The Possible Role of Artificial Intelligence in Deciding Postnatal Steroid Management in Extremely Premature Ventilated Infants

Shabih Manzar¹ and Archana Bottu¹

¹Louisiana State University Health Sciences Center Shreveport School of Medicine

March 21, 2023

The Possible Role of Artificial Intelligence in Deciding Postnatal Steroid Management in Extremely Premature Ventilated Infants

To the Editor,

Clinical decision support (CDS) is continually evolving through machine learning and artificial intelligence ¹. CDS has shown a positive effect among physicians in a systematic review and meta-analysis ². It has been proposed that preterm infants who are unable to be taken off mechanical ventilation and require postnatal steroids are at an elevated risk of developing bronchopulmonary dysplasia (BPD) ^{3,4}. The risk of BPD in these children can be estimated with free online tools. Greenberg et al.⁵ demonstrated the utility of online clinical tools in estimating the BPD risk in extremely preterm (EP) infants. We previously postulated the efficacy of combining the extubation success probability and BPD risk calculation in an EP infant before and after PNS ⁶. Based on the anecdotal experience⁶, we can further support using online tools for CDS and PNS management in EP infants. We present an example in favor of our postulation.

A 14-day-old male infant born at 23 weeks of gestation has been on a high-frequency ventilator. The fraction of inspired oxygen (FiO₂) was 0.45, with a mean airway pressure (MAP) of 14 cm H₂O. His blood gas showed a pH of 7.26. His birth weight was 525 grams, and his current weight is 665 grams. PNS use for facilitating extubation with the expectation of decreasing the likelihood of BPD along with the risk of BPD was discussed amongst the neonatal team and parents. The extubation success probability and BPD risk were calculated using the freely available online tool (Figure 1). The results were:

BPD/death risk estimate: Death 15.16%, Grade 3 BPD 13.79%, Grade 2 BPD 39.97 %, Grade 1 BPD 27.54%, no BPD 3.54%

Probability of successful extubation = 7.77%

The results were added to an MS Excel sheet to obtain the decision (Figure 2). Based on low extubation probability (7.77%) and a combined risk of death and grade 3 BPD of 29.39%, a decision was made to consider PNS use. The parents were counseled, and after obtaining their consent, a shared decision was made to start PNS. In a previous study, Hansen et al. (Figure 2) used a > 35% combined score of Death/BPD risk to decide about PNS. With the change in the BPD estimator from 2011 to 2022, we used a 25% cutoff for PNS use. We added an extubation success of < 25% in combination with > 25% risk of death/BPD as a criterion for PNS management in ventilated EP infants.

Using this example, the BPD estimator and extubation success calculator tools can be incorporated into the electronic record system to generate a CDS based on the algorithm extracting the variables from the infant's medical record.

References:

- Sutton RT, Pincock D, Baumgart DC, Sadowski DC, Fedorak RN, Kroeker KI. An overview of clinical decision support systems: benefits, risks, and strategies for success. NPJ Digit Med . 2020;3:17. Published 2020 Feb 6. doi:10.1038/s41746-020-0221-y
- Taheri Moghadam S, Sadoughi F, Velayati F, Ehsanzadeh SJ, Poursharif S. The effects of clinical decision support system for prescribing medication on patient outcomes and physician practice performance: a systematic review and meta-analysis. *BMC Med Inform Decis Mak*. 2021;21(1):98. Published 2021 Mar 10. doi:10.1186/s12911-020-01376-8
- Doyle LW, Cheong JL, Hay S, Manley BJ, Halliday HL. Late ([?] 7 days) systemic postnatal corticosteroids for prevention of bronchopulmonary dysplasia in preterm infants. *Cochrane Database Syst Rev* . 2021;11(11):CD001145. Published 2021 Nov 11. doi:10.1002/14651858.CD001145.pub5
- 4. Htun ZT, Schulz EV, Desai RK, et al. Postnatal steroid management in preterm infants with evolving bronchopulmonary dysplasia. J Perinatol . 2021;41(8):1783-1796. doi:10.1038/s41372-021-01083-w
- Greenberg RG, McDonald SA, Laughon MM, et al. Online clinical tool to estimate risk of bronchopulmonary dysplasia in extremely preterm infants [published online ahead of print, 2022 Jun 21]. Arch Dis Child Fetal Neonatal Ed. 2022;fetalneonatal-2021-323573. doi:10.1136/archdischild-2021-323573
- Manzar S. Cerebral palsy and postnatal steroids [published online ahead of print, 2023 Mar 5]. Acta Paediatr . 2023;10.1111/apa.16742. doi:10.1111/apa.16742

Authors:

Archana Bottu, MD¹

Shabih Manzar, MD, MPH²

Louisiana State University Health Sciences Center at Shreveport

¹Intern, Department of Pediatrics

²Faculty, Department of Pediatrics

Corresponding author

Shabih Manzar, MD, MPH

Louisiana State University Health Sciences Center at Shreveport

1501 Kings Hwy, Shreveport, LA, 71103

Phone: 318-675-7275

Fax: 318-675-6059

Email: shabih.manzar@lsuhs.edu

Author contribution:

Dr. Bottu and Dr. Manzar conceptualized the study and wrote the draft.

Funding and financial support: None

Conflict of interest: None

Figure legends:

Figure 1:

Panel A: The risk estimator for Bronchopulmonary Dysplasia (BPD)/Death.

Panel B: The Extubation success rate calculator

The screenshots are taken from the freely available online (used for non-commercial, educational purposes only)

Figure 2:

The MS Excel screenshot shows the decision-making algorithm.

Note:

When all three columns are 'YES': Decision is YES

When all three columns are 'NO': Decision is NO

When BPD or EXT column is 'NO' but the combined answer is YES: The decision is per the clinician's discretion.

		Fig Online Freel	e 1 vailable Tools	
RESEARCH	Network	Login	WAYNE STATE UNIVERSITY	
NETWORK CENTURS 51/0	ES PUBLICATIONS 1000.5 CM/A REDUKTIS Neonatal BPD Outcome Estim Infants with GA 22-25 weeks & Birth V	OVPORTUNEES LINKS MEMBER LOOM	Extubation Success Calculator	
	Information at Time of E	leth .	Variable	Value
Postnatal Day Gestational Age (Weeks)	- Select - V	Please select. Please select a value between 23 and 28.	Overtainformal Ages Critic is in comparison for an annupule Critical 20 $\oplus 70$ or 20 $\oplus 77$ modes should be entered as 20.	22 10 3
Birth Weight (Grame)		Please enter a value between 501 and 1250.	Exhubation Day of Life	red
Ben	Select v	Please select.	Pre-extubation % Oxygen	
	ANS should only be entered for postnatal day 1.			
ANS	ANS should only be arrived for postrulal day 1.	Please select	Highest Respitory Severity Score* In First 6 Hours	16-21
	Surgical necrotizing enterocolitis should only be-	entered for postnatal days 14 and 28.	Weight at Exhibition (g)	460
Surgical Necrotizing Enterocolitis	Surgical recruitions enterscaltis should only be entered for postnatial days 14 and 28.	Please select	Pre-exhibition pH	Z110
	Select		Probability of Successful	
Respiratory Support Type	- Select - V	Please select.	Extubation	Ciel
FIO2 ⁴		Please enter a value between 21 and 100.	09/	
"Enter the FIG2 content in percent	4.g., w/w 25.32% as 25.32.		0%	
	Catalate Care Car	cal .		

NICHD Neonatal Research Network. neonatal.rti.org. https://neonatal.rti.org/index.cfm

Extubation Readiness Estimator for Preterm Neonates. extubation.net. http://extubation.net/

Figure 2

	А	В	С	D	E	F	G	н	1	J	K	L
		BPD/Death combined Risk	Extubation Success Probability	PNS BPD	PNS EXT	Decision	PNS BPD formula: =IF(B2>25, "YES", "NO") PNX EXT formula:=IF(C2<25, "YES", "NO") Decision formula: =IF(E2+C2<50, "YES", "NO")					
	Example 1	29	7.7	YES	YES	YES		· ·		<i>.</i>		
	Example 2	12	84	NO	NO	NO	References:					
	Example 3	34	64	YES	NO	NO						
	Example 4	22	22	NO	YES	YES	NICHD Neonatal Research Network. neonatal.rti.org.					
	Example 5	26	14	YES	YES	YES	https://neonatal.rti.org/index.cfm					
	Example 6	20	86	NO	NO	NO						
	Example 7	36	12	YES	YES	YES	Excludation Readiness Estimator for Preterm Neonates. excludation.net.					
	Example 8	22	23	NO	YES	YES	inc./exubation.net/					
)	Example 9	37	18	YES	YES	NO						
ι	Example 10	32	16	YES	YES	YES	Consider postnatal steroids: (after discussion with parents and obtaning consent					
2	Example 11	22	75	NO	NO	NO						
3	Example 12	38	12	YES	YES	NO	BPD/Death combined Kisk > 25% Extubation Success Probability < 25% Combined riks < 50%					
ł	Example 13	19	66	NO	NO	NO						
5	Example 14	38	11	YES	YES	YES						
	BPD – Bronchopulmonary Dysplasia PNS – Postnatal Steroids						P, Oschman s guidelines	A, K Pallotto for postnata	E, et al. Using I steroid treat	quality imp ment of pre	provement to in term infants w	nplement ith devek