

# NAVA

Neurally Adjusted Ventilatory Assist

## In Neonates

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## Disclaimers

Dr Stein:

- Is discussing products made by Maquet
- Has no commercial interest in NAVA or Maquet
- Has received no financial support or incentives from Maquet to use NAVA or collect this data

Toledo Children's Hospital  
151 bed hospital

Level 3 NICU

60 beds

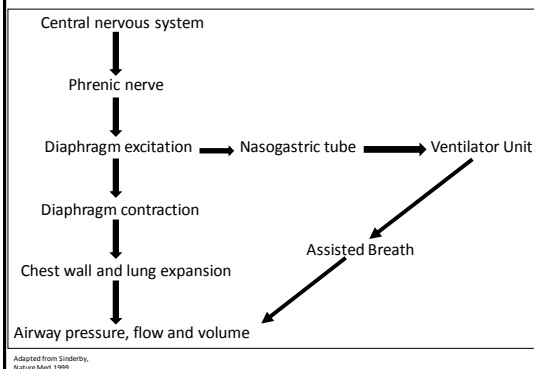
Inborn – 70%

Outborn – 30%

2011: > 800 admissions/year

Average daily census 40 – 45 patients

## How NAVA works



### Conventional Ventilation

**Patient Controls using Flow Trigger:**  
Initiation of Breath  
Rate (in some modes)

**Ventilator Controls:**  
Peak Pressure or Tidal Volume  
Inspiratory Time  
Termination of Breath  
PEEP  
Minimum Rate  
FIO<sub>2</sub>

**Synchrony:**  
Only for Initiation of Breath

### NAVA Ventilation

**Patient Controls using Neural Trigger:**  
Initiation of Breath  
Inspiratory Time  
Rate  
Peak Pressure  
Termination of Breath

**Ventilator Controls:**  
FIO<sub>2</sub>  
PEEP  
NAVA Level  
Apnea time (minimum rate)  
Peak Inspiratory pressure alarm

**Synchrony:**  
Initiation of Breath  
Size of Breath  
Termination of Breath

## Published Neonatal and Pediatric Studies

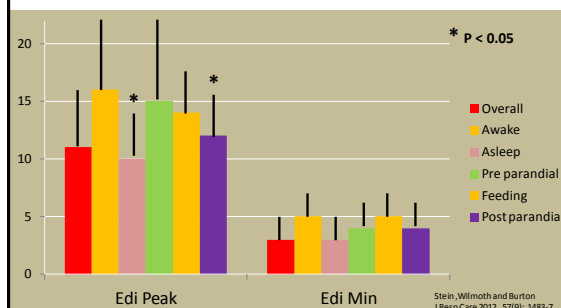
- 25 published pediatric and neonatal studies since 2004
- Samples sizes : 1 (case reports) – 52 patients (retrospective review)
- Time on NAVA: 5 min – 24 hours
- Age: 26 weeks – teenagers
- Weight: ~ 550 grams – ~ 55 kg



## Data from Toledo Children's Hospital's NICU

- Normative Edi data
  - Term neonates
  - Premature neonates
- Retrospective review of neonates < 1500 grams on NAVA
- Prospective controlled study in VLBW neonates between NAVA and PC

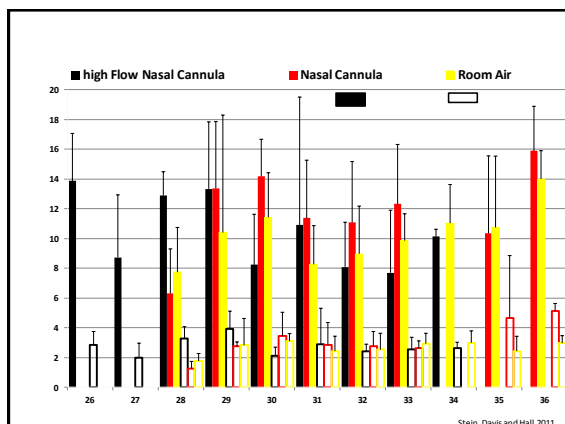
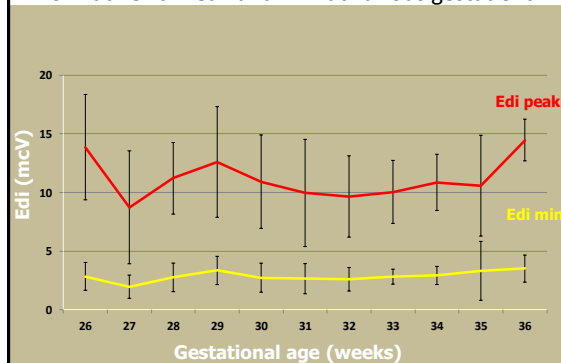
## Term Neonates with no active respiratory problems and feeding normally



## Normative Edi Data

- Premature neonates off mechanical ventilation
  - HFNC (3 - 6 lpm)
  - NC (0.5 - 2 lpm)
  - RA

## Normative Edi Peak and Min at various gestational

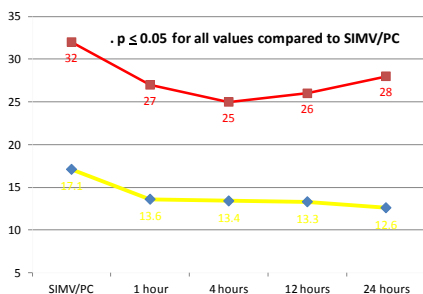


## NAVA in Neonates < 1501 grams

- 52 Neonates
  - 31 RDS
  - 21 CLD
- Gestational age:  $26.3 \pm 2.6$  weeks
- Birth weight:  $837 \pm 271$  grams
- Age at study:  $15 \pm 15$  days (range 0-50 days)
- Weight at study:  $958 \pm 294$  grams

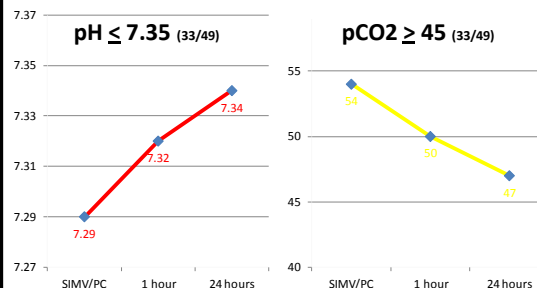
Stein HM, Howard D. Neurally Adjusted Ventilatory Assist (NAVA) in Neonates less than 1500 grams: A Retrospective Analysis. J Pediatr 2012 160: 786-789.

### NAVA in Neonates < 1501 grams Results



### NAVA in Neonates < 1501 grams Results

$p \leq 0.03$  for all values compared to SIMV/PC

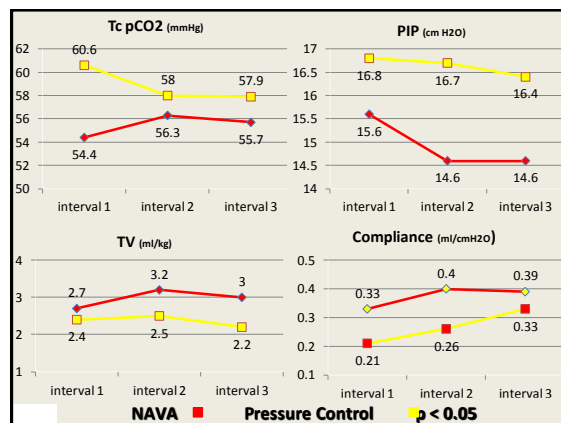


### NAVA Versus Pressure Control

- Gestational age:  $26.2 \pm 0.8$  weeks
- Birth weight:  $810 \pm 245$  grams
- Age at study:  $24 \pm 10$  days
- NAVA ventilation for 4 hours
- Pressure Control ventilation for 4 hours
- Cycle repeated for 24 hours



Stein, Aloush, Ethington and White 2012  
J Perinatol – in press



### Non-Invasive NAVA Ventilation

- Available since July 2010
- About 90 patients treated with NIV NAVA
- Uses:
  - Prevent intubation
  - Facilitate earlier extubation

### Case Presentation

- 26 weeks, 655 grams
- Extubated on day 1 to NIV NAVA
- NIV NAVA for 6 days and then HFNC 5 lpm
- 23 weeks, 650 grams
- NAVA invasively by 2 hours
- Extubated at 36 hours to NIV NAVA
- NIV NAVA for 8 days, CPAP for 1 day and then HFNC 5 lpm

## Clinical Guidelines

- Ventilator settings in NAVA:
  - Apnea time
  - Peak Inspiratory pressure alarm
  - How to set the NAVA level

## Apnea Time

- Time the neonate is apneic before getting a backup breath
- Apnea time can now be lowered to minimum of 2 seconds
  - After 2 seconds the neonate gets a pressure control breath
  - This allows the user to deliver a minimum guaranteed back-up rate of 30 breaths/min

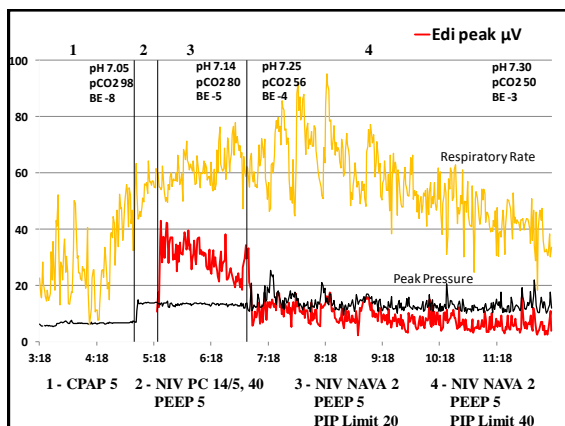
## Apnea Time

<u>Apnea alarm</u>	<u>Minimum rate</u>
15 sec	4 breaths/min
10 sec	6 breaths/min
5 sec	12 breaths/min
4 sec	15 breaths/min
3 sec	20 breaths/min
2 sec	30 breaths/min

This is different from the backup rate: RR when the neonate is apneic and getting pressure control

## Peak Inspiratory pressure alarm

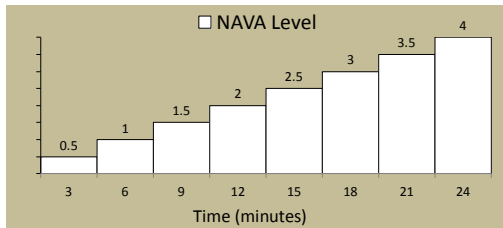
- Case presentation:
  - 32 weeks gestation
  - Primary C-section for maternal PIH
  - 1.8 kg                      Apgars 7/8
  - 8 minutes developed grunting and retractions
    - placed on CPAP 5
  - CXR showed mild to moderate RDS



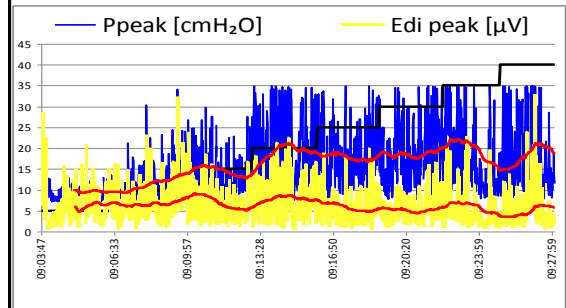
## How to set the NAVA level

- NAVA level is the proportionality factor that converts the Edi signal into a pressure
- The higher the NAVA level the more work of breathing the ventilator does
- The lower the NAVA level the more work of breathing the patient does
- Goal – to unload the work of breathing from the patient to the ventilator without over assisting the patient
- The ventilator continues to respond to the patient's respiratory drive but supports the patient's respiratory effort

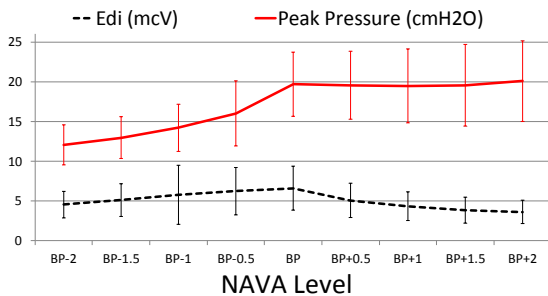
### Edi Titration Study – to determine the optimal NAVA level



### Edi Titration Study – to determine the optimal NAVA level



### Determining the Breakpoint (BP)



### NAVA WORKS IN NEONATES!

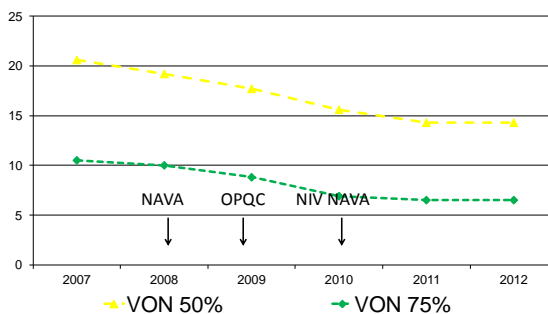
But does it make a difference?

TCH VON data - neonates < 1500 grams  
Comparison group – entire network

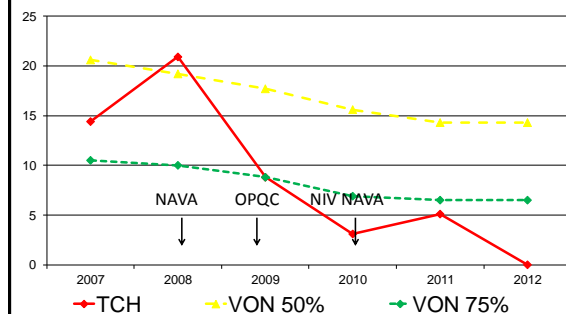
Time line events:

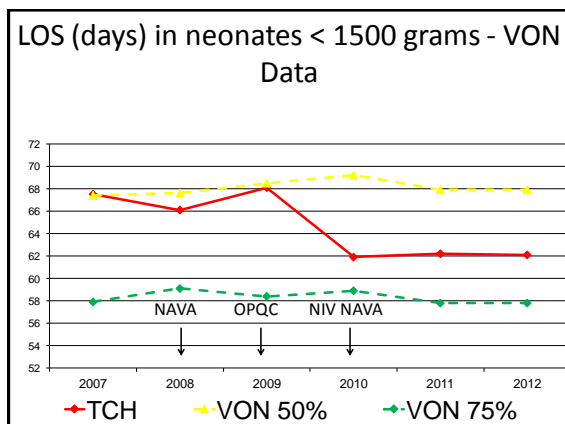
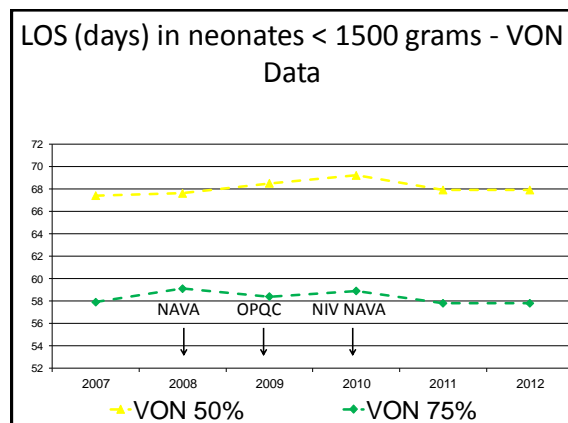
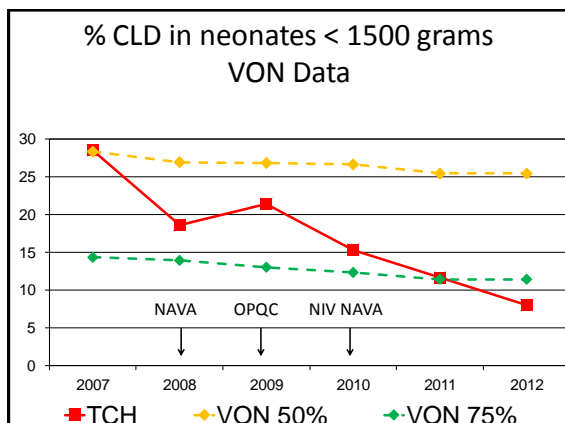
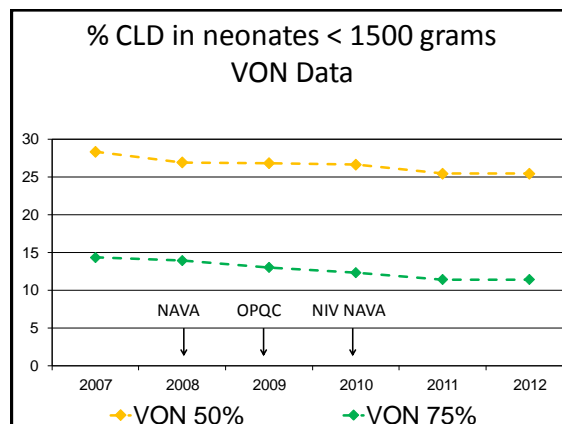
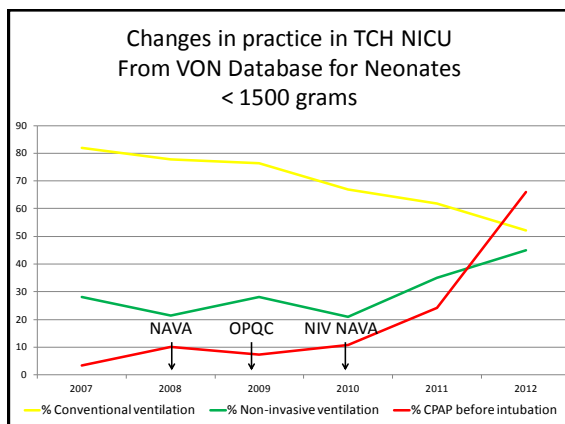
- Feb 2008 – moved into the new NICU
- May 2008 – NAVA
- 2009 – OPQC collaborative – line infection
- July 2010 – NIV NAVA

### % Late infection in neonates < 1500 grams - VON Data



### % Late infection in neonates < 1500 grams - VON Data





## NAVA WORKS IN NEONATES!

But does it make a difference?

- Large multi-center trials are needed to answer questions if:
  - NAVA prevents intubation or decreases time on ventilators?
  - NAVA decreases the incidence of chronic lung disease?
  - NAVA improves outcomes?