



MEASURE ANS
CONTROL NOCICEPTION
IMPROVE OUTCOMES

NIPE in the NICU

Newborn Infant
Parasympathetic Evaluation



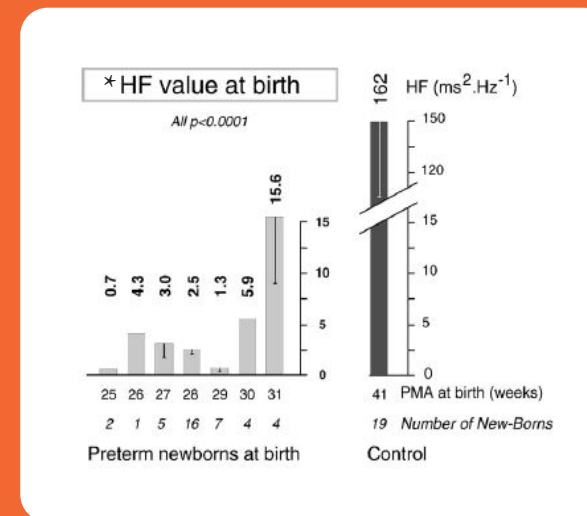


The problem

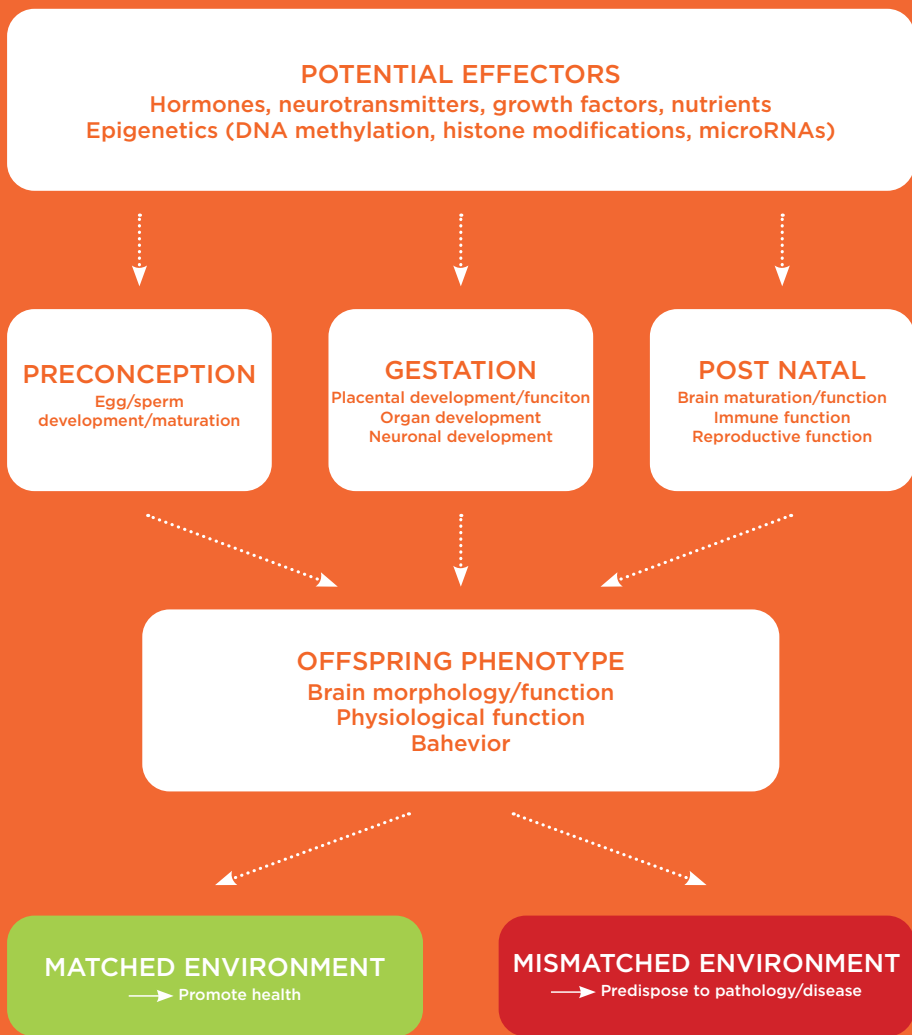
Epigenetic programming in the first 1000 days: Stress caused by nociception is a major factor.

Since conception, each new life starts to prepare itself to live. During Epigenetic programming in the first 1000 days, the autonomic nervous system (ANS) develops to allow new life to survive in its environment (1). Adverse events may lead to epigenetic changes, with implications for health and disease.

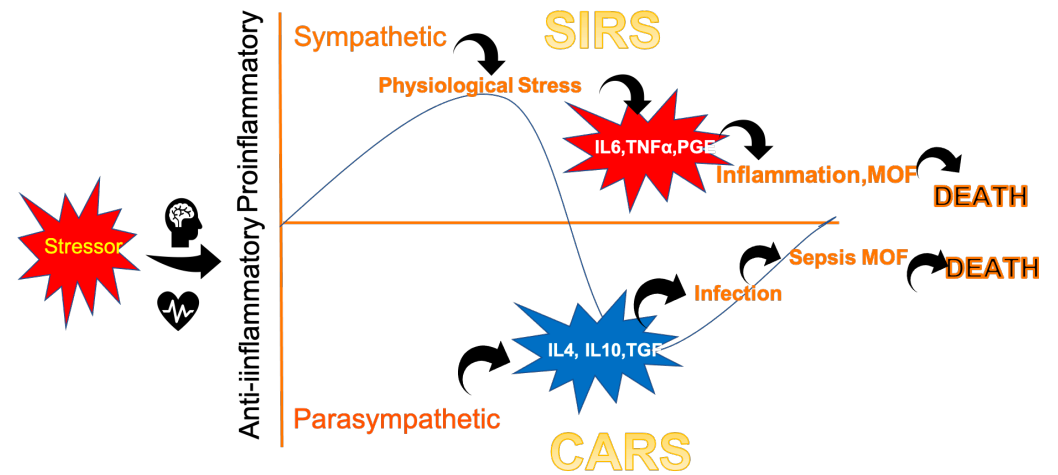
The number of preterm infants is increasing; These babies are fragile as they are born with a weak parasympathetic system (2). Newborns in the NICU may undergo more than 12 painful procedures per day, which puts them in a state of continuous stress, worsening their outcomes (3,4). Babies who experience a lot of stress during the first 1000 days of life have been shown to be at higher risk for physical and psychological problems, such as hypertension (5), diabetes (6), or behavioral problems such as alcohol abuse (7) or mental health disorders.



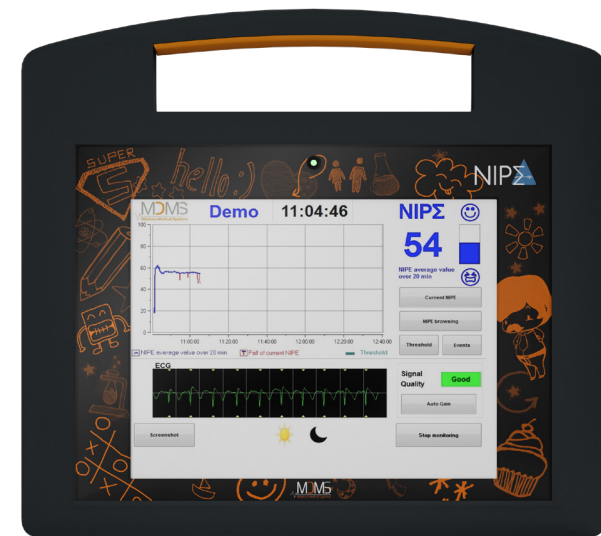
Picture modified from Hugues P. et al. (2)
*HF: High Frequency



Picture from Boersma JG. et al. (4)



Picture modified from Moore E et al. (8)

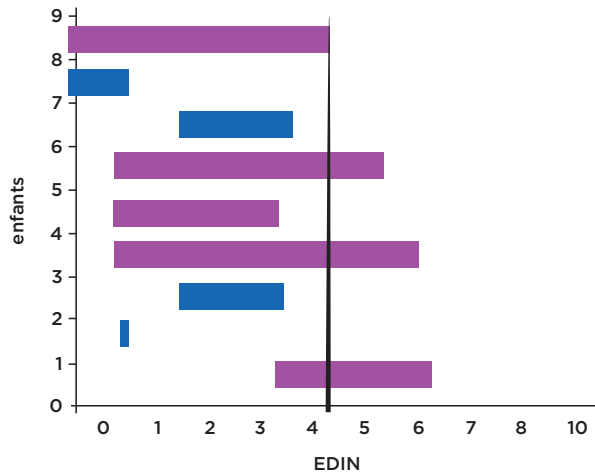


NIPE Monitor V1

Our solution

Measuring the autonomic nervous system (ANS)

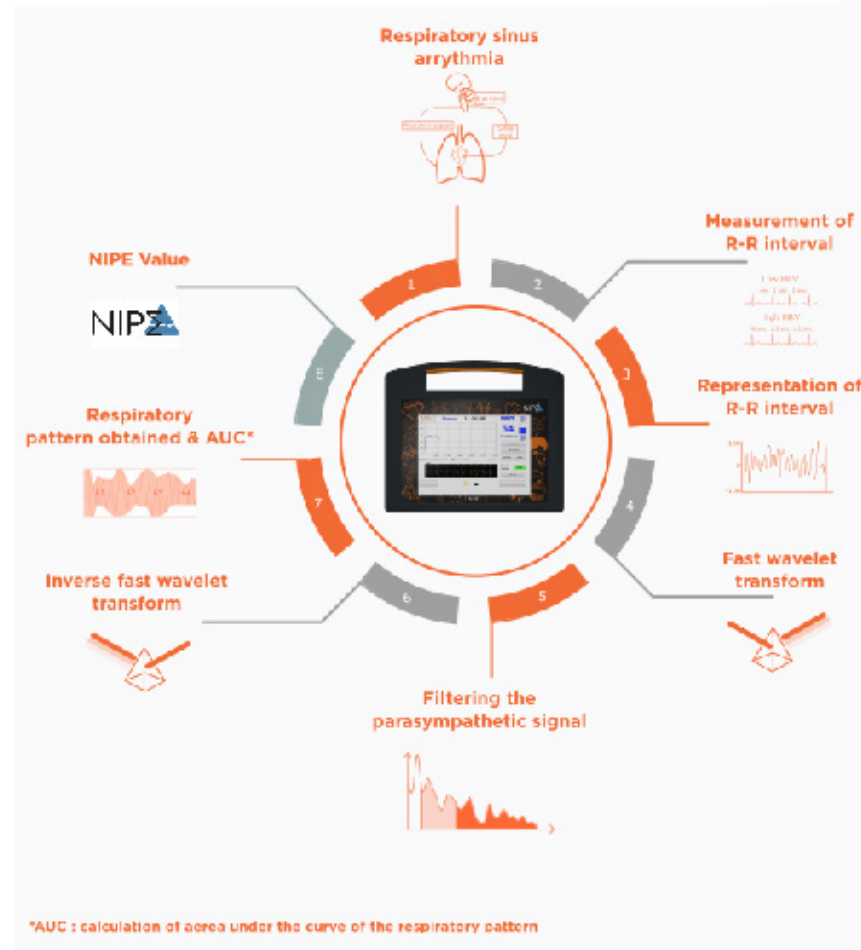
It is crucial to measure the well-being of these babies to allow them to be as comfortable as possible. However pain assessment in neonates is extremely challenging, pain scales are subject to inter-observer differences, each neonate may display different signs of pain leading to different interpretations and different results among observers (9), in addition they are time consuming to perform. Hence, a more objective, fast, reliable and easy to use physiological measure is needed.



Picture modified from Debillon T et al. (9)

The NIPE (Newborn Infant Parasympathetic Evaluation) monitor measures inter-beat distances of the R-R intervals derived from the ECG. These distances vary due to heart rate variability (HRV): the influence of respiration on the vagus nerve.

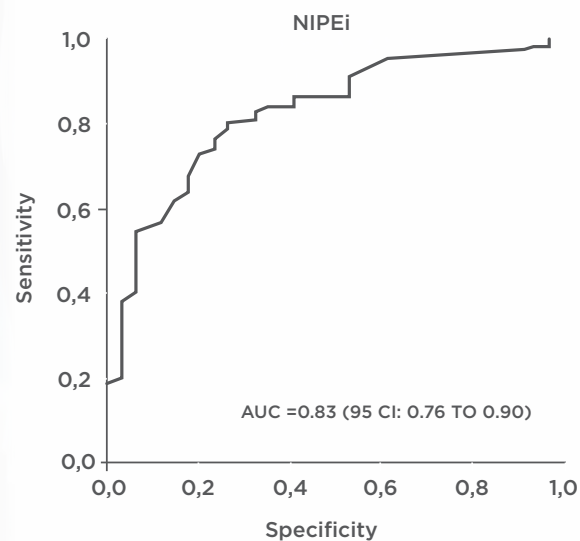
Analyzing the signal derived from HRV produces a metric (HFnu), indicating the relative of parasympathetic activity in the previous minutes.





The NIPE value shows continuously and objectively the parasympathetic activity of the patient. A NIPE of 53 corresponds to a Comfort Behavioral Scale (CBS) score > 17 (10).

Assessment of Procedural Distress in Sedated/Intubated Children Under 3 Years Old Using the Newborn Infant Parasympathetic Evaluation: A Diagnostic Accuracy Pilot Study



Relationship of NIPE with CBS - Picture modified from Morgan R. et al. (10)

Interpretation of NIPE



.....> Comfort

.....> Discomfot

0

nb : the energy must be between 0 and 4 for an interpretable NIPE.

The result

Dr. Walas validated the NIPE in an observational study, showing the NIPE value decreases more depending on the intensity of the stimulation (11). Faye PM et al. proved that Low NIPE values corresponded to high EDIN scores and vice-versa (12)

NIPE detecting different pain intensities

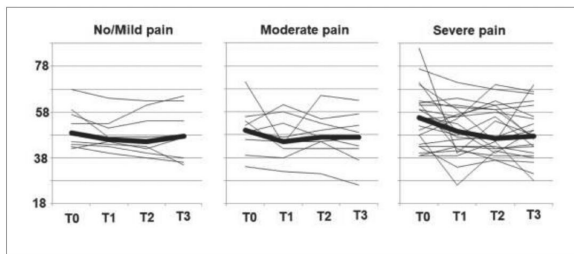
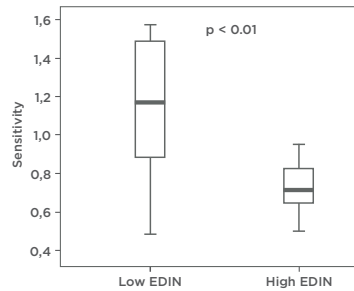


Fig. 2 Plots of individual time courses (thin lines) and median time courses (thick lines) of NIPE for no/mild pain, moderate pain and severe pain subgroups. NIPE values 1 minute before (T0), 1 (T1), 2 (T2), and 3 (T3) minutes after a painful stimulus. NIPE, Newborn Infant Parasympathetic Evaluation Index.

Picture modified from Walas W, et al. (11)

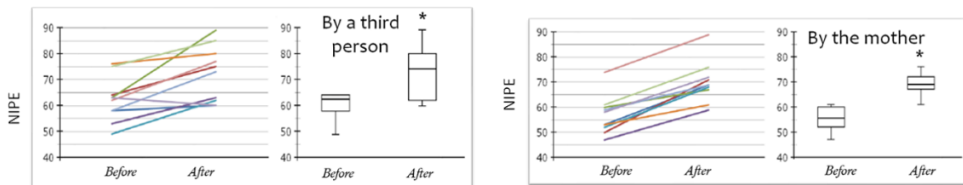


Picture modified from Faye et al. (12)

NIPE in assessing the impact of NIDCAP maneuvers

Moreover, in NICU's implementing the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) NIPE can be used to evaluate the favorable impact of cocooning (13) and skin to skin contact (14) on the preterm infant.

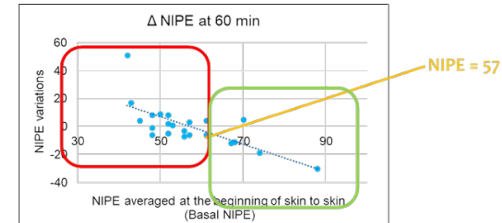
NIPE assessing the impact of cocooning



Picture modified from Alexander C. et al. (13)

NIPE on skin to skin contact

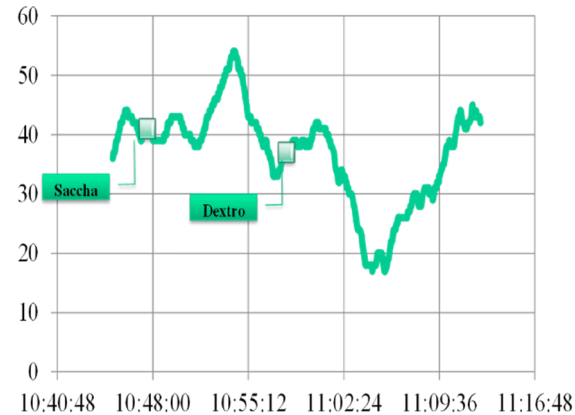
Impact of skin-to-skin contact on the autonomic nervous system in the preterm infant and his mother



Picture modified from Butruille L, et al. (14)

NIPE detecting the effects of saccharose during heel stick

Using NIPE will allow evaluation of the state of comfort/discomfort of the patient. This case study is an example where oral saccharose was given in advance to an infant increasing NIPE value and after the heel prick resulted in a decrease in the NIPE (15).



Internal case report (15)



The main benefits of using NIFE technology

NIFE shows the sympathetic/parasympathetic balance allowing taking better decisions to control nociception improving outcomes (17).



Evaluation of the newborn parasympathetic activity

C. Garabedian. et al., PLoS One 2017 Jul 12(7):e0180653.



Evaluate of the state of comfort/discomfort of the patient

Butruille L. 2017 Infant Behav Dev. doi: 10.1016/j.infbeh.2017.07.003. Alexandre et al. Arch Pediatr. 2013 doi:10.1016/j.arcped.2013.06.006



Evaluation of the newborn autonomic response to prolonged pain

Buyukiryaki M., Korean J. et al., Pediatr 2018 doi: org/10.3345/kjp.2017.05939



Detect nociception

Frank Weber F. et al., Paediatr Anaesth. 2019 Feb 21. doi: 10.1111/pan.13613.



Testimonials



“The Goldilocks principle, that means not too little, but not too much. NIFE and ANI help me optimize analgesedation in my patients.”

Dr. Wojciech Walas

Head of Anesthesiology and Intensive Therapy for Children and Neonates
University Hospital in Opole, Poland



“A tool to measure parasympathetic tone, through heart rate variability, could be useful to assess both the state of comfort and the maturity of the autonomic system in the premature newborn.”

Dr. Itziar Marsinyach Ros

Neonatology Assistant Physician
Hospital Gregorio Marañón, Madrid



“Thanks to NIFE we have an objective parameter to assess stress in our neonatal ICUs.”

Dr. Hector Boix

Neonatal Research Coordinator
Vall d'Hebron University Hospital, Barcelona

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- (11) Walas W, et al. Newborn Infant Parasympathetic Evaluation Index for the Assessment of Procedural Pain in Nonanesthetized Infants: A Multicenter Pilot Study. Am J Perinatol. 2020 Apr 10.
- (12) Faye PM, et al. Newborn Infant Pain Assessment Using Heart Rate Variability Analysis. Clin J Pain. Nov-Dec 2010;26(9): 777-82.
- (13) Alexandre C, et al. Impact of cocooning and maternal voice on the autonomic nervous system activity in the premature newborn infant]. Arch Pediatr. 2013 Sep;20(9):963-8.
- (14) Butruille L, et al. Impact of skin to-skin contact on the autonomic nervous system in the preterm infant and his mother. Infant Behav Dev. 2017 Aug 1;49:83-86.
- (15) Internal case report
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NIPE Monitor V1 is a class IIa medical device, manufactured by MDoloris Medical Systems.
CE evaluation was performed by Bureau Veritas Italy (1370) for the NIPE Monitor V1 ©
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