Hospital budget-impact model of patterned, frequency-modulated oral stimulation in preterm infants

C. Fernández-Barceló,[1] T. Münch,[1] R. Saunders,[1] A. Veloz[2]
1. Coreva Scientific GmbH & Co. KG, Königswinter, Germany; 2. HEOR Pro, Geneva, Illinois, USA

Background

- Premature childbirth can disrupt the development of essential functions like non-nutritive sucking (NNS), necessary to develop full oral feeding (FOF). This is especially relevant for very premature newborns between 27-30 GAB (Gestational Age at Birth, in weeks), since premature newborns before 32 weeks are usually not able to feed effectively from the breast or a bottle.[1]
- Oral stimulation is sometimes manually provided by nurses or caregivers. However, the efficacy in published studies may not be consistent in terms of effectiveness,[2] potentially due to variance in the training frequency, session duration and pacifier type/positioning.[1]
- Patterned and frequency-modulated oral stimulation (PFOS) promotes NNS development by simulating the natural feeding rhythms of neonates in a consistent and reproducible manner.[3]
- This study assessed the economic impact of providing PFOS to preterm infants in the US from a hospital perspective.

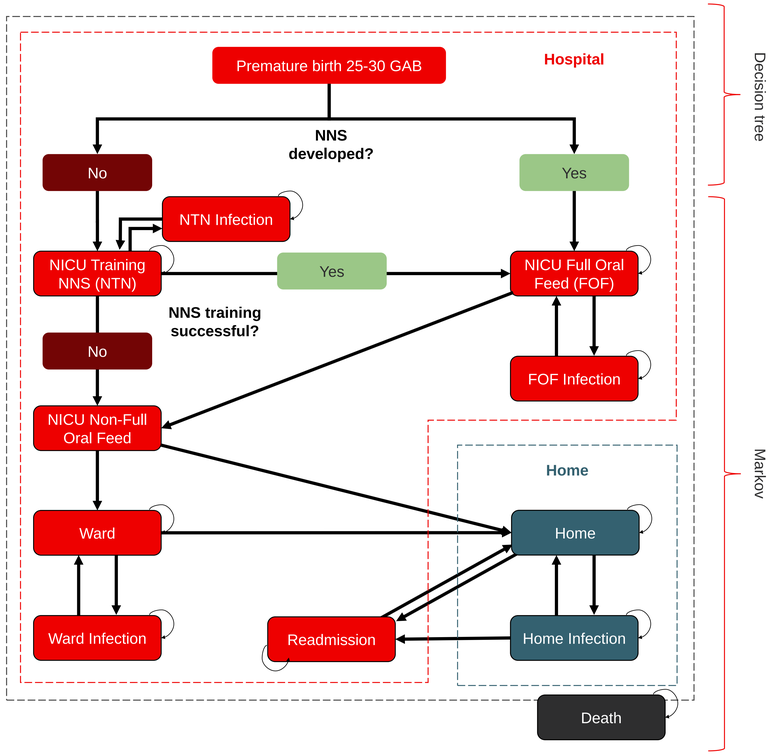

Figure 1 Decision tree and Markov model
Death can either occur in hospital (red states) or at home (blue states). NNS: Non-nutritive sucking; FOF: Full oral feed; NICU: Neonatal intensive care unit; NTN: NICU Training Non-Nutritive Sucking

Methods

- A budget impact model from a hospital perspective was developed, consisting of a decision tree and a semi-Markov model, comparing PFOS (NTrainer™ system 2.0) to the standard of care. (**Figure 1**)
- A structured literature review was conducted to retrieve model inputs. (**Figure 2**)
- The care pathway from childbirth to 30 days post hospital discharge was modelled for a 1-year cohort of preterm 25-30 GAB newborns. (**Table 1&2**)
- The main outcome measure of the analysis were total costs (in 2024 USD).
- Probabilistic and one-way sensitivity analyses were performed to address uncertainty.

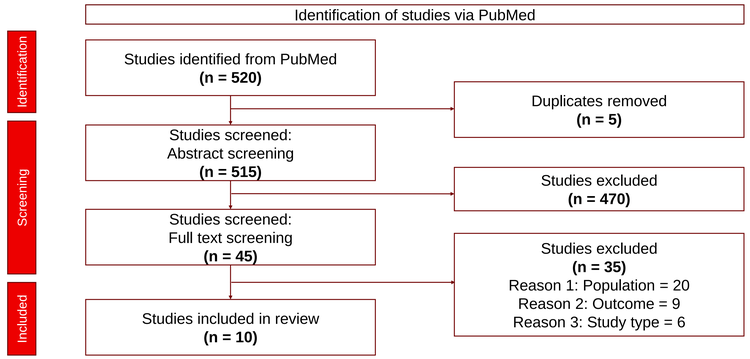

Figure 2 PRISMA diagram results of the structured literature review

Table 1 Key clinical and hospital stay inputs

Input	SoC	PFOS
NNS training success (FOF achievement)	94.06%[4†]	93.58%[4†]
Discharge from NICU to home in non-FOF patients	33.33%[4†]	42.86%[4†]
Discharge from NICU to home in FOF patients	100%[*]	100%[*]
Time to NNS training	28.3 days[4†]	26.4 days[4†]
Time to FOF	27.0 days[4]	22.9 days[4]
Time to discharge after FOF achievement	10.5 days[4†]	10.5 days[4†]

SoC: Standard of Care; PFOS: Patterned and frequency-modulated oral stimulation; NNS: Non-nutritive sucking; FOF: Full oral feed; LOS: Length of Stay. † Calculated from Song et al.[4]; * Assumption

Table 2 Key cost inputs

Input	Cost[†]
NICU level I, per day	$521[5*]
NICU level III, per day	$1,217[5*]
Infection	$624[6‡]
Readmission	$5,003[7§]
Naso-/oro-gastric tube	$1,622[8¶]

PFOS: Patterned and frequency-modulated oral stimulation; NICU: Neonatal intensive care unit; †Costs are presented and inflated to 2024 USD. ‡Calculated from Guan et al. ; §Calculated from Speer et al. ; ¶Calculated from White et al. * A charge-to-cost ratio was applied to derive costs from a publication reporting hospital charges.[9]

Conclusion

MT36

PFOS is expected to reduce hospital-associated costs for preterm infants GAB25-30 in the US due to reduced time to full oral feed and length of NICU stay.

Results

- For 120 preterm infants born at a GAB of 25-30 weeks, the model resulted in average cost savings of $1,181,074 (95% CrI $2,497,162 ; -$199,360), when comparing the standard of care to PFOS (total costs: $11,635,783 vs. $10,454,709, respectively).
- The PFOS system would be cost-neutral at $9,842 per patient.
- PFOS was cost-saving in 93.8% of the 1,500 Monte Carlo simulations.
- The main drivers were time to achieve full oral feed, and the percentage of newborns discharged with full oral feed. (**Figure 3**)

Table 3 Results by cost category

Category	SoC	PFOS	Difference (95% CI)
NICU	9,933,609	11,091,207	-1,157,598 [-2,481,373 ; 216,899]
General ward	44,565	48,610	-4,045 [-22,212 ; 13,341]
Hospital infection	7,343	8,530	-1,187 [-2,774 ; 265]
Staff training	47,017	55,093	-8,076 [-18,037 ; 1,833]
Home care*	422,176	432,344	-10,168 [-22,794 ; 957]
Total costs	**11,635,783**	**10,454,709**	**-1,181,074 [2,497,162 ; -199,360]**

SoC: Standard of Care; PFOS: Patterned and frequency-modulated oral stimulation; NNS: Non-nutritive sucking; FOF: Full oral feed; LOS: Length of Stay. * Including discharged with NGT, infections at home and readmission.

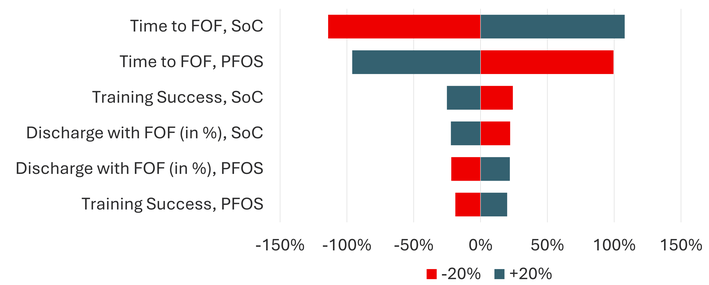

Figure 3 Main drivers of model outcomes
FOF: Full oral feed; SoC; Standard of care; PFOS: Patterned and frequency-modulated oral stimulation

References

1. Foster, J. P., Psaila, K. & Patterson, T. Non-nutritive sucking for increasing physiologic stability and nutrition in preterm infants. The Cochrane database of systematic reviews 10, CD001071; 10.1002/14651858.CD001071.pub3 (2016).
2. Zhao S, Jiang H, Miao Y, Liu W, Li Y, Zhang Y, Wang A, Cui X. Effects of implementing non-nutritive sucking on oral feeding progression and outcomes in preterm infants: A systematic review and meta-analysis. PLoS One. 2024 Apr 16;19(4):e0302267. doi: 10.1371/journal.pone.0302267. PMID: 38626172; PMCID: PMC11020483.
3. Barlow SM, Finan DS, Lee J, Chu S. Synthetic orocutaneous stimulation entrains preterm infants with feeding difficulties to suck. J Perinatol. 2008 Aug;28(8):541-8. doi: 10.1038/jp.2008.57. Epub 2008 Jun 12. PMID: 18548084; PMCID: PMC3725753.
4. Song D, et al. Patterned frequency-modulated oral stimulation in preterm infants: A multicenter randomized controlled trial. *PLoS One*. 2019;14(2):e0212675.
5. Valencia, Zehra; Sen, Aditi; Martin, Katie (2023): NICU Admissions and Spending Increased Slightly from 2017-2021. Health Care Cost Institute. Available online at https://healthcostinstitute.org/hcci-originals-dropdown/all-hcci-reports/nicu-use-and-spending-1, Accessed Sep 2024.
6. Guan G, et al. Resource Utilization and Costs Associated with Approaches to Identify Infants with Early-Onset Sepsis. *MDM Policy & Practice*. 2024;9(1).
7. Speer RR, et al. Trends in Costs of Birth Hospitalization and Readmissions for Late Preterm Infants. *Children (Basel)*. 2021 Feb 10;8(2):127.
8. White BR, Ermarth A, Thomas D, Arguinchona O, Presson AP, Ling CY. Creation of a Standard Model for Tube Feeding at Neonatal Intensive Care Unit Discharge. JPEN J Parenter Enteral Nutr. 2020 Mar;44(3):491-499. doi: 10.1002/jpen.1718. Epub 2019 Sep 24. PMID: 31549429; PMCID: PMC7060820.
9. Bai G, Anderson GF. Extreme Markup: The Fifty US Hospitals With The Highest Charge-To-Cost Ratios. Health Aff (Millwood). 2015;34(6):922-928. doi:10.1377/hlthaff.2014.1414.

Disclaimer

CFB and TM are employees, and RS is the owner of Coreva Scientific, which received consulting fees for this work.
AV is employed by HEOR Pro, who received consultation fees from Cardinal Health to design and carry out the work presented here.
This work was funded by Cardinal Health.