



Hearing, Vestibular Function and CMV Driver Safety

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Current Physical Qualification Standard

- ▶ 49 CFR 391.41(b)(5) states that –
 - A person is physically qualified to drive a CMV if that person:
 - First perceives a forced whispering the better ear at not less than 5 feet with or without the use of a hearing aid or, if tested by use of an audiometric device, does not have an average hearing loss in the better ear greater than 40 dB at 500 Hz, 1,000 Hz, and 2,000 Hz with or without a hearing aid when the audiometric device is calibrated to American National Standard – Z24.5–1951



Guidance

- ▶ Federal Highway Administration – 1976
 - “FHWA concluded that hearing is important when a driver must act on emergency sounds or improper mechanical sounds and when a driver needs to communicate; noise levels are not high in all driving situations; and the literature suggests that accidents are higher among deaf drivers.”
 - “Persons who are deaf or who suffer from moderate hearing loss cannot be licensed to operate CMVs in interstate commerce.”



Key Question 1

- ▶ Are individuals with hearing loss (defined as hearing thresholds of 40 dB or greater at 500 to 3000 Hz) at an increased risk for a crash?



Previous Evidence Reports

- ▶ Hearing Disorders and Commercial Motor Vehicles – Songer et al., 1993
- ▶ 8 studies reviewed (published: 1962 – 1991)
 - 2 studies found increased risk
 - Coppin and Peck, 1964; Cook, 1974
 - 5 studies found decreased risk
 - Finesilver, 1962; Wagner, 1962; Ysander 1966; Roydhouse, 1967; Schein, 1968
 - 1 study found no difference
 - Wolf, 1991
- ▶ Concluded that evidence was inconsistent and thus no conclusion as to whether hearing loss was a risk factor for crash was drawn



Key Question 1

► Evidence Base

- 3 studies
 - Ivers et al., 1999 (cohort design)
 - Gresset et al., 1994 (case-control design)
 - McCloskey et al., 1994 (case-control design)
- Cohort study = hearing deficit vs. non-hearing deficit
- Case-control study = crash vs. non-crash



Key Question 1

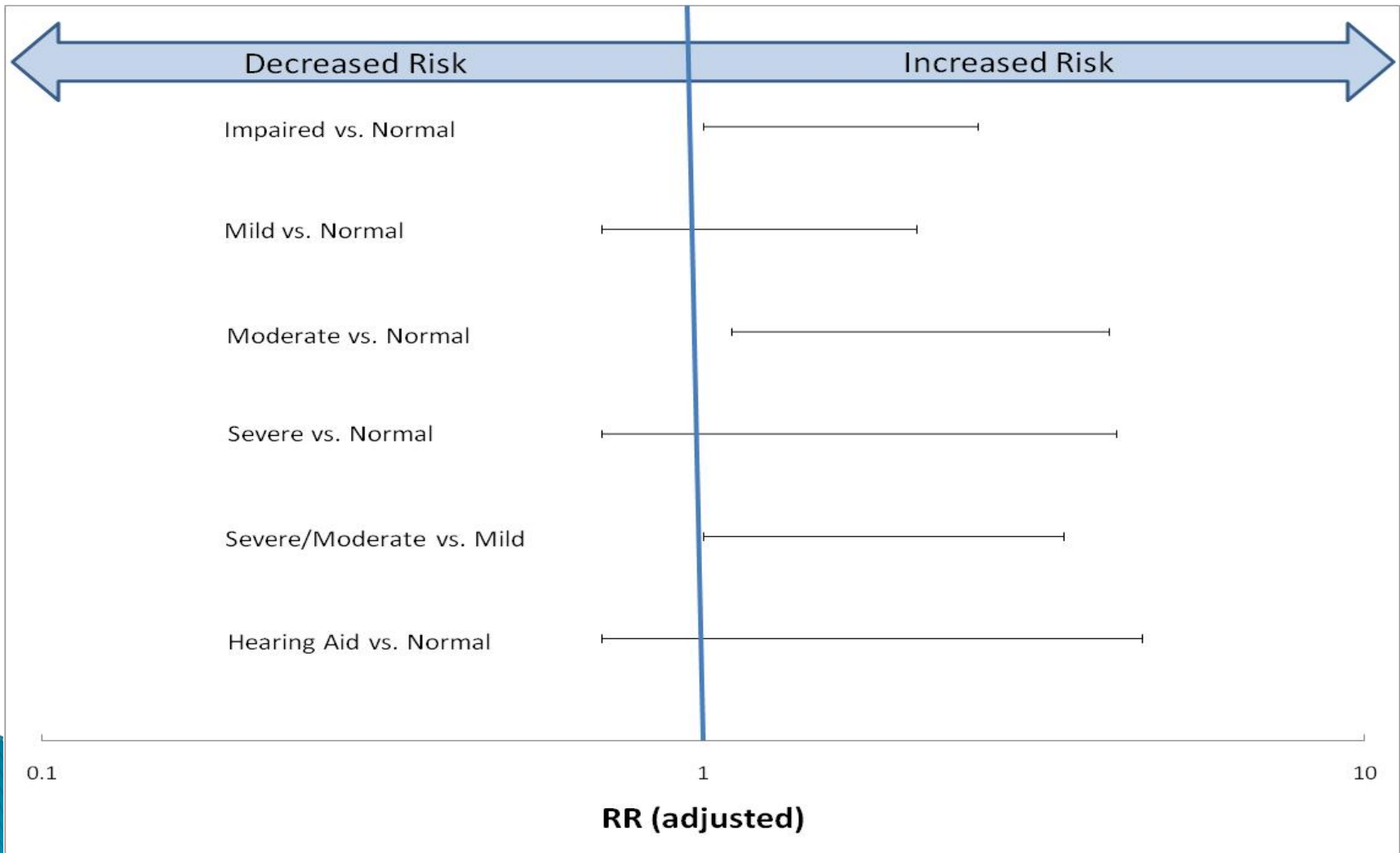
- ▶ Quality of Evidence Base
 - Ivers et al. – Low quality
 - Gresset et al. – Moderate quality
 - McCloskey et al. – Moderate quality

Key Question 1

► Findings – Ivers et al., 1999

Variable	N (%)	Age / Sex Adjusted		↑ <i>Risk</i>	Adjusted		↑ <i>Risk</i>
		OR	95% CI		OR	95% CI	
None	1444 (63.4)	1.0	Reference	NA	1.0	Reference	NA
Any hearing loss	866 (37.5)	1.4	1.0 – 2.0	Yes	1.5	(1.0 – 2.1)	Yes
Mild	559 (24.5)	1.2	0.8 – 2.5	No	1.1	0.7 – 1.7	No
Moderate	187 (8.2)	1.9	1.1 – 3.2	Yes	1.9	1.1 – 3.3	Yes
Severe	88 (3.9)	1.6	0.7 – 3.6	No	1.5	0.7 – 3.4	No
Moderate/severe vs. mild	275 (33.0)	1.5	0.9 – 2.5	No	1.7	1.0 – 2.9	Yes
Use of hearing aid	103 (6.7)	1.6	0.7 – 3.7	No	1.6	0.7 – 3.6	No

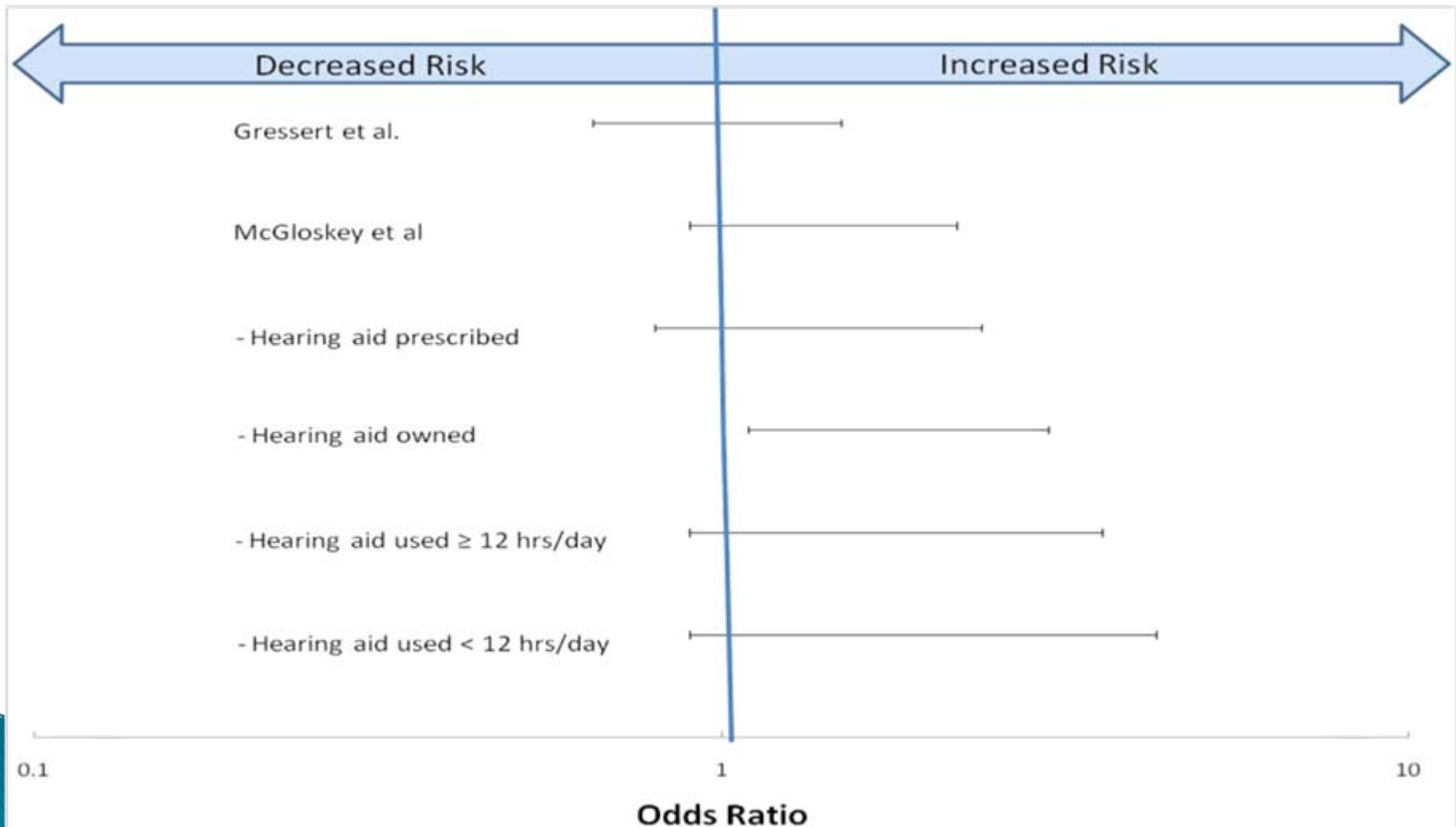
Key Question 1



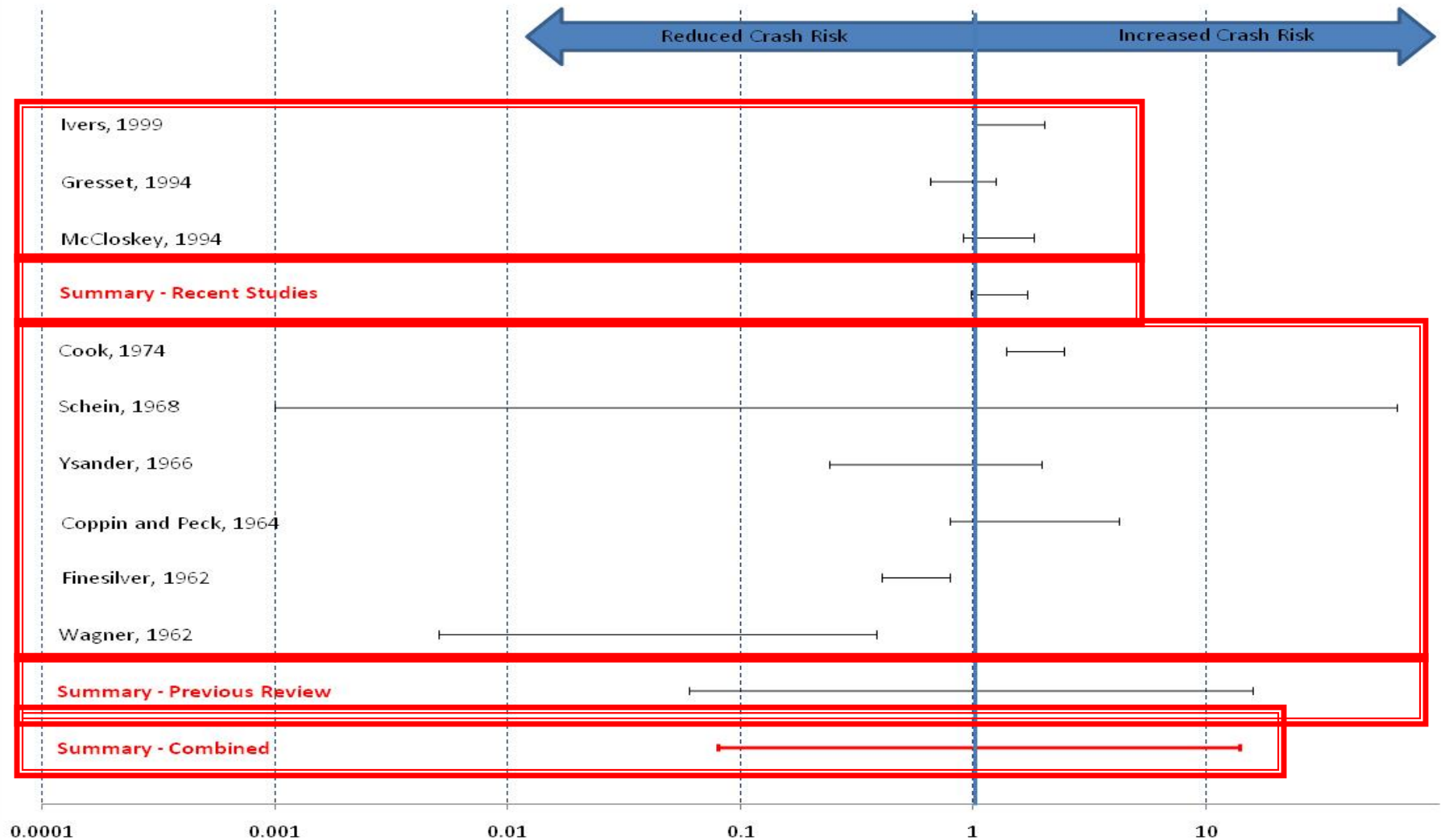
Key Question 1

Reference	Year	Condition	Crash Rate Data			
			% with condition (crashers)	% with condition (non-crashers)	Effect Size (95% CI)	↑ Risk
Gresset et al.	1994	Hearing impairments	NR	NR	OR = 0.90 (0.65–1.24)	No
McCloskey et al.	1994	Hearing impairment ever diagnosed	27.3	22.4	OR = 1.3 (0.9–1.8)	No
		Hearing aid:				
		• Prescribed	14.2	12.1	OR = 1.2 (0.8–2.0)	No
		• Owned	19.7	13.8	OR = 1.6 (1.1–2.6)	Yes
		• Used \geq 12 hours / day*	9.2	7.2	OR = 1.6 (0.9–3.0)	No
		• Used < 12 hours / day*	11.4	6.1	OR = 1.8 (0.9–3.4)	No
		• Owned and worn for driving*	13.0	8.7	OR = 1.9 (1.1–3.3)	Yes
		• Owned but not worn for driving*	8.3	5.6	OR = 1.7 (0.8–3.6)	No

Key Question 1



Key Question 1





Key Question 1

► Conclusions

- It is unclear whether individuals with a hearing deficit are at an increased risk for a motor vehicle accident
- If one takes into account the earlier findings of Songer et al. one's conclusions remain the same



Key Question 2

- ▶ Is the forced-whisper test a valid measure of hearing ability?



Key Question 2

- ▶ 4 studies
 - Lee et al., 1998
 - Browning et al., 1989
 - MacPhee et al., 1988
 - Swan and Browning, 1985
- ▶ All diagnostic cohort studies
 - Reference standard – pure-tone audiometry



Key Question 2

- ▶ Quality of studies
 - Lee et al. – Moderate
 - Browning et al. – Low
 - MacPhee et al. – Low
 - Swan and Browning – Low
- ▶ All diagnostic cohort studies
 - Reference standard – pure-tone audiometry



Key Question 2

- ▶ Sensitivity values high
 - 100.0% at 5 feet
 - 85.7 to 100.0% at 2 feet
 - Most cases of poor hearing will be detected by test
- ▶ Specificity values low
 - 32.5 to 46.4% at 5 feet
 - 62.5 to 96.0% at 2 feet
 - A large number of individuals with normal hearing will fail test (high false positive rate)



Key Question 2

► Conclusion

- The forced-whisper test is viable for screening for hearing loss (high sensitivity); however, the test suffers from a number of shortcomings that limit its value as a diagnostic tool (low sensitivity)
- Strength of evidence – Moderate



Key Question 3

- ▶ Are individuals with a vestibular dysfunction (any condition that causes dizziness and/or vertigo) at an increased risk for a crash?



Key Question 3

- ▶ 1 study
 - Cohen et al., 2003
- ▶ Study design – retrospective cohort design
 - 5 cohorts
 - 51 controls
 - 34 individuals with BPPV
 - 27 individuals with CV
 - 18 individuals with Meniere's disease from Texas
 - 30 individuals with Meniere's disease from Alabama

Key Question 3

Reference	Year	Driving Challenge	Percent of individuals having difficulty				Cases vs. Controls (p-value)	Evidence of increased driving difficulty
			Controls	BPPV	CV	Ménière's		
Cohen et al.	2003	Rain	35	36	67	40	0.024	YES
		Alone	0	26	67	29	< 0.001	YES
		Parallel parking	33	41	62	45	0.101	NO
		Left turns across traffic	4	15	46	30	0.001	YES
		Freeway driving	12	15	67	26	0.011	YES
		High traffic local roads	13	13	58	33	0.022	YES
		Rush hour driving	21	19	59	31	0.004	YES
		Night	22	37	73	57	0.002	YES
		Parking spaces	10	15	44	21	0.037	YES
		Changing lanes	12	18	59	30	0.007	YES
		Staying in lane	2	12	44	17	< 0.001	YES
		Traffic checks	4	26	52	33	< 0.001	YES
		Ramped garages	10	29	61	35	0.003	YES
		Pulled off the road due to vertigo	0	14	36	35	< 0.001	YES



Key Question 3

- ▶ What about crash risk?
 - Authors did not present data
 - However they stated the following:
 - *Individuals with vestibular dysfunction reported slightly fewer incidents of being pulled over by the police, and few actual crashes, at a rate that did not differ from normal subjects*



Key Question 3

► Conclusion

- The best available evidence suggests that individuals with vestibular dysfunction experience difficulty in driving; however, evidence is insufficient to determine whether these difficulties translate into an increased crash risk



Key Question 4

- ▶ How long after the most recent episode of vertigo until it is safe to drive?



Key Question 4

- ▶ No studies met inclusion criteria
- ▶ No evidence-based conclusions drawn



Key Question 5

- ▶ Which treatments have been shown to effectively treat individuals with Meniere's disease (or other vestibular diseases that cause dizziness)?






Key Question 5

- ▶ 8 studies (4 systematic reviews + 4 RCTs)

Reference	Year	Type of study	Dietary Manipulations	Diuretics	Anti-emetic, Anti-nausea, Anti-vertigo Drugs	Ototoxic Antibiotics	Surgery
Thirlwall et al.	2006	SR		✓			
Cohen-Kerem et al.	2004	SR				✓	
Stokroos et al.	2004	RCT				✓	
Diamond et al.	2003	SR				✓	
Mira et al.	2003	RCT			✓		
James et al.	2001	SR			✓		
Thomsen et al.	1986	RCT					✓
Futaki et al.	1975	RCT			✓		
Totals =			0	1	3	3	1

Key Question 5

	Diuretics	Anti-emetic, Anti-nausea, Anti-vertigo Drugs		Ototoxic Antibiotics	Surgery
		Betahistine	Diphenidol	Intratympanic Gentamicin	Endolymphatic Sac Shunt Surgery
Vertigo Control	 *	 **	?	?	?
Hearing	 *	?	?	?	?



Summary