

Children and Automated Vehicles: What Should We Be Worrying About?

Kathleen D. Klinich, PhD





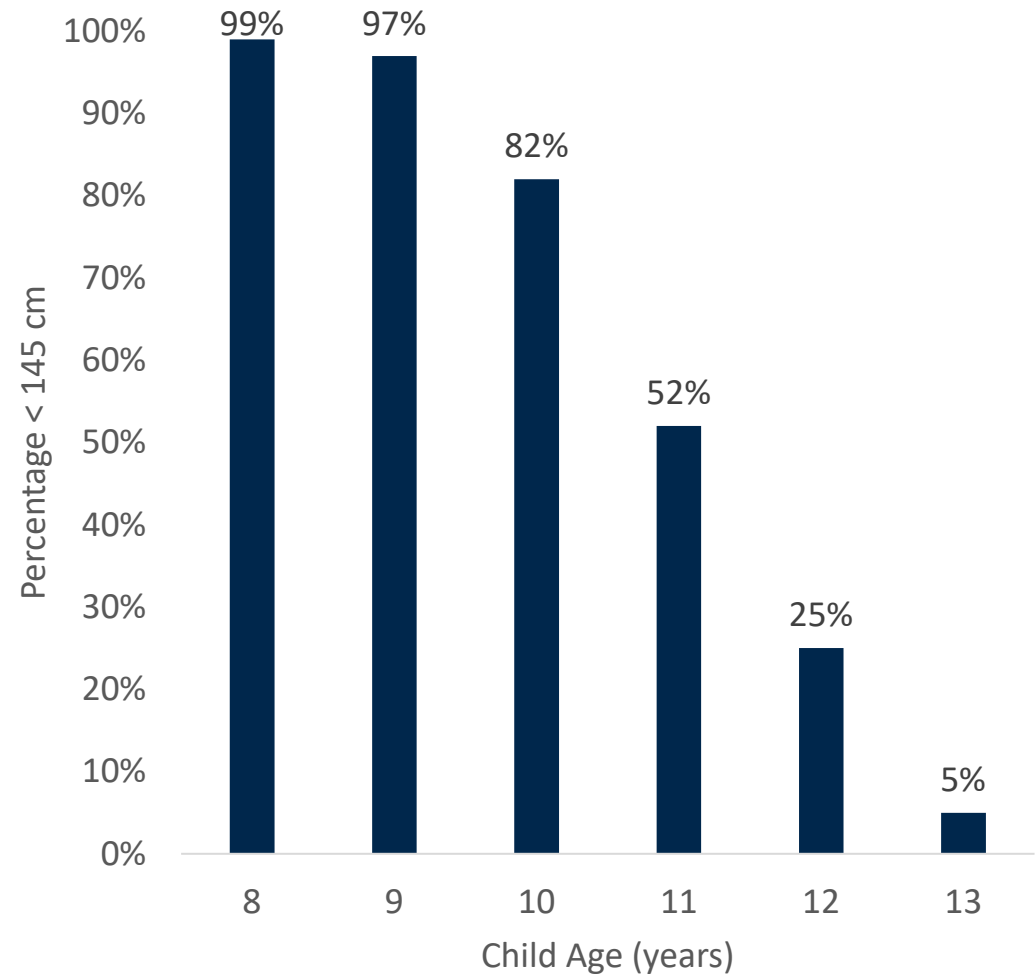
**CHILD RESTRAINT SYSTEMS
ARE EXTREMELY
EFFECTIVE!**



**The best thing we can do to improve child
passenger safety:
every child,
restrained according to best practice,
on every trip.**

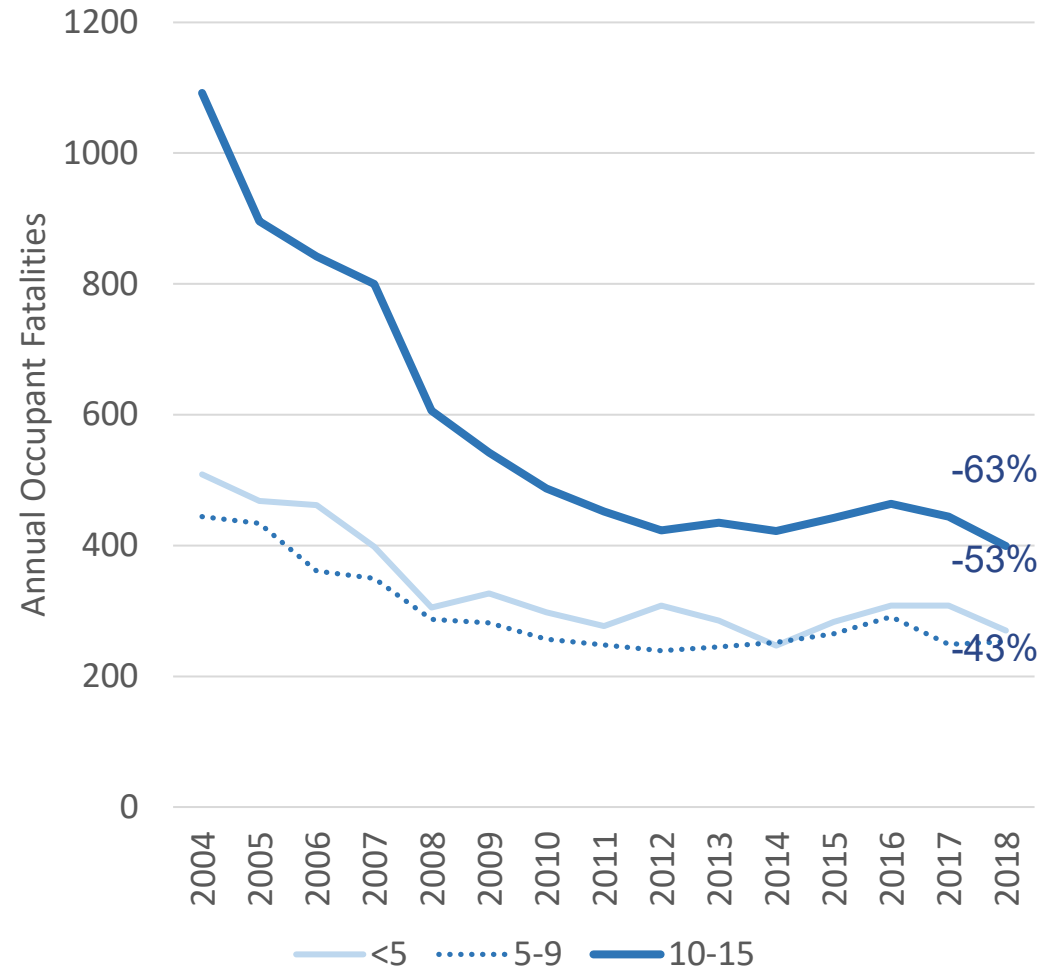
Best Practice Recommendations

- Rear-facing to at least age 2
- Rear-facing or forward-facing harnessed restraints until age 5
- Forward-facing harnessed restraints or boosters until age 11 or 145 cm
- Boosters or seatbelts in all seating positions for age 11+

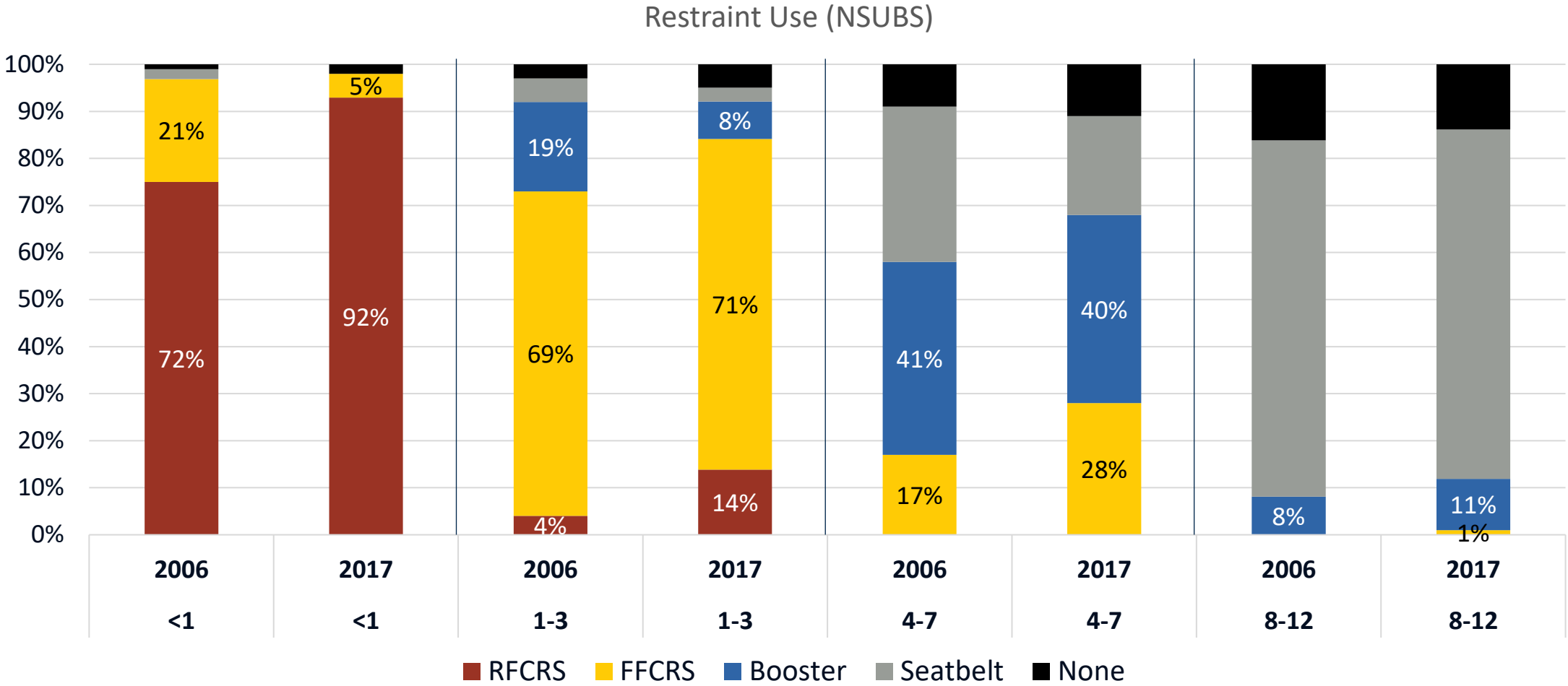


Pediatric Motor-Vehicle Fatalities

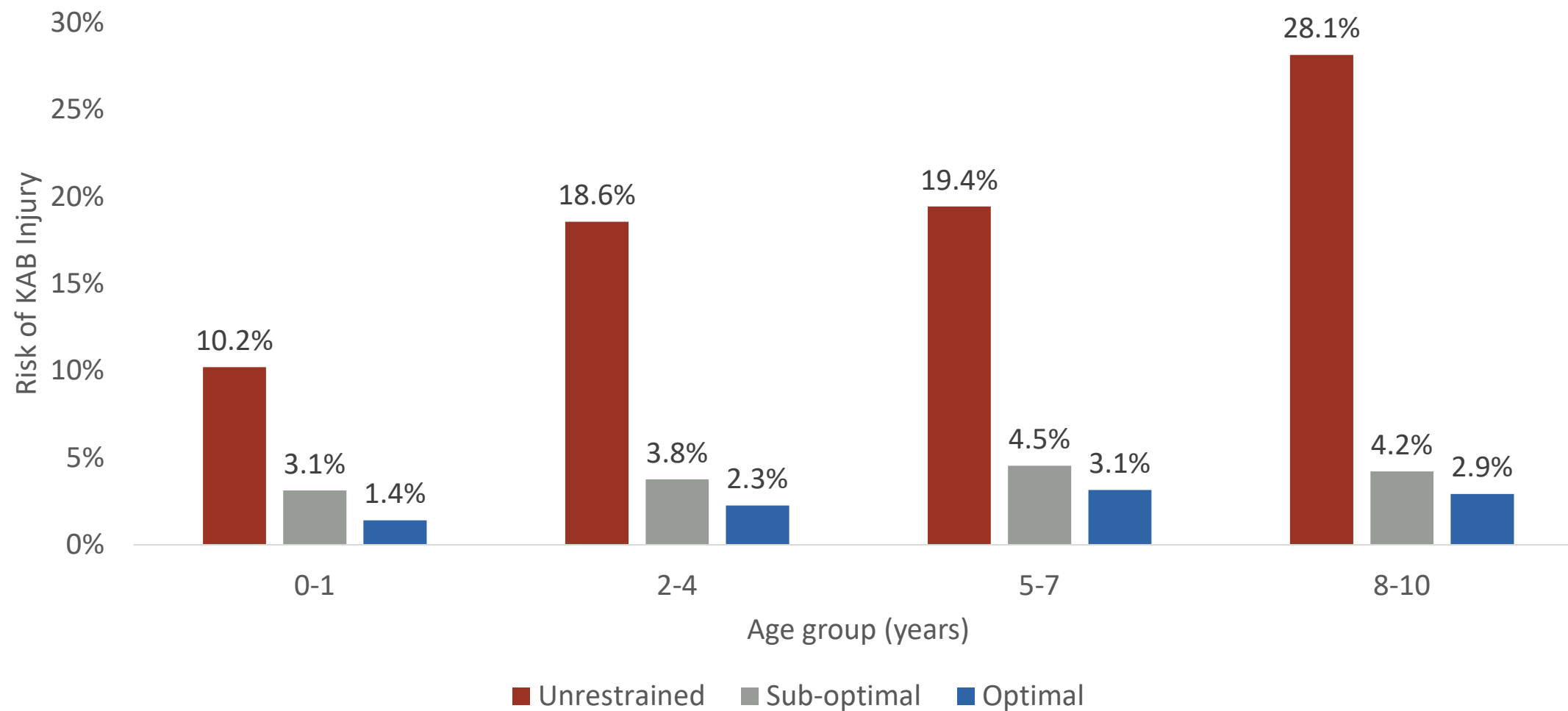
- Overall occupant fatalities have decreased 22% from 2004-2018
- Child fatalities have dropped 43-63%
- This includes all crash types
- This includes child restraints “as used”, so ~>70% misuse rates



Child Restraint: Use 2006 vs. 2017



Pediatric Injury Risk in MVC





Child Restraint Regulatory Testing vs. Field Experience

Testing

- Only test in frontal crashes on a forward-facing bench
- Only test at one crash severity
- Only test with 12MO, 3YO, 6YO, and 10YO frontal crash dummies
- Crash dummy thoracic spines are rigid steel boxes; neck injury measures are not consistent with what we see in field data so we don't evaluate them in regulation

Field Experience

- Child restraints are very effective in all types of crash directions and severities
- Child restraints work with almost every size of kid
- We don't see many serious injuries in rear impacts among kids of any age, even those in rear-facing child restraints

Initial AV Deployments

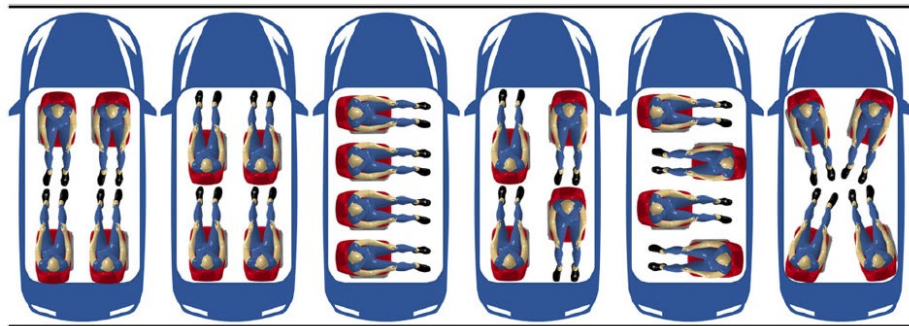
- The initial deployments of AVs are expected to be in a shared-services model, not private vehicles
- In NHTS 2017, only 1.7% of all trips in the US were in taxis/ride-hailing
 - Even fewer with kids
- ADA requirements mean that companies offering shared services cannot deploy without accessible options
- Providing safe, independent options for wheelchair users in AVs is challenging.



Unconventional Seating in AVs

Vehicle Seat Direction

- Not all vehicle seats will be rear-facing
- Not all AVs will operate bidirectionally
- Seats that can change orientation will have integrated seatbelts and have LATCH

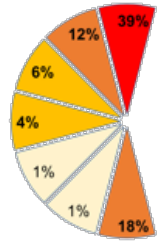


Reclined Seating

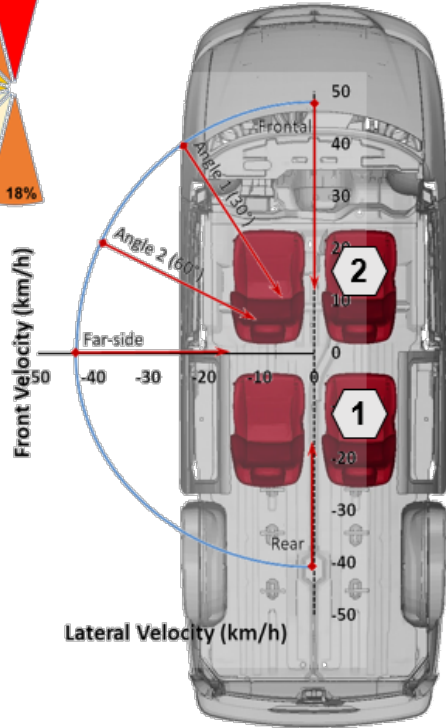
- Seats that recline will still have standard upright mode
- Providing a reclined option will be limited by the ability to design a seatbelt system that doesn't cause lumbar spine injuries in reclined passengers
- Mean length of trips is 15 minutes, and 90% are less than 40 minutes; do we really have time for naps?

Research: CRS In Unconventional Seating

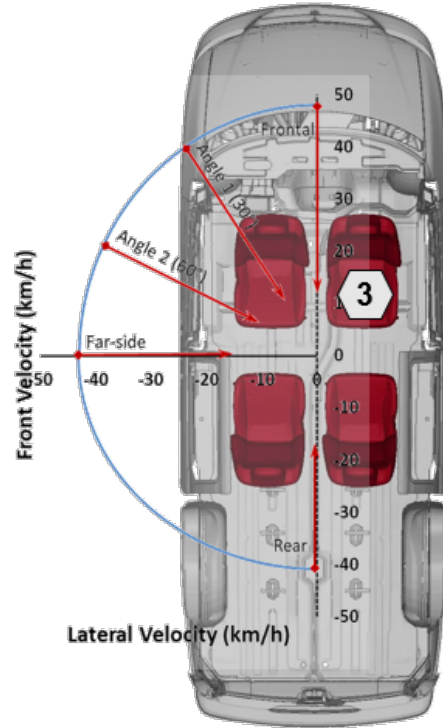
Crash Distribution by PDOF



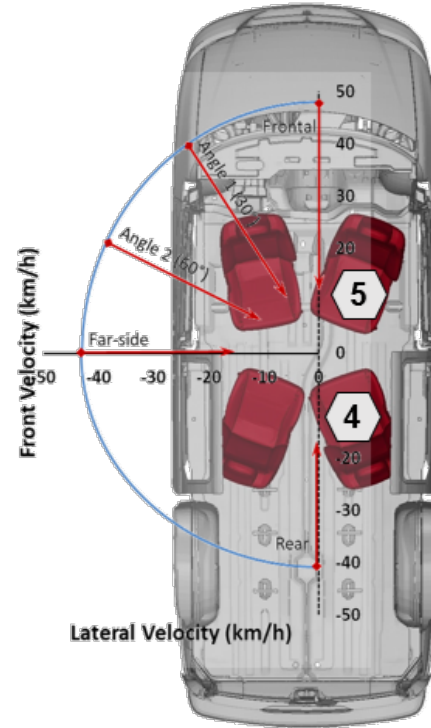
Baseline:
two front seats, two rear seats, all facing forward



Carriage:
two rear seats facing forward, two front seats facing rearward



Campfire:
four seats all angled towards center



- 6YO and 10YO frontal crash dummies have problems assessing CRS in oblique, lateral, and rear impacts
- Far-side impacts have potential for injurious contact in forward-facing and rear-facing vehicle seats
- RFCRS in rear-facing seats in frontal impacts similar to RFCRS in forward-facing seats in rear impacts



Possible Future Directions

- We could spend tens of millions of dollars developing new child crash dummies and test procedures to test CRS in other crash modes and in unconventional seating
- Because of extra testing costs, CRS could become more expensive, which could lead to unintended consequence of lower recommended use
- We can trust current field data that CRS are extremely effective in all crash directions, even when misused
- Spend available funding on education and providing CRS for people who can't afford them to get more kids using recommended child restraints



Children Traveling Alone in AVs

- The American Academy of Pediatrics does not recommend that children stay home alone until age 11-12.
- For consistency, children should not be able to travel in AVs alone until they are age 11-12.
- When would a kid child be able to safely travel alone using public transportation?
 - Getting lost
 - Dealing with strangers
- Any child needing a CRS will be traveling with a caregiver who can install it.
- There should never be a situation where the only place to install a CRS is behind the steering wheel of a Level-4 or Level-5 vehicle.



Priorities for Child Passenger Safety

Now

- Increase child restraint use according to best practice recommendations
 - Provide funding for CRS to those who cannot afford them
 - Improve wording of state laws to meet best practice recommendations
 - Align CRS labeling to meet best practice recommendations
- Reduce misuse of CRS

Future

- No solo children under 12
- CRS use required in AVs
- Caregivers install CRS for kids under 11
- Avoid use of RFCRS in rear-facing vehicle seats
- Work on vehicle-based farside injury prevention solutions for everyone



Suggested Law Wording

- All children under age 11 should use a child restraint system, unless they achieve good belt fit without it (usually not until they reach a height of 145 cm).
- Children aged 11 to 16 should use a child restraint system or seat belt in all seating positions.
- Children aged four and under who weigh 30 pounds or less should use a rear-facing harnessed child restraint.
- Children aged four and under who weigh 30 to 50 pounds should use a rear-facing or forward-facing harnessed child restraint.
- Children weighing over 50 lbs or are over age 4 should use a forward-facing harnessed child restraint or a belt-positioning booster seat.

Thank you for your attention!

Kathleen D. Klinich, PhD kklinich@Umich.edu

