

Interventions Toward Ensuring Wheelchair Transportation Safety

Dana Benoit MSc., erg., OT (c), CDRS
Alyssa Merilees erg/OT, CDRS

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constance-lethbridge
CENTRE DE RÉADAPTATION - REHABILITATION CENTRE

Objectives

- Participants will understand the current guidelines to wheelchair transportation safety (WTS) and appreciate the importance of seat belt positioning and mobility device tie-down systems for this clientele.
- Participants will identify common barriers to implementing WTS best practice guidelines
- Participants will develop problem-solving skills specific to optimising the safety of their adult or pediatric clients who present with challenging positioning requirements.

Objectives

- Participants will consolidate the seminar information via case studies and active analysis
- Participants will identify the profile of clients who require the expertise of a Driver Rehab specialist (DRS) in the vehicle adaptation evaluation process
- Participants will be equipped to transfer their knowledge regarding current wheelchair transportation safety (WTS) guidelines to their clients, their clients' caregivers and drivers working in Adapted Transportation Services.

Acknowledgments:
Dr. Lawrence Schneider
Clients of CLRC

Workshop outline

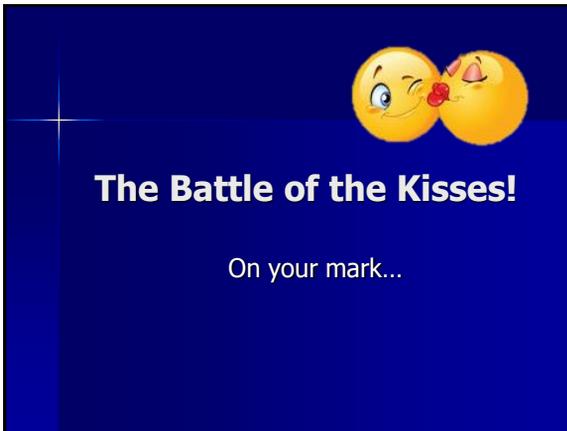
- The Problem
- Current guidelines to WTS- ie: safe transportation for occupants seated in wheelchairs
- Common barriers to implementing WTS best practice guidelines
- Specific considerations for Pediatric client/Case presentation
- *Health Break*
- Active Analysis: Identifying problems and potential solutions
- Outside the box/Exploring complex situations
- Quick Tips/wrap-up
- Discussion/Questions

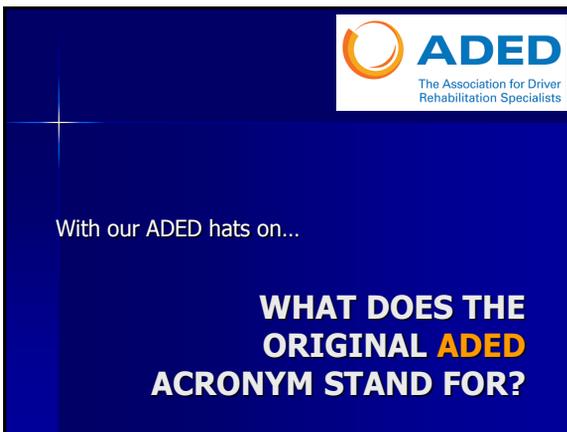
Assumptions

- You have a basic knowledge with respect to structural modifications made to vehicles to render them accessible to the client traveling in their mobility device
- You are aware of the funding procedures that are relevant to your province/state*

* Quebec Reality

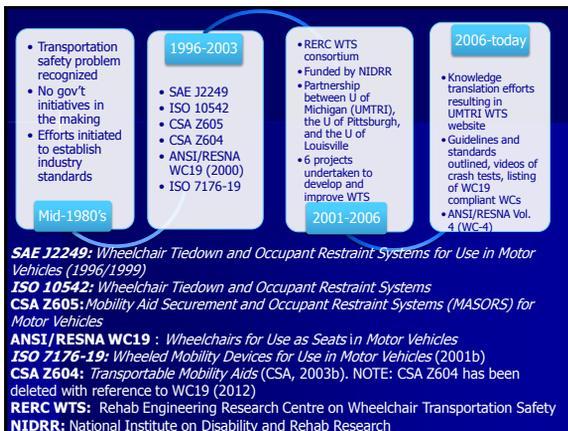






Transportation Safety

- Occupant-crash protection studies clearly indicate that the vehicle seat is an important part of the occupant protection system.
- For this reason, clients for whom transfer from their wheelchair to an OEM vehicle seat is feasible and safe should do so... But some simply cannot...
- Should clients who MUST use their wheelchair as a vehicle seat during travel be expected to do so at their own risk?



WTORS/MASOR

- Engineering Analysis: Safety of WC-seated occupants requires:

1. a system or device for securing the wheelchair and
2. a belt-type restraint system for limiting occupant movement in a motor vehicle crash.

Wheelchair Tiedowns and Occupant Restraint System (WTORS) = Mobility Aid Securement and Occupant Restraint (MASOR)

Canadian Standard Z605 (2003), ISO 10542 (2001), ANSI/RESNA WC18 (2012)

WTORS

1) Secure the Wheelchair



- Usually 4 Crash-tested tie-down straps
- Rear strap anchor point directly behind the sides of the seat (30-45° to the horizontal)
- Front anchor points at 40-60° to horizontal and angled outward 25° for lateral support
- If tilt seating system, attach all straps to the seat or to the wheelchair base unless WC19 securement points



Choice of conversion may render ideal tie-down angles an impossible task...

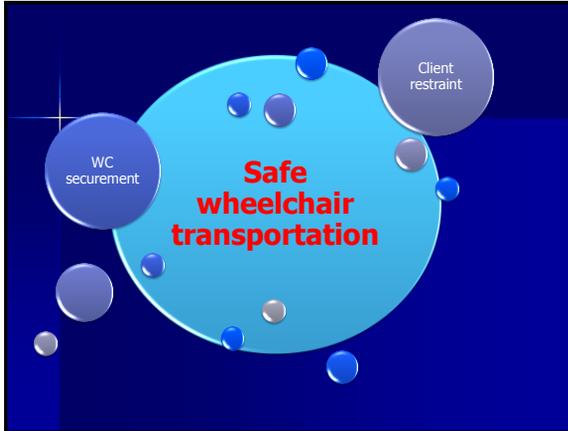
"Securement points on WC19 wheelchairs are often located so low to the ground that it is impossible to achieve the ideal angles. However, these WC19 securement points should always be used rather than achieving the ideal angles."
L. Schneider
2017-02-13

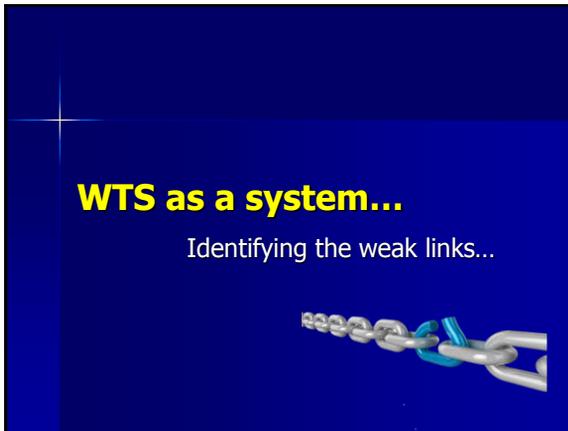
WTORS

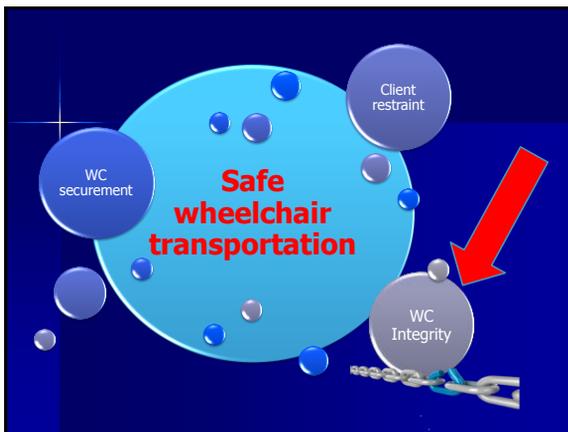
2) Secure the occupant

- a seatbelt system with both pelvic and upper torso belts must be used.
- Pelvic belt: Low across the front of the pelvis near the upper thighs, not high over the abdomen, not over the WC armrests
- Shoulder belt: Should cross the middle of the shoulder and the center of the chest, and should connect to the lap belt near the hip of the wheelchair rider. *It is best if the WC is positioned close to the shoulder belt anchor point
- NOTE: Postural support belts usually attached to the wheelchair are not strong enough and are usually not positioned correctly to restrain the occupant safely in a crash









The Wheelchair/Mobility Aid

- Most mobility aids have not been designed for use as a seat in a vehicle
 - do not provide effective seat and back support in a crash,
 - may not be effectively secured to the vehicle and
 - may compromise performance/effectiveness of seatbelts

WC19

Manary et al. (2010) Medical engineering & physics, vol. 32, no 3. p. 59
Schneider et al., (2008) Assistive Technology, vol. 20 no. 4

- Development led by a consortium of rehabilitation and safety engineers from U of Michigan/ U of Pittsburgh/ U of Louisville
- Vision: to reduce injuries and fatalities to occupants seated in wheelchairs
- An industry standard that specifies design and performance requirements for wheelchairs that are suitable for use as seats in motor vehicles
- In addition to frontal-impact testing of wheelchairs, the standard includes tests for securement-point accessibility, tiedown-strap clear paths, lateral stability, and accommodation of vehicle-anchored belt restraints.

A picture is worth 1000 words...

UMTRI Wheelchair crash test videos
<https://www.youtube.com/watch?v=8ZLHeTeGyWw>





WC19 (cont'd)

- WC must provide four, crash-tested securement points with specific geometry where manual tiedowns can be easily attached
- Crash tested WC mounted lap belt (integrated lapbelts transmit occupant restraint forces to the wheelchair and to the tiedown system... WC18 standards changed in consequence in Dec. 2015)
- Now requires wheelchairs for small children to provide a five-point restraint harness
- Requires wheelchairs to achieve a minimal rating of « acceptable » for the ease of achieving proper positioning of vehicle-anchored belt restraints.

RESNA WC-4:2012



LISTS OF COMPLIANT PRODUCTS

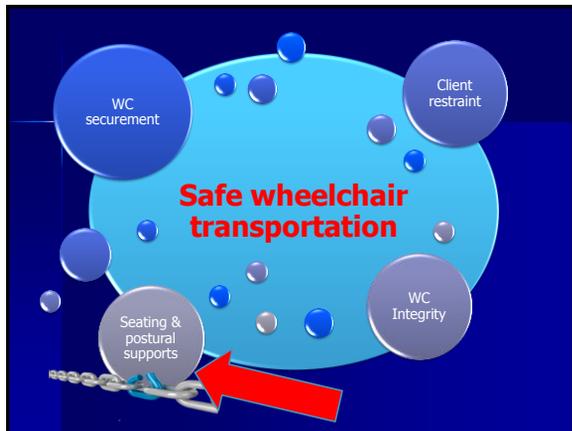
Wheelchair Product List - WC19 Full Compliance - Update Jan 2017

Website: www.pride-mobility.com
 Contact: William Meier
 E-mail: meier@pridemobility.com
 Phone: 1-800-890-8588

Wheelchair Name and Model	Occupant Weight Limit (lb)	Full WC19 Compliance
W/Over 250 lb (Provision to WA Only) with:		
- Swing Seat		
- Captain's Seat		X
- High Back Seat	300	X
Quantum 6000 with Synergy Seat		X
GE Edge with:		
- Swing Seat		
- Captain's Seat		
- High Back Seat		
- ION Seat, Synergy Seat		
- T83 Tilt Seat		
- T83 Recline Seat		
- T83 Tilt & Recline Seat	300	X
GE Edge 2 with:		
- T83 Recline Seat		
- T83 Tilt Seat		
- T83 Recline Seat		
- T83 Tilt & Recline Seat	300	X
- T83 L/R, Tilt & Recline with Level Seat	300	X
Quantum 6000 with Synergy Seat	300	X
Quantum 6000 with Synergy Seat	300	X
Kids Up / Kids Fast with Reclining Seat	80	X
Rock 3 with Swing Seat	115	X
Rock 3 with Swing Seat	215	X
Lightbeam AF with Swing Seat	250	X

Update Jan 2017

<http://wc-transportation-safety.umtri.umich.edu/home>



Seating Systems

WC20 and Guidelines for recommended practice

- ### Seating Systems - WC20
- Seating systems often added independently to a WC frame
 - WC20 tests seating systems (seat + back support + hardware) on a surrogate WC frame (SWCF) which intentionally produces worst-case loading conditions on the seating system by the crash-test dummy
 - Applies to seating systems intended for clients weighing 51 lbs+ (about 6 yrs)
 - Also rates the seating system for:
 - Ease of achieving proper belt restraint placement
 - Optimal belt fit and belt paths

RESOURCES (available on internet)



White papers WC20:

- **Sunrise Medical**
 - <http://marketing.sunrisemedical.com/Education/GoingGreen/Seating/media/References/WC20.pdf>
- **Therafin Corporation**
 - <http://www.therafin.com/pdf/WC-20-Transit-Solution-White-Paper.pdf>
- **Q'Straint (WC18, WC19, WC20)**
 - Google for pdf

Clinical implications (WC20)

PEDIATRICS

- Custom seating inserts are extremely common!
- Explore if a tested product is available to insert onto the stroller base...
- Ex: Squiggle seat compatible with Ottobock products

Custom Seat:



Squiggle seat



Clinical implications (WC20)

Replacing a low backrest:



Sunrise Jay 3 (tested)



SUMMARY (ENGINEERING PERSPECTIVE)



Postural supports and other clinical barriers...

Engineering principles to help guide clinical practice...

Quick Tips Postural Support Devices

Headrests:

- Wheelchair head rests may help to better protect the head and neck in the event of a rear-end crash
- At least as high as the ears and close to the back of the head



Recent study:

Young, C., Tiernan, J., Bertocci, G., & Simms, C. (2016). A Model of a Wheelchair Head Restraint to Reduce the Risk of Whiplash. In *IRCOBI Conference Proceedings*.



2.5 cm distance from head to headrest... with a stiff cushion reduces risk of whiplash by 78% (even the least effective design will reduce by 58%)

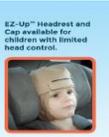
Quick Tips Postural Support Devices



AMF Bruns of America
<https://www.amfbrunsamerica.com/futuresafe.php>

"If a rear head restraint is installed in the vehicle to reduce the risk of neck injury in rear impacts, it is very important to also install a vehicle-anchored back restraint to limit rearward movement of the passenger's upper torso during rear impacts." (Schneider 2016)

Quick Tips Postural Support Devices



EZ-Up™ Headrest and Cap available for children with limited head control.

- Clients unable to maintain an appropriate posture without support: (email L. Schneider Jan 2017)
 - recline the W/C (0-30° recommended, but up to 45° is acceptable providing a good seatbelt fit across shoulder ... angle adjuster!)
 - Soft cervical collar may be introduced
 - EZ-up cap which resists forward head mvt. as a final alternative only (Merritt Manufacturing)

- Do not recommend a cervical collar (ie: to keep head upright & reduce the distance between head and headrest) unless there is a medical need (Email 2017-01-25: M.Manary UMTRI)

Quick Tips Lap Trays



- Rigid lap trays should be removed and stowed during travel when possible; otherwise a foam tray recommended as safer option
- Crash tested Foam Transportation tray is available -made of 2" high density etha-foam, with a belt to secure to the wheelchair.

– **Innovative Concepts**, 300 North State, Girard, OH, USA 44420
 ■ Tel: (330) 545-6390 or 1-800-676-5030
 ■ http://s186295877.onlinehome.us/Down%20Load/section_6.pdf

Quick Tips Lap Trays

- If cannot remove rigid lap tray, and cannot obtain a foam lap tray...
 - Ensure that the laptray is secured so that it will not break free in a crash
 - Position the inner edge 75 mm away from the clients abdomen (allow seatbelt to pass)
 - Place energy absorbing padding on the edge of the tray closest to the client's abdomen

(RESNA WC-4: 2012)

Positioning/Lap Tray Issues

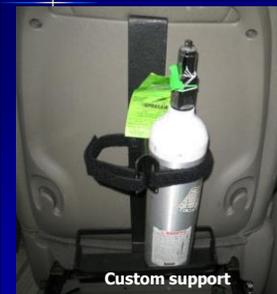


Quick Tips Oxygen Equipment

- Oxygen cylinders should be transported upright and kept away from heat sources.
- Oxygen equipment (cylinders, concentrators) should be secured to vehicle so that they will remain in place in an impact.

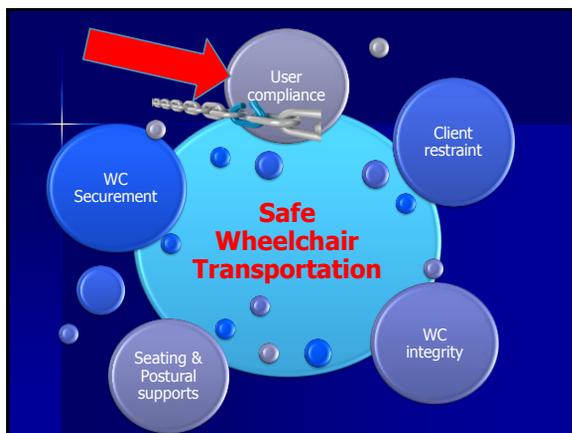
(Best practice: Secured in a manner that will resist a force 20 times the weight load of the item restrained)

Quick Tips Oxygen Transportation



Custom support





Key factors that contribute to injury

* Linda van Roosmalen, PhD. (NMEDA Feb 2010)

- Nonuse or misuse of vehicle seatbelts
- Seatbelt anchored incorrectly in vehicle
- Poor fit of seatbelts (e.g., over WC armrests and high on abdomen)
- Loosely positioned seatbelts
- Seatbelt buckle near/on hard WC components
- Non-crashworthy seat

}

DRS intervention is key!!!

Achieving proper WC securement & occupant restraint... Easier said than done!



A glimpse of reality from the Research World...

- A group of researchers* from the **National Center for the Safe Transportation of Children With Special Health Care Needs** (CSHCN) performed a study to compare real-life practice with the WC19 standard.
- In a sample of 20 personal vehicles transporting CSHCN seated in their wheelchairs, they looked at wheelchair type, WC securement, use of occupant restraints and postural challenges (positioning).

*Yonkman, J., O'Neil, J., Talby, J., & Bull, M. J. (2010). Brief Report: Transporting children in wheelchairs in passenger vehicles: A comparison of best practice to observed and reported practice in a pilot sample. *American Journal of Occupational Therapy*, 64, 804-808. doi: 10.5014/ajot.2010.09162

Study Results

Securement of WC in vehicle: Wheelchair type:

- 90% (18/20) were forward facing
- 100% of vehicles had wheelchair tiedown system installed by a mobility specialist. 😊
- 90% were using the tiedown system appropriately. 😊
- 25% (5/20) of wheelchairs met WC19 standard & were equipped with securement points (However, only 3/5 of these were secured using the designated securement points...)

However!!!

Use of Occupant Restraints:

- 30% were using only postural/positioning belts for occupant protection. 😞
- 50% were using lap/shoulder belt incorrectly. 😞
- Only 20% (4 out of 20) were using a lap and shoulder belt correctly! 😞

Study Results cont'd.

Postural Devices & Medical Equipment :

- 😞 7/20 had lap trays on their wheelchairs. 5/7 were being used during travel (not recommended), the other 2 were removed & transported unsecured in the vehicle.
- 😞 6/20 required special medical equipment for transport. In 6/6 of cases, medical equipment was not appropriately secured in the vehicle.
- 😞 25% of the CSHCN could have benefitted from additional trunk & head support (soft collar) during transport.

The authors of the study conclude;

« The results of this study demonstrate critical misuse among people using a wheelchair as a seat in a motor vehicle. »

« Because of their unique access to these patients, rehabilitation therapists such as occupational therapists have an obligation to be educated about the safe transportation of CSHCN »

(Yonkman, J., O'Neil, J., Talty, J., & Bull, M. J., 2010)



OT/DRS intervention is key !!!

Similar study was very recently completed by a group of Masters Students from McGill University in Montreal, Quebec ©

UMTRI. Wheelchair occupant studies. (Schneider et al. 2016)



"A primary reason for occupants sustaining serious-to-fatal injuries, even in minor to moderate crashes and non-crash events such as sudden braking, is a lack of use and/or proper positioning of a crashworthy lap/shoulder-belt restraint system."

"There is a critical need to continue efforts to educate vehicle modifiers, their clients, and other key stakeholder groups with regard to implementing best practice in wheelchair transportation safety, and to prescribing and using products that have been tested to, and that fully comply with, WTS standards."

« Knowledge is power »

... but it's not always easy!



From theory to clinic...

Warm-up exercise- Client 1
Final fitting remotely...
Identify 3 things you would say
to the client (on the phone) to
improve his seatbelt fit ...





Client's result after your phone
conversation... now what do you tell him?
(and his caregiver)



Client 2

Identify 3 problems with the seatbelt fit of this client...



Identify potential solutions...

Problem

Solution

The wheelchair challenge

You have determined your client needs to remain in his/her wheelchair when traveling in motor vehicles. What are your primary concerns with providing safe transportation in the following...

Concerns:



Concerns:



Solutions?



Concerns?

Rear-Impact Protection for Drivers Seated in Wheelchairs

BakkFlip



Purchased by Permobil... tested by UMTRI and suggestions for improvement were provided. Hoping for design changes and availability in the North American Market...

Pediatric Considerations

The small stature of these clients, as well as regulations regarding car seats, render kids with complex profiles especially challenging



Good examples to develop critical analysis and problem solving skills!

Norms, Guidelines and Regulations



- A good understanding of the current guidelines related to the safe transportation of babies and children is important

- Canada:  Transport Canada
(<http://www.tc.gc.ca/eng/roadsafety/safedrivers-childsafety-car-time-stages-1083.htm>)

- US:  NHTSA
(<https://www.safercar.gov/parents/CarSeats/Right-Car-Seat-Age-Size.htm?view=full>)

- As of Jan 2017, a new law in CA requires children to remain rear-facing until 2 years old! (unless the child weighs 40 or more pounds OR is 40 or more inches tall)

Transport Canada Guidelines Child Safety Seat Regulations

Motor Vehicle Restraint Systems and Booster Seat Safety Regulations (Effective January 2012)

<http://www.tc.gc.ca/eng/roadsafety/safedrivers-childsafety-index-53.htm>

It is safest to keep your child in each stage for as long as possible (Transport Canada)



<http://www.tc.gc.ca/eng/roadsafety/safedrivers-childsafety-car-time-stages-1083.htm>

When a client's (or family's) needs are not met by child safety seats available on the market...

Family seeks help



Special Needs Child Safety Seats (tested FMVSS 213)

- **Britax (Traveller plus and Snug seat)**

www.britaxusa.com



- **Carrot Seat by Convaid**

<http://www.adaptivemail.com/convaidcarrot3booster.html>



- **Merritt Manufacturing**

<http://www.merrittcarseat.com>



Special Tomato (20-150 lbs)

Be careful re: LATCH/UAS system for the bigger carseats...

- Lower anchors are rated for a **maximum weight of 65 pounds** (total weight includes car seat and child).
- Parents should check the car seat manufacturer's recommendations as well as the car user manual for maximum load capacity for lower anchors.



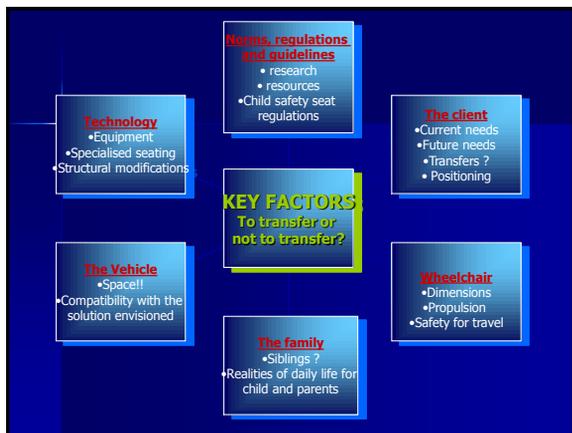
Source: <https://www.healthychildren.org/English/safety-prevention/for-the-go/Pages/Car-Safety-Seats-Information-for-Families.aspx>

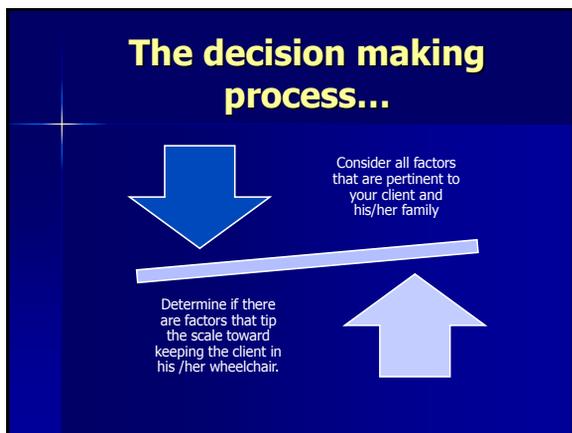
<http://www.specialtomato.com/specialtomatocarseat.html>

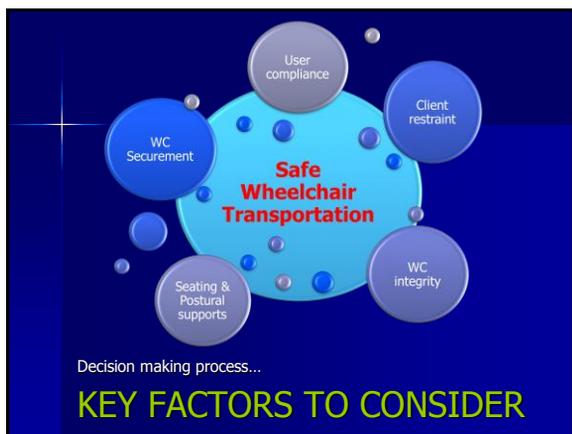
Should my client remain in their wheelchair/mobility device during travel???



A regular-market or a special needs child safety seat or booster seat should be considered as the front-line solution.









Justin

- 1. To transfer or not to transfer?
- 2. Bonus: Assuming the family has a minivan... what type of access may be a good solution to explore?





Decision making process...

Identify the barriers to WTS

Barriers to WTS for Justin?



What is the PRIMARY concern?

Zoë



Barriers to WTS for Zoë?



1. What is my first question?
2. What are my barriers?

Meet Johnny

Johnny



- **Atypical** pediatric case first seen in 2009- last intervention Jan 2017.
- Johnny was a **24 month** old boy (20 pounds) diagnosed with quadriplegia following a cardio-respiratory arrest at 3 weeks of age.
- Associated conditions include:
 - severe developmental delay, visual impairments, severe gastro-esophageal reflux (feeding tube) and dysphasia.

➡ **Completely dependant, totally adorable**

Wheelchair, Environment & Vehicle

- Johnny lives with his parents and 2 siblings (4 and 6 years old) in a bungalow
- No garage, long narrow driveway
- Honda Odyssey, 2007

Mobility device



- Recently procured Kids Rock stroller from Pediatric Seating and Mobility (53 pounds).
- Features include:
 - A tilt seating system with reclining backrest
 - Various lateral and side supports, pommel, and a head rest
 - The stroller found to be WC19 compliant with WC19 securement points and crash tested lap belt available.
 - Loading of the complete stroller is difficult for father and even more difficult for mother.

Initial analysis (in theory)...

- At 20 pounds & with parents both in good physical condition, this client should be transferred into a regular child safety seat.
- NHTSA/TC regulations: Rear facing 5-point harness
- If increased tone requires positioning within the child safety seat, an adapted carseat would be explored.
- If the loading of the stroller is problematic, explore hoist possibilities

In reality...

- Although parents can easily transfer their son, they report he does not tolerate the seated position at all, and will usually cry unless he is in their arms- Car travel was absolutely intolerable- outings only in extreme circumstances. Johnny becomes *inconsolable* as soon as he is transferred into his child safety seat.
- Validated by treating OT via on-road observation
- Treatment goals in rehab: to improve Johnny's tolerance to remain seated in his stroller
- Conclusion:
 - Despite his small stature, Johnny will remain in his stroller during travel.

Rear-entry conversion

- **Primary concern:**
 - Children this size are usually in a child safety seat with a 5-point harness and do not use vehicle seat belts (wider)- safety concern re: travel in wheelchair
 - ? Positioning of Johnny in the vehicle and appropriate placement of the seat belt to secure him properly during travel.
- Discussed concerns with rehab engineers at RERCWTS (photos shared etc)
- Validated Best Practices Guide from Transport Canada

Functional Trial at Dealer

- The positioning concern regarding seat belt was confirmed
- The shoulder belt was well-positioned over the clavicle, but the lap belt passed over Johnny's abdomen (very close to feeding portal)





- *Inappropriate placement of lap belt!*
- *?? Crash-tested lap belt integral in stroller*



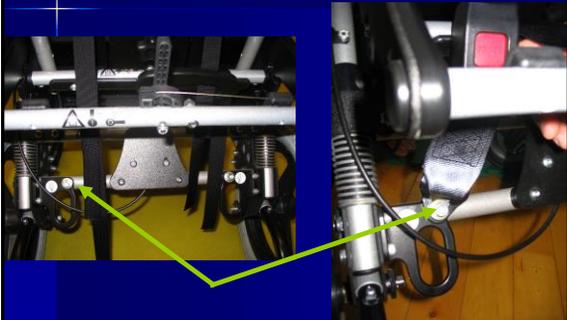
Not compliant with WC19

WC19 compliance with lap belt

- Pelvic belt in stroller was present and perfectly positioned but... no appropriate labelling
- What does « crash-tested lap belt» REALLY mean?
- Contacts with RERCWTS* and manufacturer
- Contact with Q'Straint
- Team effort

* RERCWTS = **R**ehabilitation **E**ngineering **R**esearch **C**entre on **W**heelchair **T**ransportation **S**afety

Before and after anchoring a WC19 lap belt to WC

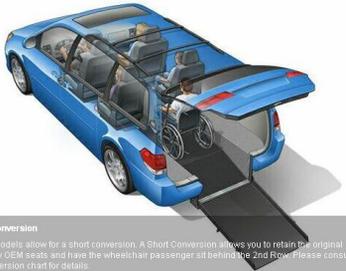


WC19 Lap belt- Final Result



Recommendation to funding agency (SAAQ-PAV)

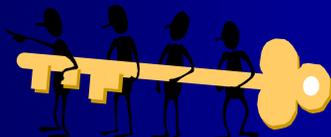
Viewpoint Conversion Options



Short Conversion
Some models allow for a short conversion. A Short Conversion allows you to retain the original 2nd Row OEM seats and have the wheelchair passenger sit behind the 2nd Row. Please consult the conversion chart for details.

Vehicle Adaptations with the Pediatric Client

- Key to success is the involvement of many players...
...the parents, treating OT, mobility specialist, rehab and safety engineers, tiedown manufacturers, WC manufacturer, vehicle modifier



Two years later...

Johnny has outgrown his WC and has just received a new one. His parents call me to discuss...

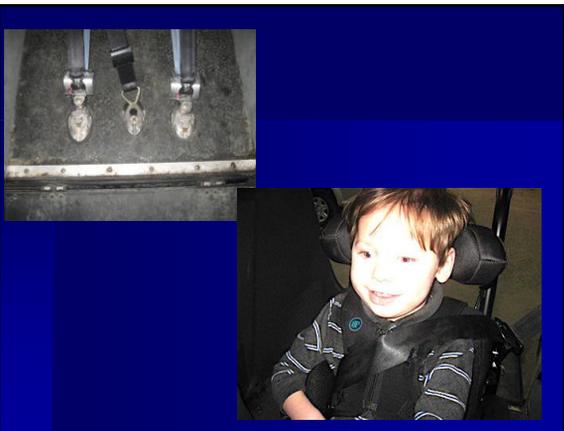
New wheelchair is ISO 7176-19 but not WC19 compliant (what does that mean?)

2012



Seat Belt Adjuster...





Another 3 years pass...

Family situation has changed...



- Mom pregnant with child #4
- Rear-entry Honda has no room for new baby
- After much exploration, decide to purchase a larger van
- Nissan 2500 is of particular interest

Exploring solutions...

5-point harness?



Anchor where?



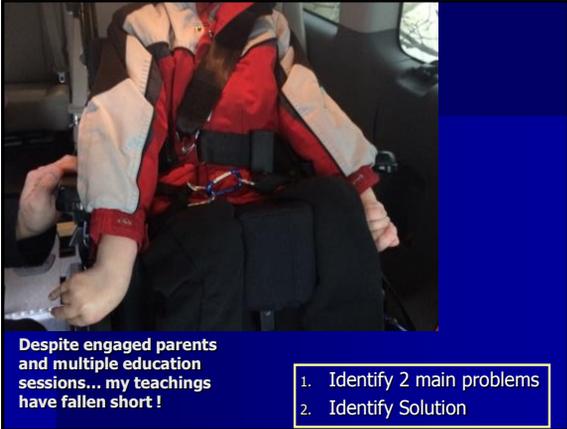
Q'Straint 3-point seems better



Anchor via OEM Seatbelt origin of seat behind Johnny...



Final fitting Jan 2017









Critical analysis of the end result...

- WC integrity ✓
- Seating ☐
- Client restraint ✓ - not perfect
- WC securement ?... ✓
- User compliance ✓ (Mom very good... Dad learning!)
- Improved protection from larger vehicle ✓

CASE STUDIES

Putting it all into practice...

Discuss the case in small groups

Work thru concerns, barriers and potential solutions with the large group

What conclusions do we reach?

Find out what really happened!

Becky



- 4 yrs old, 25 lbs, lives with both parents
- Recently discharged after spending 18 mos in hospital
- Completely dependent, Dev. Delay., does not speak
- Feeding tube, tracheostomy
- High risk for aspiration... requires suction every 15 minutes
- Severe gastro-reflux: requires slow-fed a total of 10 hrs/day
- Becky is able to sit with minimal postural support
- Parents own Honda Civic but changing for a minivan

Mobility Aid

New adapted stroller (tilt seating system):

Swiftly (by Thomashilfen)

According to the website, this adapted buggy is meets ISO-7176-19 & WC19 however it was is not listed on the UMTRI website list.



Medical Equipment

Req'd at close hand

- Suction machine
- Feeding machine,
- Emergency equipment,
- Suction apparatus,
- Medication and trach components
- Diaper bag



The task

- List 2 potential solutions to facilitate travel for this family
- What are the advantages & disadvantages (concerns or barriers) for each solution?

The final stretch...

A few extra tidbits of interest...



WC manufacturers and their labels...

Pride Mobility



Competitor: No testing ...

- **Orthofab** does not limit or exclude that the user remains seated in his wheelchair when using a road vehicle adapted for transportation (paratransit), provided the driver and the owner of the aforesaid road vehicle respects, on this subject, all legislative requirements, rules, laws, protocols, directives, norms, standards, instructions and recommendations pertaining to such use by competent authorities.

Invacare warnings:

Invacare® TDK® 19" and TDK 18 Power Wheelchair Base

WARNING!

- Only use the transport brackets included with TRACO or TRABCT for the purposes described in this manual.
- TRACO (Transport Ready Chair) - TRACO includes four factory-installed transport brackets and a wheelchair anchored pelvic belt. TRACO has been crash-tested in accordance with ANSI/ENSA WC 19.1 Section 19.1 Front Impact Test requirements for wheelchairs with a 130 to 159 kg crash test dummy, which corresponds to a person with a weight of 125 to 145 kg to 145 kg (75 kg) for junior seat sizes or a 148 kg (75 kg) crash dummy, which corresponds to a person with a weight of 145 kg (75 kg) to 200 kg (136 kg) for Adult seat sizes.
- TRABCT (Off-Wheelchair Transport Brackets) - TRABCT includes four factory-installed wheelchair transport brackets. TRABCT has not been crash-tested in accordance with WC 19. Use these transport brackets only to secure an unoccupied wheelchair during transport.

WARNING!

- As of this date, the Department of Transportation has not approved any tie-down systems for transportation of a user while in a wheelchair in a moving vehicle of any type. It is Invacare's position that users of wheelchairs should be transferred into appropriate seating in vehicles for transportation and use in made of the receptors made available by the auto industry. Invacare cannot and does not recommend any wheelchair transportation systems.
- Binary support brackets **MUST** be installed at all times. Otherwise, the wheelchair will not be WC19 compliant. Refer to the Transport section in the base user manual that was shipped with the product for more information about transporting the wheelchair.

Zone of comfort may differ from DRS to DRS... but it is important to document that you are aware of the manufacturer's warning and why you (and the client) have decided to pursue a particular plan...

The introductions to WC19 and WC20 STATE (in bold text):

“Failure of an individual’s wheelchair to comply with the provisions of this section of WC-4 (WC19, WC20) should not and cannot, under federal law, be used to limit access to, and availability of, motor vehicle transportation to wheelchair users”.
(pg 19-6 and 20-4)

Position in vehicle and vehicle mass

- Remember that larger vehicles provide extra protection to clients travelling while seated in the mobility devices
- If you can achieve a good seatbelt fit**, the center of the vehicle provides a space cushion in the event of a side impact collision. However, proper seatbelt fit should be prioritized. Usually, this requires that the upper anchor point for the shoulder be located at the rear of the vehicle and may require a long length of shoulder-belt webbing which can be less effective in frontal crashes because of more stretch during impact loading.

Keeping perspective...

Some clients will present us with MAJOR barriers to WTS...



Gabriel – at 6 years: Kyphosis causes large space between head and head support

Gabriel at 10 years:



Wheelchair not WC19 compliant, has positioning tablet and cushion to help support head

- Added foam barrier at tummy and tray blockers, ensured good seat belt fit and proper 4-pt tie down attached to wheelchair frame

Gabriel at 15:



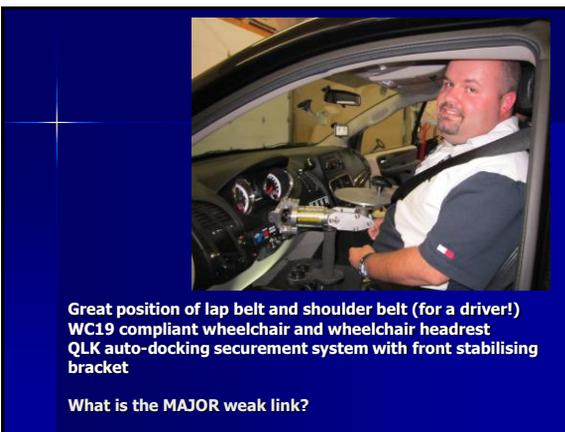
Parents returned to Montreal for a made to measure positioning.

Wheelchair has tilt seating system and is WC19 compliant









Transporting Side-lying

Client transported in a Ford Econoline van with an after-market bed installed.



Keeping perspective...



40 year old completely dependent man who is taken care of by his parents (in their 70s). Trach, feeding tube, requires suctioning every half hour...

Weak links?

Solutions for improvement:

- Sprinter (larger and safer vehicle if involved in a crash)
- Upfitted with a bench that transforms to a bed... Two 3-pt seatbelts integrated (tested)
- 5 point harness tested for racecar drivers

Weak links?
Weigh these
against the
alternatives



Keeping perspective...



Figure 2.56 - Photos of a manual WC19-compliant wheelchair and mid-sized male ATD before and after a 25-kph, 14-g rear-impact sled test

- Even WC19 compliant wheelchairs are not designed to withstand forces of a rear-impact (Schneider, 2016)

Safety issues to consider when clients travel in their mobility aid



Improving WTS

- Avoid remaining in WC if possible ✓
- Understand and consider using ANSI/RESNA WC-4 components (WC18,19,20) ✓
- Know and follow guidelines to proper WC-securement ✓
- Optimize seatbelt fit ✓
- Educate, educate, educate! ✓

Improving WTS

- Approach WTS as a SYSTEM, comprised of several elements
- Identify the weak links in your system
- Can you optimise these weak links?
- If you have to work way outside the box, validation with an expert at UMTRI is extremely helpful
- Ensure client/caregiver are aware of the weak links... document decision making process!

Final fitting required!

- You must ensure that the wheelchair is properly secured, the positioning of the seat belt is appropriate and *that the caregivers (or clients) know the importance of using the WTORS system.*
- DO NOT rely on the dealer for this- your primary responsibility is to ensure the safety of your client.

Final fitting- example

Wrap up and next steps

10.01.2017 ROUGH CUT

Interventions Toward Ensuring **IMPROVING** Wheelchair Transportation Safety

Dana Benoit MSc., erg., OT (c), CDRS
Alyssa Merilees, erg/OT, CDRS

Ottawa, Ontario
October 13th, 2017



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CENTRE DE RÉADAPTATION - REHABILITATION CENTRE

Questions ?



Thank you! Merci! 😊

Dana Benoit:
(514) 487-1891 ext: 377
dana_benoit@ssss.gouv.qc.ca

Alyssa Merilees:
(514) 487-1891 ext: 246
alyssa.merilees.clethb@ssss.gouv.qc.ca

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Fabulous resources

- UMTRI: <http://wc-transportation-safety.umtri.umich.edu/home>
- www.travelsafer.org
- **Guidelines for Use of Secondary Postural Support Devices by Wheelchair Users During Travel in Motor Vehicles**
http://www.rercwts.org/REFC_WTS2_KT/REFC_WTS2_KT_Pub/REFC_WTS_Pub_Doc/REFC_WTS_032_06.pdf

Fabulous resources: Pediatrics

- **Car Safety Seats: A Guide for Families 2017** (Copyright © 2017 American Academy of Pediatrics) <https://shop.aap.org/car-safety-seats-2017-guide-for-families-50pk-brochure/>
- **Healthy Children.org**
<https://www.healthychildren.org/English/safety-prevention/on-the-go/Pages/Car-Safety-Seats-Information-for-Families.aspx>
- **Child Passenger Safety** (Amer. Academy of Pediatrics), *Pediatrics* 2011;127:e1050;DOI: 10.1542/peds.2011-0215 (originally published online March 21, 2011)
- **National Center for the Safe Transportation of Children with Special Health Care Needs**
www.preventinjury.org
- **Transporting Infants and Children with special needs in personal vehicles: a best practices guide for healthcare practitioners**
(TP 14772 Transport Canada Jan 2008, également disponible en français)

Resources (cont'd)

Child Safety Seat Installation Help

- NHTSA Vehicle Safety Hotline (866-327-4236)
- www.seatcheck.org
- National Child Passenger Safety Certified Technicians
<http://cert.safekids.org> OR 877-366-8154
