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Bronchopulmonary Dysplasia

Nobody puts baby in a corner

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Objectives

1. Review the changing definitions of Bronchopulmonary dysplasia (BPD)
2. Describe risk factors for developing and current strategies to prevent BPD
3. Describe the comorbidities of BPD
4. Describe the changing outcomes of BPD
5. Compare guidelines for outpatient management of BPD
6. Describe our BPD program at UAB

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Definitions of BPD

- Originally described as a pulmonary sequelae of hyaline-membrane disease (Northway et al., 1967)
- A 1979 BPD workshop proposed the definition of the need for supplemental oxygen therapy for more than 28 days
- Additional of 36 weeks postmenstrual age
- Addition of grades/severity
- 2019 Jensen et al. comparisons of definitions based on outcomes data

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Definition of bronchopulmonary dysplasia

I. Oxygen supplementation alone

Oxygen supplementation either at 28 days postnatal age or 36 weeks PMA

II. Diagnostic criteria 2001 NICHD consensus workshop*[1]

	Gestational age	
	<32 weeks	**≥32 weeks**
Time point of assessment	36 weeks PMA or discharge to home, whichever comes first	>28 days but <56 days postnatal age or discharge to home, whichever comes first
Grade	**Treatment with oxygen >21% for at least 28 days plus**	**Treatment with oxygen >21% for at least 28 days plus**
Mild BPD	Breathing room air at 36 weeks PMA or discharge, whichever comes first	Breathing room air by 56 days postnatal age or discharge, whichever comes first
Moderate BPD	Need* for <30% oxygen at 36 weeks PMA or discharge, whichever comes first	Need* for <30% oxygen at 56 days postnatal age or discharge, whichever comes first
Severe BPD	Need* for ≥30% oxygen and/or positive pressure (PPV or nCPAP) at 36 weeks PMA or discharge, whichever comes first	Need* for ≥30% oxygen and/or positive pressure (PPV or nCPAP) at 56 days postnatal age or discharge, whichever comes first

IIa. 2016 Revisions of NICHD criteria based on oxygen concentration (percentage)[2]¶

Grades^	Invasive IPPV	nCPAP, NIPPV, or nasal cannula ≥3 L/min	Nasal cannula flow of 1 to <3 L/min	Nasal cannula flow of <1 L/min	Hood O_2
I (mild)	–	21	22 to 29	22 to 70	22 to 29
II (moderate)	21	22 to 29	≥30	≥70	≥30
III (severe)	>21	≥30	–	–	–
III(A)°	–	–	–	–	–

III. 2019 Diagnosis based on prospective NICHD study[3]

Grades^	Invasive PPV	nCPAP or NIPPV	Nasal cannula flow of >2 L/min	Nasal cannula flow of <2 L/min
I (mild)	–	–	–	≥21
II (moderate)	–	≥21	≥21	–
III (severe)	≥21	–	–	–

A preterm infant (<32 weeks gestational age) with BPD has persistent parenchymal lung disease confirmed by radiography, and at 36 weeks PMA requires 1 of the above interventions based on FiO_2 ranges.

Eichenwald et al. Bronchopulmonary dysplasia: Definition, pathogenesis, and clinical features. Uptodate. 2023 March.

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Treatment with the following support at 36 weeks PMA or discharge to home, if earlier:

Room Air No BPD: No 28d O_2 assessment Grade I: > 21% FiO_2 for ≥ 28d	NC ≤ 2L/min "low" flow		NC > 2L/min "high" flow		nCPAP NIPPV	Invasive PPV	
	FiO_2 < 30%	FiO_2 ≥ 30%	FiO_2 < 30%	FiO_2 ≥ 30%	Any FiO_2	FiO_2 < 30%	FiO_2 ≥ 30%
No BPD	Grade 1	Grade 1	Grade 2	Grade 2	Grade 2	Grade 3	Grade 3
Grade 1	Grade 2	Grade 2	Grade 3	Grade 3	Grade 3	Grade 4	Grade 4
No BPD	Grade 1	Grade 1	Grade 2	Grade 2	Grade 2	Grade 2	Grade 3
Grade 1	Grade 2	Grade 2	Grade 3	Grade 3	Grade 3	Grade 3	Grade 4
No BPD	Grade 1	Grade 2	Grade 2	Grade 2	Grade 2	Grade 3	Grade 3
No BPD	Grade 1	Grade 2	Grade 1	Grade 2	Grade 2	Grade 3	Grade 3
Grade 1	Grade 2	Grade 3	Grade 3	Grade 3	Grade 3	Grade 4	Grade 4
Grade 1	Grade 2	Grade 3	Grade 2	Grade 3	Grade 3	Grade 4	Grade 4
No BPD	Grade 1	Grade 2	Grade 2	Grade 2	Grade 2	Grade 2	Grade 3
No BPD	Grade 1	Grade 2	Grade 1	Grade 2	Grade 2	Grade 2	Grade 3
Grade 1	Grade 2	Grade 3	Grade 3	Grade 3	Grade 3	Grade 3	Grade 4
Grade 1	Grade 2	Grade 3	Grade 2	Grade 3	Grade 3	Grade 3	Grade 4
No BPD	Grade 1	Grade 1	Grade 2	Grade 2	Grade 2	Grade 2	Grade 2
Grade 1	Grade 2	Grade 2	Grade 3	Grade 3	Grade 3	Grade 3	Grade 3
No BPD	Grade 1	Grade 2	Grade 1	Grade 2	Grade 2	Grade 2	Grade 2
No BPD	Grade 1	Grade 2	Grade 2	Grade 2	Grade 2	Grade 2	Grade 2
Grade 1	Grade 2	Grade 3	Grade 3	Grade 3	Grade 3	Grade 3	Grade 3
Grade 1	Grade 2	Grade 3	Grade 3	Grade 3	Grade 3	Grade 3	Grade 3

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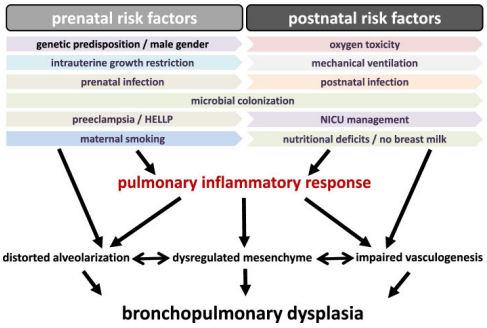
BPD Risk Factors



Holzfurtner L, Shahzad T, Dong Y, Rekers L, Selting A, Staude B, Lauer T, Schmidt A, Rivetti S, Zimmer KP, Behnke J, Bellusci S, Ehrhardt H. When inflammation meets lung development-an update on the pathogenesis of bronchopulmonary dysplasia. Mol Cell Pediatr. 2022 Apr 20;9(1):7. doi: 10.1186/s40348-022-00137-z. PMID: 35445327; PMCID: PMC9021337.

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Comorbidities of BPD

- Asthma/obstructive and sometimes fixed lung disease
- Airway malacia, subglottic stenosis, vocal cord issues
- Pulmonary hypertension
- Feeding/reflux/aspiration issues
- Neurodevelopmental delays, cerebral palsy

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Outcomes: BPD is changing over time

- OLD
  - Fibrosis from baro/volume trauma
  - Lower CO2
  - Higher O2 goals
  - Higher vent settings and more trauma

- NEW
  - Developmental dysplasia of **airways** and **vasculature**
  - Permissive hypercapnia
  - Lower O2 targets
  - More non-invasive options

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BPD Prevention

- Things that may help
  - Caffeine* and similar drugs
  - Noninvasive ventilation works in meta-analysis
  - Limiting volumes on vents
  - Time and growth
    - Good nutrition
- Things that likely don't help
  - Surfactant with RDS but not BPD
  - Diuretics
  - Nitric oxide
  - Intramuscular Vitamin A (not practical, expensive)
  - Severe fluid restriction
  - Steroids
    - "Early" dexamethasone associated with higher CP rates

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Outpatient management guidelines

	2021 American Thoracic Society	2020 European Respiratory Society Guideline
Albuterol	Option if symptomatic	Option for severe BPD, asthma-like symptoms or recurrent hospitalizations
Steroids	Systemic: more likely to respond Inhaled: try if symptomatic	Systemic: discouraged Inhaled: discouraged
Oxygen	Wean daytime first, then night Some centers wean flow to 1/8 Overnight oximetry directed wean Months to years	Target sats 90-95%
Diuretics	Not recommended, wean "judiciously"	Wean by relative decrease in dose with increasing weight gain
PSG	If symptomatic, FTT or still on support at 2yrs	NA
Swallow evaluation	If symptomatic with feeds, failure to wean O2, worsening disease or FTT	NA
Bronchoscopy	If persistent unexplained symptoms, stridor, weak cry and hx of PDA ligation	NA
Antibiotics	They may be predisposed to aspiration pneumonia	NA
Imaging	NA	Serial imaging for severe course of BPD/sxs and recurrent hospitalizations
Lung function	NA	Monitor
Infection control	NA	Give individual advice about daycare

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Our BPD team

- Dietician: Brittany Belcher
- Social Worker: Daphne Arnold
- Respiratory Therapist: LaShonna Stodghill
- Nurses: Trinity Reed, Kelsey Ankenbrandt, Macey Gully, Michelle Seamon
- Providers: Brett Turner, Miles Fowler, Katheryn Petricevic

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Our patients

- We follow children with BPD who meet any of the following criteria
  1. Go home on oxygen or a tracheostomy but not a ventilator
  2. Go home on a diuretic
  3. Have a twin/triplet that we see already

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(Some of) What we do

- Evaluation of transition readiness
- Help the babies grow
  - Adding calories by fortifying feeds
  - Switching feeds when age appropriate
  - Teaching families about feeding milestones and corrected age before adding foods
  - Monitoring for signs of difficulty feeding (aspiration, aversion etc.)
  - Thickening for those who aspirate
- Counseling families
  - Reducing the risk of respiratory infections
    - Encouraging families to discuss Synagis and Flu shots with their provider
    - Talking about day care/travel/etc.
  - Safe sleep
  - Smoking cessation
- Social support
  - Helping families navigate services like SSI, Early Intervention, WIC etc
  - Coordinating care with other providers and agencies
- Respiratory care
  - Teaching families to recognize respiratory distress
  - Giving families a plan for dealing with respiratory illnesses
  - Gradually weaning therapies as babies grow
- Community Resource for families and providers

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Synagis PAs

- Is the patient 12 months or younger with a diagnosis of “chronic lung disease of prematurity” defined as gestational age <32 weeks, 0 days and has received oxygen >21% for at least the first 28 days after birth
- Is the patient 24 months or younger with a diagnosis of “chronic lung disease of prematurity” defined as gestational age <32 weeks, 0 days and has received oxygen >21% for at least the first 28 days after birth AND continue to require medical support (chronic steroids, diuretics or O2 within 6 months before the start of the second RSV season

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Family discussion

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Thank you!

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https://www.childrensal.org/services/pulmonology/bronchopulmonary-dysplasia-bpd-clinic