Is It OK to Be Little?
How Can You Be Sure I Am Safe?

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Disclosures

• I have no financial relationships to disclose or Conflicts of Interest to resolve
• Discussion of any specific car seat or brand is purely informative, not meant as an endorsement of that brand.
• This presentation will not involve discussion of unapproved or off-label, experimental or investigational use

http://vendratattoostyle.blogspot.com/2011/03/apnea-monitor-for-infant.html
When is a baby ready for discharge?

• Advances in medical technology and neonatal care
  – 10% of babies in the US are born prematurely each year \textit{(March of Dimes)}
  – Sicker, smaller babies are surviving to discharge
    • Birth weights ≤ 1lb
    • 16-17 weeks before due date
    • (23-24 weeks gestational age)

• Babies are going home at smaller weights and lower corrected gestational ages

https://www.elitereaders.com/preemie-babies-smiling-happy/
HOW DO WE SEND PREMATURE BABIES HOME?

In car seats, of course!

Car Seats for our Smallest Patients

• **Proper fit**
  – Preterm, low birth weight infants often fit poorly in standard car seats\(^1\)
  – Small size, low tone, low strength

\(^1\)Bull, *Pediatrics* (1985)
Preterm, low birth weight infants often fit poorly in standard car seats...

**Low birth weights**

*Too small for standard car seats*

![Image of a preterm infant in a car seat]


**Low tone and poor head control**

*Easily flop forward*

![Image of a preterm infant in a car seat]

https://fn.bmj.com/content/102/2/F136
Safe Fit for Small Babies

• All infants, regardless of size, must travel in a child-restraint system that meets requirements set by Federal Motor Vehicle Safety Standard (FMVSS) 213\(^1\)

• Most rear-facing car safety seats were designated by manufacturers for use by infants weighing \(\geq 5\) lb
  – Premature infants often \(< 5\) lbs at discharge!!
  – No specific minimum weight for discharge per American Academy of Pediatrics (AAP)

    • This may differ at each hospital – check with your Pediatrics/NICU team for specific policy

\(^{1}\)Bull, *Pediatrics* (2009)
Safe Fit for Small Babies

• Preemie car seats -> consider discharge weight

• 4 lbs at discharge
  – More than 50 different varieties

• Less than 4 lbs at discharge
  – Combi
    • Shuttle -> “Birth” to 35lbs (no weight minimum)
    • Coccoro -> 3lbs to 33lbs
  – Evenflo Essential LiteMax Rear Facing Only Car Seat
    • Per company approved for 3lbs to 35lbs in August 2019
Safe Fit for Small Babies

• **Car Beds** -> allow flat travel

• **Use ONLY** if there is a medical need to lay flat
  – If a baby CAN tolerate the semi-upright position, they should ride in a rear-facing car seat -> BEST crash protection
  – Do not use just to discharge a small baby who can *medically* tolerate a car seat

• Check minimum weight:
  – 5 lbs -> *Dream Ride Car Bed (Cosco)*
  – 4.5 lbs -> *Hope Car Bed (Merritt)*
  – **4 lbs or less** -> *Angel Ride (birth to 9 lbs)*
    • Angel Guard through 2018 -> Merritt
    • Recall in November 2019 (*Harness*)
Car Seats for our Smallest Patients

• **Proper fit**
  – Preterm, low birth weight infants often fit poorly in standard car seats\(^1\)
  – Small size, low tone, low strength

• **Safe breathing**
  – SIDS with no other known extrinsic risk factors (such as sleeping prone, bed-sharing, soft bedding, or having their head-covered) found 27% had been put to sleep in a semi-upright car/bouncy seat.\(^2\)
  – Study evaluating infant deaths in sitting devices found that 63% occurred in car seats, with <10% were being used as directed.\(^3\)

Car Seat Tolerance Screen (CSTS)

- Period of observation in car seat prior to discharge to monitor for:
  - Breathing pauses (apnea)
  - Oxygen drops (desaturations)
  - Heart rate drops (bradycardia)
  - Unsafe breathing (respiratory distress)

- Infants born:
  - Prematurely
  - Low birth weight <2.5kg, ~5.5lbs
  - Other high risk medical conditions

- 90-120 minutes, or duration of car ride home, whichever is longer

https://grahamsfoundation.org/seven-tips-for-car-seat-safety-with-your-nicu-grad/
Suggested Failure Criteria\textsuperscript{1,2}

• Apnea >20 seconds
• Heart Rate <80 beats per minute for >10-20 seconds
• Oxygen saturation <90% for >10-20 seconds
• Respiratory distress not improved with proper positioning

• Canadian Paediatric Society:
  – 2016 – no longer recommends routine CSTS\textsuperscript{3}

\textsuperscript{1,2}Davis, Academic Pediatrics (2013 and 2020); \textsuperscript{3}Narvey MR, \textit{Paediatr Child Health} (2016)
Figure 2. CSTS Failure SpO₂ and Duration

Failure SpO₂ and Duration

% of NICUs

- >60sec
- >30sec
- >20sec
- >15sec
- >10sec
- >5sec
- >3sec
- Any

Davis, Academic Pediatrics (2020)
Figure 2. CSTS Failure SpO$_2$ and Duration

86% for 25 seconds
Figure 2. CSTS Failure SpO_2 and Duration

86% for 25 seconds


Davis, Academic Pediatrics (2020)
Figure 2. CSTS Failure SpO2 and Duration

86% for 25 seconds


Davis, Academic Pediatrics (2020)
American Academy of Pediatrics (AAP) + Committee on Fetus and Newborn (COFN)

- Infants are not safe for hospital discharge until “physiologically mature and stable cardio-respiratory function has been documented for a sufficient duration.”

- This must apply not only while supine in a crib, but also while semi-upright in a car seat.

Kilpatrick SJ, Guidelines for Perinatal Care (2017); COFN, Pediatrics (2019)
CSTS FAQs... aka when the hospital team is being challenging

- Medical team doesn’t want to perform CSTS -> “Is a CSTS really necessary? Canada stopped doing them!”
  - Still the standard of care for preterm infants in the US.\(^1\)
    - Over 96% of NICUs report performing CSTS as of 2020.\(^2\)
  - Studies have shown that 5-25% of neonates “fail” a CSTS prior to discharge.
  - A 2018 study of CSTS in NICU patients found that although patients who failed had longer lengths of stay, they also had significantly decreased odds of readmission within 30 days.\(^3\)
  - A 2017 study focusing exclusively on nursery infants who were automatically admitted to the NICU for continuous monitoring after one failed CSTS found that 39% had ongoing apnea (breathing pause).\(^4\)
  - A 2020 study\(^5\) evaluating late preterm infants found that 21% of those who failed >1 CSTS from the nursery ultimately required NICU admission for low oxygen levels
    - Two-thirds required supplemental oxygen for safe discharge home.\(^5\)

\(^1\)Bull, Pediatrics (2009); \(^2\)Davis, Academic Peds (2020); \(^3\)Jensen, J Pediatrics (2018); \(^4\)Shah, J Pediatrics (2017); \(^5\)Magnarelli, Pediatrics (2020)
Parents decline CSTS
  - “We don’t have a car”
    • Not the law, but is a recommendation by the AAP to ensure babies are breathing safely
    • Discuss that similar risks apply to the semi-upright position in bouncy seats, rockers, slings, swings as well
    • May ride in a car at some point in the upcoming months

NICU team wants to test for shorter duration
  - “Ride home is only 30 minutes”
    • Travel may take longer due to unforeseen circumstances including weather, traffic, etc., so is important to be safe
    • Risk applies to all semi-upright positions
    • AAP current recommendation is 90-120 minutes, or duration of car ride home, whichever is longer
    • 2020 study\(^1\) -> 85% of NICUs test for minimum of 90 minutes

\(^1\)Davis, Academic Pediatrics (2020)
Benefit of Certified Child Passenger Safety Techs
– “We don’t need any/more CPSTs”
  • 63% of infant deaths in sitting devices are in car seats, and in these cases fewer than 10% were being used as directed.¹
  • A 2016 study² demonstrated that 86% of families made an error in infant positioning in the car seat at the time of discharge...
    – However, those families who worked with a CPST prior to delivery had one-tenth the odds of misuse when compared to families who did not have access to CPSTs.
• Involvement of CPSTs for staff and caregiver education could decrease the number of infants who have unstable cardiorespiratory status in the car seat due to improper positioning or poor fit.

¹Hoffman, J Pediatrics (2016); ²Liaw, Pediatrics (2019)
Thank you!

Questions?
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Helpful References continued

Helpful Websites

• Choosing the right car seat for small babies

• Canada vs. US policies commentary

• The Car Seat Lady
Car Bed literature for preemies


Extra Slides
Safety: Car Seat vs. Car Bed

- 150 VLBW babies born <37 weeks gestation
- Cross over study, each tested in car bed and car seat
- Randomly assigned to one, then retested in the other mode

<table>
<thead>
<tr>
<th>Car Seat</th>
<th>Car Bed</th>
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<tbody>
<tr>
<td>15% had an event</td>
<td>19% had an event</td>
</tr>
<tr>
<td>One needed test stopped</td>
<td>One needed test stopped</td>
</tr>
<tr>
<td>Time to first event: 55 minutes</td>
<td>Time to first event: 54 minutes</td>
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</tbody>
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28% had an event in BOTH

Same number had events after 60 minutes and 90 minutes

Same number needed nursing intervention

Why do they fail?

• Likely multi-factorial
  – Lung immaturity/inflammation
    • Low reserve, small lung capacity
  – Low tone and strength
    • Floppy, easily malpositioned, unable to correct neck flexion
    • Straps compress the chest
  – Small size
    • Poor fit in car seat - neck flexed/occlude airway
    • Straps hit incorrectly
  – Neurologic immaturity and increased risk of apnea
    • Poor response to low oxygen saturations
Test-Retest Reliability of CST

• DeGrazia, 2007
  – Performed 2 CSTs on each subject
  – 8% of subjects passed a 1st CST and failed their 2nd

• Davis, 2014
  – Performed 3 CSTs on each subject 24-48hrs apart
  – 11% passed an initial CST and failed one subsequent test

• Similar findings:
  – ~90% of those who pass one test will go on to pass future CSTs, but...
  – ~10% will pass a CST but go on to fail!

Davis NL, Gregory ML, Rhein L. J Perinatol. 2014
Best Practice for CST

• Discuss the test with the family and the reasons for performing it BEFORE testing
  – Performed on premature babies and babies with other issues that put them at risk of breathing problems
  – Goal is to make sure their breathing is safe in that position before they go home
  – How long is their car ride home?

• Bring in car seat well before anticipated discharge
  – NICU: 2-3 days before discharge
  – Nursery or Mother/baby unit: bring in as soon as they can
  – Assess for safety of the seat, appropriate sizing
Best Practice for CST

• Test can be done any time of night or day, but make sure parents are aware
  – Demonstrate proper positioning

• Perform a “realistic” CSTS – recreate what will be happening at home
  – Use family’s actual car seat
  – Perform within 30 minutes of a feed
  – Ok to use pacifier if the family will be using this at home
Failed CSTS

- Assess for fit of infant in car seat, appropriateness of positioning
- Update family
- Perform repeat CST > 12-24 hours from failed test
  - Time to recover
  - Additional day of respiratory maturity and improved tone
- Fail a 2\textsuperscript{nd} CST:
  - Discuss with family
  - Consider subspecialty consult (NICU, pulmonology, cardiology)
  - Discuss further work up with sleepy study, etc. with repeat CSTS vs. alternative discharge plan (ie car bed)
  - If planning DC in car bed, must perform similar observation (car bed test)
    - PASS: discharge in car bed
      - Follow-up at 44 weeks corrected or one month of age
    - FAIL: recommend medical evaluation
      - Rule out respiratory, neurologic, cardiac etiology
Counseling Families

• Minimize time in the car seat or semi-upright position
  – Left sleeping in car seat
  – Bouncy chairs
  – Slings

• Close observation while in the car seat
  – Try to take breaks during long periods of travel to allow infant to lay flat