol (Ventolin; GlaxoSmithKline, USA)
Hydration	Nasal suctioning	Corticosteroids
	3% hypertonic saline nebulization	Antibiotics
	Combined epinephrine and dexamethasone	Antivirals
		Cool mist therapies or therapy with saline aerosol

**TABLE 3**

**Role of diagnostic studies in typical cases of bronchiolitis**

<b>Type</b>	<b>Specific indications</b>
Chest radiograph	Only if severity or course suggests alternate diagnosis ( <a href="#">Table 2</a> )
Nasopharyngeal swabs	Only if required for cohorting admitted patients
Complete blood count	Generally not helpful in diagnosis or monitoring of routine cases
Blood gas	Only if concerned about potential respiratory failure
Bacterial cultures	Not recommended routinely; may be required based on clinical findings and a child's age.

## CURRENT EVIDENCE – INTERNATIONAL GUIDELINES

	<b>Australia (2016)</b>	<b>NICE UK (2015)</b>	<b>AAP – US (2014)</b>	<b>CPS – Canada (2014)</b>	<b>Italy (2014)</b>	<b>France (2015)</b>	<b>Spain (2010)</b>
Age	<12	-	1-23	<2 yo	<12	<12	<24
X ray	Not routinely						
CBC	Not routinely						
BC	Not routinely						
Gas	Not routinely, many do not mention						
Viral testing	Not routinely, some only recommend when cohorting						

# CURRENT EVIDENCE – INTERNATIONAL GUIDELINES

	<b>Australia (2016)</b>	<b>NICE UK (2015)</b>	<b>AAP – US (2014)</b>	<b>CPS – Canada (2014)</b>	<b>Italy (2014)</b>	<b>France (2015)</b>	<b>Spain (2010)</b>
B agonist	No	No	No	No	No/trial?	No/trial?	No/trial?
Steroids	Not recommended						
Adrenaline	Not recommended						
Hypertonic saline	No	No	No, trial inpatient?	No, trial inpatient?	yes	Yes in moderate to severe	Yes in inpatients
Antibiotics	Not recommended						
Antivirals	Not recommended						

# CURRENT EVIDENCE – INTERNATIONAL GUIDELINES

	<b>Australia (2016)</b>	<b>NICE UK (2015)</b>	<b>AAP – US (2014)</b>	<b>CPS – Canada (2014)</b>	<b>Italy (2014)</b>	<b>France (2015)</b>	<b>Spain (2010)</b>
Suctioning	Controversial, tip suction yes, no routine deep suction						
Chest physio	Not recommended						
O <sub>2</sub>	YES! Variable O <sub>2</sub> sat (90-92%)						
HHF	Controversial, not enough data						

# VARIATION IN RECOMMENDED THERAPY

- Significant variation in treatment provided across the world
  - 3000 infants with bronchiolitis at 38 PERN ED
  - Looked a full EBM treatment
  - 52% did not receive full EBM
  - And 87% less likely in Canada/USA to receive full EBM
  - Odds of hospitalization 23% lower if full EBM received

# Bronchiolitis conundrum

We all see tons of  
bronchiolitis

Treatment is easy

We all know how to  
treat it

Then why do we  
engage into practices  
that are not EBM  
supported?

# Benchmarks

Going back to CPS statement

<b>TABLE 3</b>	
<b>Role of diagnostic studies in typical cases of bronchiolitis</b>	
<b>Type</b>	<b>Specific indications</b>
Chest radiograph	Only if severity or course suggests alternate diagnosis (Table 2)
Nasopharyngeal swabs	Only if required for cohorting admitted patients
Complete blood count	Generally not helpful in diagnosis or monitoring of routine cases
Blood gas	Only if concerned about potential respiratory failure
Bacterial cultures	Not recommended routinely; may be required based on clinical findings and a child's age.



# Benchmarks

**TABLE 3** Selected Clinical Quality Indicators According to Diagnosis With Performance Measures

Condition	Median Hospital Performance, %	No. of Hospitals Included in ABC	ABC, %
<b>Asthma</b>			
CXR	46.1	5	24.5
Ipratropium bromide $\geq 0$ d	73.3	5	2.4
Ipratropium bromide $\geq 1$ d	7.8	4	0.3
Ipratropium bromide $\geq 2$ d	1.5	5	0
Antibiotics	15.7	5	6.6
<b>Bronchiolitis</b>			
Viral test	45.0	4	0.6
CXR	52.9	4	32.4
Steroids	18.1	3	6.4
Antibiotics	37.0	5	18.5
Bronchodilator $\geq 0$ d	74.4	4	18.9
Bronchodilator $\geq 1$ d	30.3	3	0
Bronchodilator $\geq 2$ d	11.4	3	0
<b>Pneumonia</b>			
C-reactive protein	19.3	5	0.1
Erythrocyte sedimentation rate	8.2	5	3.5
Complete blood cell count	55.1	5	28.8
Viral test	24.6	5	1.5
Initial narrow-spectrum antibiotics	27.3	5	60.7



# *To Do* or *Not To Do*?

## Oximetry:

- ✓ Intermittent oximetry
- ✓ Saturations > 90% awake and > 88% asleep
- ✓ If patient stable --> with or without hypoxia who are being managed with an oxygen saturation target of 90% or higher, clinical outcomes, including length of hospital stay and safety, were similar with intermittent vs continuous pulse oximetry.
  - Nursing satisfaction superior with intermittent
  - **Bottom line → Intermittent oximetry**

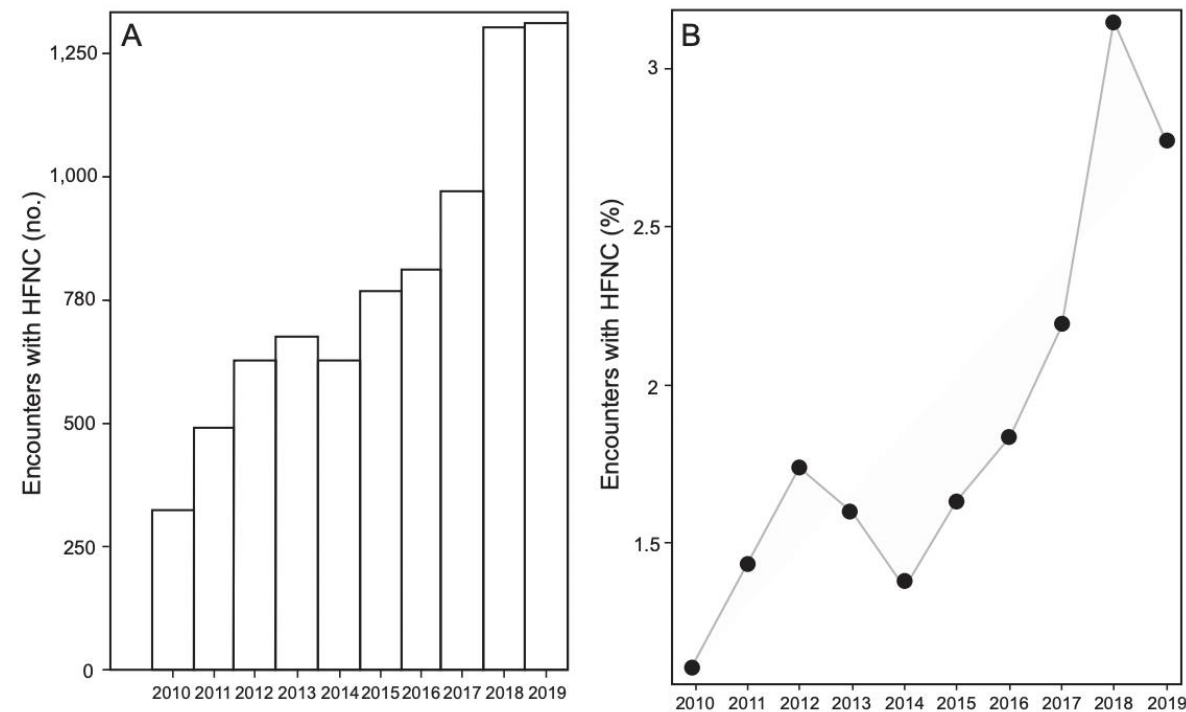
# To Do or *Not To Do*

- Ventolin and Hypertonic Saline nebuliser
  - Not generally recommended

Hypertonic saline	Ventolin
<ul style="list-style-type: none"><li>• Substantial statistical heterogeneity in LOS</li><li>• Insufficient subjects (pooled) to extrapolate results of individual studies that show successful outcomes with this therapy</li></ul>	<ul style="list-style-type: none"><li>• Hazy population --&gt; previous episodes, early asthma</li><li>• Studies do not include SEVERE bronchiolitis</li><li>• If considering, document response, reevaluate</li></ul>
<p>Wade Harrison, Francois Angoulvant, Samantha House, Vincent Gajdos, Shawn L. Ralston; Hypertonic Saline in Bronchiolitis and Type I Error: A Trial Sequential Analysis. <i>Pediatrics</i> September 2018; 142 (3): e20181144. 10.1542/peds.2018-1144</p>	<p>Gadomski AM, Scribani MB. Bronchodilators for bronchiolitis. <i>Cochrane Database Syst Rev.</i> 2014 Jun 17;2014(6):CD001266. doi: 10.1002/14651858.CD001266.pub4. PMID: 24937099; PMCID: PMC7055016. Horvat CM, Pelletier J. A Trial of Albuterol Should Still Be Considered for Children With Severe Bronchiolitis COMMENT &amp; RESPONSE. <i>JAMA pediatrics.</i> 2021;175(11).</p>

# Heated High Flow Nasal Cannula (HHFNC)

Dramatic increase over last 10 years

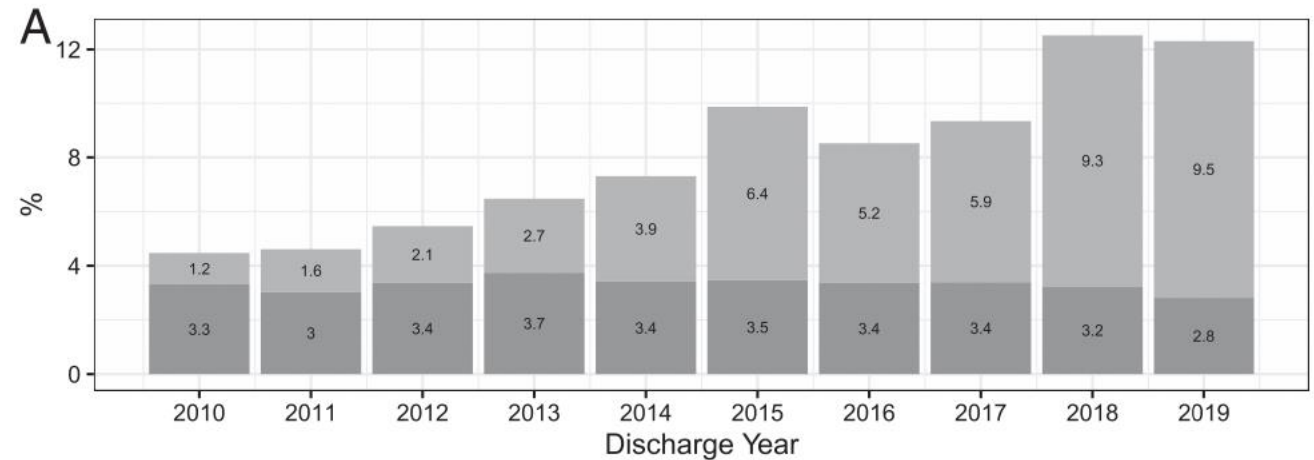
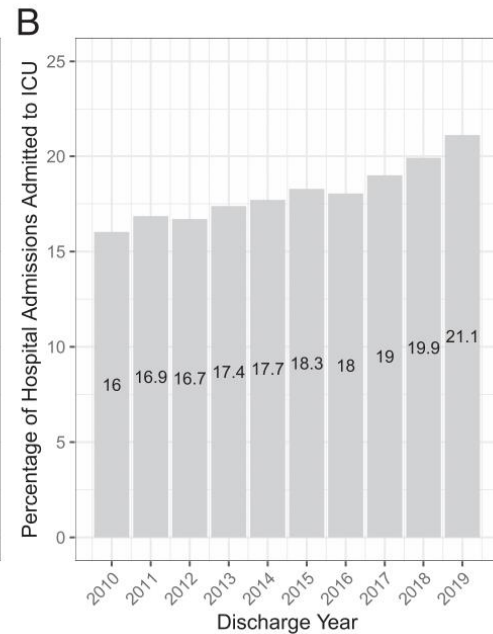
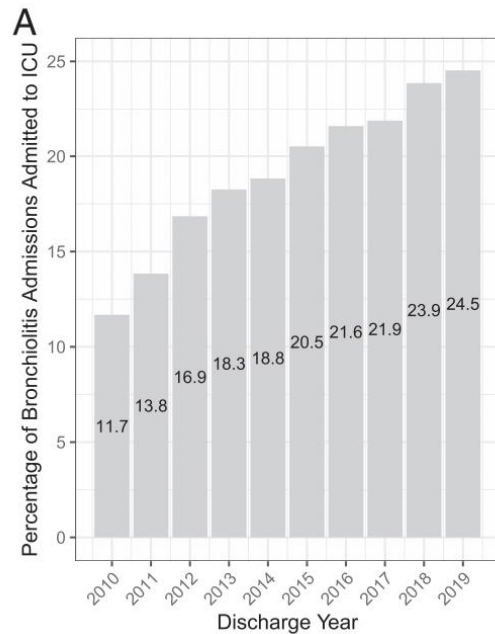


# INCREASE IN PICU ADMISSION

## Trends in Bronchiolitis ICU Admissions and Ventilation Practices: 2010–2019

Jonathan H. Pelletier, MD,<sup>a</sup> Alicia K. Au, MD, MS,<sup>a</sup> Dana Fuhrman, DO, MS,<sup>a</sup> Robert S. B. Clark, MD,<sup>a</sup> Christopher Horvat, MD, MHA<sup>a,b</sup>

More patients admitted with bronchiolitis going to PICU, no increase on patients receiving invasive ventilation





# LOW FLOW & HIGH FLOW: NON-INFERIOR

- Safe
- Used as a rescue therapy when low flow O2 fails
- As a primary therapy for bronchiolitis, it is not superior to low flow O2 (no change in LOS and PICU transfer)
  - When offered two similar therapies, pick the cheapest one

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

## A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis

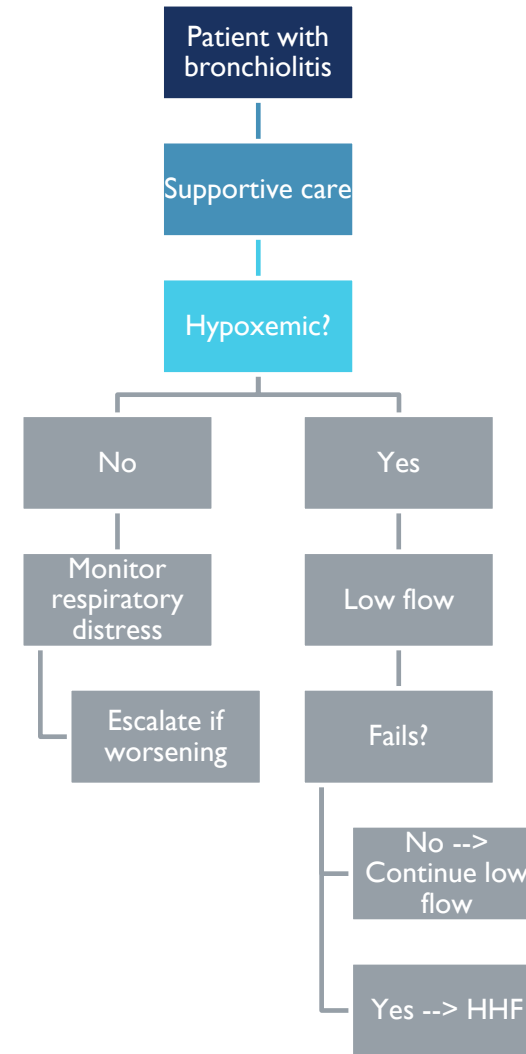
Donna Franklin, B.N., M.B.A., Franz E. Babl, M.D., M.P.H.,  
Luregn J. Schlapbach, M.D., Ed Oakley, M.B., B.S.,  
Simon Craig, M.B., B.S., M.H.P.E., M.P.H., Jocelyn Neutze, M.B., Ch.B.,  
Jeremy Furyk, M.B., B.S., M.P.H.&T.M., John F. Fraser, M.B., Ch.B., Ph.D.,  
Mark Jones, Ph.D., Jennifer A. Whitty, B.Pharm., Grad.Dip.Clin.Pharm., Ph.D.,  
Stuart R. Dalziel, M.B., Ch.B., Ph.D., and Andreas Schibler, M.D.

### High-flow warm humidified oxygen versus standard low-flow nasal cannula oxygen for moderate bronchiolitis (HFWHO RCT): an open, phase 4, randomised controlled trial

Elizabeth Kepreotes, Bruce Whitehead, John Attia, Christopher Oldmeadow, Adam Collison, Andrew Searles, Bernadette Goddard, Jodi Hilton, Mark Lee, Joerg Mattes

Tessa Davis . What is the evidence for high flow in bronchiolitis?, Don't Forget the Bubbles, 2019. Available at: <https://doi.org/10.31440/DFTB.20191>  
Kepreotes E, Whitehead B, Attia J, Oldmeadow C, Collison A, Searles A, 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. The Lancet (British edition). 2017;389(10072):930–9.  
Franklin et al, A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis. NEJM. 2018. 378(12):1121-1131

# RECOMMENDED PATHWAY 2022





# HHFNC SUMMARY

---

Early studies showed HHFNC may reduce ICU use, intubations

---

RCTs with ~2900 mild-moderate patients, found no benefit in ICU, oxygen duration, intubation, LOS

---

Long-term observational studies found either no change in outcomes or paradoxical increase in ICU use

---

We are now in the de-implementation phase!

---

The routine use of HHFNC is not indicated in mild-moderate illness.

# QI strategies for de-implementation



American Academy of Pediatrics



# Our Goals



Reduce HHFNC utilization by 30%



Reduce non-EBM interventions by 50%

# Our Journey



Create MDT & define goals



Assess baseline



Develop measures



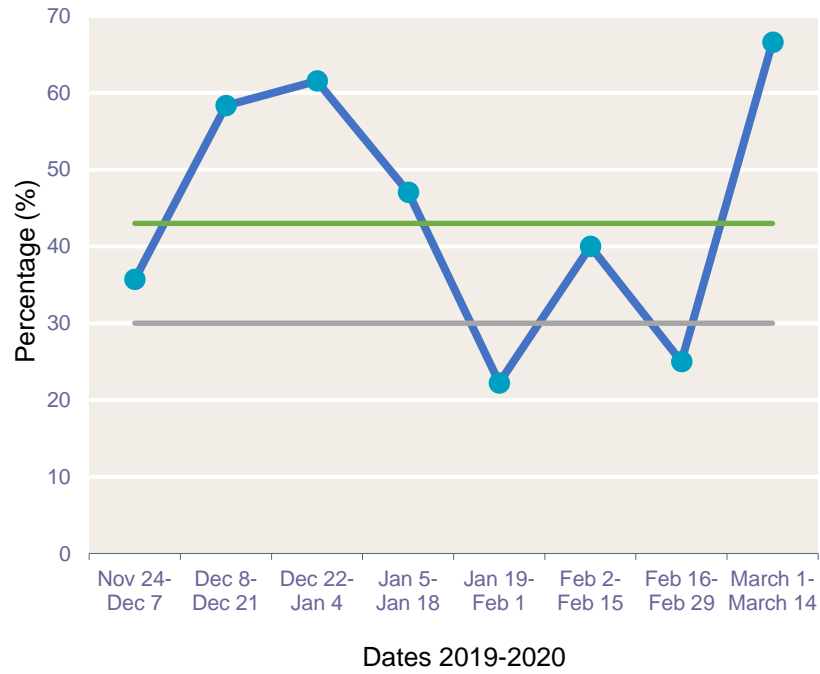
Develop interventions (PDSA cycles)



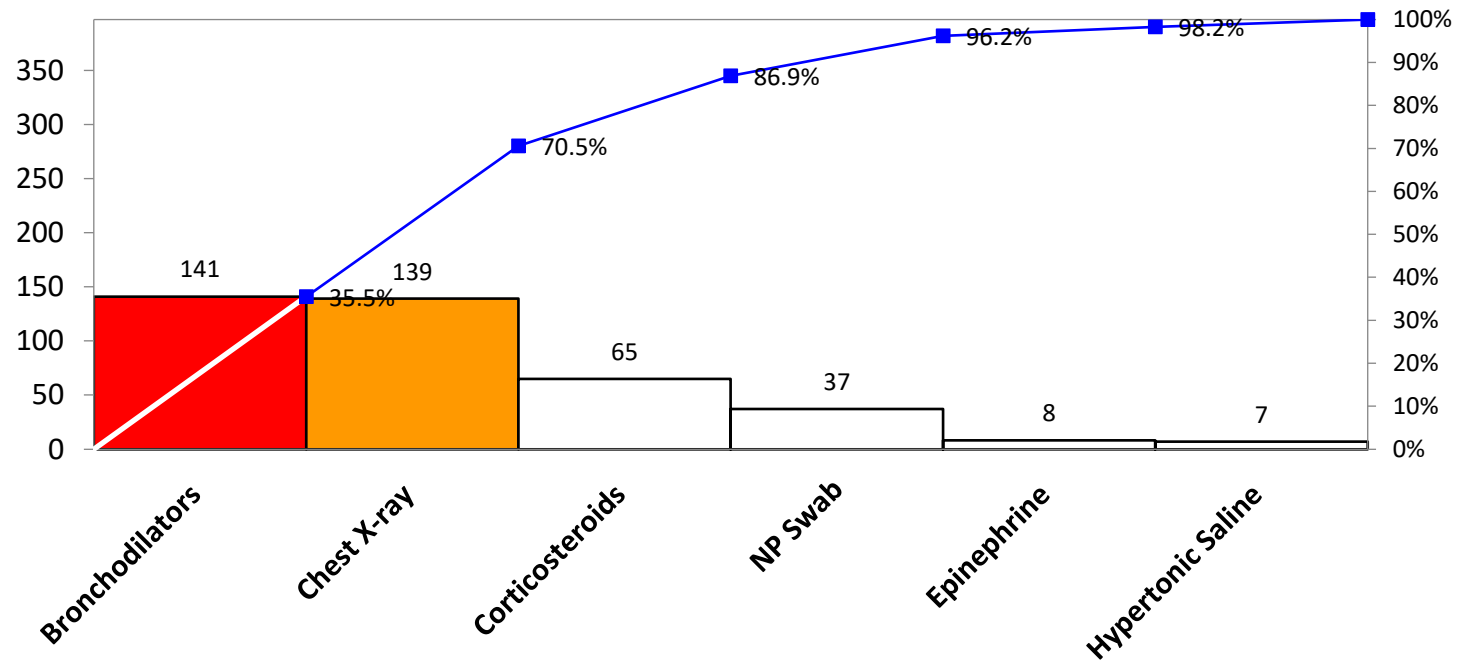
Re-evaluate with the MDT

# Baseline Assessment

**Baseline HFNC initiation  
(#HFNC/ #Bronchiolitis Admissions)**



**Baseline Non-Evidenced Based Interventions  
Pareto Chart**



# QI Measures

<b>Goals</b>	<b>Reducing HFNC</b>	<b>Reducing non-EBM interventions</b>
<b>Outcome</b>	% HFNC initiation	% Non-EBM interventions
<b>Process</b>	% Bronchiolitis Bundle performed	% Order set use
<b>Balancing</b>	LOS (ED and inpatient)	LOS (ED and inpatient)

# Bronchiolitis Bundle

---

Antipyretics

---

Assess hydration, encourage oral feeding if safe

---

Reposition and suction nasal passages

---

Apply low flow nasal prongs to maintain sats > 88% when asleep and >90% when awake

---

Minimal handling, bundle cares

---

Dim lights

## BRONCHIOLITIS SEVERITY SCORE (BSS)

Purpose: To assess patient's respiratory status and to help determine severity of work of breathing. Total score ranges from 0-9, with higher scores indicating greater respiratory status. To be used on children 0-24 months who meet criteria for bronchiolitis.

This tool is designed for use while the child is awake and not feeding.

This tool is to be used before and after an intervention is complete (ie. suction, oxygen, etc.)

# HSC Bronchiolitis Severity Score

---

SEVERITY CRITERIA		0 point	1 point	2 point	3 point
RR	<2 months		50-59	60-69	≥70
	2-<12 months		40-49	50-59	≥60
	12-24 months		30-39	40-49	≥50
Retraction Signs		None	Intercostal only	Intercostal with subcostal and/or substernal indrawing	Intercostal and subcostal with nasal flaring and/or chest wall indrawing
Wheezing		None	Expiratory	Inspiratory and Expiratory	Audible without Stethoscope

Note. Adapted from "Inter-Observer Agreement Between Physicians, Nurses, and Respiratory Therapists for Respiratory Clinical Evaluation in Bronchiolitis," by V. Gajdos, N. Beydon, L. Bommenel, B. Pellegrino, L. de Pontual, S. Bailleux, P. Labrune, and J. Bouyer, 2009, *Pediatric Pulmonology*, 44, p. 755. Copyright 2009 by Wiley-Liss, Inc.

Mild: 1-3 points

Moderate: 4-6 points

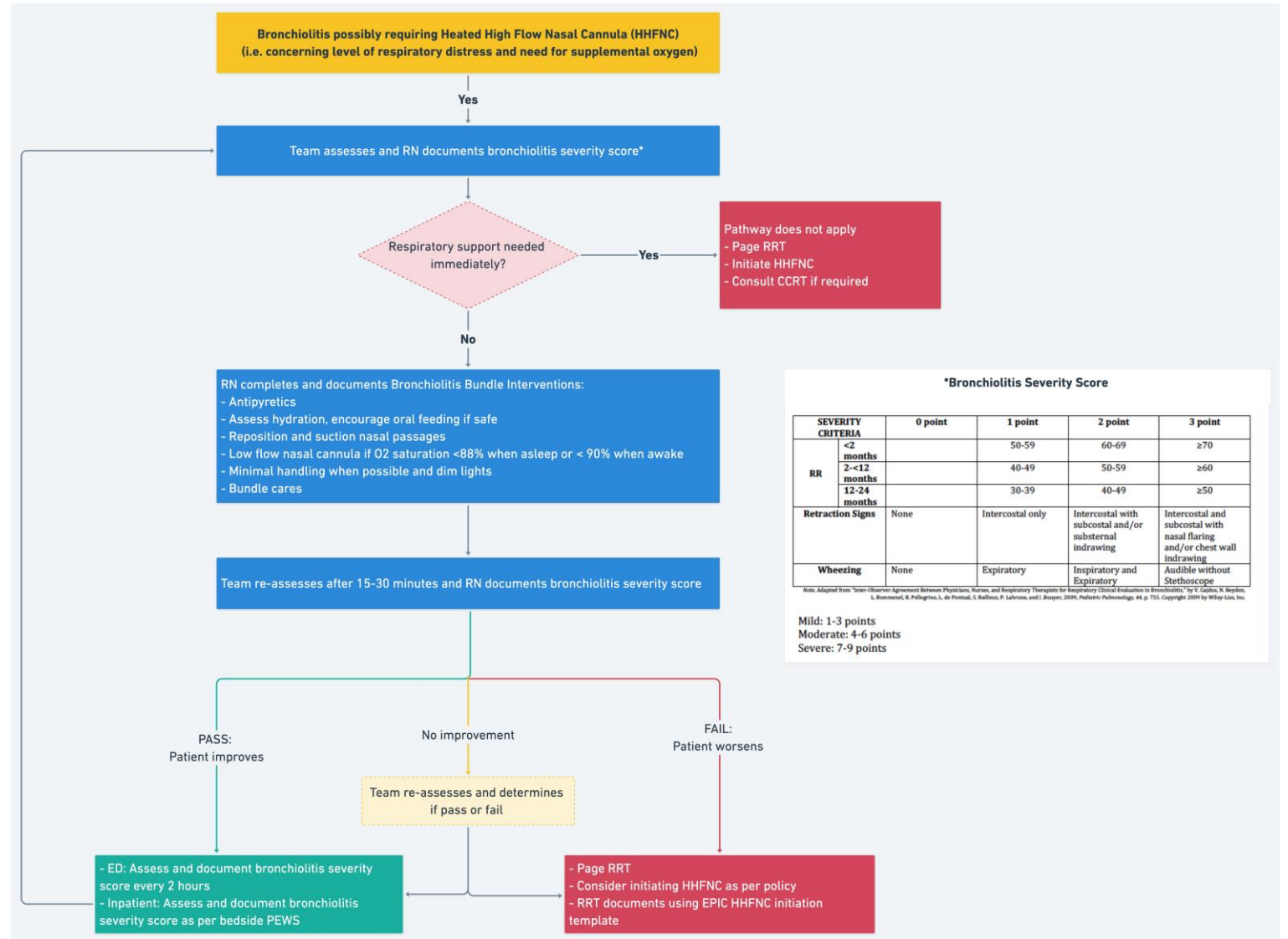
Severe: 7-9 points

### References:

Gajdose, V., Beydon, N., Bommenel, L., Pellegrino, B., de Pontual, L., Bailleux, S., Labrune, P., and Bouyer, J. (2009). Inter-Observer Agreement Between Physicians, Nurses, and Respiratory Therapists for Respiratory Clinical Evaluation in Bronchiolitis. *Pediatric Pulmonology*, 44, 754-762. Doi: 10.1002/ppul.21016



# HHFNC initiation workflow



**\*Bronchiolitis Severity Score**

SEVERITY CRITERIA		0 point	1 point	2 point	3 point
RR	<2 months		50-59	60-69	≥70
	2-<12 months		40-49	50-59	≥60
	12-24 months		30-39	40-49	≥50
Retraction Signs	None	Intercostal only	Intercostal with subcostal and/or substernal indrawing	Intercostal with subcostal and/or chest wall indrawing	Audible without Stethoscope
Wheezing	None	Expiratory	Inspiratory and Expiratory	Audible without Stethoscope	

Note: Adapted from "Inter-Observer Agreement Between Physicians, Nurses, and Respiratory Therapists for Respiratory Clinical Evaluation in Bronchiolitis," by V. Galton, N. Baydin, L. Bommelaer, G. Pellegrino, L. de Fontaine, S. Raffieux, F. Labrousse, and J. Brochez, 2019, Pediatric Pulmonology, 44, p. 715. Copyright 2019 by Wiley-Liss, Inc.

Mild: 1-3 points  
Moderate: 4-6 points  
Severe: 7-9 points

**Bronchiolitis possibly requiring Heated High Flow Nasal Cannula (HHFNC)  
(i.e. concerning level of respiratory distress and need for supplemental oxygen)**

Yes

Team assesses and RN documents bronchiolitis severity score\*

Respiratory support needed immediately?

Yes

Pathway does not apply  
- Page RRT  
- Initiate HHFNC  
- Consult CCRT if required

No

RN completes and documents Bronchiolitis Bundle Interventions:

- Antipyretics
- Assess hydration, encourage oral feeding if safe
- Reposition and suction nasal passages
- Low flow nasal cannula if O2 saturation <88% when asleep or < 90% when awake
- Minimal handling when possible and dim lights
- Bundle cares

Team re-assesses after 15-30 minutes and RN documents bronchiolitis severity score

**\*Bronchiolitis Severity Score**

SEVERITY CRITERIA		0 point	1 point	2 point	3 point
RR	<2 months		50-59	60-69	≥70
	2-<12 months		40-49	50-59	≥60
	12-24 months		30-39	40-49	≥50
Retraction Signs	None	Intercostal only	Intercostal with subcostal and/or substernal indrawing	Intercostal and subcostal with nasal flaring and/or chest wall indrawing	
Wheezing	None	Expiratory	Inspiratory and Expiratory	Audible without Stethoscope	

Note. Adapted from "Inter-Observer Agreement Between Physicians, Nurses, and Respiratory Therapists for Respiratory Clinical Evaluation in Bronchiolitis," by V. Gajdos, N. Beydon, L. Bommene, B. Pellegrino, L. de Pontual, S. Balleux, P. Labrune, and J. Bouyer, 2009, *Pediatric Pulmonology*, 44, p. 755. Copyright 2009 by Wiley-Liss, Inc.

Team re-assesses after 15-30 minutes and RN documents bronchiolitis severity score

<b>Wheezing</b>	No
-----------------	----

Note. Adapted from "Inter-Observer Ag  
L. Bommen

Mild: 1-3 points  
Moderate: 4-6 points  
Severe: 7-9 points

PASS:  
Patient improves

No improvement

FAIL:  
Patient worsens

Team re-assesses and determines if pass or fail

- ED: Assess and document bronchiolitis severity score every 2 hours  
- Inpatient: Assess and document bronchiolitis severity score as per bedside PEWS

- Page RRT  
- Consider initiating HHFNC as per policy  
- RRT documents using EPIC HHFNC initiation template

# ED Bronchiolitis order set

## Division of Paediatric Emergency Medicine Moderate-Severe Bronchiolitis Order Set

For children less than 24 months of age who meet criteria for moderate-severe bronchiolitis as described on the back page

DATE OF BIRTH  
YYYY-MM-DD

SEX

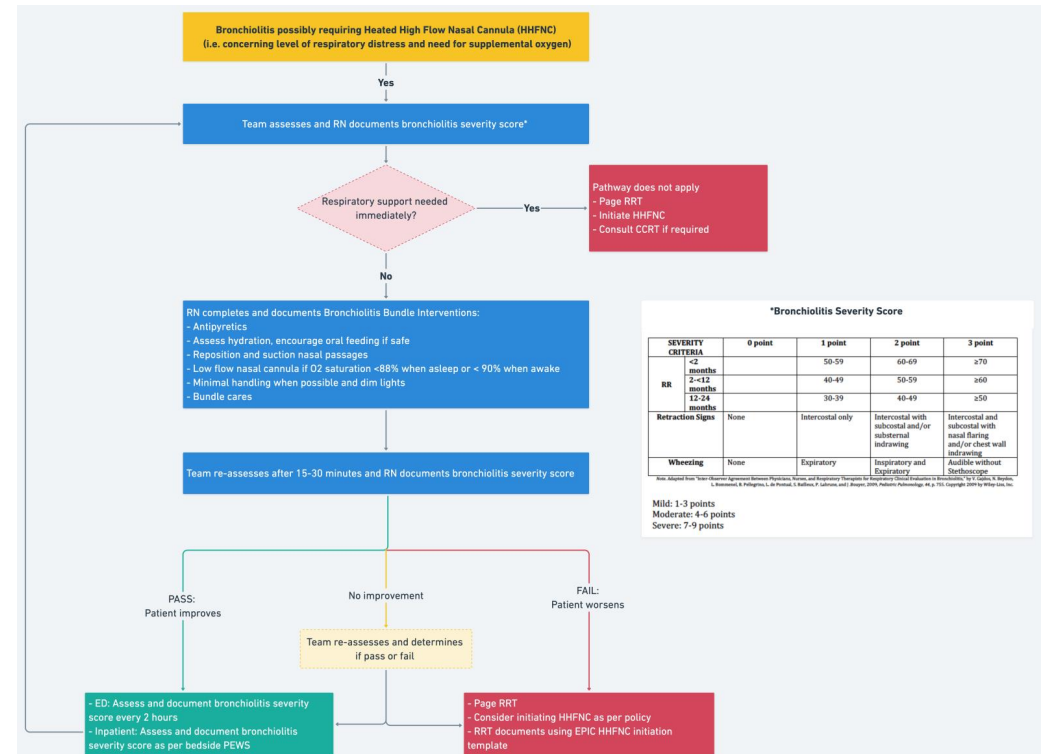
### Signature key

Name	Initials

WEIGHT (kg)	ALLERGIES
	<input type="checkbox"/> NKDA

Bronchiolitis should be diagnosed from history and physical exam. Routine laboratory tests and chest x-rays are not required. The mainstay of management is conservative. There is no evidence to support use of salbutamol, ipratropium bromide, inhaled/systemic corticosteroids or routine antibiotics.

Provider Initials / Date/Time	ORDERS	Noted by RN Initials / Time
	<p><b>Initial assessment:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Full vital signs (HR, RR, BP, O2 sat, Temp).</li> <li><input checked="" type="checkbox"/> Intermittent O<sub>2</sub> sat every 2 hours</li> <li><input checked="" type="checkbox"/> Bronchiolitis Severity Score (Obtain at baseline, 15-30 minutes after Bronchiolitis Bundle then every 2 hours. See second page)</li> </ul> <p><b>Testing:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> COVID swab (as applicable)</li> <li><input type="checkbox"/> febrile infant age 29-90 days</li> <li><input type="checkbox"/> In &amp; out urine catheter, POC urinalysis and culture</li> <li><i>*Consider using Young Infant Fever or sepsis order set as needed</i></li> </ul> <p><b>Perform Bronchiolitis Bundle</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Reposition and nasal suction as needed</li> <li><input checked="" type="checkbox"/> Minimize handling and dim the lights</li> <li><input checked="" type="checkbox"/> Initiate oral feeds (if safe, i.e. mild-moderate WOB and not requiring oxygen)</li> <li><input type="checkbox"/> Insert NG and initiate feeds if not tolerating oral feeds</li> </ul> <p>if fever: <input type="checkbox"/> acetaminophen ___ mg PO q4h pm (15mg/kg/dose, max 75mg/kg/day or 4g/day)  <input type="checkbox"/> ibuprofen ___ mg (age less than 6 months: 5mg/kg/dose PO q6h pm age greater than or equal to 6 months: 10mg/kg/dose PO q6h pm)</p> <p><b>if hypoxia and/or severe WOB:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Low flow nasal cannula if oxygen saturation &lt;90% when awake and &lt;88% when asleep Max rate: 0-30 days: 1L/min; 91days-6 months: 1.5L/min; 6 months-2 years: 2L/min</li> <li><input type="checkbox"/> Continuous O<sub>2</sub> saturation monitoring</li> </ul> <p><b>Ongoing assessment (15-30 minutes after Bronchiolitis Bundle)</b></p> <p><b>if mild WOB and stable FIO<sub>2</sub> requirement on low flow nasal cannula (LFNC):</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Encourage oral feeding</li> <li><input type="checkbox"/> IP consult to paediatrics or transfer to other hospital</li> </ul> <p><b>if increasing WOB, FIO<sub>2</sub> or severe bronchiolitis severity score on LFNC:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Perform Bronchiolitis Bundle (if &gt;2 hours from last bundle)</li> <li><input type="checkbox"/> Consult Respiratory Therapist if worsening despite Bronchiolitis Bundle</li> <li><input type="checkbox"/> Heated High Flow Nasal Cannula (HHFNC) at 2 LPM/kg or maximal flow rate tolerated</li> <li><input type="checkbox"/> Initiate oral feeds or <input type="checkbox"/> Insert NG and initiate feeds if not tolerating oral feeds</li> <li><input type="checkbox"/> IP consult to paediatrics</li> </ul> <p><b>if increasing WOB, FIO<sub>2</sub> or severe bronchiolitis severity score on HHFNC</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bronchiolitis Severity Score every 1 hour</li> <li><input type="checkbox"/> Continuous Positive Airway Pressure (CPAP)</li> <li><input type="checkbox"/> Insert peripheral IV <input type="checkbox"/> CBC, Na, K, glucose, creatinine, venous blood gas</li> <li><input type="checkbox"/> NPO <input type="checkbox"/> DSWINS at ___ ml/hr (TFI 80% maintenance if HD stable)</li> <li><input type="checkbox"/> CXR (if ICU admission)</li> <li><input type="checkbox"/> IP consult to CCRT</li> </ul>	



### \*Bronchiolitis Severity Score

SEVERITY CRITERIA	0 point	1 point	2 point	3 point
RR				
<2 months		50-59	60-69	≥70
2-42 months		40-49	50-59	≥60
12-24 months		30-39	40-49	≥50
Retraction Signs	None	Intercostal only	Intercostal with subcostal and/or substernal indrawing	Intercostal and subcostal with nasal flaring and/or chest wall indrawing
Wheezing	None	Expiratory	Inspiratory and Expiratory	Audible without Stethoscope

Mild: 1-3 points  
Moderate: 4-6 points  
Severe: 7-9 points

## Division of Paediatric Emergency Medicine

### Moderate-Severe Bronchiolitis Order Set

For children less than 24 months of age who meet criteria for moderate-severe bronchiolitis as described on the back page

DATE OF BIRTH  
YYYY-MM-DD

SEX

WEIGHT (kg)	ALLERGIES <input type="checkbox"/> NKDA
Bronchiolitis should be diagnosed from history and physical exam. Routine laboratory tests and chest x-rays are not required. The mainstay of management is conservative. There is no evidence to support use of salbutamol, ipratropium bromide, inhaled/systemic corticosteroids or routine antibiotics.	

Signature key	
Name	Initials

Provider Initials / Date/Time	ORDERS	Noted by RN Initials / Time
	<p><b>Initial assessment:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Full vital signs (HR, RR, BP, O2 sat, Temp).</li> <li><input checked="" type="checkbox"/> Intermittent O<sub>2</sub> sat every 2 hours</li> <li><input checked="" type="checkbox"/> Bronchiolitis Severity Score (<i>Obtain at baseline, 15-30 minutes after Bronchiolitis Bundle then every 2 hours. See second page</i>)</li> </ul> <p><b>Testing:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> COVID swab (as applicable)</li> </ul> <p>If febrile infant age 29-90 days:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> In &amp; out urine catheter, POC urinalysis and culture</li> </ul> <p><i>*Consider using Young Infant Fever or sepsis order set as needed</i></p> <p><b>Perform Bronchiolitis Bundle</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Reposition and nasal suction as needed</li> <li><input checked="" type="checkbox"/> Minimize handling and dim the lights</li> <li><input type="checkbox"/> Initiate oral feeds (if safe, i.e mild-moderate WOB and not requiring oxygen)</li> <li><input type="checkbox"/> Insert NG and initiate feeds if not tolerating oral feeds</li> </ul> <p>If fever: <input type="checkbox"/> acetaminophen ___ mg PO q4h prn (15mg/kg/dose, max 75mg/kg/day or 4g/day)</p> <p style="margin-left: 20px;"><input type="checkbox"/> ibuprofen ___ mg (age less than 6 months: 5mg/kg/dose PO q8h prn age greater than or equal to 6 months:10mg/kg/dose PO q6h prn)</p> <p><b>If hypoxia and/or severe WOB:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Low flow nasal cannula if oxygen saturation &lt;90% when awake and &lt;88% when asleep <i>Max rate: 0-90 days: 1L/min; 91days-6 months: 1.5L/min; 6 months-2 years: 2L/min</i></li> <li><input type="checkbox"/> Continuous O<sub>2</sub> saturation monitoring</li> </ul>	



**Ongoing assessment (15-30 minutes after Bronchiolitis Bundle)**

**If mild WOB and stable FiO<sub>2</sub> requirement on low flow nasal cannula (LFNC):**

- Encourage oral feeding
- IP consult to paediatrics or transfer to other hospital

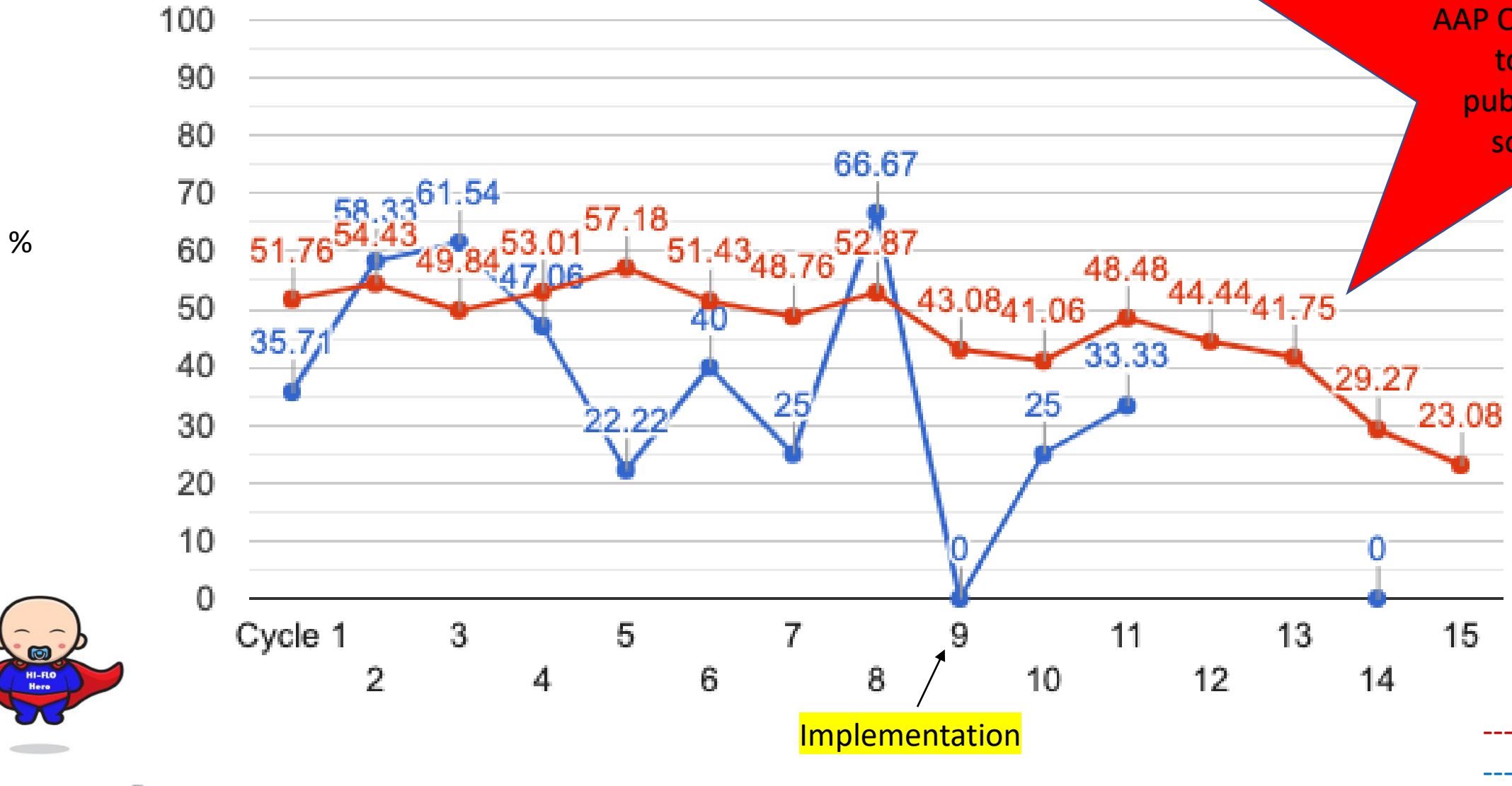
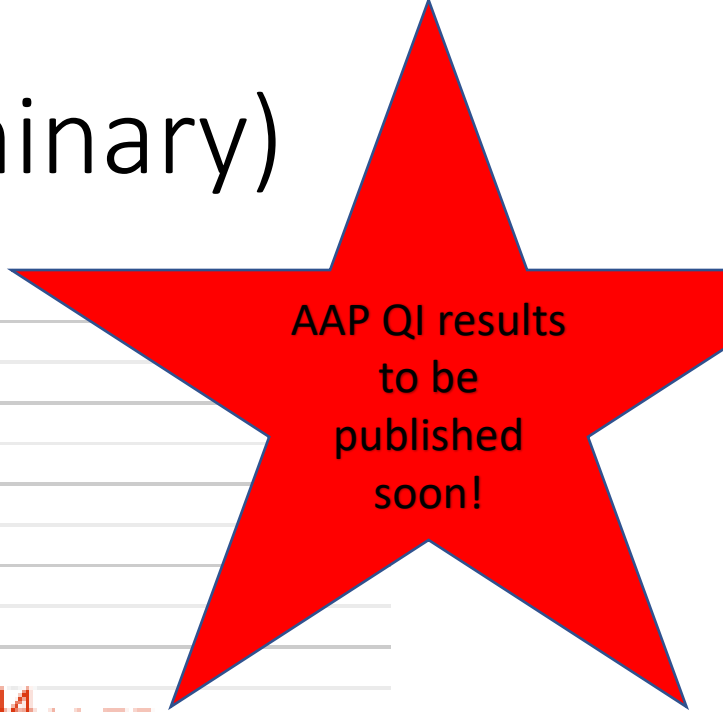
**If increasing WOB, FiO<sub>2</sub> or severe bronchiolitis severity score on LFNC:**

- Perform Bronchiolitis Bundle (if >2 hours from last bundle)
- Consult Respiratory Therapist if worsening despite Bronchiolitis Bundle
- Heated High Flow Nasal Cannula (HHFNC) at 2 LPM/kg or maximal flow rate tolerated
- Initiate oral feeds or  Insert NG and initiate feeds if not tolerating oral feeds
- IP consult to paediatrics

**If increasing WOB, FiO<sub>2</sub> or severe bronchiolitis severity score on HHFNC**

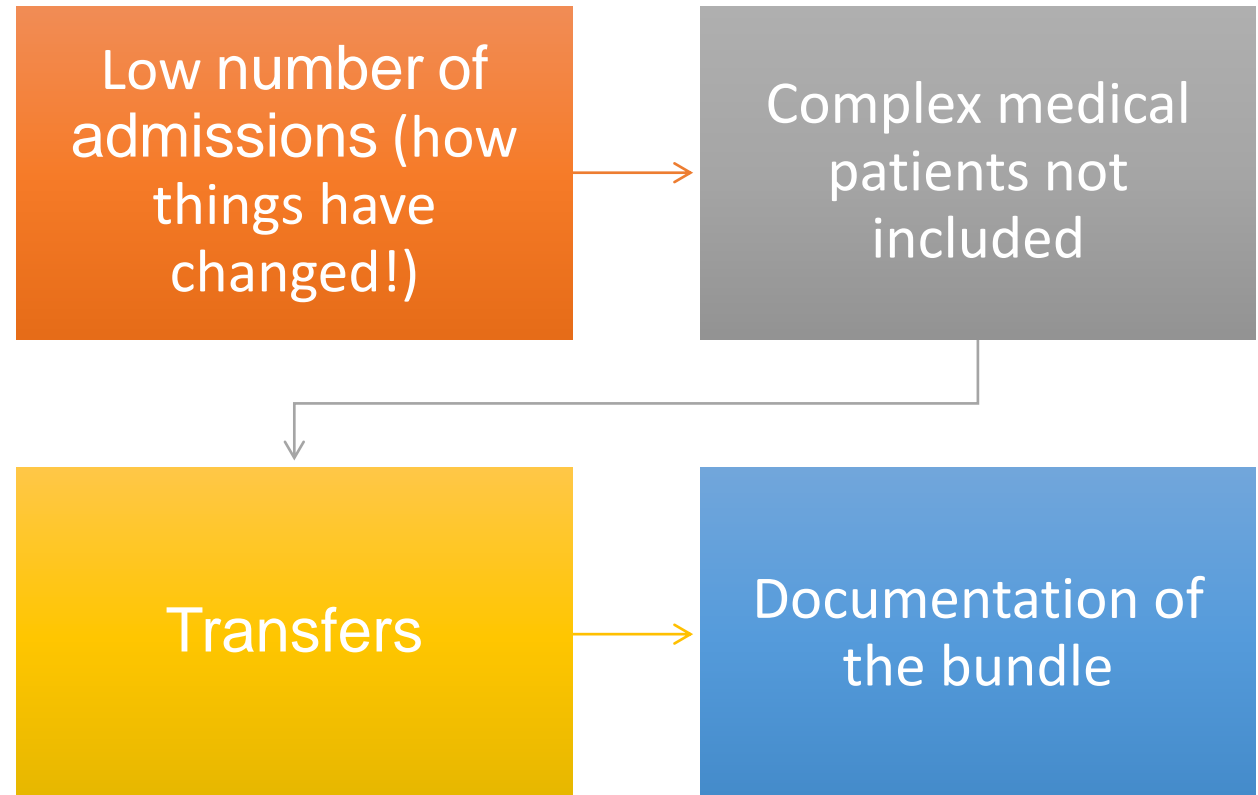
- Bronchiolitis Severity Score every 1 hour
- Continuous Positive Airway Pressure (CPAP)
- Insert peripheral IV  CBC, Na, K, glucose, creatinine, venous blood gas
- NPO  D5W/NS at \_\_\_ ml/hr (TFI 80% maintenance if HD stable)
- CXR (if ICU admission)
- IP consult to CCRT

# Results – HHFNC Use (Preliminary)



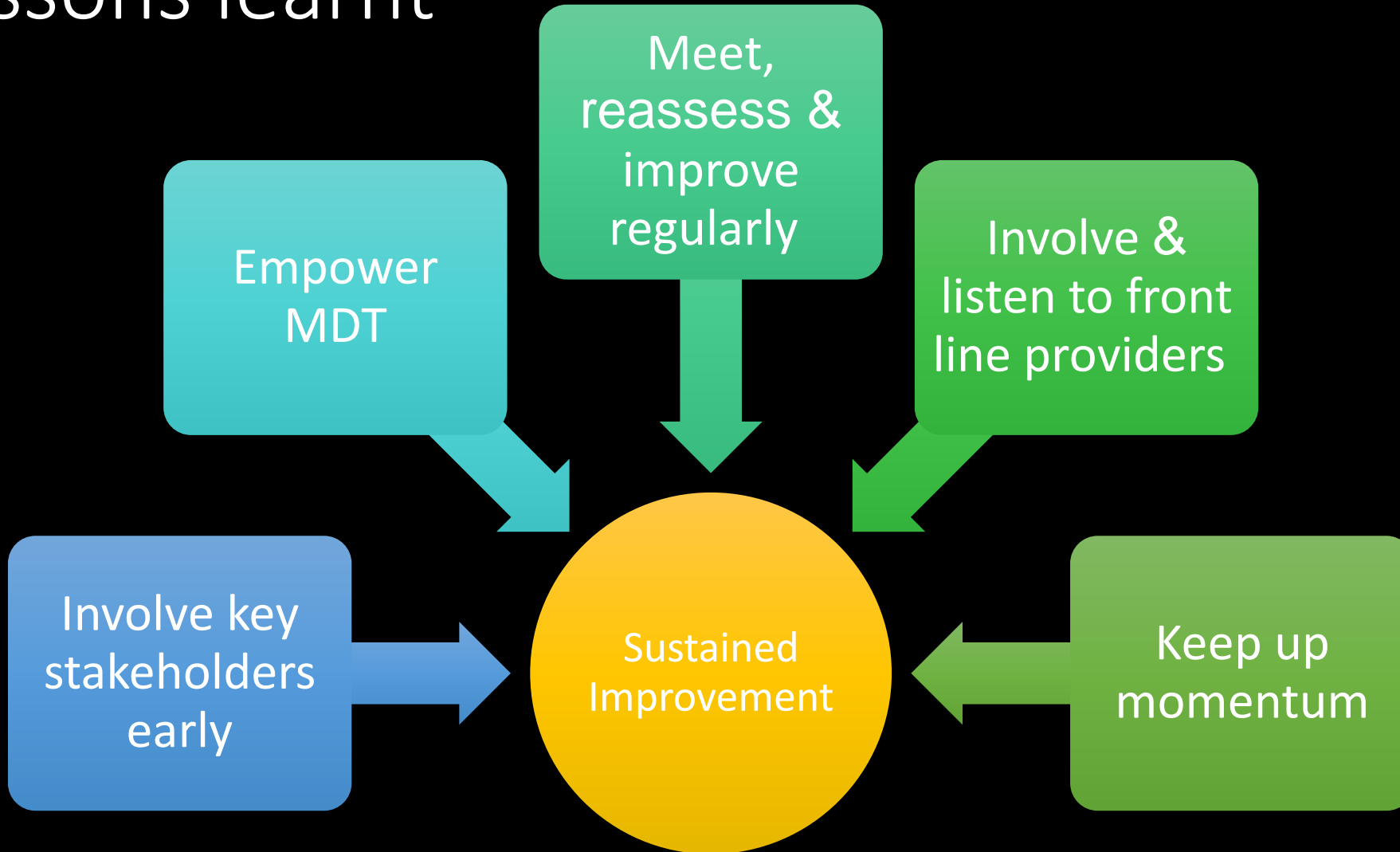
# Our challenges

---






# Lessons learnt



Objective 3) Review strategies on respiratory management of infants with bronchiolitis

	Document Scope: Hospital-wide Patient Care	
	Document Type: Clinical Practice Guideline	
	Approved on 2019-07-02 Next Review Date: 2021-07-01	
<b>Management of Bronchiolitis in Infants</b>		Version: 3

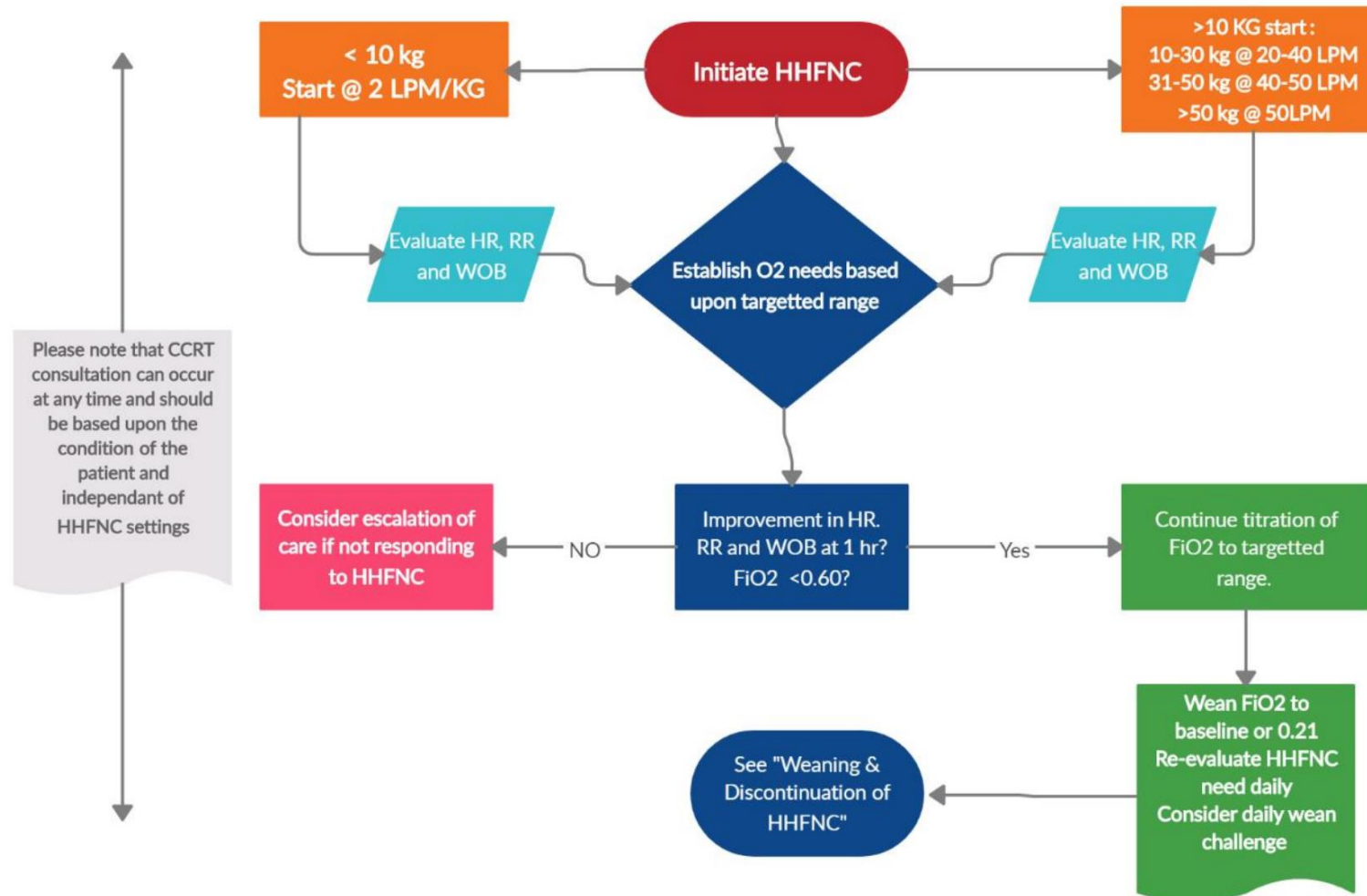
## Let's Review... Recommended Routine Cares


- Use minimal handling strategy whenever possible (bundle cares, dim lights and limit stimulation).
- Assess for fever and treat with antipyretics as indicated.
- Assess hydration status.
  - consider TFI of 80-100% maintenance needs if not significantly hypovolemic.
- Nasal suction & reposition as needed
- If SpO<sub>2</sub> <90% awake, <88% asleep, apply low flow nasal cannula
  - max flow rate: 0-90 days: 1L/min; 91 days-6 months: 1.5L/min; 6 months-2 years: 2L/min]
  - Attempt O<sub>2</sub> wean Q12hrs. Attempt O<sub>2</sub> wean Q4hrs after initial successful wean.
- Assess and document Work of Breathing Q4H (or sooner as needed)

<b>SickKids</b>	<b>Document Scope: Hospital-wide Patient Care</b>	
	<b>Document Type: Guideline</b> <b>Approved on 2020-03-11</b> <b>Next Review Date: 2023-03-11</b>	
	<b>Heated High Flow Nasal Cannula Therapy</b>	<b>Version: 2</b>

# How to initiate HFNC when routine care fails?

Figure 1. Initiation of HHFNC



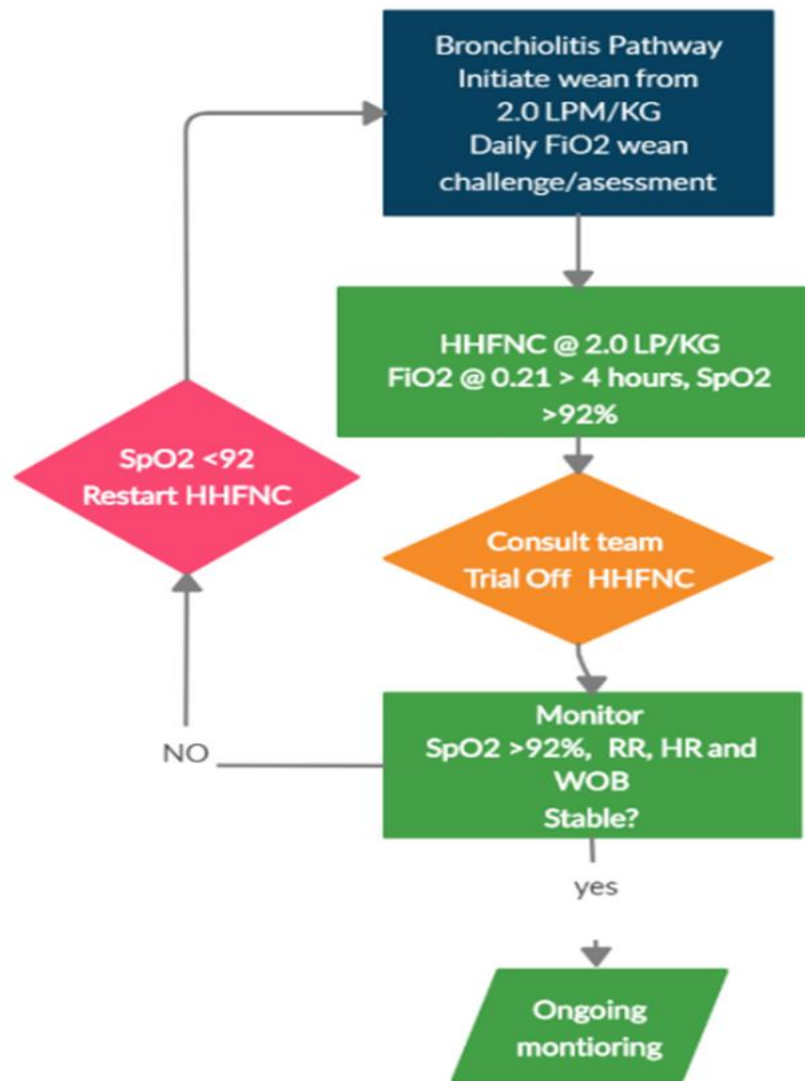
	Document Scope: Hospital-wide Patient Care	
	Document Type: Clinical Practice Guideline Approved on 2019-07-02 Next Review Date: 2021-07-01	
	<b>Management of Bronchiolitis in Infants</b>	Version: 3

## Nutrition

- Early initiation of oral nutrition or, as a second line, insertion of naso-gastric tubes for enteral feeding is recommended.
  - Oral nutrition is tolerated across a range of oxygen delivery mechanisms, including a range of HFNC flows and respiratory rates but should be closely monitored for tolerance.
  - Infants can be orally fed on HFNC, provided therapy can be turned down to low flow for the duration of the feeds.
  - After a maximum of 20 minutes, oral feeds/breastfeeding should be stopped and HFNC therapy restarted.

**Heated High Flow Nasal Cannula Therapy**

Version: 2



# Starting Technology

## Community Hospitals Webinars

Connected Care delivers live and interactive competency-based education led by SickKids interprofessional providers (RNs, RTs, MDs, Pharmacists, and more). Interprofessional colleagues are encouraged to register and/or attend together.

*Click on the icon to register for upcoming dates and view previously recorded webinar archives*



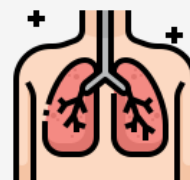
**Essentials in  
Paediatric Health  
Assessment**



**Nursing Care of  
the Child with  
Bronchiolitis**



**Essentials in  
Paediatric Oxygen  
Therapy & Heated  
High Flow**



**Essentials in  
Paediatric Airway  
Suctioning**



**Recognition and  
Management of  
Sepsis in  
Paediatrics**



**Nurse Extenders  
in Paediatric  
Acute Care**



**Basics of Invasive  
Mechanical  
Ventilation in  
Paediatrics**



**Equipment and  
Basics of NIV in  
Paediatrics**



**Webinars for MDs**

### PHYSICIANS

#### Managing Bronchiolitis & Asthma in Community Hospitals Pending Transfer to Tertiary Critical Care

Recommended for Physicians. This webinar will review approaches to the critical care of children with bronchiolitis, asthma or ARDS, and focus on medical management and use of NIV in stabilization of a child less than 14 years pending transfer to a paediatric intensive care unit.

#### Archived Webinars:

- [Managing Bronchiolitis & Asthma in Community Hospitals Pending Transfer to Tertiary Critical Care](#)

# Nebulization during HFNC

## **Recommendation:**

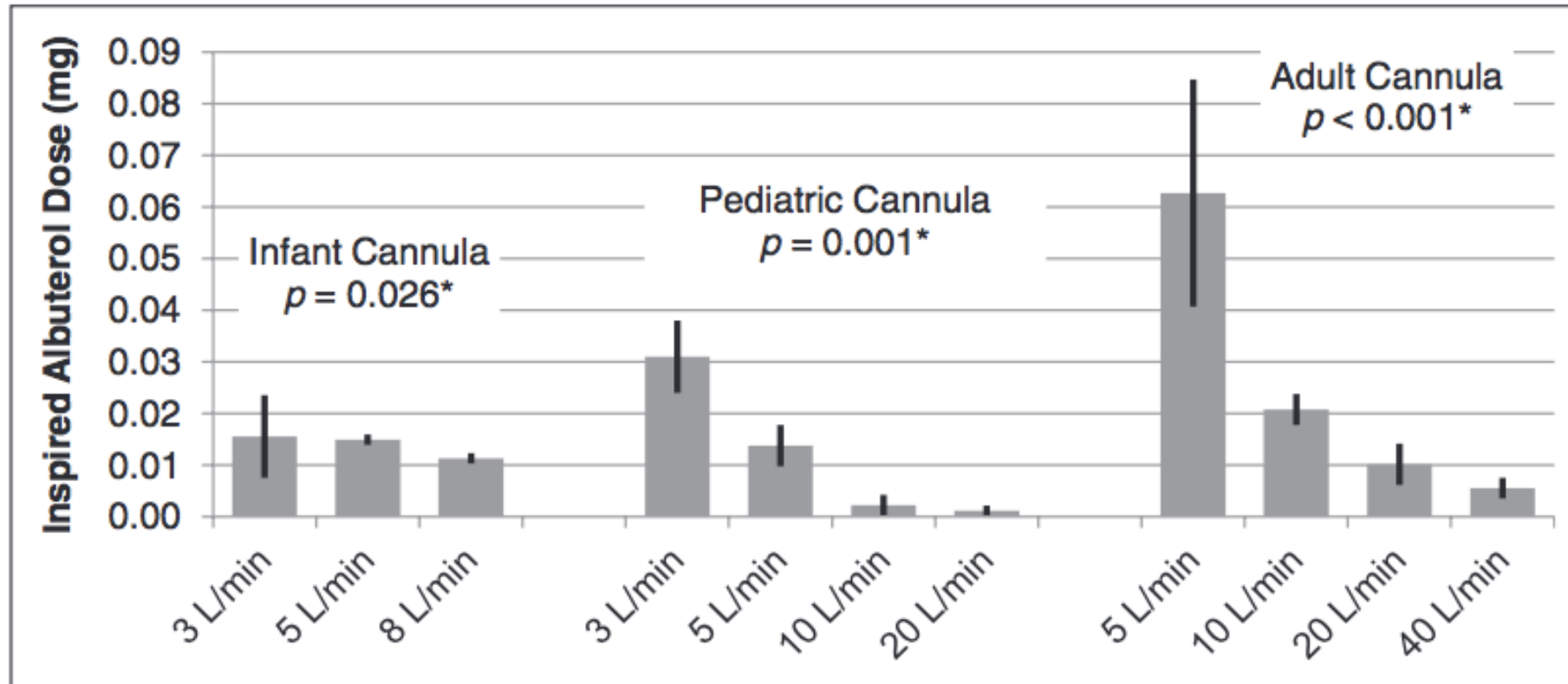
- Scheduled or serial Salbutamol aerosol therapies are not recommended.
- HOWEVER, a single trial inhalation of Salbutamol may be considered as an option in children > 12 months of age, particularly when there is a family history for allergy, asthma, or atopy.
- Inhalation therapy should not be continued if there is no documented improvement in respiratory rate and effort between 15-30 minutes after a trial inhalation therapy.

## **Practice:**

- ACTS
  - The ACTS team will utilize Aerogen for nebulization during transport on a routine bases
  - AGMP status is a serious consideration during transport via EMS
  - This support may not continue once the patient arrives to SickKids
- SickKids Practice varies specific to the patient



# Deposition decreases with higher flows, smaller cannula



**Figure 2.** Total inspired dose (ID) of albuterol among the different cannula sizes and flow rates. L/min = liters per minute. *Asterisk* represents difference in ID between different flow rates for each NC size; 62% to 80% of the loaded albuterol dose accumulated within the adaptor.

See full list of references at the end of presentation

# Nebulization Recommendations

1. For all patients on HFNC, reconsider need for HFNC/inhaled medications... not routine care.
2. For patients that tolerate removal of their HFNC
  - Delivery of inhaled medications will be either via pMDI with VHC (recommended) or jet nebulizer with mask (used for patients who cannot actuate the VHC valve, etc.)
  - *Masks should NEVER be administered on top of HFNC*

# Nebulization Recommendations

## 3) For patients who do NOT tolerate removal of HFNC:

HFNC + Aerogen can be used if dependent on HFNC

- *Balance patient comfort, frequency*
- *Refer to CritiCall for patient specific guidance*
- Goal should be to decrease flow temporarily during administration as close to recommended rate as possible.

HFNC Titration Rates during Nebulization	
Infants <10kg or <1yr	2 LPM
Toddler/Child > 10kg	3-4 LPM
Adolescents	5-6 LPM

- If titration is not tolerated, continue with therapeutic flow and reconsider dosing if needed.

# Don't underestimate the importance of nasal suctioning

## **Recommendation:**

- Nasal suction & reposition as needed
- Heterogeneous presentations
- Hand in hand with hydration status
  - can use facemask, oxyhoods, etc.
- Most common reported cause of reversible distress by our bedside RRT's
- For patients who require suction, try to do so regularly when handling to prevent the need for emergent suction.

# What to do when HFNC Fails

- If the patient does not improve with HFNC or continues to get worse over time, support from CritiCall is necessary.
- May require NIV or Intubation and Invasive Ventilation.
- Support from our Intensive Care Team including Respiratory Therapy is available as needed.

# Questions?

[diane.soares@sickkids.ca](mailto:diane.soares@sickkids.ca)

[marie-pier.lirette@sickkids.ca](mailto:marie-pier.lirette@sickkids.ca)

[mariajose.conejeromuller@sickkids.ca](mailto:mariajose.conejeromuller@sickkids.ca)



Online evaluation form will be sent after the session or scan the QR Code to complete now.  
We appreciate your feedback.  
<https://skconnect.typeform.com/to/jmP9E8IZ>

# References

1. Alcoforado L, Arzi A, De Melo Barcelar J, Brandao SC, Fink JB, Dornelas De Andrade A. Comparison of Aerosol Deposition with Heated and Unheated High Flow Nasal Cannula (HFNC) in Healthy Adults. *American Journal of Respiratory and Critical Care Medicine* 2016;193:A5320.
2. Gardenhire DS, Burnett D, Strickland S, Myers TR. *A Guide to Aerosol Delivery Devices for Respiratory Therapists*, 4th ed. Irving, Texas: American Association for Respiratory Care; 2017.
3. Ari A, Fink JB. Recent advances in aerosol devices for the delivery of inhaled medications. *Expert Opin Drug Deliv.* 2020 Feb;17(2):133-144. doi: 10.1080/17425247.2020.1712356. Epub 2020 Jan 20. PMID: 31959028.
4. Ari A. Effect of nebulizer type, delivery interface, and flow rate on aerosol drug delivery to spontaneously breathing pediatric and infant lung models. *Pediatr Pulmonol.* 2019 Nov;54(11):1735-1741. doi: 10.1002/ppul.24449. Epub 2019 Jul 16. PMID: 31313534.
5. Rubin BK, Fink JB. Chapter 34: Treatment delivery systems. In Castro M, Kraft M (eds). *Clinical Asthma*. Mosby; 2008. 303-312. ISBN 9780323042895, <https://doi.org/10.1016/B978-032304289-5.10034-7>
6. Bhashyam AR, Wolf MT, Marcinkowski AL, Saville A, Thomas K, Carcillo JA, Corcoran TE. Aerosol delivery through nasal cannulas: an in vitro study. *J Aerosol Med Pulm Drug Deliv* 2008;21(2):181- 188.
7. Perry SA, Kesser KC, Geller DE, Selhorst DM, Rendle JK, Hertzog JH. Influences of cannula size and flow rate on aerosol drug delivery through the VapoTherm humidified high-flow nasal cannula system. *Pediatr Crit Care Med.* 2013 Jun;14(5):e250-6. doi: 10.1097/PCC.0b013e31828a7f79. PMID: 23628834.
8. Li, J, Gong, L, Ari, A, Fink, JB. Decrease the flow setting to improve trans-nasal pulmonary aerosol delivery via “high-flow nasal cannula” to infants and toddlers. *Pediatric Pulmonology.* 2019; 54: 914– 921. <https://doi.org/10.1002/ppul.24274>
9. Réminiac F, Vecellio L, Loughlin RM, Le Pennec D, Cabrera M, Vourc'h NH, Fink JB and Ehrmann S. Nasal high flow nebulization in infants and toddlers: An in vitro and in vivo scintigraphic study. *Pediatr Pulmonol*, 2017; 52: 337-344. doi:10.1002/ppul.23509
10. Madney YM, Fathy M, Elberry AA, Rabea H, Abdelrahim ME. Aerosol Delivery Through an Adult High-Flow Nasal Cannula Circuit Using Low-Flow Oxygen. *Respir Care.* 2019 Apr;64(4):453-461. doi: 10.4187/respcare.06345. Epub 2019 Jan 22. PMID: 30670669.