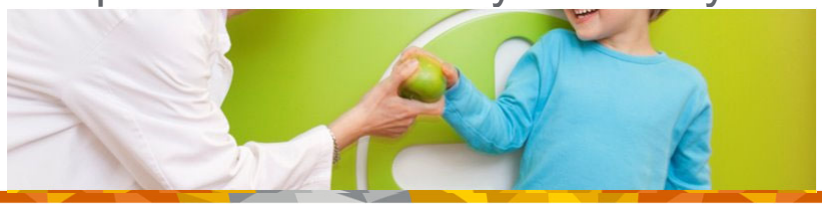
OPTUMHealth™ Education

NRS Nursing Educational Series

Apnea of Prematurity & Infancy



Jamie Rosterman, DO, FAAP

National Medical Director, Neonatal Resource Services | Optum Health Solutions

3/9/22

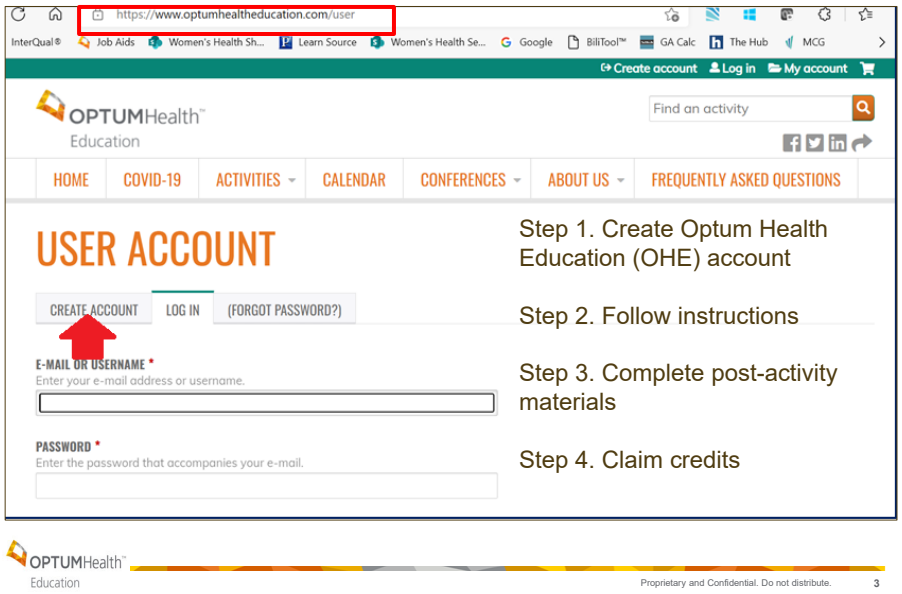
1

Disclosure Information

- No pertinent financial disclosures or conflicts of interest

2

New CME Process



Step 1. Create Optum Health Education (OHE) account

Step 2. Follow instructions

Step 3. Complete post-activity materials

Step 4. Claim credits

3

OPTUMHealth
Education

To complete the post-activity materials and claim credit for today's activity, please visit:

www.optumhealtheducation.com/neonatal-apnea-live

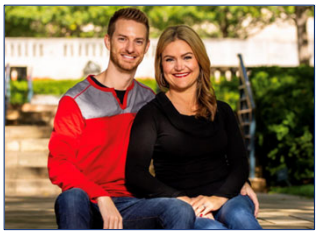
or scan the QR code below:

You will need to login into your OHE account or create an account to proceed. Please follow the instructions under FAQ on the homepage or email moreinfo@optumhealtheducation.com for assistance.

4

A little about me

- Dr. Jamie Rosterman
- NRS Medical Director, HFS cross-trained
- Optum since Oct. 2021
- Practice Neonatology part time at Pediatrix Medical Group of KS
- Clinical interests: ELGAN, Quality improvement, Education
- Reside in Kansas, Missouri
- Married to my best friend – 10 years, 3 kiddos, 1 fur baby


5

Question # 1 - A little about you

How long have you worked for Optum NRS?

- A. Less than 1 year
- B. 1-5 years
- C. 5-10 years
- D. Greater than 10 years

6

Question # 2 - A little about you

What type of degree do you have?

- A. LPN
- B. RN
- C. BSN
- D. APRN

7

Question # 3 – A little about you

What's your favorite past time?

- A. Spending time with family/friends
- B. Traveling
- C. Physical activity
- D. Shopping (including Amazon)
- E. All of the above

8

Question # 4 – A little about you

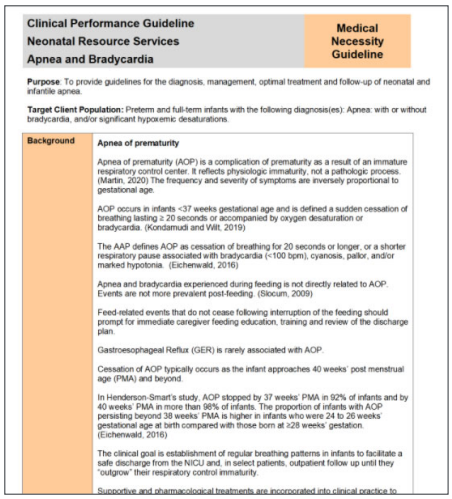
Who is excited to learn about apnea?

- A. Absolutely - Lets do this!
- B. Kinda/sorta/meh
- C. Really? Do I have to?
- D. Definitely not!

9

Objectives/Plan

- Define apnea
- Review pathophysiology
- Discuss different types of apnea
- Differentiate between AOP and apnea of infancy
- Review diagnosis and treatment options
- Sprinkle in some questions and cases
- Highlight the NRS guidelines



Clinical Performance Guideline
Neonatal Resource Services
Apnea and Bradycardia

Medical Necessity Guideline

Purpose: To provide guidelines for the diagnosis, management, optimal treatment and follow-up of neonatal and infantile apnea.

Target Client Population: Preterm and full-term infants with the following diagnosis(es): Apnea: with or without bradycardia, and/or significant hypoxemic desaturations.

Background

Apnea of prematurity

Apnea of prematurity (AOP) is a complication of prematurity as a result of an immature respiratory control center. It reflects physiologic immaturity, not a pathologic process. (Martin, 2020) The frequency and severity of symptoms are inversely proportional to gestational age.

AOP occurs in infants <37 weeks gestational age and is defined a sudden cessation of breathing lasting ≥ 20 seconds or accompanied by oxygen desaturation or bradycardia. (Kondamudi and Witt, 2019)

The AAP defines AOP as cessation of breathing for 20 seconds or longer, or a shorter respiratory pause associated with bradycardia (<100 bpm), cyanosis, pallor, and/or marked hypotonia. (Eichenwald, 2016)

Apnea and bradycardia experienced during feeding is not directly related to AOP. Events are not more prevalent post-feeding. (Slocum, 2009)

Feed-related events that do not cease following interruption of the feeding should prompt for immediate caregiver feeding education, training and review of the discharge plan.

Gastroesophageal Reflux (GER) is rarely associated with AOP.

Cessation of AOP typically occurs as the infant approaches 40 weeks' post menstrual age (PMA) and beyond.

In Henderson-Smart's study, AOP stopped by 37 weeks' PMA in 92% of infants and by 40 weeks' PMA in more than 98% of infants. The proportion of infants with AOP persisting beyond 38 weeks' PMA is higher in infants who were 24 to 26 weeks' gestational age at birth compared with those born at ≥28 weeks' gestation. (Eichenwald, 2016)

The clinical goal is establishment of regular breathing patterns in infants to facilitate a safe discharge from the NICU and, in select patients, outpatient follow up until they "outgrow" their respiratory control immaturity.

Supportive and pharmacological treatments are incorporated into clinical practice to

10

Question # 5 - Audience Response

How long does cessation of breathing last for it to be defined as apnea?

- A. 10 secs
- B. 15 secs
- C. 20 secs or a shorter time period with associated brady or desat
- D. 25 secs or a shorter time period with associated brady or desat

11

Apnea – What is it?

- **Definition**
  - cessation of respiratory airflow/breathing for more than 20 seconds

  or
  - shorter respiratory pause associated with oxygen desaturation or bradycardia (<100 bpm) in infants

Apnea of Infancy	Apnea of Prematurity
• Apnea in an infant older than 37 weeks gestation at birth • Pathologic	• Apnea in an infant younger than 37 weeks gestation at birth • Physiologic

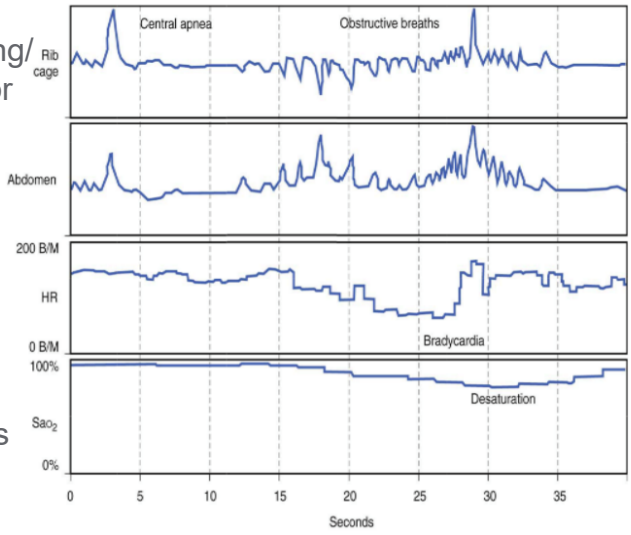
12

Apnea – What is it?

Cessation of breathing/ respiratory air flow for more than 20 secs

Or

Shorter respiratory pause associated with oxygen desaturation or bradycardia in infants



13

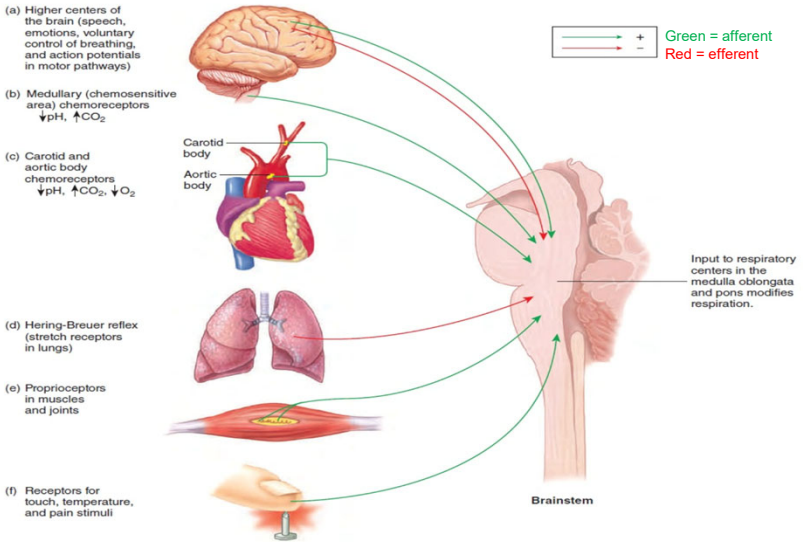
Apnea – Why is it important?

- One of the most common diagnoses in the NICU
  - virtually all infants less than 28 weeks have symptoms
- Potentially harmful
- In term infants, it should be assumed to be pathologic
- Contributes to prolonged hospitalization
- Resolution is a requirement for discharge

Eichenwald E. What's the story today? Apnea, Discharge and the Brain. PPT Presentation. 2017. Neo Conference. Orlando, FL.

14

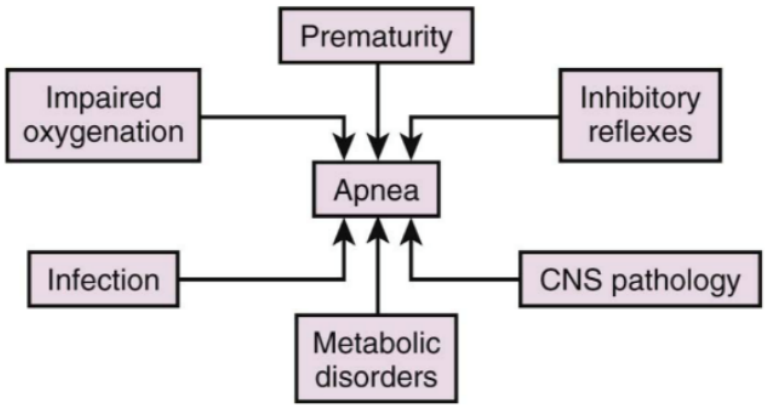
Apnea – Why does it happen?



Erickson E, Dobson N, Hunt CE. Immature control of breathing and apnea of prematurity: the known and unknown. Journal of Perinatology. 2021. 41:2111–2123

15

Apnea – Why does it happen?



Martin RJ, et al. Pathogenesis of apnea in preterm infants. *Journal Pediatrics*. 1986;109:733

16

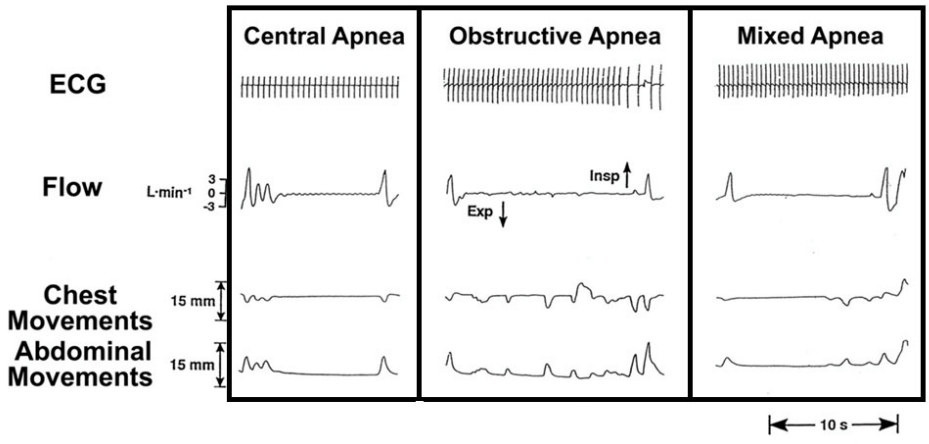
Question # 6 - Audience Response

How many types of apnea are there?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

17

Apnea- What types are there?



Alvaro RE. Control of breathing and apnea of prematurity. Neoreviews.2018. 19(4): e225-e234

18

Apnea – What types are there?

Criteria	Central Apnea	Obstructive Apnea	Mixed Apnea	Periodic Breathing
Duration of breathing cessation	At least 20 secs	At least 20 secs	At least 20 secs	5-10 secs
Respiratory effort	Absent	Present	Absent/present	Absent
Movement of air	Absent	Reduced/absent	Reduced/absent	Reduced/absent
Brady/desat	May occur	May occur	May occur	No

19

Question # 7 - Audience Response

Is Apnea of Infancy Physiologic or Pathologic?

- A. Physiologic
- B. Pathologic

20

Apnea of Infancy

Apnea of Infancy

- Apnea in an infant older than 37 weeks gestation at birth
- Pathologic

21

Apnea of Infancy

- Hypoxic ischemic encephalopathy
- Intrapartum maternal drug exposure
  - Narcotics, magnesium, general anesthesia, illicit drugs
- Early onset sepsis
- Congenital central nervous system malformations
- Ischemic infarction or stroke
- Temporal lobe lesions
- Metabolic causes
  - abnormalities in glucose, electrolytes, calcium
- Feeding related choking/apnea
- Congenital or acquired airway obstruction
  - Laryngomalacia, VCD, phrenic nerve injury, Pierre Robin, Stickler, Treacher Collins, Goldenhar, Crouzon, Downs syndromes
- Congenital central hypoventilation syndrome
- Traumatic brain injury
- Intracranial hemorrhage, and inflammation
  - secondary to pneumonia, sepsis, or meningitis
- BRUE

Patrinos ME, Martin RJ. Apnea in the term infant. Seminars in Fetal and Neonatal Medicine. 2017. 22(4):240-244

22

Apnea of Infancy

- **Diagnosis**
  - Evaluation for underlying etiology of apnea
- **Management**
  - Based on diagnosis
- **Duration of Stay**
  - Depends on diagnosis
  - Up to 3 days of observation may be appropriate in most cases

23

Apnea of Infancy – What do the NRS Guidelines say?

Apnea of infancy

Apnea of infancy, as opposed to AOP, refers to infants > 37 weeks' gestation at the onset of apnea and is likely to be associated with underlying etiology including hypoglycemia, seizures, infection, severe birth asphyxia, intracranial hemorrhage, stroke, drug depression, or anatomic abnormalities and warrant further investigation.

In stable term infants, heart rates as low as 70 beats per minute while sleeping are acceptable. (Benitz, 2015)

Apnea Countdown Prior to Discharge

Term

- An apnea/bradycardia countdown in a term infant should be based on etiology. Up to 3 days observation may be appropriate in the majority of such cases.

24

Case Study # 1

Concurrent Clinical Note with InterQual
CGA: 40.4
CW: 2953
Brief History: Ex 39.4 wkr, BW 3000 g, C/S 3/1. H/O RDS, R/O Sepsis d/t chorioamnionitis, Stridor, Apnea, Congenital Laryngomalacia.
Current Clinical Status: 3/7 Wt 2878 (+27). RA, OC. DBF/PO ad lib feeds, nippling 159 ml/kg/d; parents working on feeds. Rx for Prevacid called in to pharmacy. IVF d/c 3/2. Last gavage 3/2
3/8 remains in RA (3/2), in OC. DBF/PO ad lib feeds EBN/Sim Sensitive. Hoarse when crying, mild intermittent stridor. Last Apnea 3/1, infant blue at rest, stim required; no further events. Passed car seat challenge.
Discharge order on chart.
Medications: Updated. Please see Medication Tab.

Criteria Status: Criteria Not Met
Criteria Product: LOC: Acute Pediatric
Criteria Subset: Nursery
Criteria Version: InterQual® 2021, Oct. 2021 Release
Review Summary:
Recommended Level of Care: Home
Discharge Review: MET
Episode Day 2X, One:
SPECIAL CARE LEVEL II, One:
Responder, discharge expected today if clinically stable last 24h, All:
Feeding and elimination within acceptable limits with current nutritional route
Normothermia maintained in open crib ≥ 24h
Parent or caregiver demonstrates ability to provide care and, Both:
Discharge teaching complete
Home environment safe or alternative living arranged
Complication or comorbidity, One:
Complication or comorbidity and clinically stable for discharge, ≥ One:
Apnea or bradycardia, no clinically significant event > 5d or home monitoring arranged

Discharge, Level of Care, ≥ One:
HOME, Both:
Level of care appropriateness, Both:
Home environment safe and accessible
Parent or caregiver demonstrates ability to manage care
Nursery/NICU discharge planning, All:
Provide comprehensive written discharge and teaching instructions
Medication reconciliation
Followup care planned
Identify and address transportation needs

NRS Barriers to Discharge: None
Discharge Planning Update: Discharge 3/8.
UM Action Plan: Refer to NRS MD for Extended LOS/Delay in Discharge. Notify facility of potential for adverse determination, offer of P2P. NRS Family Advocacy for family outreach and support.
Anticipated Date of Discharge: 03/05/2022
No Days Certified Past: 03/04/2022

OPTUMHealth™ Education

Case Study # 1

- **Key Charting Items**
- Date of last event
- Severity of event (SpO2, HR)
- Duration of event (secs)
- What infant was doing during that time
- Intervention required
- How long the facility plans to monitor?

OPTUMHealth™ Education

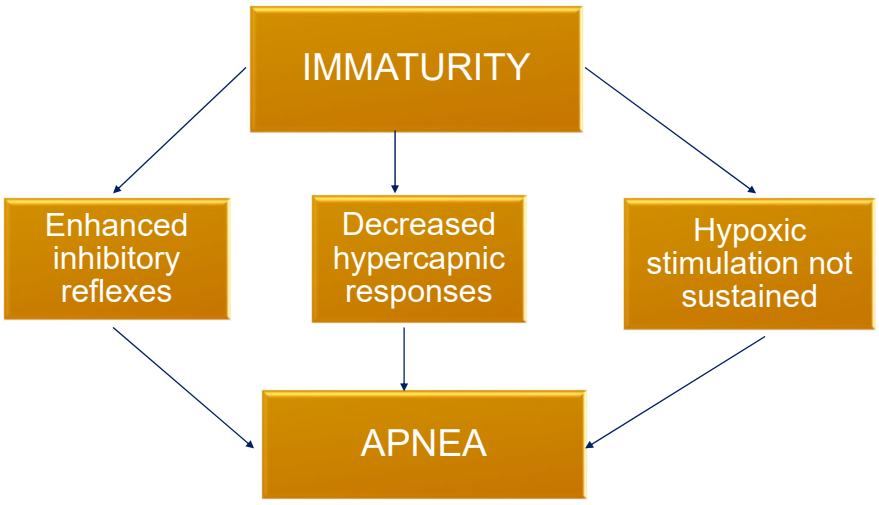
Apnea of Prematurity

Apnea of Prematurity

- Apnea in an infant younger than 37 weeks gestation at birth
- Physiologic

27

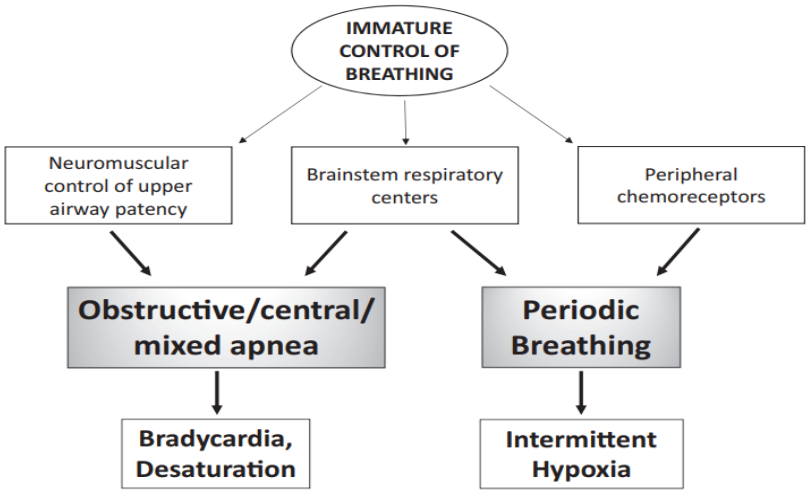
Apnea of Prematurity – Why does it happen?



Martin RJ. Apnea of Prematurity. PPT Presentation. APP NeoPrep Board Review. San Diego, CA. 2019.

28

Apnea of Prematurity– Why does it happen?

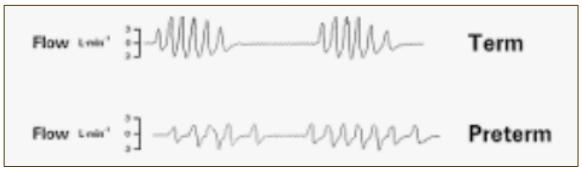


Erickson E, Dobson N, Hunt CE. Immature control of breathing and apnea of prematurity: the known and unknown. Journal of Perinatology (2021) 41:2111–2123

29

Periodic Breathing – What is it?

- **Definition**
  - Pattern of alternating breaths and brief respiratory pauses that are approx. 5-10 secs in duration
  - May be accompanied by modest desats and bradys
  - Absent in the first few days of life, becomes frequent at 2-4 weeks of age
  - Resolves typically by 44 weeks PMA or 6 months of age
  - Occurs predominantly during quiet sleep



Weintraub Z, Cates D, et al. The morphology of periodic breathing in infants and adults. Respiratory Physiology. 2001. 127 (2-3); 173-814

30

Treatment – What can be done?

Measures to reduce risk

- Environmental temperature control
- Head and neck in neutral position, avoiding hyperextension or hyperflexion
- Maintain nasal patency
- Oxygen supplementation

Non-invasive respiratory support

- Humidified nasal cannula
- CPAP
- NIPPV

OPTUMHealth Education

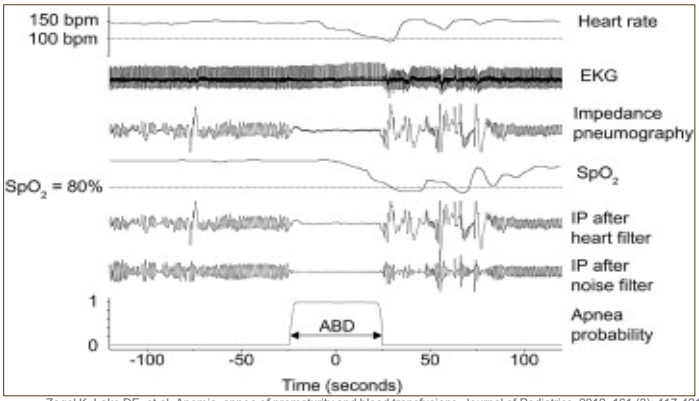
Martin R, Management of apnea of prematurity. In. Garcia-Prats JA, Mallory GB ed. UpToDate. 2022. Accessed 3/4/22

 29

31

Diagnosis – How do you diagnose AOP?

- Cardiorespiratory and pulse oximetry monitors
  - Cessation of respiratory airflow/breathing for more than 20 seconds or shorter respiratory pause assoc. with oxygen desaturation or bradycardia



Zagol K, Lake DE, et al. Anemia, apnea of prematurity and blood transfusions. Journal of Pediatrics. 2012. 161 (3); 417-421

OPTUMHealth Education

 32

32

Pneumocardiograms/ Multi-Channel Pneumograms

- Multi-channel Pneumogram: recording of respiration and HR
  - 4 channel pneumogram: measures of respiration and HR
  - 5 channel pneumogram: 4 channel + pulse oximetry
  - 6 channel pneumogram: 5 channel + pH probe monitoring
  - Grossly distinguishes between central and obstructive apnea
- Controversy in usefulness, result interpretation, normative data

Treatment Criteria	Clinical evidence supports the following: Diagnosis • Apnea and bradycardia are diagnosed clinically based on the definitions above. • Pneumocardiograms (PCGs) are not recommended in the management of apnea because they have a high false-positive rate, cannot predict with accuracy the occurrence of severe apnea or death, and are not beneficial in identifying which patients should be discharged with a home monitor. (AAP, 2008)

Ginsburg, D, Maken, K, Deming, D, et al. Etiologies of apnea of infancy. Pediatric Pulmonology. 2020; 55: 1495– 1502.

OPTUMHealth™ Education

GERD and Apnea

- Controversial
- Multiple studies have failed to support relationship between GERD and apnea
  - Despite strong physiologic evidence that stimulation of laryngeal afferents elicit central apnea and laryngeal adduction
- GERD does not prolong respiratory pauses and cause apnea
- Anti-reflux meds should not be used to treat apnea

PEDIATRICS®

Nov 2005
VOL. 116
NO. 5

Apnea Is Not Prolonged by Acid Gastroesophageal Reflux in Preterm Infants

Juliann M. Di Fiore, BSEE*; Marina Arko, RN, BSN*; Meghan Whitehouse, BS‡; Amy Kimball, MD§; and Richard J. Martin, MD||

ABSTRACT. *Objective.* To examine the temporal relationship between apnea and gastroesophageal reflux (GER) and to assess the effect of GER on apnea duration. *Methods.* A total of 119 preterm infants underwent 12-hour cardiorespiratory monitoring studies using respiratory inductance plethysmography, heart rate, oxygen saturation (SaO_2), and esophageal pH. The studies were scored for GER (pH <4 for ≥5 seconds) and apnea ≥15 seconds or ≥10 seconds that occurred within 30 seconds of GER. Apnea ≥10 seconds was used to assess whether GER would prolong apnea duration. *Results.* There were 6255 episodes of GER. Only 1% of GER episodes were associated with apnea ≥15 seconds, and there was no difference in apnea rate before, during, or after GER. There was also no difference in rate of apnea ≥10 seconds before versus during GER; however, there was a decrease in apnea rate immediately after GER. The presence of GER during apnea did not prolong apnea duration, and GER had no effect on the lowest SaO_2 or heart rate during apnea. *Conclusion.* There is no evidence of a temporal relationship between acid-based GER and apnea in preterm infants. In addition, GER does not prolong apnea duration and does not exacerbate the resultant decrease in heart rate and SaO_2. *Pediatrics* 2005;116:1059–1063; *apnea, gastroesophageal reflux, neonates.*

ABBREVIATIONS. GER, gastroesophageal reflux; SaO_2, oxygen saturation; ANOVA, analysis of variance.

From the *Department of Pediatrics, University Hospitals of Cleveland, Case Western Reserve University, Cleveland, Ohio; ‡Shaker Heights, Ohio; §Salt Lake City, Utah; and ||Departments of Pediatrics, Reproductive Biology, Physiology, and Biophysics, Case Western Reserve University School of Medicine, and Division of Neonatology, Rainbow Babies & Children's Hospital, Cleveland, Ohio.
Accepted for publication Jan 24, 2005.
doi:10.1542/peds.2004-2757
No conflict of interest declared.
Reprint requests to (J.M.D.F.) Department of Pediatrics, Division of Neonatology, Rainbow Babies & Children's Hospital, 11100 Euclid Ave, Cleveland, OH 44106. E-mail: jmd3@po.cwru.edu
PEDIATRICS (ISSN 0031 4005). Copyright © 2005 by the American Academy of Pediatrics.

Gastroesophageal reflux (GER) and apnea are 2 clinical events that both occur commonly in the premature infant population. Early studies have suggested a relationship between GER and apnea[1–4] in term and preterm infants, possibly contributing to widespread use of antireflux medications to treat apnea of prematurity. More recent studies have consistently failed to support this relationship[5–9]; however, the use of antireflux medications in the treatment for apnea of prematurity remains widespread.

Although a significant overall temporal relationship between apnea and GER has not been established, these same studies have shown that up to 19% of apneic episodes may occur concurrently with GER.[5,7,10] It is unclear, in such instances, whether short respiratory pauses may be prolonged when accompanied by GER, thereby becoming clinically significant events.

Therefore, the purpose of this study was to examine the temporal relationship between apnea and GER in a large group of premature infants to assess the effect of GER on apnea duration. We hypothesized that when GER and apnea do coincide, GER would prolong the duration of apnea. If short respiratory pauses are indeed significantly prolonged when accompanied by GER, then this might justify the use of antireflux medications in the treatment of such episodes of apnea.

METHODS

We reviewed 12-hour overnight bedside cardiorespiratory monitoring studies in a population of 119 premature infants at Rainbow Babies & Children's Hospital recorded over a period of 5 years (1998–2002) with demographic data presented in Table 1. Infants who were enrolled in the study (97% of whom were <1500 g at birth) were of comparable weight and gestational age as infants who were <1500 g at birth and were not enrolled in the study during the same period (1019 ± 301 g vs 1060 ± 273 g and 28 ± 2 weeks vs 28 ± 3 weeks, infants in the study versus infants not enrolled in the study, respectively). All infants were referred for an overnight bedside cardiorespiratory monitoring study by

PEDIATRICS Vol. 116 No. 5 November 2005 1059

OPTUMHealth™ Education

Question # 8 - Audience Response

What are the primary methods of treatment for apnea of prematurity?

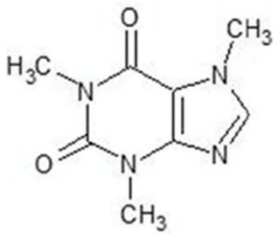
- A. General measures that reduce the risk of apnea
- B. Non-invasive respiratory support
- C. Caffeine
- D. All the above

35

Treatment – Methylxanthine

Mechanism of Action

- Stimulate respiratory neural output
- Blockade of inhibitory Adenosine A_1R
- Excitation of respiratory neural output
- Blockade of A_2R on GABA neurons



Caffeine

Options

- Theophylline
- Caffeine

36

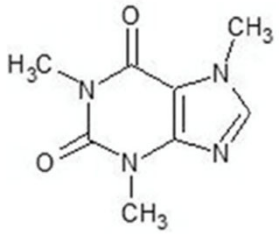
Treatment – Caffeine

Side Effects

- Tachycardia
- Feeding intolerance

Duration

- Longer half life: 60-100 hours
- Clearance: 7-10 days



Caffeine

When to Stop

- No trials have addressed when to stop
- AAP: Discontinuation should not delay discharge

OPTUMHealth Education

Martin R, Management of apnea of prematurity. In. Garcia-Prats JA, Mallory GB ed. UpToDate. 2022. Accessed 3/4/22

 37

37

Treatment – Caffeine Current Studies

	Moderately preterm Infants with Caffeine at Home for Apnea (MoCHA) Trial	Intermittent Hypoxia and Caffeine in Infants Born Preterm (ICAF) Trial
Purpose	Study effects of caffeine in infants with resolved apnea	Study effects of caffeine on intermittent hypoxia
Primary Outcome	Number of days of hospitalization	Extent of intermittent hypoxia (number of secs below 90%) until 42.6 weeks
Number	800 participants	220 participants
Design	Randomized controlled trial	Randomized, double-blinded, placebo controlled, trial
Details	Randomized to caffeine or placebo when planned to discontinue caffeine. Continue caffeine or placebo for 28 days after discharge.	Caffeine until 36.5 weeks then randomized to caffeine until 42.6 weeks or placebo. Pulse ox continued for 1 week after stopping. MRI Brain x 2. Cytokine measurements.
Study Start	February 2019	January 2019
Completion	October 2023	May 2022

38

Question # 9 - Audience Response

How long does caffeine typically last in an infant's system after discontinuation?

- A. 3 days
- B. 5 days
- C. 7 days
- D. 14 days

39

Case Study # 2

Concurrent Clinical Note with InterQual
CGA: 34.5
CW: 1750
Brief History: Former 32.0wk, BW 1320g. RDS requiring NCPaP; weaned to RA 2.13. Caffeine bolus/maint. Initiated 2.11; Sepsis w/u: No abx; Hx of hypoglycemia, s/p D10W x1/resolved. Enteral feeds initiated 2.10. TPN d/c'd 2.13. Photo tx (2.12-2.14). Poss. S trait.

Current Clinical Status: (3.01) Incubator(temp. not provide). RA; no events last 24hrs. NG/cue-based feeds 24cal EBM @ 38cc q 3hrs.; Completed 0/5 attempts for 22% of total volume last 24 hrs.; ST consulting. Caffeine dc'd 2.23; Plan to follow x14 days PTD(3.09).

Medications: Updated. Please see medication tab.

Criteria Status: Special Care Level II Met
Criteria Product: LOC: Acute Pediatric
Criteria Subset: Nursery
Criteria Version: InterQual® 2021, Oct. 2021 Release
Review Summary:
Episode Day 2X, One:
SPECIAL CARE LEVEL II, One:
Partial responder, not clinically stable for discharge and requires continued stay, ≥ One:
Nutrition management or hydration, ≥ One:
Tube feeding ≥ 50%(0.50) of daily caloric requirement

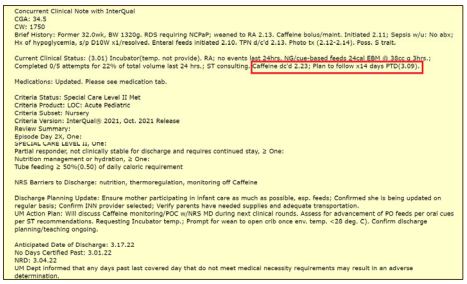
NRS Barriers to Discharge: nutrition, thermoregulation, monitoring off Caffeine

Discharge Planning Update: Ensure mother participating in infant care as much as possible, esp. feeds; Confirmed she is being updated on regular basis; Confirm INN provider selected; Verify parents have needed supplies and adequate transportation.
UM Action Plan: Will discuss Caffeine monitoring/POC w/NRS MD during next clinical rounds. Assess for advancement of PO feeds per oral cues per ST recommendations. Requesting Incubator temp.; Prompt for wean to open crib once env. temp. <28 deg. C). Confirm discharge planning/teaching ongoing.

Anticipated Date of Discharge: 3.17.22
No Days Certified Past: 3.01.22
NRD: 3.04.22
UM Dept informed that any days past last covered day that do not meet medical necessity requirements may result in an adverse determination.

40

Case Study # 2



Concurrent Clinical Note with InterQual
CGA: 34.5
CW: 1750
Brief History: Former 32.0wk, BW 1320g. RDS requiring NCPaP; weaned to RA 2.13. Caffeine bolus/maint. Initiated 2.11; Sepsis w/u: No abx; Hx of hypoglycemia, s/p D10W x1/resolved. Enteral feeds initiated 2.10. TPN d/c'd 2.13. Photo tx (2.12-2.14). Poss. S trait.

Current Clinical Status: (3.01) Incubator(temp. not provide). RA; no events last 24hrs. NG/cue-based feeds 24cal EBM @ 38cc q 3hrs.; Completed 0/5 attempts for 22% of total volume last 24 hrs.; ST consulting. Caffeine dc'd 2.23; Plan to follow x14 days PTD(3.09).

Medications: Updated. Please see medication tab.

Criteria Status: Special Care Level II Met
Criteria Product: LOC: Acute Pediatric
Criteria Subset: Nursery
Criteria Version: InterQual® 2021, Oct. 2021 Release
Review Summary:
Episode Day 2X, One:
SPECIAL CARE LEVEL II, One:
Partial responder, not clinically stable for discharge and requires continued stay, 2 One:
Nutrition management or hydration, 2 One:
Tube feeding ≥ 50%(0.50) of daily caloric requirement

NRS Barriers to Discharge: nutrition, thermoregulation, monitoring off Caffeine

Discharge Planning Update: Ensure mother participating in infant care as much as possible, esp. feeds; Confirmed she is being updated on regular basis; Confirm INN provider selected; Verify parents have needed supplies and adequate transportation.
UM Action Plan: Will discuss Caffeine monitoring/POC w/NRS MD during next clinical rounds. Assess for advancement of PO feeds per oral cues per ST recommendations. Requesting Incubator temp.; Prompt for vaan to open crib once env. temp. <28 deg. C). Confirm discharge planning/teaching ongoing.

Anticipated Date of Discharge: 3.17.22
No Days Certified Past: 3.01.22
NRD: 3.04.22
UM Dept informed that any days past last covered day that do not meet medical necessity requirements may result in an adverse determination.

- **Key Charting Items**
- Date of last caffeine dose
- How long the facility plans to monitor?
- Date of last event
- Severity of event (SpO2, HR)
- Duration of event (secs)
- What infant was doing during that time
- Intervention required

41

Caffeine– What do the NRS Guidelines say?

Medication Therapy

- Caffeine is the only FDA approved treatment for AOP and is the preferred drug of choice for this indication particularly due to its long half-life, wide therapeutic index and lack of need to monitor drug level. Caffeine is generally considered very safe. Although caffeine toxicity can occur at higher doses, routine monitoring of caffeine levels has not been recommended. Theophylline is not recommended due to its side effects including the increased risk of seizures, tachycardia and feeding intolerance.
- It is recommended to discontinue caffeine once the infant is apnea free for 5-7 days off positive airway pressure (defined by high-flow nasal cannula or CPAP) or by 33-35 weeks' PMA, whichever comes sooner. (Eichenwald, 2016) (Please refer to clinical evidence section for ongoing clinical trial evaluating caffeine post-discharge. (ICAF clinical trial NCT03321734))
- Caffeine has shown to have both short-term and long-term pulmonary benefits, facilitating transition from invasive to non-invasive respiratory support, reducing intermittent hypoxia events and decreasing bronchopulmonary dysplasia (BPD). (Schmidt, 2006, Dobson, 2016)
- When caffeine is used to treat apnea of prematurity, discontinuation needs to occur prior to discharge with an observation period of up to 7 days to demonstrate cardio-respiratory stability.
- An observation period of 5 days after discontinuing caffeine is a reasonable timeframe to demonstrate cardio-respiratory stability before safe hospital discharge.

42

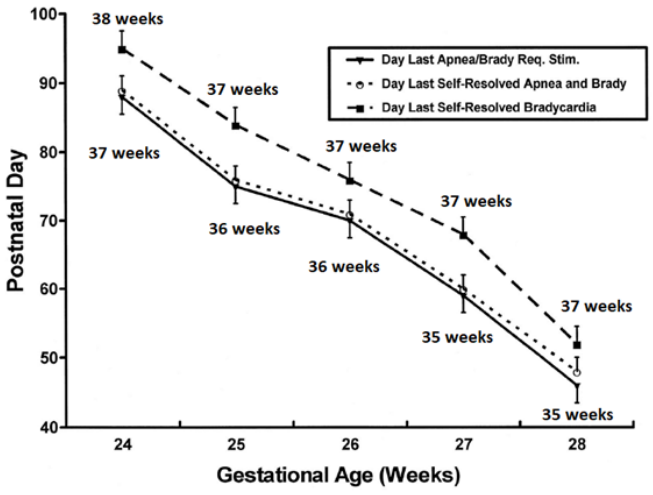
Question # 10 - Audience Response

When does apnea of prematurity typically resolve?

- A. 34 weeks PMA
- B. 36 weeks PMA
- C. 38 weeks PMA
- D. 40 weeks PMA
- E. 44 weeks PMA

43

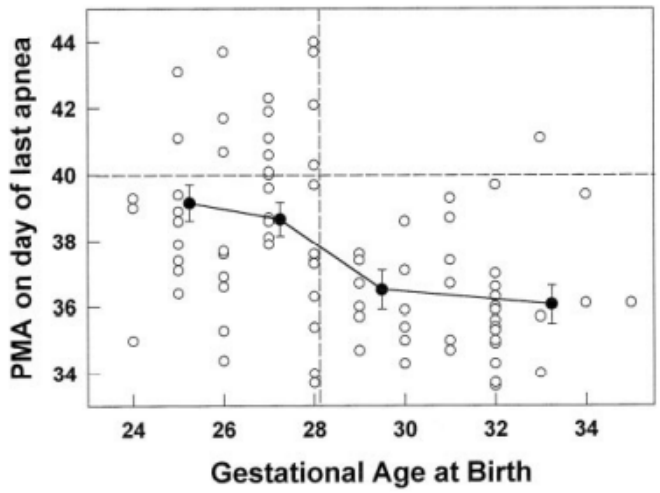
Discharge – When does AOP resolve?



Eichenwald E. What's the story today? Apnea, Discharge and the Brain. PPT Presentation. 2017. Neo Conference. Orlando, FL. – Data 1997

44

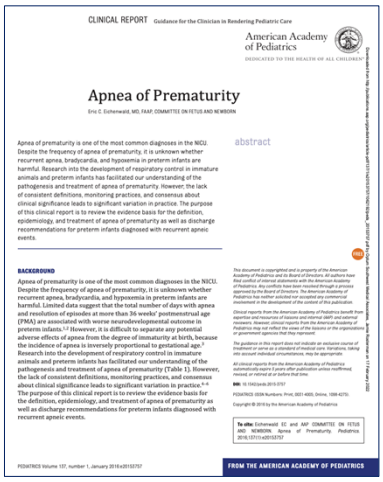
Discharge – When does AOP resolve?



Darnall RA, Kattwinkle J. et al. Margin of safety for discharge after apnea in preterm infants. Pediatrics.1997.100(4):795-801

45

Discharge – What is a safe interval for discharge?



CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

Apnea of Prematurity

abstract

BACKGROUND

FROM THE AMERICAN ACADEMY OF PEDIATRICS

- A clinically significant apnea event–free period before discharge of 5 to 7 days is commonly used
- A longer period may be suitable for infants born < 26 weeks' gestation.
- Specific event-free period may need to be individualized for some infants depending on GA at birth and nature and severity of recorded events

Eichenwald EC, Watterberg KL, et al. COMMITTEE ON FETUS AND NEWBORN. Apnea of Prematurity. *Pediatrics* January 2016; 137 (1): e20153757. 10.1542/peds.2015-3757

46

ABD Monitoring– What do the NRS guidelines say?

Apnea Countdown Prior to Discharge

Term

- An apnea/bradycardia countdown in a term infant should be based on etiology. Up to 3 days observation may be appropriate in the majority of such cases.

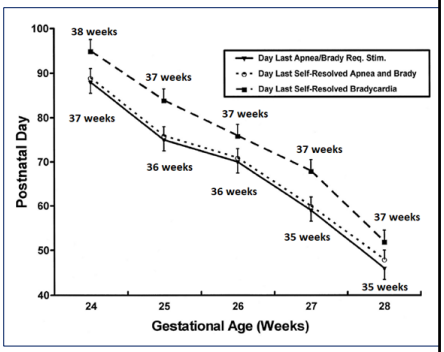
Preterm

- An apnea/bradycardia "countdown" of up to 5 days for a preterm infant is a reasonable period to demonstrate cardio-respiratory stability before a safe hospital discharge. (Coughlin, 2020)
- Up to 7 days is a reasonable period of monitoring after cessation of caffeine. (Coughlin, 2020)
- There may be select infants born at ≤26 weeks' gestation that warrant a longer observation period prior to discharge . (Eichenwald, 2016)
- The period of countdown following events should be based on the frequency and severity of the events and a reasonable countdown may be 3-7 days. (Chandrasekharan, 2018)
- In convalescing preterm infants, brief isolated self-limited bradycardia occurrences and feed-related events that cease with interruption of the feeding are not indications to delay discharge. (Eichenwald, 2016) Extended stay for a brief observation period may be warranted based on the degree and duration

47

Home apnea/cardiorespiratory monitors

- Home monitoring of respiratory and heart rates with event recordings
- Typical settings: Alarms if apnea greater than 20 secs or heart rate less than 80bpm
- For infants with discharge before 38 weeks PMA, discharged home on caffeine or certain medical conditions
  - BPD, neurologic or metabolic disorders, pertussis, NAS on narcotics, GERD,

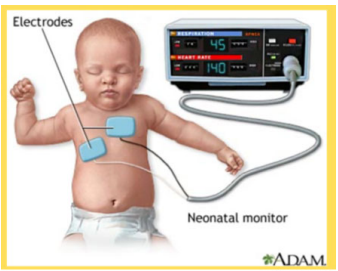


Eichenwald E. What's the story today? Apnea, Discharge and the Brain. PPT Presentation. 2017. Neo Conference. Orlando, FL.

48

Home apnea/cardiorespiratory monitors

- Typical settings: Alarms if apnea greater than 20 secs or heart rate less than 80bpm
- Interpretation by physician helps determine type of apnea and when to discontinue monitor
- Continued up until 43 weeks PMA or event free for 2 weeks, whichever comes later



Eichenwald E. What's the story today? Apnea, Discharge and the Brain. PPT Presentation. 2017. Neo Conference. Orlando, FL.

49

Home monitors – What do the NRS guidelines say?

Home Cardiorespiratory Monitoring

- Home cardiorespiratory monitoring might be considered for:
  - infants discharged home on caffeine.
  - Infants who continue to have self-resolved apneic events (Eichenwald, 2016)
  - Infants who have experienced an ALTE and who are technology-dependent (ventilator, tracheostomy with collar, gastrostomy, etc.), have unstable airways, have rare medical conditions affecting regulation of breathing, or have symptomatic chronic lung disease.
- Routine home cardiorespiratory monitoring for preterm infants with resolved apnea of prematurity is not recommended. (Eichenwald, 2016)
- An association between AOP and an increased risk for sudden infant death is not supported in the medical literature. (Eichenwald, 2016) Due to lack of medical evidence, home monitoring to prevent SIDS is not recommended.
- CPR, home monitoring equipment training, caregiver education, discharge teaching and rooming-in for parent(s)/caregivers(s) are recommended prior to discharge of infants with a home monitor.

50

Case Study # 3

Concurrent Clinical Note with InterQual
CGA: 36.0
CW: 2170 (+17)

Brief History: is an ex-32.3wkr/BW 1660g adm for prematurity, RDS, temp instability, thrombocytopenia (Plt 55K), hypoglycemia (BS 32, 33 > D10 bolus x 1 given) and feeding problems r/t prematurity. CPAP > RA 1/9. MOB Covid (+) at delivery. Infant Covid (-) x 2.
Current Clinical Status: (1/31) OC, RA, FEBM/Neosure 24kcal po ad lib; last NG feed 1/26. Reported A/B event < 20 sec w/ HR 69 on 1/27 which required stim.
Medications: Updated to reflect all medication information provided by facility, not all details provided. Please see medication tab.

Criteria Status: Special Care Level II Met
Criteria Product: LOC: Acute Pediatric
Criteria Subset: Nursery
Criteria Version: InterQual® 2021, Oct. 2021 Release

Review Summary:

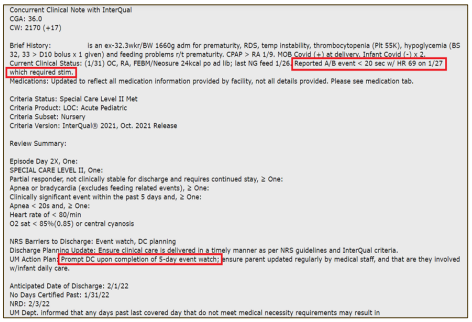
Episode Day 2X, One:
SPECIAL CARE LEVEL II, One:
Partial responder, not clinically stable for discharge and requires continued stay, ≥ One:
Apnea or bradycardia (excludes feeding related events), ≥ One:
Clinically significant event within the past 5 days and, ≥ One:
Apnea < 20s and, ≥ One:
Heart rate of < 80/min
O2 sat < 85%(0.85) or central cyanosis

NRS Barriers to Discharge: Event watch, DC planning
Discharge Planning Update: Ensure clinical care is delivered in a timely manner as per NRS guidelines and InterQual criteria.
UM Action Plan: Prompt DC upon completion of 5-day event watch; ensure parent updated regularly by medical staff, and that are they involved w/infant daily care.

Anticipated Date of Discharge: 2/1/22
No Days Certified Past: 1/31/22
NRD: 2/3/22
UM Dept. informed that any days past last covered day that do not meet medical necessity requirements may result in

51

Case Study # 3



- **Key Charting Items**
- Date of last event
- Severity of event (SpO2, HR)
- Duration of event (secs)
- What infant was doing during that time
- Intervention required
- How long the facility plans to monitor?

52

When to escalate to NRS Medical Director?

Medical Director Escalation	Medical Director escalation is needed for the following:

- When the infant has a countdown of greater than 7 days after discontinuation of caffeine.
- When a preterm infant has a countdown of greater than 5 days for apnea/brady/desaturation events.
- When a term infant has a length of stay more than 3 days following resolution of apnea.
- When the infant has self-limited bradycardia or desaturation episodes that prolong length of stay.
- When the infant has feeding related events and resolution with interruption of feedings that is extending hospital stay.
- When hospital stay is prolonged for an asymptomatic patient due to a pneumocardiogram study that is interpreted as abnormal.

53

Take Home Pointers…

- More details about the ABD events are better ☺
  - Date of last event, Severity of event (SpO2, HR), Duration of event (secs), What infant was doing during that time, Intervention required, How long the facility plans to monitor?
- Apnea in a term infant is pathologic
  - length of hospitalization should be determined by evaluation and management
- Apnea of prematurity typically resolves by 37 weeks in infant greater than 28 weeks at birth and term equivalent or longer in infants born less than 28 weeks

54

Take Home Pointers…

- Caffeine takes approx. 7 days to become sub-therapeutic
- Pneumocardiograms should not prolong hospital stay
- Duration of monitoring for ABD events prior to discharge depends on gestational age at birth, frequency and severity of events
  - Typical 5-7 day monitoring period
  - Infant born less than 26 weeks may warrant a longer period

55

References

- Eichenwald EC, Watterberg KL, et al. COMMITTEE ON FETUS AND NEWBORN. Apnea of Prematurity. *Pediatrics.* 2016; 137 (1): e20153757. 10.1542/peds.2015-3757
- Martin RJ, et al. Pathogenesis of apnea in preterm infants. *Journal Pediatrics.* 1986;109:733
- Eichenwald E. What's the story today? Apnea, Discharge and the Brain. PPT Presentation. 2017. Neo Conference. Orlando, FL.
- Erickson E, Dobson N, Hunt CE. Immature control of breathing and apnea of prematurity: the known and unknown. *Journal of Perinatology*. 2021. 41:2111–2123
- Alvaro RE. Control of breathing and apnea of prematurity. *Neoreviews*. 2018. 19(4): e225-e234
- Patrinos ME, Martin RJ. Apnea in the term infant. *Seminars in Fetal and Neonatal Medicine*. 2017. 22(4):240-244
- Weintraub Z, Cates D, et al. The morphology of periodic breathing in infants and adults. *Respiratory Physiology*. 2001.127 (2-3); 173-814
- Martin R, Management of apnea of prematurity. Garcia-Prats JA, Mallory GB ed. *UpToDate*. 2022. Accessed 3/4/22
- Darnall RA, Kattwinkle J. et al. Margin of safety for discharge after apnea in preterm infants. *Pediatrics*.1997.100(4):795-801

56

Any Questions?

57

OPTUMHealth Education

58