The Safe Transport of Children in Ambulances

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Children's Hospital Colorado
Here, it's different.™

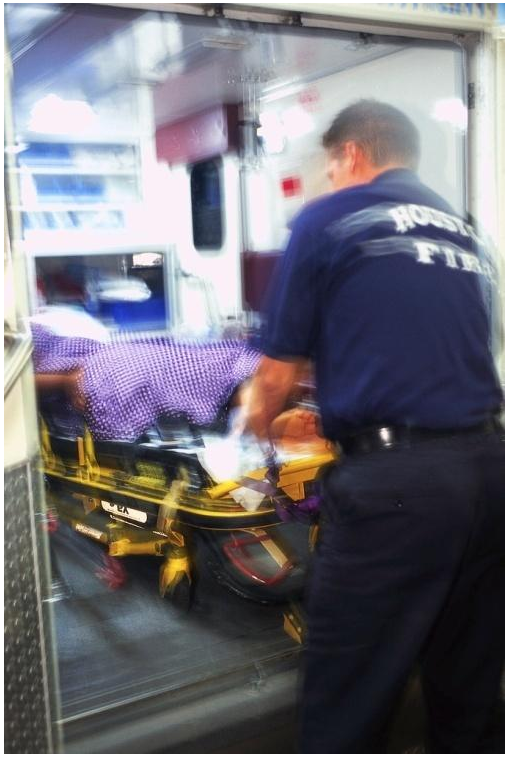
We have no relevant financial disclosures

Objectives

1. Discuss Ambulance Transportation Issues and Considerations
2. Crash Dynamics/ Rear-facing
3. Review Child Safety Seats (CSS) Basics
4. Child Safety Seats: Considerations for Ambulance use
5. Discuss Ambulance -Specific Child Restraints

It Ain't Sexy But They Work…

- March 9th in Spanish Fork River, UT
- Mom found dead / 18 mo Lily found dangling from car seat for approx 14 hrs
- Lily recovering well and discharged



Ambulance Crash Characteristics

Approximately 6.2 million people transported via ambulance each year in the U.S.

Approx. 10,000 ambulance crashes result in injury or death annually

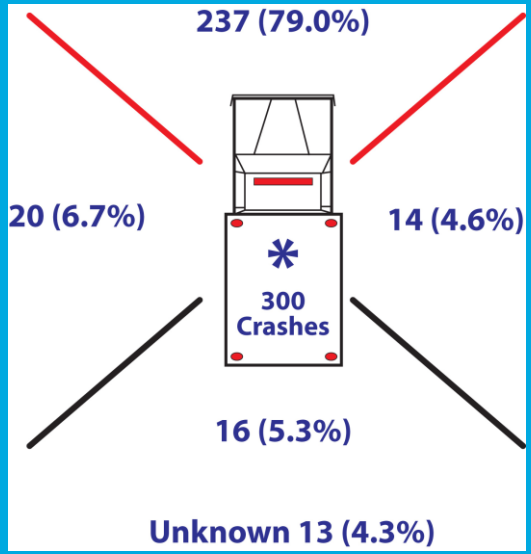
Up to 1,000 ambulance crashes a year involve pediatric patients

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

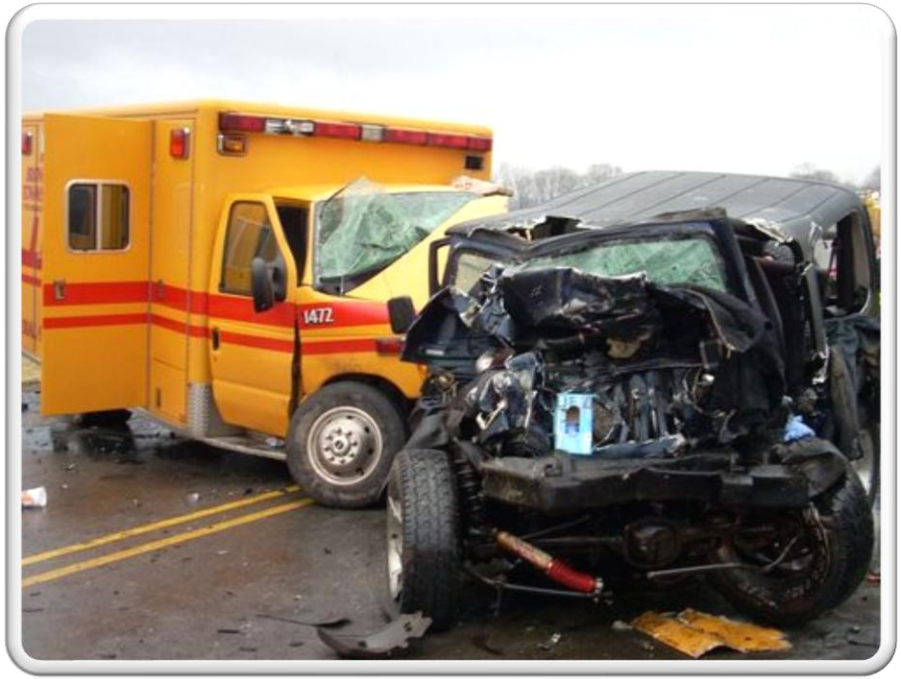
Ambulance Crash Characteristics

NIOSH analysis of field crash data

Of 300 fatal crashes, 79% considered frontal impacts



2. NHTSA Fatality Analysis Reporting System (FARS), 1991-2000; Green J. et al, "Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems", World Congress on Safety & Health at Work, 9/05.



Ambulance Crash Characteristics

- Most serious/fatal injuries occur:
  - in rear compartment
  - to unrestrained or improperly restrained occupants
  - at intersections
  - during emergency use

- 82% of fatally injured rear occupants were unrestrained

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

Ambulance Crash Characteristics

- EMTs and Paramedics have a rate of injury that is three times the national average for all occupations.
- Cause of death
  86% transportation related

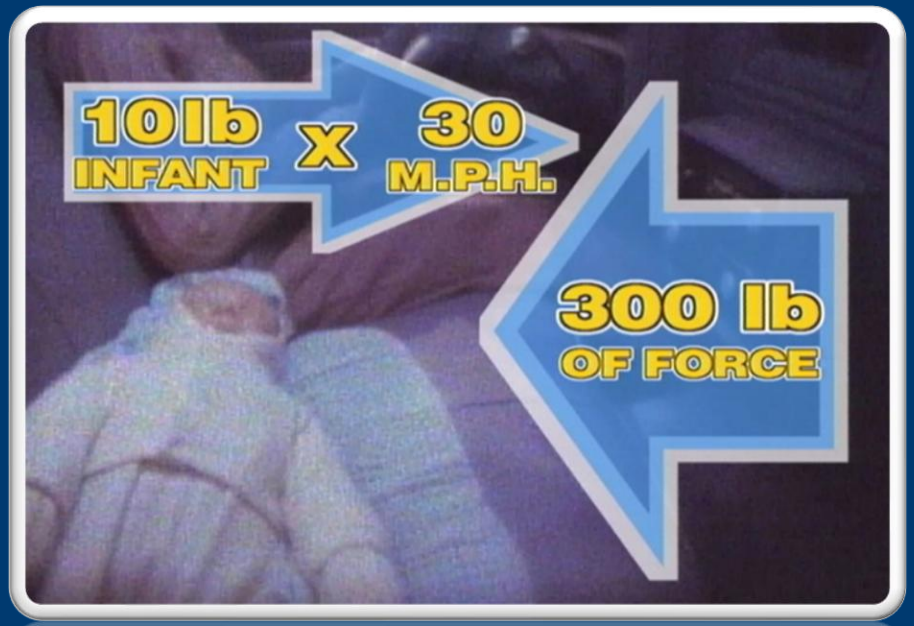
Maguire, BJ.,Smith,S. (2013). Injuries and fatalities Among Emergency Medical Technicians in the United States. *Prehosp Disaster Med*; 28 (4):376-82.

It's Personal

- 2006 along I-76 in northeast Colorado
- CCT tx pregnant pt w/ RN from NE to CO
- Rear occupant pt (ejected) & RN both pronounced dead on scene
- EMT driver cited

It’s An Extension of Clinical Care

Crash Dynamics



Crash Dynamics

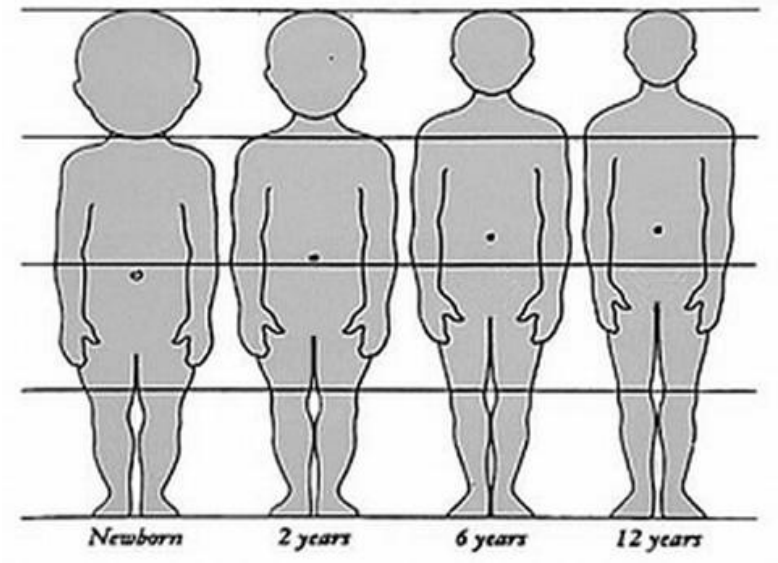
Explaining Crash Forces

Weight X Speed =
Restraining Force

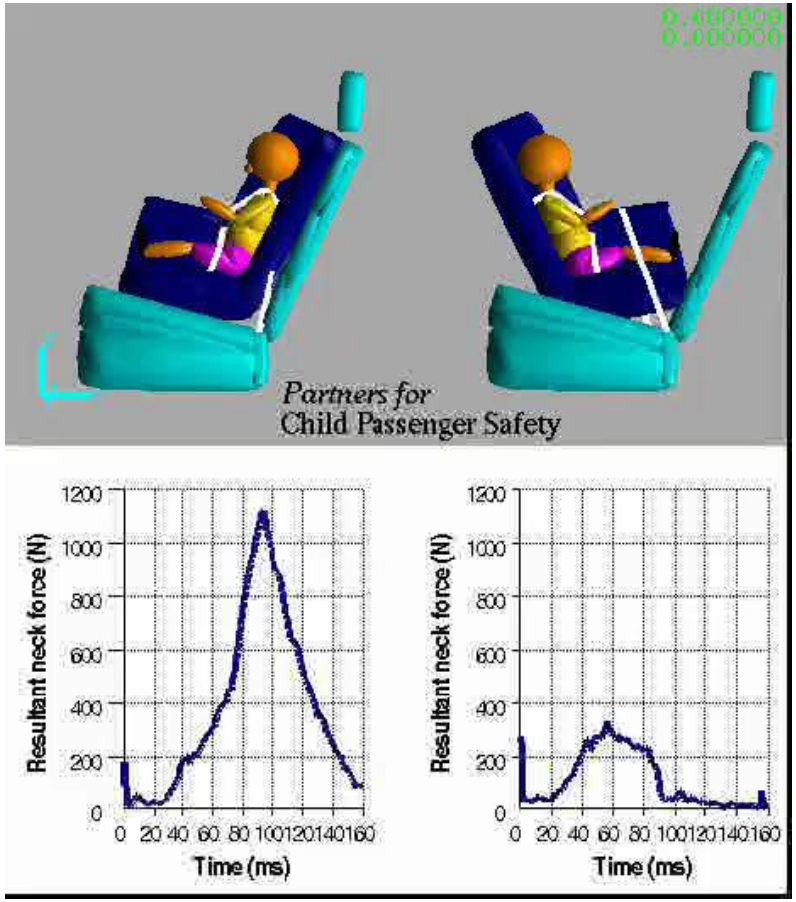
Why Children Should Travel Rear-Facing

- Physical Development
  - Babies have big heads
  - Bones, tendons, and muscles are not fully developed

Child's Body Proportions



Why Children Should Travel Rear-Facing, cont'd



It Was a Beautiful Halloween Sunday Morning

Pop Case Review

- Sunday morning, rural area, high speed MVA in front of church.
- ~9 y/o boy, restrained front passenger SUV
  - Awake, mumbling, moaning, following simple commands, pupils equal and eyes tracking, breathing, skin warm/dry, cap refill < 3 seconds, left open femur fracture
  - Sick/Not sick?

Pop Case Review

- Initial Documentation
  - History (~9 year boy, estimated 25kg – how?)
    - Airway - Patent
    - Breathing - Unlabored and equal breath sounds, 10L oxygen by NRBM
    - Circulation - Warm, pink, dry, CR <3 seconds, + bleeding, 18G IV with NS infusing
    - Disability/Da Brain/Dextrose - Awake, PERRL, GCS 13, not moving bilateral lower extremities, D-stick 121
    - Expose – Open left femur fracture, two small bruises noted on abdomen (upper quadrants); blankets for warmth
    - **VS: HR 60, RR 22, 75/P, 97% spO2**

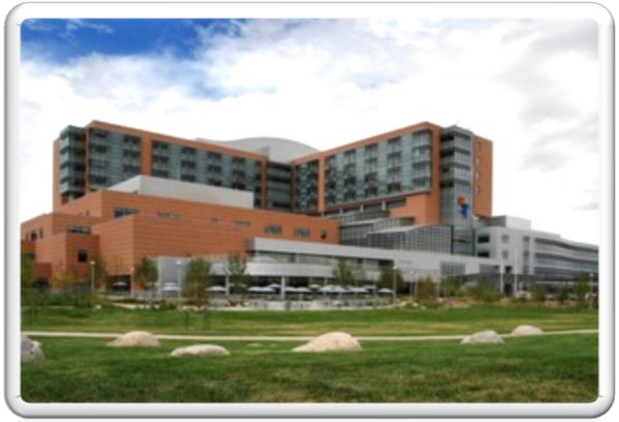
Pop Case Review

Clinical Features / Neurogenic Shock

- Acute Spinal Cord Injury (mechanism, BLE paralysis)
- Warm, dry skin
- Hypotension
- Bradycardia
- Hypothermia (later)

Pop Case Review

- Arrive in 58 min to Trauma Room 1
- Trauma Team activated prior to arrival
- 500mL infused
- Respiratory effort waning, pale
- HR 40's no distal pulses
- Cardiovascular collapse → CPR, intubation, IV
- Epi, Mannitol,
- Massive Transfusion Protocol started:
  - 40mL/kg NS and 2 units blood via rapid infuser
- FAST Ultrasound = + fluid in abdomen



Pop Case Review

- PICU
- Mid-cervical spinal cord injury with evidence of disruption at C7-T2 and epidural hemorrhage, rib fractures, femur fracture, posterior fusion from C5-T6

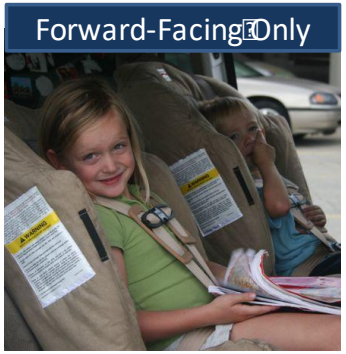
Pop Case Review

Pop Case Review

Child Safety Seats

Types of Child Safety Seats

Infant Only



Forward-Facing Only

Combination

Convertible

Special Needs

Booster Seat

Convertible Child Safety Seat

Example of convertible seat installed rear facing with recline feature

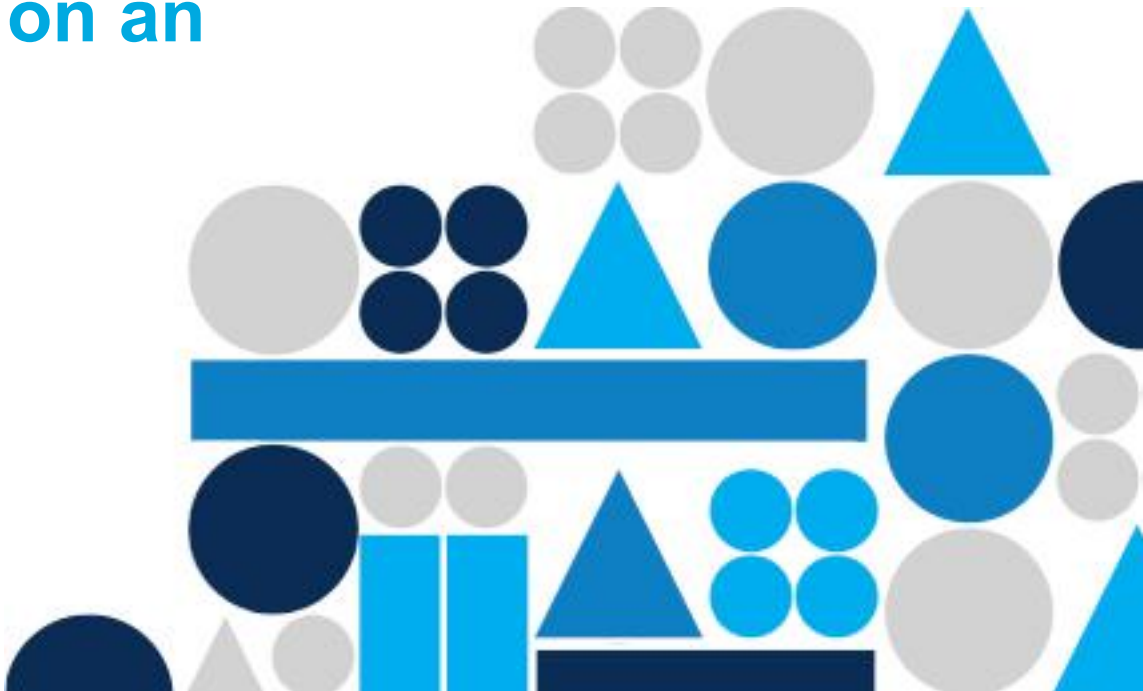
Example of convertible seat installed forward- facing

Source: Automotive Safety Program

Harness Fit

- Harness should fit snuggly. Your fingers should slide off the harness when you pinch the webbing at the shoulder.
- Position harness retainer clip arm-pit level

Research of Convertible Child Restraints on an Ambulance Cot



Background

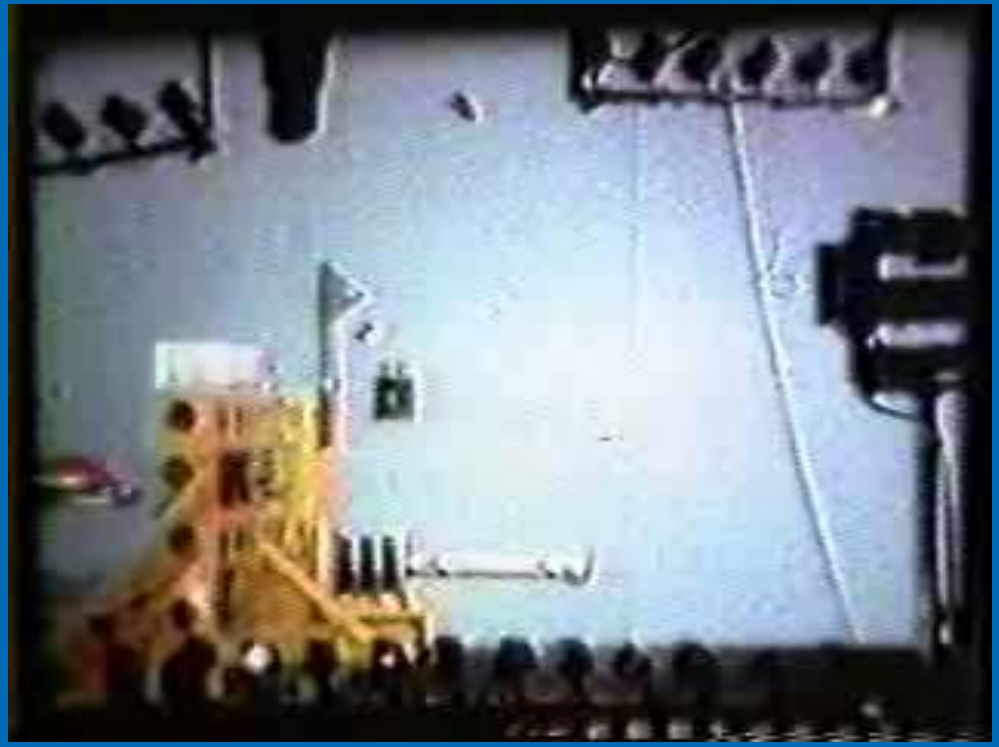
UMTRI
UNIVERSITY OF MICHIGAN
TRANSPORTATION RESEARCH INSTITUTE

- Research conducted in 1990 and 2000 by the Automotive Safety Program at Riley Hospital for Children with the University of Michigan Transportation Research Institute (UMTRI)
- Recommendations from 2000 were published by Bull et. al (2001) entitled: “Crash Protection for Children in Ambulances”, 45th Annual Proceedings, AAAM, Sept. 2001

1990 Test: Convertible CSS

- Test date: January 30, 1990.
- 3 year old test dummy.
- Convertible seat facing the rear of the ambulance on Ferno 30 ambulance cot with Ferno 175 ambulance cot fastening system.
- The convertible seat was reclined with the harness through the middle slots. The convertible CSS was installed using a cot belt through each (rear facing and forward facing) belt path.
- Frontal impact at 48km/h (30 mph), 20 G with cot backrest fully reclined and side rails up.
- This test dummy was not instrumented. Failure of the fastener system appeared to be imminent at the conclusion of the test. If safety lanyards had not been used, it is suspected that the fastener system would have failed.

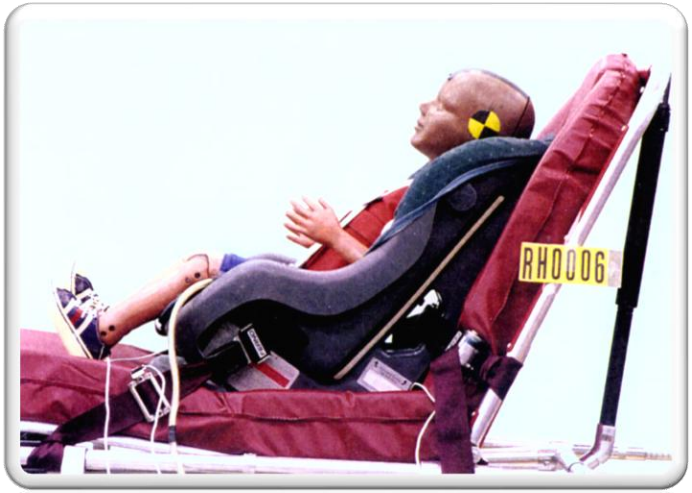
1990 Convertible Test



1990 Isolette Test (Has Not Been Repeated)

2000 Test Set-Up: Convertible CSS

- Test date: **July 11, 2000**
- Convertible CSS meeting FMVSS 213
- 3 year old, 15 kg test dummy weighted to 18kg
- CSS facing the rear of the ambulance on Ferno Mobile Transporter 35-AST with sheet metal back on Ferno Stat Trac 185 cot fastening system
- CSS reclined, harness through middle slots; cot belts through rear-facing and forward-facing belt paths
- Frontal impact at 48km/h (30 mph), 23 G, simulated ambulance floor on impact sled; cot backrest fully up with side rails down

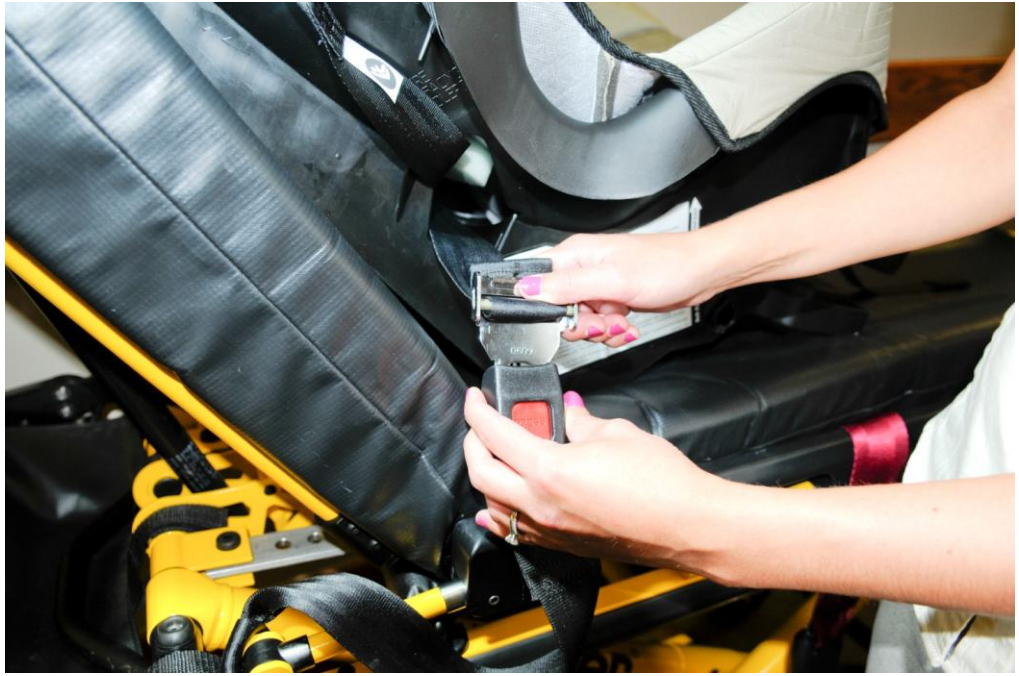


2000 Convertible CSS Crash Test

Results: Convertible CSS

- Good restraint performance during impact and rebound
- Chest G resultant was 43G
  (compliant with 213 standard)
- Head Injury Criterion was 501
  (compliant with 213 standard)
- Head target was well contained

Convertible CSS: Cot Belt Through FF Belt Path



Convertible CSS: Cot Belt Through RF Belt Path

Convertible Car Seat

Child Safety Seats: Considerations for Ambulance Use

Uninjured children should ride in a passenger vehicle in a child restraint appropriate for their height, weight, and age whenever possible

These are safer than…

these

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

CSS Use in Front Passenger Seat of Ambulance

- Infant-only seat could be installed:
  - rear-facing if no active airbag
- Convertible seat could be installed:
  - rear-facing or forward-facing if no active airbag
- Forward facing or booster is fine

  (slide seat all the way back)

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

Child Safety Seats: Considerations for Use in Rear-Compartment

NEVER install a child restraint side-facing on a bench seat or captain's chair

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

Rear-Facing CSS on Rear-Facing Attendant Seats

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

CSS Use on Ambulance Cot

CANNOT install:

- Infant-only, forward-facing only, combination, or specialty CSS

  These seats have only one belt bath and cannot be adequately secured to the cot

- Belt-Positioning Booster

  Requires use of vehicle lap/shoulder belt

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

CSS Use on Ambulance Cot

CAN Install:

- Convertible CSS
- Two separate belt paths allow for installation on a cot
- Crash test results and specific procedures for use on the ambulance cot for children under 40 pounds are discussed in NHTSA Best Practice Recommendations

NHTSA, (2012). Working Group Best-Practice Recommendations for the Safe Transport of Children in Emergency Ground Ambulances.

Contraindications: Convertible CSS on Cot

Not appropriate if:

- Child acutely ill or unable to maintain thermoregulatory stable
- Child's injuries cannot be treated in a semi-reclined position
- Child may have a spinal cord injury
- Child requires intubation
- Child does not meet or exceeds wt./ht. limits of CSS

Harness Systems

- Adult cot-mounted harness systems may not provide adequate restraint for pediatric patients in the event of a crash
- Design of harness systems that provide adequate occupant protection remains an area of future research and development

Put Your Parent Hat On…

The sampling of products is not intended to be all inclusive or imply endorsement or crashworthiness of products

We have no financial disclosures; however, we would love some.

Child Restraints Designed for Ambulance Use

2 Types:

- Cot Mounted Child Restraints

- Integrated Child Restraints Located Inside Ambulance Seats

Safe Guard Transport by IMMI

www.IMMInet.com
1-317-896-9531

- Cot-mounted restraint for patients over 1 year of age from 22 to 100 lbs
- Restraint weighs 22 pounds
- 5-point harness system with one-handed adjustment for harness height and tightness
- Children 22-40 pounds can use with cot back angle at 70 and 45 degrees
- Children 40-100 pounds can use
with cot back angle at 70 degrees
and completely flat
- Not a Spine Board

The Rescu-Air: Air Filled Child Transport Seat

- For children 20-40 pounds and less than 40” tall
- Five-point restraint system with pelvic adjustment
- 2-level adjustable shoulder harness
- Must purchase “cot harness system” separately to use on ambulance cot
- Inflates/deflates with included 12v DC pump in 60 seconds

www.epandr.com

1-800-322-5725

Ferno

1-877-733-0911
www.ferno.com

Neo-Mate
7-14 lbs.

Pedi-Mate
10-40 lbs.

Pedi-Mate Plus
10-100 lbs.

Neo-Mate

Ped-Mate

Pedi-Mate Plus

The Paraid ACR (Ambulance Child Restraint)

- Weight range 4 lbs - 100 lbs
- Universally compatible with any cot
- Smart color-coding for easy selection of 4 sizes
- Machine washable
- Quick release chest strap for medical intervention

- www.paraid.com

Aegis Neo Wrap by Saplacor

www.saplacor.com

- Hands Free
- Optimize Thermoregulation
- Skin to Skin
- Crash Tested
- Variety of sizes
- ABEO - Seatbelt attachment Sold Separately

EVS 1880 Hi-Bac Seat by E.V.S. Ltd.

1-800-364-3218

www.evsltd.com

- Designed for uninjured children who must be transported in the ambulance with the patient
- Accommodates children 20-50 pounds
- 5-point harness, folds down from seat back
- Child restraint cannot be used side-facing
- Can be equipped with lap/shoulder belt for staff use

Guardian Safety Seat by Serenity Safety Products

1-800-536-0676
www.SerenitySafetyProducts.com

- 3 in 1 attendant seat with built-in infant only seat, toddler restraint, and 4-point restraint for attendant

THANK YOU

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