Protocol-Driven Initiation and Weaning of High Flow Nasal Cannula for Patients with Bronchiolitis: A Quality Improvement Initiative

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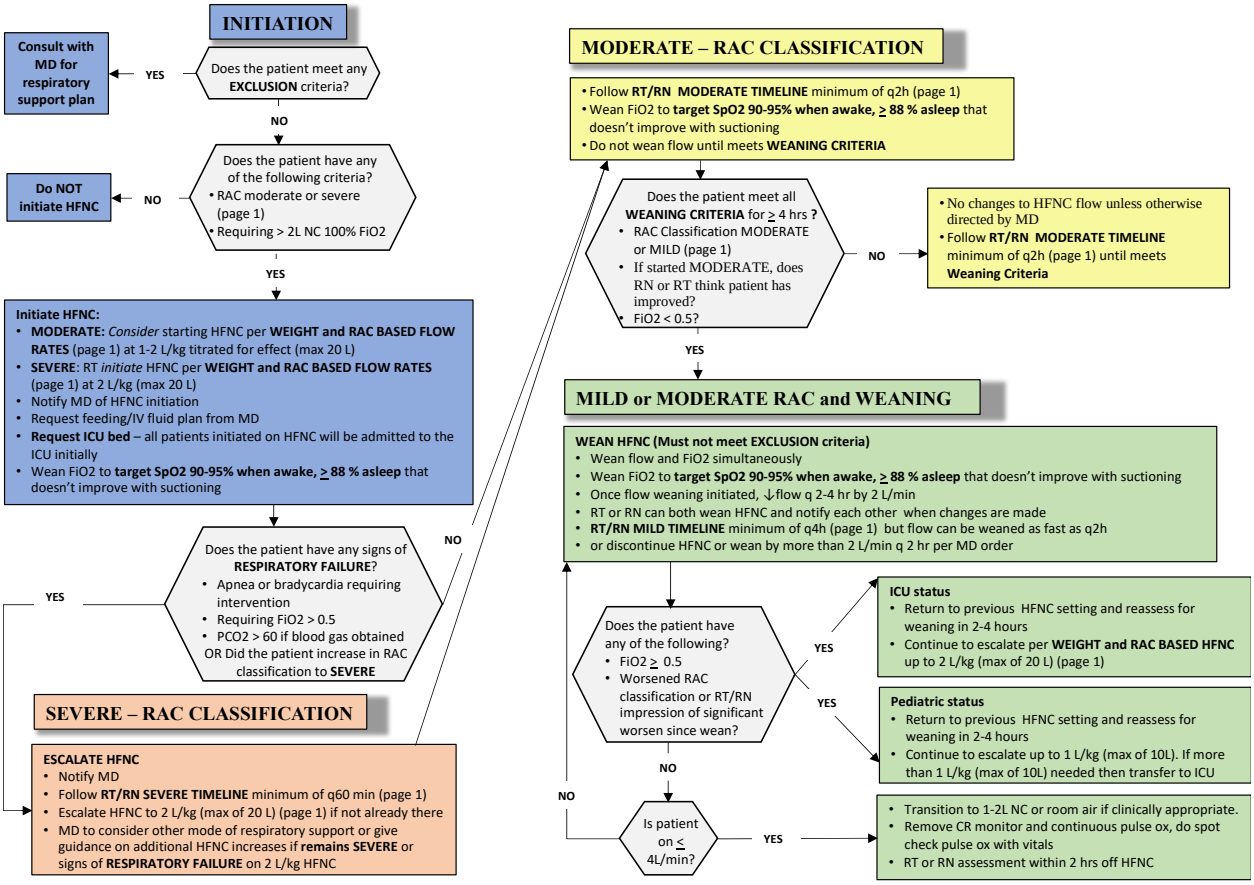
eFigure 1: Institutional protocol for patients on high flow nasal cannula (HFNC) therapy



The portion of our institution protocol that show the guidelines for initiation, escalation, and weaning for patients with bronchiolitis who required high flow nasal cannula (HFNC) therapy. *Copyright Heather Siefkes*

eFigure 2a: Respiratory Assessment Classification (RAC)

RESPIRATORY ASSSESSMENT CLASSIFICATION (RAC) Can be used on patients on and off HFNC. If patient requires suctioning, use post-suctioning classification. Preferably classify when the child is calm unless child is inconsolable.				
ASSESSMENT COMPONENTS		**CLASSIFICATION**		
		Mild	**Moderate**	**Severe**
AGE-BASED RR	≤ 3 months	≤ 60	61-69	≥ 70
	4 – 12 months	≤ 50	51-59	≥ 60
	> 12 months	≤ 40	41-44	≥ 45
WORK OF BREATHING		Normal OR mild retractions	Moderate retractions	Severe retractions, head bobbing, OR grunting
MENTAL STATUS		Baseline	Fussy, anxious, OR sleepy	Lethargic (not just sleepy), OR inconsolable
The HIGHEST score for any component determines the patient's classification. A severe rating in any component would indicate a SEVERE classification. A mix of mild and moderate ratings would indicate a MODERATE classification. When in doubt, err on the side classifying a patient as more severe.				

Respiratory Assessment Classification (RAC) is based on three components: age-based respiratory rate/minute, work of breathing, and mental status. RAC defaulted to the highest severity classification based on individual components rather than adding up a cumulative score[12] and was adapted from an established response to intervention score.

eFigure 2b: Weight and Respiratory Classification (RAC) Based Flow Rates

WEIGHT and RESPIRATORY CLASSIFICATION (RAC) BASED FLOW RATES			
LOCATION	**WEIGHT**	**FLOW**	**FIO2**
MODERATE – *Consider* HFNC at the following			
ICU or awaiting transfer*	**< 10 kg**	RT can titrate 1-2 L/kg for effect	Initiate at 0.5 Titrate for SpO2 90-95% awake ≥ 88% asleep That doesn't improve with suctioning
	≥ 10 kg	RT can titrate 1- 2 L/kg for effect Max 20 L	
SEVERE – *Start* HFNC at the following			
ICU or awaiting transfer	**< 10 kg**	2 L/kg	Initiate at 0.5 Titrate for SpO2 90-95% awake ≥ 88% asleep That doesn't improve with suctioning
	≥ 10 kg	20 L	

Round to nearest whole number flow for weight-based flows.
Examples for MODERATE: 4.6 kg x 1 L/kg = 5L 12.5 kg x 1 L/kg = 13 L
Example for SEVERE: 4.6 kg x 2 L/kg = 9 L 12. 5 kg = 20 L
Titrate FiO2 to **target SpO2 90-95%.** Consider escalation of flow rate if FiO2 > 0.5
*A patient can be transferred to floor on HFNC after meeting "out of ICU" criteria and can be on a maximum flow of 1 L/kg (max of 10L if > 10 kg) before transfer back to ICU is needed

eTable1: Summary of Plan-Do-Study-Act Cycles

Cycle	Plan/Do	Study	Act
PDSA 1 (Dec 2018)	Initial rollout of protocol in PICU and ED	Received feedback on difficulty following RAC for patient	ADAPT Simplified RAC and modified protocol
PDSA 2 (Jan 2019)	Reviewed patients on initial protocol	Favorable response from team on 2nd version HFNC protocol	ADAPT protocol to highlight weaning by SpO_2 in 2nd version
	Reviewed simplified scoring tool and protocol	Patients not weaned for SpO_2 90-95% per protocol	ADOPT
PDSA 3 (March 2019)	Initiated 2nd version of protocol in PICU and ED	Positive response from users on revised protocol	ADAPT Protocol to clarify weaning parameters and remove barriers to weaning
		Staff requested scoring tool in EMR	Discussion to add scoring tool in EMR
		Suggestion of multidisciplinary training	Planning for M&M session to discuss QI effort, review current literature on bronchiolitis
PDSA 4 (Sept 2019)	Near real-time identification and feedback of protocol violations	Identified issues contributing to protocol compliance and difficulty with utilizing paper forms	ADAPT Daily QI rounds to rounds to discuss patients on protocol and provide in-the-moment feedback with nurses and RTs with the goal to increase protocol compliance
	Began education to nurses and RTs on wards in anticipation of transferring patients out of ICU on HFNC in subsequent PDSA cycles	Identified issues contributing to protocol compliance and difficulty with utilizing paper forms	

	Continue work with EMR to build HFNC flowsheet	Identified stakeholders involved in building components of RAC in EMR	ADAPT Daily QI rounds to improve utilization of paper form until EMR tool is enabled
PDSA 5 (Oct 2019)	Held 4-hour symposium on bronchiolitis for residents/attendings, nurses, and RTs	Positive response to education and presentation	ADAPT Patient transferring out to rounds on HFNC when
PDSA 6 (Nov 2019)	Started transfer out of ICU Increased education with monthly teaching to residents on bronchiolitis	Positive response to QI rounds and education	ADOPT
PDSA 7 (Dec 2019)	Modified paper scoring sheet to better meet the needs of RNs/RT Increased visualization of protocol binders	Nurses expressing concerns with not being familiar with protocol	ADAPT Tip sheet for protocol, learning module, more one-on-one education, and protocol refreshers
PDSA 8 (Jan 2020)	Increased education on protocol for residents and other members of the care team.	Identified protocol adherence <80% and issues identified include HFNC initiated without notifying resident/attending, poor adherence during transition to day-night or night-day	ADAPT Education for nurses and RT
PDSA 9 (Feb 2020)	Increased visibility of protocol in workspace for residents	Aborted QI rounds due to need for social distancing during COVID19 pandemic	ADOPT

ED = Emergency Department, EMR = Electronic Medical Record, HFNC = high flow nasal cannula, QI = quality improvement, M&M = Morbidity and mortality, PDSA = Plan-Do-Study-Act, RAC = Respiratory Assessment Classification, RN = nurse, RT = respiratory therapist, SpO_2 = Oxygen saturation