UAMS/ACH NICU
Bronchopulmonary Dysplasia Management Guidelines

Although there is neither consensus nor sufficient evidence to describe the ideal management strategies for infants with bronchopulmonary dysplasia (BPD), a standardized approach is helpful. Below, several areas of inconsistency in management are described, and a standardized approach is suggested. The well-established standard-of-care strategies for BPD management about which there is consensus are described elsewhere.

- **Which patients should be discussed with the multidisciplinary team during weekly BPD Rounds?**
  - All patients with a GA ≤32 weeks at birth and a current PMA ≥36 weeks who are still requiring invasive mechanical ventilation due to BPD.
  - All patients with a GA ≤32 weeks at birth and a current PMA ≥40 weeks who are still requiring positive pressure in the form of CPAP, NIPPV, NIV NAVA, or ≥2LPM NC flow.
  - Other patients at the team’s discretion and request in whom the involvement of the group is felt to be beneficial to ensure continuity with a focus on the long-term plan related to BPD management.
  - Additionally, when providers have questions such as when to start certain treatments (such as a repeat course of systemic steroids) or obtain certain diagnostic tests (such as a dynamic or high-resolution chest CT, bronchoscopy, or cardiac cath), it is appropriate to discuss a patient in BPD Rounds.

- **When is chest physiotherapy (CPT) indicated in the treatment of BPD?**
  - BPD is not, by itself, an indication for CPT. However, CPT can be helpful to treat focal or global atelectasis and assist with clearing secretions. For patients receiving CPT, the necessity and frequency should be regularly assessed (at least weekly) and discussed with the bedside providers to determine if the infant is tolerating the therapy and whether or not the sessions are helping clear secretions. Providers performing CPT should be encouraged to provide feedback and review its necessity regularly with the primary team. Continuing CPT, especially more frequently than every 12 hours, without a clear indication should be discouraged. The use of a therapist-driven protocol when available is also appropriate to determine the frequency and type of CPT provided.

- **Who should be tested for Ureaplasma/Mycoplasma and receive 5 days of Azithromycin?**
  - Routine use is discouraged. This can be considered in infants who develop severe lung disease or cystic changes on CXR in the first few weeks of life.

- **When should fluid restriction to ~130-140mL/kg/day be considered for infants at risk for or with BPD?**
  - Gentle fluid restriction can be considered for infants with or at risk for BPD if able to maintain adequate growth. This is preferred over chronic diuretic use.

- **Who should be started on inhaled corticosteroids?**
  - Routine use is discouraged. Not usually before 34-36 weeks PMA. Use sparingly, but reasonable to consider if failing to wean support by 36-40 weeks adjusted age. Available evidence suggests only short-term benefit.
• **Who should be started on chronic diuretics?**
  o Routine use is discouraged. Not usually before 34-36 weeks PMA. Use sparingly, but reasonable to consider if failing to wean support by 36-40 weeks adjusted age. Follow electrolytes closely anticipating need for supplementation. Available evidence suggests only short-term benefit.  

• **Who should be started on inhaled bronchodilators?**
  o Routine use is discouraged. Not usually before 34-36 weeks PMA. Use sparingly, but reasonable to consider on an as needed basis for signs of bronchospasm, which improves with administration.  

• **Who should be continued on caffeine beyond 34-36 weeks PMA?**
  o In infants <32 weeks birth GA and still requiring support ≥2 LPM or CPAP, continuing caffeine until nearing discharge or ≥44 weeks PMA should be considered.  

• **Who should be changed from gastric to transpyloric feeds?**
  o Routine use is discouraged. Not usually before 34-36 weeks PMA. Reasonable to consider in infants who have already received postnatal steroids, are consistently requiring >40% FiO₂, and whose lung disease is worsening. Evidence of benefit is limited. Relatively contraindicated if there is a history of NEC or intestinal perforation.  

• **Who should have an echocardiogram and when?**
  o All infants with severe hypoxemic respiratory failure at birth
  o All infants requiring invasive ventilation at ~7 days of life
  o All infants at BPD diagnosis (~36 weeks PMA)
  o Every 1-2 months in infants born ≤32 weeks GA who have required oxygen or flow beyond 34-36 weeks PMA (infants with BPD)  

• **Who should be started on sildenafil?**
  o Not usually before 34-36 weeks PMA. Recommended in older infants with BPD and evidence of pulmonary hypertension on echocardiogram despite ruling out hypoxia (or treating with low flow oxygen or higher saturation goals), aspiration, and other contributing causes.
  o Other infants on a case-by-case basis (e.g. still requiring invasive ventilation and iNO or very high FiO₂ at >34-36 weeks PMA, to facilitate weaning iNO or other support).  
  o The assumption should be made upon starting sildenafil in the setting of BPD that the infant will be discharged on this medication and will require close follow up with a provider with expertise in the management of pulmonary hypertension.  

• **What should be done prior to starting sildenafil?**
  o The infant should, at the least, be discussed with another neonatologist, and ideally be discussed during BPD Rounds, and/or follow up providers, pulmonary, and possibly cardiology.
• **What sort of follow up should be done for infants discharged on sildenafil?**
  - Infants must be discussed with either a Complex Care or Pulmonary Hypertension Clinic provider prior to discharge and follow up in either clinic.
  - For example, infants already requiring Complex Care follow up could follow there, and infants requiring Cardiology and/or Pulmonary follow up could follow with Pulmonary Hypertension Clinic.
  - Cardiac catheterization to confirm pulmonary hypertension and exclude pulmonary venous stenosis should be considered, especially for refractory disease.

• **When should atrial/brain natriuretic peptide be followed?**
  - In infants requiring pulmonary hypertension treatment with chronic iNO or sildenafil, BNP or pro-BNP trends can help guide weaning. These values can be followed weekly in lieu of but in conjunction with echocardiograms for cost-savings.\(^\text{17}\)

• **Who should have a dynamic (or high-resolution) chest CT?**
  - Infants still requiring invasive ventilation at 36-40 weeks PMA or positive pressure at 44-46 weeks in whom the study is necessary to guide decision making.
  - Only after discussion with additional providers (pulmonary, BPD Rounds, other team attendings) and in view of how the study will aid decision making with regard to the long-term plan.
  - Bronchoscopy and/or microlaryngoscopy and bronchoscopy can also be considered, especially if the infant requires another surgery or has signs of an upper airway abnormality (eg stridor).

• **When should “BPD Ventilator Settings” be used?**
  - Not usually before 32-34 weeks PMA. Infants born $\leq 32$ weeks GA and requiring ongoing invasive ventilation at 34-36 weeks PMA due to severe BPD (e.g. cystic changes on CXR) should transition to higher PEEP, longer inspiratory times, lower rates, and larger tidal volumes in coordination with recommendations from pulmonary / BPD Rounds. Alternatively, NAVA can be used at any PMA in infants with a reliable respiratory drive.

• **Which infants with BPD should be transferred to a level IV center and when?**
  - Infants born $\leq 32$ weeks and requiring invasive ventilation at 36 weeks PMA should be discussed in BPD Rounds and evaluated for whether transfer is appropriate/indicated.
  - Infants felt likely to benefit from NAVA, HFJV, pulmonary consultation, fluoroscopic swallow study, advanced chest imaging, bronchoscopy, or other subspecialty evaluation.

• **When are systemic corticosteroids indicated in the treatment of BPD?**
  - Systemic corticosteroids are often administered to facilitate extubation and improve short-term respiratory status in infants at $\sim 14$-28 days chronologic age with high risk for progression to moderate to severe BPD.\(^\text{18, 19, 20}\) An institutional guideline is available to guide the use of systemic steroids for this indication.
  - Oral or intravenous corticosteroids are also used in infants with established BPD to facilitate short-term improvement in respiratory status or as an heroic measure in gravely ill infants. Doses used for these indications are often higher than the “DART” dosing used to lessen the severity of BPD and decrease duration of mechanical ventilation.
  - Additionally, prolonged courses or recurrent “bursts” of low-dose steroids are sometimes used in infants with the most severe BPD, who are often $\geq 44$-48 weeks PMA and status post tracheostomy. With the paucity of available evidence, expert opinion and
multidisciplinary consensus are most often used to guide when and how to use steroids for these latter indications on a case-by-case basis. An understanding of the phase of illness with the goal of achieving a pro-growth state should inform this consensus.\textsuperscript{21}

Discussion at BPD Rounds and/or with pulmonary consultants and multiple providers is indicated to guide decision making and facilitate continuity of care in these situations.

- Finally, while a formal informed consent is not typically obtained, a discussion of the risks and benefits with an infant’s parent(s)/guardian(s) is indicated.
Abbreviations
University of Arkansas for Medical Sciences (UAMS), Arkansas Children’s Hospital (ACH), neonatal intensive care unit (NICU), bronchopulmonary dysplasia (BPD), gestational age (GA), postmenstrual age (PMA), continuous positive airways pressure (CPAP), nasal intermittent positive pressure ventilation (NIPPV), non-invasive ventilation (NIV), neurally adjusted ventilatory assist (NAVA), liters per minute (LPM), nasal cannula (NC), computed tomography (CT), chest radiograph (CXR), inhaled nitric oxide (iNO), positive end expiratory pressure (PEEP), High frequency jet ventilation (HFJV).

References
7. Onland W, Offringa M, van Kaam A. Late (>7 days) inhalation corticosteroids to reduce bronchopulmonary dysplasia in preterm infants. Cochrane Database Syst Rev 2017, 8: CD002311.

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