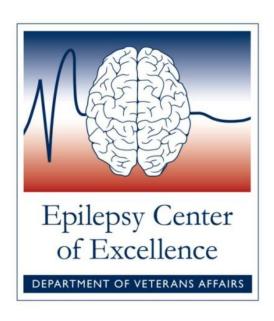


Driving and Epilepsy

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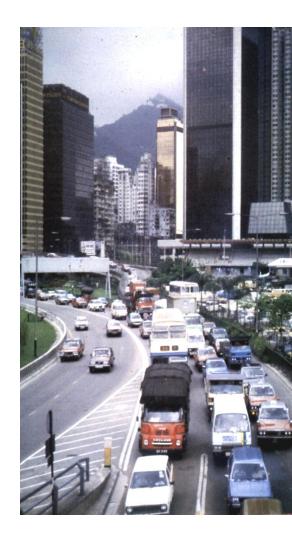
Driving and Epilepsy

- Significance of driving for people with epilepsy and others
- History of restrictions on driving by people with seizures
- Driving risk of seizures
- Laws and regulations governing drivers with seizures
- Physician's role



USA: Importance of Driving

- More cars and trucks than people of driving age.*
- In 1969, 30% of two adult households had two or more cars; in 1990 it was up to 76%*
- Only 8% of US households have no vehicles*
- Of workers, 73% drive themselves to work and 13% carpool (only 5% use public transport.)*
- Of 180 million Americans licensed to drive, 700,000 have epilepsy



^{*}Bureau of Transportation Statistics-2003

Driving and Epilepsy: Affects

People with epilepsy and seizures

State and federal regulators

Health Providers (Physicians)

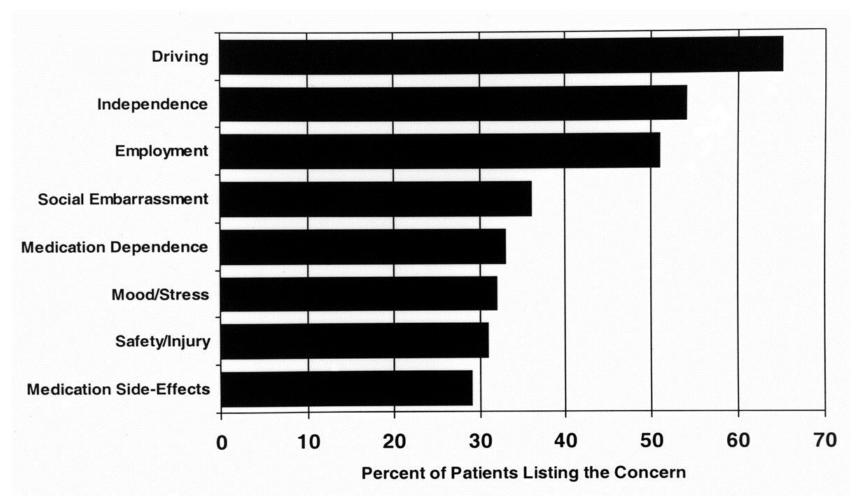
Public

Epilepsy and Driving: Patient Concerns

Social function **Employment Psychological** function (selfesteem)



Driving: major listed concern of people with epilepsy

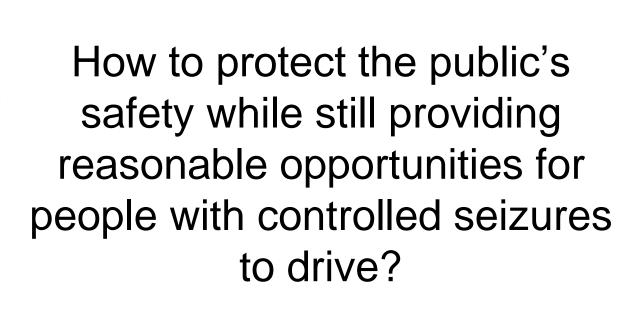


Epilepsy and Driving: Physician Concerns

- Advisors to patients
- Information for regulators
- Consultants to regulators
- Legal jeopardy



Epilepsy and Driving: the Dilemma



History of Driving and Epilepsy

- Late 1800s Automobiles introduced
- 1906 First automobile crash and death due to a seizure
- Therefore when licenses become obligatory for driving a car, people with epilepsy or seizures are excluded.



Figure 4: Panhard-Levassor, 1891, the first vehicle with an internal-combustion engine mounted at the front of the chassis.

History of Driving and Epilepsy -2

- 1940s- With introduction of the EEG and phenytoin, epilepsy better understood and potentially "curable"
- 1949 –Wisconsin is the first state to permit some people with controlled seizures drive an automobile.



History of Driving and Epilepsy -3

- 1970s All US states grant licenses to some people with epilepsy or seizures
- 1980s to today Trend to liberalize restrictions on driving and epilepsy in the US and worldwide.



Driving and Epilepsy-2014

- USA- all states permit driving by some people with epilepsy, but standards and rules vary widely.
- European Union- has adopted the standard of an one year seizure-free interval
- India, Brazil, and Russia- prohibit driving for all with epilepsy



Risk of Driving with Seizures



Risk of Driving with Seizures and Epilepsy

- Seizures while driving*
- Crashes due to seizures while driving*
- Deaths due to seizures while driving*
- Sedative effects of antiepileptic medications impairing driving
- Crash rates in drivers with epilepsy**

Risks

- "Acceptable Risks" are hard to agree upon

 (e.g.) Prior to the hurricane Katrina, the risk
 of New Orleans' levees failing was 1 every 200
 years or more and it was accepted, but in 2005
 when it really happened, it was an
 unacceptable risk.
- "Accepted Risks" are part of our lives and can be measured and compared, even when they may seem unacceptable.



The Bubble Boy – Motion Picture Film 2001

Risk Assessment

Situation

Motorcycling **Smoking** Influenza Auto driving (UK) Leukemia Drinking (1btl wine/day) Struck by auto Taking contraceptive pills Floods Earthquake (California) Lightening (UK) Release from a nuclear reactor

Death/Person/Year(Odds)

1 in 50

1 in 200

1 in 5,000

1 in 5,900

1 in 12,500

1 in 13,300

1 in 20,000

1 in 50,000

1 in 45,000

1 in 588,000

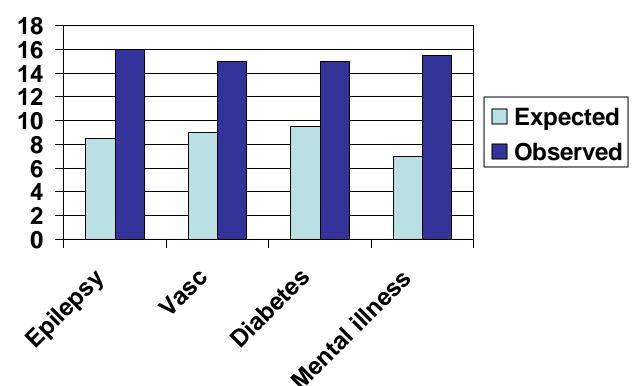
1 in 10 million

1 in 10 million

Risk of Driving with Seizures and Epilepsy

- Seizures while driving*
- Crashes due to seizures while driving*
- Deaths due to seizures while driving*
- Sedative effects of antiepileptic medications impairing driving
- Crash rates in drivers with epilepsy**

Comparative Risk of Driving Accidents for People with Epilepsy* (~2X expected)

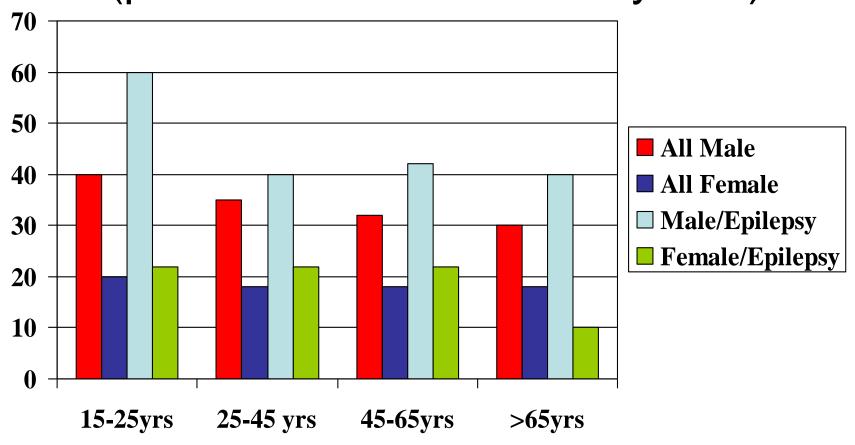


*Known to MVA as drivers with epilepsy complying with rules Majority of crashes related to driver error and not medical impairment

Hansiota et al., NEJM 1991

Crash Rates by Age and Sex for Epileptic Drivers

(per 100 drivers over 10 years)



Washington State 1967-1976

Risk of Driving with Seizures and Epilepsy

- Seizures while driving*
- Crashes due to seizures while driving*
- Deaths due to seizures while driving*
- Sedative effects of antiepileptic medications impairing driving
- Crash rates in drivers with epilepsy**

Comparative Risks (Traffic Accidents)

1/10,000 related to epilepsy*

1,000/10,000 related to alcohol*

 6/10,000 related to sudden cardiac death behind the wheel

Risk of Crashing Due to Seizures*

- Of 367 patients with intractable seizures presenting as candidates for epilepsy surgery, 115 (31%) had driven in the last year and 237 (65%) had ever been licensed to drive.
- 144 (39%) had a seizure while driving and 98 (27%) had a crash due to a seizure
- Of drivers with crashes due to seizures, 80% reported only 1; 10%, 2; and 10%>3.
- 94% of crashes involved property damage; 32% moderate or severe medical injuries to the driver; and 20% moderate or severe injuries to others; no deaths

Risk of Driving with Seizures and Epilepsy

- Seizures while driving*
- Crashes due to seizures while driving*
- Deaths due to seizures while driving*
- Sedative effects of antiepileptic medications impairing driving
- Crash rates in drivers with epilepsy**

Comparative Risks (Traffic Deaths)*

1 per 10,000 related to epilepsy

4,000 per 10,000 related to alcohol

Problems and Risks of Restricting Drivers with Epilepsy

- Loss of employment
- Social consequences
- Psychological consequences
- Noncompliance with regulations

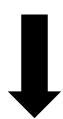
Noncompliance with Driving Regulations

 40% to 60% of patients with epilepsy who drive do not report this condition to authorities.



Harsher restrictions = Lower compliance





Less harsh restrictions = Higher compliance

French Seizure Clinic Study of 400 Drivers with Epilepsy*

- > Weekly seizures reported by 23% of drivers
- > Monthly seizures reported by 46% of drivers
- 33% report a seizure while driving
- 17% reported a crash due to a seizure while driving
- 2 deaths due to seizure related crashes

*Gastaut and Zifkin, Neurology 1987 (study conducted at a time that driving by people with epilepsy was severely restricted in France)

Sometimes risk is predictable



Factors Predictive of Seizure Recurrence Risk

- Recent history of seizure control
- Type of seizures or epilepsy
- Total number of seizures
- Associated neurological deficits
- EEG abnormalities
- MRI/CT lesions

Conclusion: Epilepsy and Driving

- Public safety risks not unacceptably high
- Individual risks elevated but similar to other less regulated medical disorders, and much less than alcohol
- Seizure-related crashes potentially predictable and preventable
- Restricting drivers with epilepsy is appropriate, but optimal restriction have not prospectively validated

Krumholz, JAMA 1991

Rules for Driving with Epilepsy



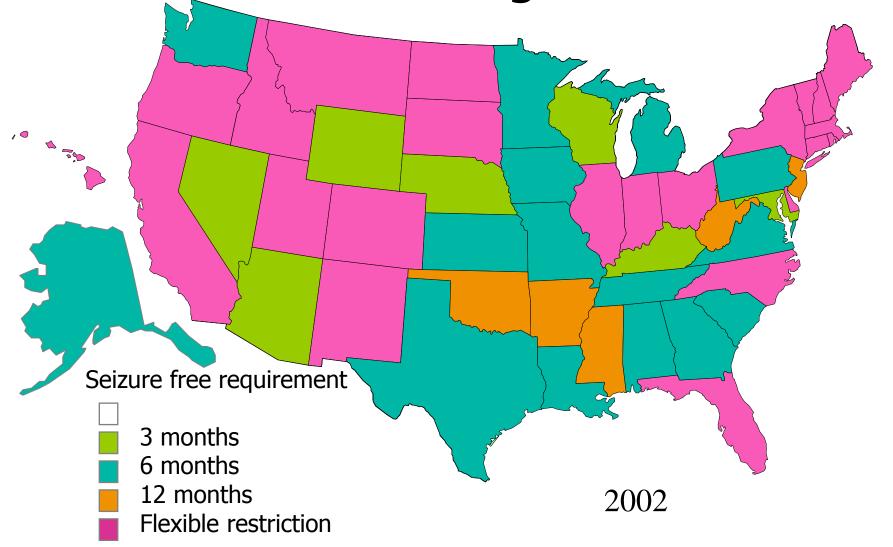
Rules Determining Driving for the Person with Epilepsy in the USA

- Federal laws
- State laws*
- State Motor Vehicle Department regulations*
- State policies, procedures, and practices
- State or Federal case or common law

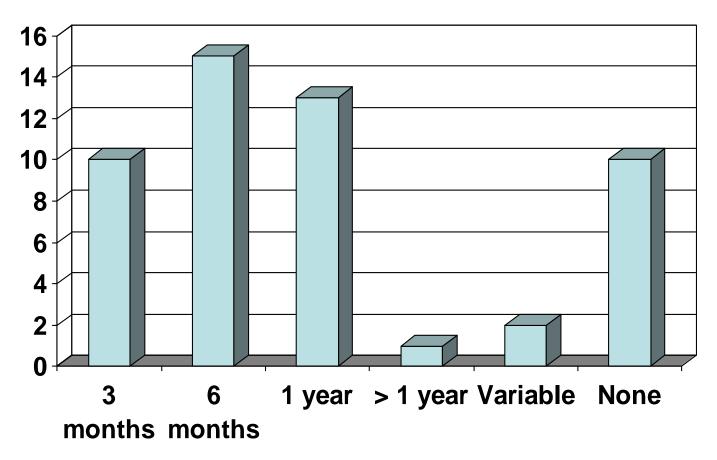
Varied State Rules and Regulations

- Seizure-free interval*
- Physician mandatory reporting
- Physician immunity for reporting or advising motor vehicle administration
- Mitigating circumstances (e.g. physician recommended reduction of meds or 1st sz)
- Commercial intrastate drivers

Seizure-free restrictions for noncommercial driving: U.S. states

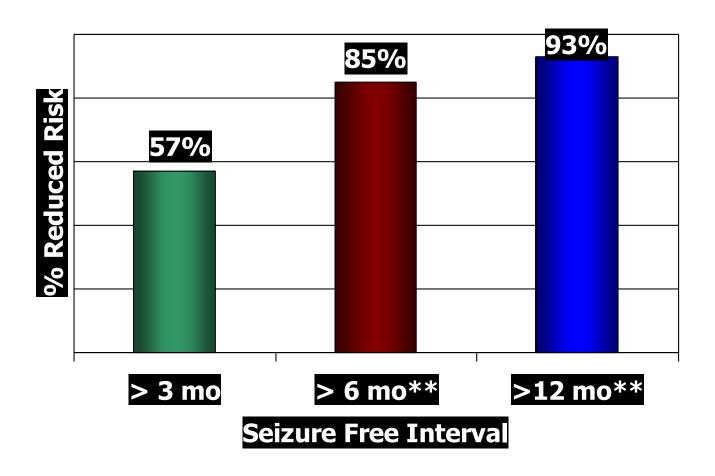


Seizure-Free Requirement (# of States in USA)



Based on 2001

Crash risk decreases progressively with longer seizure-free intervals



Note: seizure-free cutoffs are from separate multivariate models of crash odds

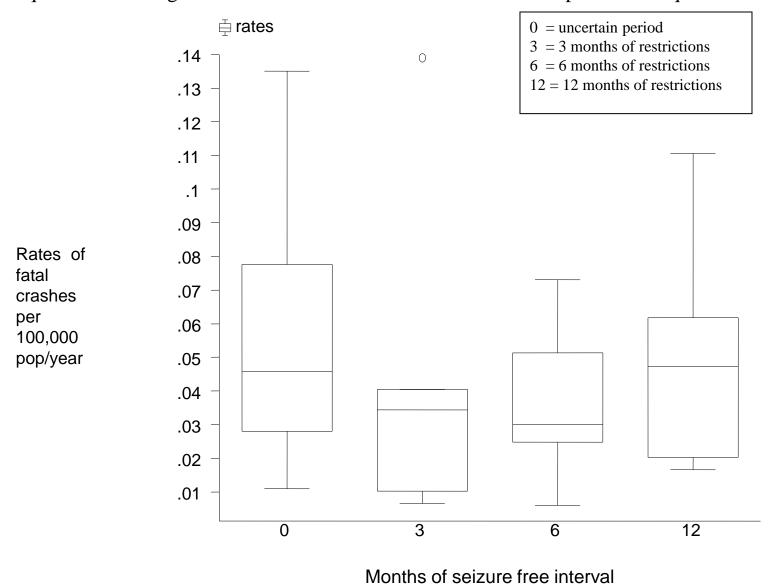
**p<0.05

Potential tradeoffs: seizure-free intervals*

1 yr sz-free = eliminates 80% of crashed drivers but also 50% not crashing lose driving privilege

3 mos sz-free = eliminates 50% of crashed drivers and only 25% not crashing lose their driving privilege

Whisker-box plots for rates of fatal crashes according to months of seizure free intervals required for driving laws in different states in US. 0 indicates no particular requirement.



Seth, 2004

Noncompliance with Driving Regulations

 40% to 60% of patients with epilepsy who drive do not report this condition.

Harsher restrictions = Lower compliance

Less harsh restrictions = Higher compliance

AAN, AES, EF Consensus on Driving and Epilepsy (1991)*

- A seizure-free interval should be stated: 3 months is preferred.
- Both favorable and unfavorable modifiers modifiers could alter this interval (individualized determinations)
- Physicians should not be required to report patients to the DMV (physician immunity)
- Patients should be responsible to selfreport

Epilepsia, 1994

Mandatory Physician Reporting States

- California
- Delaware
- Nevada
- New Jersey
- Oregon
- Pennsylvania



Give it to me straight Doc. How long do I have to ignore your driving advice?

Mandatory Reporting of Epilepsy or Seizures

- Not clear that mandatory reporting reduces crash risk, but some recent evidence supports that it does for many medical conditions - not just epilepsy*
- Even in jurisdictions with mandatory reporting, it may be inconsistent
- Interferes with patient/physician communication, honest reporting of seizures, and optimal treatment

^{*} Redelmeier et al,. NEJM 2012;367:1128-36

Physician warnings for unfit drivers and the risk of trauma from road crashes*

- Encouraged by Ontario (Canada) financial incentives (\$36) to warn and report
- Over 100,000 patients reported followed for 4 years
- 45% reduction in annual crashes in the subsequent 1 year for drivers with alcoholism, epilepsy**, dementia, sleep disorders, fainting, stroke, diabetes, depression
- Adverse patient effects 1. significant increase in depression, 2. compromise doctor/patient relationship, 3. still does not reduce patient crash risk to that of the general population

^{*} Redelmeier et al, NEJM 2012;367:1128-36

Consensus Statement (AAN, AES, EFA) (1991)- Modifiers

Favorable:

- 1. Seizure during medically directed medication change
- 2. Seizures related to a reversible acute illness
- 3. Simple partial seizures that do not interfere with consciousness or motor function
- 4. Seizures with persistent prolonged auras
- 5. Purely nocturnal seizures
- 6. Sleep deprived seizures

Consensus Statement (AAN, AES, EFA) (1991)- Modifiers

Unfavorable

- 1. Noncompliance with medication, medical visits and/or lack of credibility
- 2. Recent alcohol or drug abuse
- 3. Prior bad driving record
- 4. Prior crashes due to seizures
- 5. Frequent seizures after seizure-free interval

Driving and Epilepsy: Recommendations for MDs

- Be familiar with and follow state rules and regulations
- Notify patient of those rules and their risks
- Document discussion of rules with patient in records
- Refer patients to other resources such as the Epilepsy Foundation for further support and advice
- Support clarification, improvements, scientific study and validation of the systems used and rules applied

Public Policy Solutions

- Improve transportation alternatives to cars for
- impaired drivers- Public Transportation.
- Smart cars and highways (Google)







 Improve and use crash and mortality data systems to monitoring risks and assess effectiveness of

rules and regulations



