

Children's Mercy Kansas City

SHARE @ Children's Mercy

Research Days

GME Research Days 2024

May 14th, 12:30 PM - 12:45 PM

To BPD or Not to BPD: A Comparison of the 2022 versus 2011 NICHD Web-Based Risk Estimator for Bronchopulmonary Dysplasia

Mitch Kinkor

Jake Schneider

Children's Mercy Kansas City

Farhath Sulthana

Janelle R. Noel-Macdonnell PhD

Children's Mercy Hospital

Alain Cuna

Children's Mercy Hospital

Let us know how access to this publication benefits you

Follow this and additional works at: <https://scholarlyexchange.childrensmercy.org/researchdays>



Part of the [Higher Education and Teaching Commons](#), [Medical Education Commons](#), [Pediatrics Commons](#), and the [Science and Mathematics Education Commons](#)

Kinkor, Mitch; Schneider, Jake; Sulthana, Farhath; Noel-Macdonnell, Janelle R. PhD; and Cuna, Alain, "To BPD or Not to BPD: A Comparison of the 2022 versus 2011 NICHD Web-Based Risk Estimator for Bronchopulmonary Dysplasia" (2024). *Research Days*. 3.

https://scholarlyexchange.childrensmercy.org/researchdays/GME_Research_Days_2024/ResearchDay2/3

This Oral Presentation is brought to you for free and open access by the Conferences and Events at SHARE @ Children's Mercy. It has been accepted for inclusion in Research Days by an authorized administrator of SHARE @ Children's Mercy. For more information, please contact hlsteel@cmh.edu.

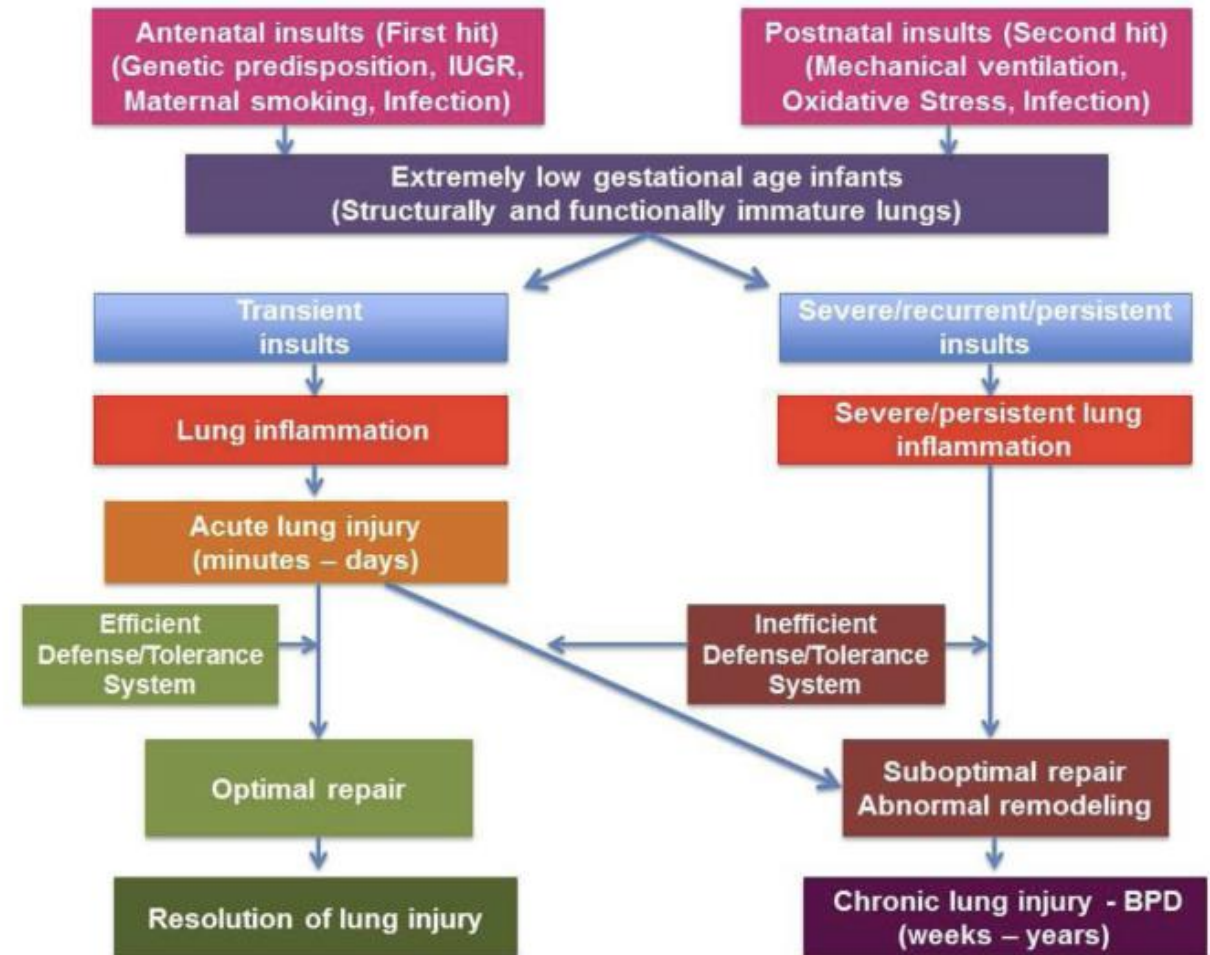
To BPD or Not to BPD: A Comparison of the 2022 versus 2011 NICHD Web-Based Risk Estimator for Bronchopulmonary Dysplasia

Authors: Mitchell Kinkor MD, Jake Schneider, Farhath Sulthana MD, Janelle Noel-Macdonnell PhD, Alain Cuna MD



Bronchopulmonary Dysplasia

- Chronic lung disease that impacts preterm infants
- Risk factors include:
 - Antenatal insults
 - Extreme prematurity
 - Mechanical ventilation
 - Infection (surgical necrotizing enterocolitis (NEC))
- Not diagnosed until 36 weeks corrected gestational age



Kalikkot 2017

Benefits of early prediction of BPD

- Prognostic information to families, care teams
- Targeted recruitment of high-risk infants into clinical trials
- Estimating treatment effect of interventions for BPD in randomized controlled trials
- Anticipate eventual systemic steroid treatment
 - Stratify infants at highest risk for BPD who could benefit from steroids
 - BPD risk estimation can help with cost and benefit analysis of systemic steroids
 - Improved lung compliance and weaning from mechanical ventilation vs. CP, adverse neurologic outcomes

2011 BPD Estimator

NICHD

NEONATAL RESEARCH NETWORK

Login

HOME ABOUT NETWORK CENTERS STUDIES PUBLICATIONS TOOLS DATA REQUESTS OPPORTUNITIES LINKS MEMBER LOGIN

Neonatal BPD Outcome Estimator
Infants with GA 23-30 weeks & Birth Weight 501-1249g

Information at Time of Birth	
Gestational Age (Weeks)	<input type="text" value="26"/>
Birth Weight (Grams)	<input type="text" value="850"/>
Sex	<input type="text" value="Male"/>
Race / Ethnicity	<input type="text" value="White"/>
Postnatal Day	<input type="text" value="1"/>
Ventilator Type	<input type="text" value="IMV/SIMV"/>
FiO2 ¹	<input type="text" value="40"/>

Calculate Clear Cancel

Neonatal BPD Outcome Estimator
 Infants with GA 23-30 weeks & Birth Weight 501-1249g

Gestational Age (Weeks)	26
Birth Weight (Grams)	850
Sex	Male
Race / Ethnicity	White

Probability of Outcome
 (expressed as a percent)

Time Period	Ventilator Type	FiO2	Death	Severe BPD	Moderate BPD	Mild BPD	No BPD
Day 1	IMV/SIMV	40	8.7	22.4	33.3	25.9	9.7



2022 BPD Estimator

- 2022 – version 2 released
 - Definition of BPD updated, increased sample size
 - Surgical NEC, antenatal steroid administration on DOL 1 included as prognostic factors
 - Non-invasive positive pressure ventilation as ventilator type
 - No option for DOL 21 prediction
- Impact of these changes to the calculator is unknown

	2011 BPD Calculator Definition	2022 BPD Calculator (Jensen 2019) Definition ¹
<i>Categories of BPD</i>	none, mild, moderate, severe	no BPD, grade 1, grade 2, grade 3
<i>Definition of no BPD</i>	no supplemental O ₂ for 28 days or at 36 weeks' PMA	breathing in room air at 36 weeks' PMA
<i>Definition of mild/Stage 1 BPD</i>	receiving O ₂ for ≥ 28 days, but not at 36 weeks' PMA	receiving of NC ≤ 2 L/min (or hood O ₂) at 36 weeks' PMA
<i>Definition of moderate/Stage 2 BPD</i>	receiving O ₂ for ≥ 28 days plus treatment with less than 30% O ₂ at 36 weeks' PMA	receiving NC ≥ 2 L/min, nasal CPAP, or nasal intermittent positive pressure ventilation at 36 weeks' PMA
<i>Definition of severe/Stage 3 BPD</i>	receiving O ₂ for ≥ 28 days plus treatment with ≥ 30% O ₂ or positive pressure at 36 weeks' PMA	receiving invasive mechanical ventilation at 36 weeks' PMA

Neonatal BPD Outcome Estimator (2022)
Infants with GA 23-28 weeks & Birth Weight 501-1250g

Information at Time of Birth		
Postnatal Day	<input type="text" value="1"/>	OK
Gestational Age (Weeks)	<input type="text" value="26"/>	OK
Birth Weight (Grams)	<input type="text" value="850"/>	OK
Sex	<input type="text" value="Male"/>	OK
ANS should only be entered for postnatal day 1.		
ANS	ANS should only be entered for postnatal day 1. <input type="text" value="Yes"/>	OK
Surgical necrotizing enterocolitis should only be entered for postnatal days 14 and 28.		
Surgical Necrotizing Enterocolitis	Surgical necrotizing enterocolitis should only be entered for postnatal days 14 and 28. <input type="text" value="-- Select --"/>	Surgical NEC not required when Postnatal Day = 1
Respiratory Support Type	<input type="text" value="CV (conventional ventilation)"/>	OK
FiO2 ¹	<input type="text" value="40"/>	OK
<small>¹Enter the FiO2 content in percent, e.g., enter 23.22% as 23.22.</small>		
<input type="button" value="Calculate"/> <input type="button" value="Clear"/> <input type="button" value="Cancel"/>		



NICHD
NEONATAL RESEARCH NETWORK

HOME ABOUT NETWORK CENTERS STUDIES PUBLICATIONS TOOLS DATA REQUESTS OPPORTUNITIES

Neonatal BPD Outcome Estimator (2022)
Infants with GA 23-28 weeks & Birth Weight 501-1250g

Postnatal Day	1
Gestational Age (Weeks)	26
Birth Weight (Grams)	850
Sex	Male
ANS	Yes
Surgical Necrotizing Enterocolitis	N/A
Respiratory Support Type	CV (conventional ventilation)
FIO2	40

Probability of Outcome
(expressed as a percent)

Death	Grade 3 BPD	Grade 2 BPD	Grade 1 BPD	No BPD
9.48	8.50	22.98	35.60	23.44

2011

NICHHD
NEONATAL RESEARCH NETWORK

HOME ABOUT NETWORK CENTERS STUDIES PUBLICATIONS TOOLS DATA

Neonatal BPD Outcome Estimator
Infants with GA 23-30 weeks & Birth Weight 501-1249g

Gestational Age (Weeks)	26
Birth Weight (Grams)	850
Sex	Male
Race / Ethnicity	White

Probability of Outcome
(expressed as a percent)

Time Period	Ventilator Type	FiO2	Death	Severe BPD	Moderate BPD	Mild BPD	No BPD
Day 1	IMV/SIMV	40	8.7	22.4	33.3	25.9	9.7

2022

NICHHD
NEONATAL RESEARCH NETWORK

HOME ABOUT NETWORK CENTERS STUDIES PUBLICATIONS TOOLS DATA REQUESTS OPPORTU

Neonatal BPD Outcome Estimator (2022)
Infants with GA 23-28 weeks & Birth Weight 501-1250g

Postnatal Day	1
Gestational Age (Weeks)	26
Birth Weight (Grams)	850
Sex	Male
ANS	Yes
Surgical Necrotizing Enterocolitis	N/A
Respiratory Support Type	CV (conventional ventilation)
FIO2	40

Probability of Outcome
(expressed as a percent)

Death	Grade 3 BPD	Grade 2 BPD	Grade 1 BPD	No BPD
9.48	8.50	22.98	35.60	23.44



Objective

- Compare predictive performance of 2022 and 2011 BPD estimator for two outcome variables
 1. Treatment with postnatal steroids for BPD
 2. Identification of infants who developed death/highest severity BPD

Hypothesis

- 2022 BPD estimator would offer improved accuracy for predicting both postnatal steroid treatment and severe outcomes compared to 2011 BPD estimator

Methods

- Retrospective cohort study
 - Population: 165 premature infants admitted to level IV neonatal intensive care unit at Children's Mercy
 - Data collection: demographic and respiratory support data abstracted from electronic medical record
 - Statistics: logistic regression with receiver operator characteristic (ROC) analysis with two focused outcomes
 - Identifying treatment with postnatal steroids
 - Predicting severe outcomes

RESULTS



Baseline demographics

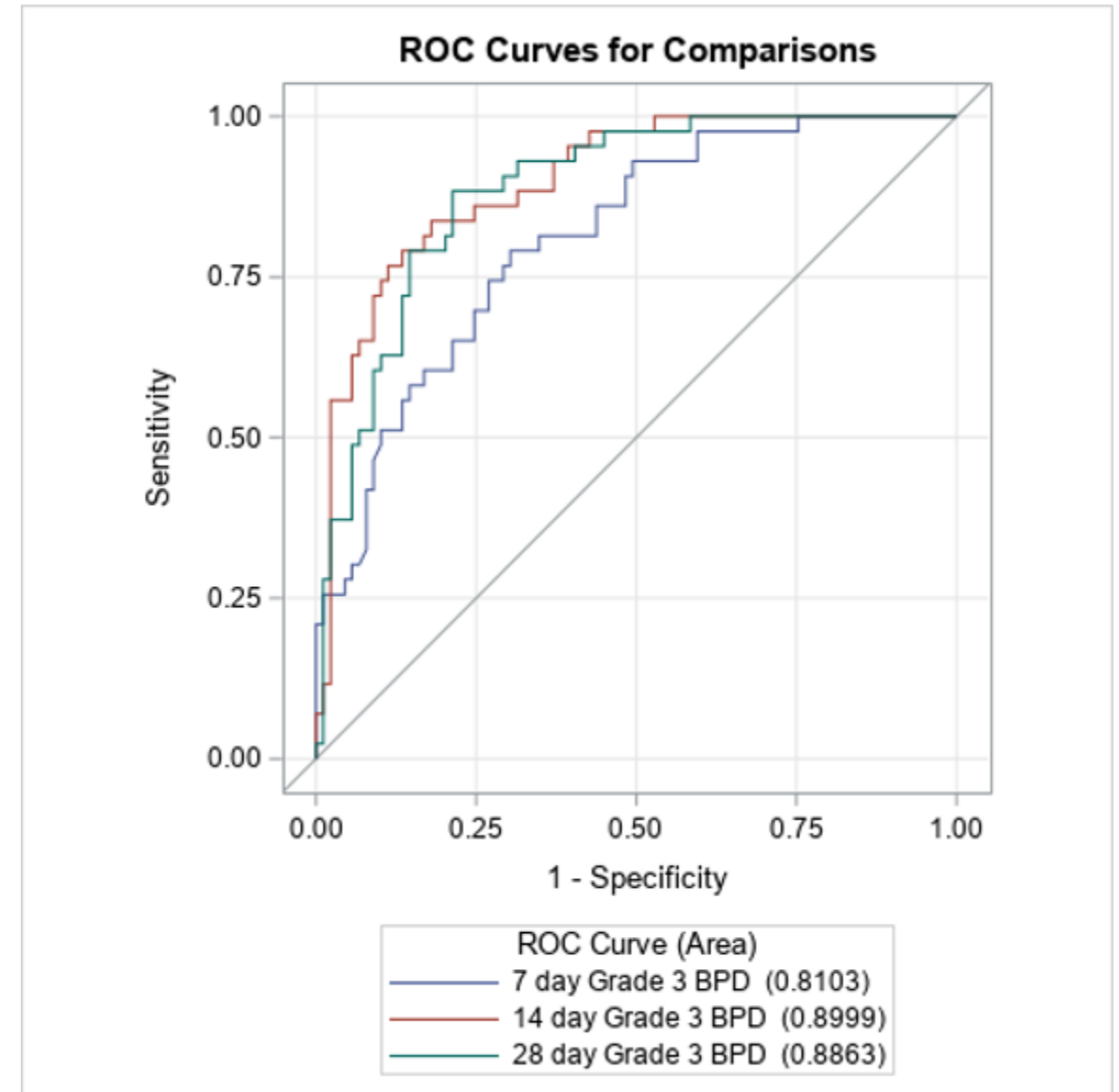
Demographics	n = 165
Gestational age, weeks	26.0 ± 1.6
Birth weight, grams	837.4 ± 170.8
Male sex, n (%)	94 (57)
White race, n (%)	87 (53)
Small for gestational age, n (%)	12 (7)
Maternal age at delivery, years ^a	26.0 ± 6.1
Multiple birth, n (%)	48 (29)
Cesarean delivery, n (%)	116 (70)
Antenatal steroids, n (%)	125 (76)
Apgar score ≤ 5 at 1 min, n (%) ^b	129 (82)
Apgar score ≤ 5 at 5 min, n (%) ^b	70 (45)
Surfactant, n (%)	163 (99)

Identifying steroid treatment: Best models

DOL	2011 Estimator		2022 Estimator	
	<i>Best model</i>	<i>C Statistic</i>	<i>Best model</i>	<i>C statistic</i>
1	Severe BPD or death	0.836	No BPD	0.783
3	No BPD	0.790	Grade 3 BPD	0.761
7	Moderate BPD or death	0.800	Grade 3 BPD	0.810
14	Severe BPD or death	0.867	Grade 3 BPD	0.882
21	No BPD	0.881		
28	No BPD	0.879	Grade 3 BPD	0.884

Identifying steroid treatment: Best time

- DOL 21 estimation not available in new 2022 calculator
- Predictive accuracy was significantly improved for DOL 14 compared to DOL 7 (P=0.003).
- No significant difference in predictive accuracy when comparing DOL 14 and DOL 28 (p=0.69).



Identifying severe/Gr3 BPD or death: Accuracy




DOL	2011 BPD Estimator	2022 BPD Estimator
Day 1	0.588 (0.483 – 0.694)	0.685 (0.526 – 0.845)
Day 3	0.595 (0.496 – 0.694)	0.628 (0.485 – 0.771)
Day 7	0.577 (0.482 – 0.673)	0.679 (0.545 – 0.813)
Day 14	0.595 (0.499 – 0.691)	0.677 (0.539 – 0.816)
Day 21	0.635 (0.550 – 0.721)	NA
Day 28	0.691 (0.610 – 0.773)	0.786 (0.677 – 0.894)

* Highest severity of BPD refers to severe BPD in the 2011 BPD estimator and Grade 3 BPD in the 2022 BPD estimator.




Identifying severe/Gr3 BPD or death: Accuracy



DOL	2011 BPD Estimator	2022 BPD Estimator
Day 1	0.588 (0.483 – 0.694)	0.685 (0.526 – 0.845)
Day 3	0.595 (0.496 – 0.694)	0.628 (0.485 – 0.771)
Day 7	0.577 (0.482 – 0.673)	0.679 (0.545 – 0.813)
Day 14	0.595 (0.499 – 0.691)	0.677 (0.539 – 0.816)
Day 21	0.635 (0.550 – 0.721)	NA
Day 28	0.691 (0.610 – 0.773)	0.786 (0.677 – 0.894)

* Highest severity of BPD refers to severe BPD in the 2011 BPD estimator and Grade 3 BPD in the 2022 BPD estimator.

Identifying severe/Gr3 BPD or death: Accuracy



DOL	2011 BPD Estimator	2022 BPD Estimator
Day 1	0.588 (0.483 – 0.694)	0.685 (0.526 – 0.845)
Day 3	0.595 (0.496 – 0.694)	0.628 (0.485 – 0.771)
Day 7	0.577 (0.482 – 0.673)	0.679 (0.545 – 0.813)
Day 14	0.595 (0.499 – 0.691)	0.677 (0.539 – 0.816)
Day 21	0.635 (0.550 – 0.721)	NA
Day 28	0.691 (0.610 – 0.773)	0.786 (0.677 – 0.894)

* Highest severity of BPD refers to severe BPD in the 2011 BPD estimator and Grade 3 BPD in the 2022 BPD estimator.

Conclusions

- 2022 and 2011 BPD estimator head-to-head comparison
 - Similar (good-to-excellent) accuracy in identifying infants at high risk for steroid treatment as early as DOL 14
 - 2022 estimator preformed better than 2011 in predicting death or high severity BPD
 - However, accuracy of both models generally poor for this outcome
 - Exception: DOL 28 in 2022 estimator (AUC > 0.75)
- Clinical application
 - Less applicable for use in early recruitment for research studies
 - Most helpful for family counseling at DOL 28
 - Potential for steroid treatment based on DOL 14 output

Citations

- Jensen, E. A. et al. The Diagnosis of Bronchopulmonary Dysplasia in Very Preterm Infants. An Evidence-based Approach. *Am. J. Respir. Crit. Care Med.* 200, 751–759 (2019).
- Cuna, A. et al. Usefulness of an Online Risk Estimator for Bronchopulmonary Dysplasia in Predicting Corticosteroid Treatment in Infants Born Preterm. *J. Pediatr.* 197, 23-28.e2 (2018).
- Kalikkot Thekkeveedu R, Guaman MC, Shivanna B. Bronchopulmonary dysplasia: A review of pathogenesis and pathophysiology. *Respir Med.* 2017 Nov;132:170-177. doi: 10.1016/j.rmed.2017.10.014. Epub 2017 Oct 24. PMID: 29229093; PMCID: PMC5729938.
- Jobe, A. H. & Bancalari, E. Bronchopulmonary dysplasia. *Am. J. Respir. Crit. Care Med.* 163, 1723–1729 (2001).
- Cuna, A., Lewis, T., Dai, H., Nyp, M. & Truog, W. E. Timing of postnatal corticosteroid treatment for bronchopulmonary dysplasia and its effect on outcomes. *Pediatr. Pulmonol.* 54, 165–170 (2019).

