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The Contribution of Medical Conditions to Passenger Vehicle Crashes

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16. Abstract

Objective- There is a growing concern about risks associated with driving for people with known medical conditions. However, the association between having a chronic medical condition and being involved in a motor vehicle crash remains controversial. This analysis aims to identify crashes that have been precipitated by medical emergencies or other medical conditions while driving.

Method- This report provides a retrospective analysis of the National Motor Vehicle Crash Causation Survey (NMVCCS). NMVCCS was a nationwide survey of crashes that occurred between 6 a.m. and 12 a.m. in the period from July 3, 2005, to December 31, 2007. NMVCCS was limited to crashes involving light passenger vehicles to which EMS had been dispatched.

Results- The percentage of drivers in crashes precipitated by their medical emergencies while driving are relatively rare and account for only 1.3 percent of all drivers that have been included in NMVCCS. Older drivers have relatively higher incidences of crashes precipitated by drivers' medical emergencies when compared to young and middle-age drivers.

Eighty-four percent of the drivers in crashes precipitated by medical emergencies experienced seizures, blackouts, or diabetic reactions prior to the crashes. Drivers or surrogate responses to questions about general health, use of medications, and feelings on the day of the crash suggest that most of the drivers were aware of the medical conditions associated with the crash. Drivers in crashes precipitated by medical emergencies were more likely than other drivers to be more severely injured or to die as a result of the crashes. An estimate of 62 percent of the drivers who had crashes precipitated by medical emergencies were involved in single-vehicle crashes compared to an estimate of only 17 percent of the other drivers In an estimate of 85 percent of the drivers who had crashes precipitated by medical emergencies, the driver was the only occupant in the vehicle compared to an estimate of 69 percent of the other drivers. An estimated 69 percent of the drivers who had crashes precipitated by medical emergencies departed the roadway before the collision compared to only 17 percent of the other drivers. Drivers who had crashes that have been precipitated by medical emergencies were more likely to be involved in crashes during the morning hours between 6 a.m. and 11:59 a.m. when compared to other drivers.

Conclusion- This analysis suggests that crashes precipitated by drivers' medical emergencies are not related to vehicle design or roadway integrity as indicated by the type of crashes and manner of collisions. Patient education by health care providers on early warning signs of a health crisis, such as warning signs before seizure attacks, diabetic or hypoglycemic comas, and potential side effects of medications are recommended as the most effective countermeasure. In addition to patient education, other safety technologies such as the Drowsy Driver Warning System can help in reducing the risk of crashes precipitated by medical emergencies. As indicated in this report, in most cases of the crashes that have been precipitated by medical emergencies, the drivers departed the roadway. A lane departure prevention system can help detecting by positional information of a vehicle with respect to a lane of travel and alert drivers to correct their positioning on roadway.

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EXECUTIVE SUMMARY

Objective: There is a growing concern about risks associated with driving for people with known medical conditions. However, the association between having a chronic medical condition and being involved in a motor vehicle crash remains controversial. This analysis aims to identify crashes that have been precipitated by medical emergencies or other medical conditions while driving.

Method: This report provides a retrospective analysis of the National Motor Vehicle Crash Causation Survey (NMVCCS). NMVCCS was a nationwide survey of crashes that occurred between 6 a.m. and 12 a.m. in the period from July 3, 2005, to December 31, 2007. NMVCCS was limited to crashes involving light passenger vehicles to which emergency medical services had been dispatched.

Results: Incidences of drivers who had crashes precipitated by their medical emergencies while driving are relatively rare and account for only 1.3 percent of all drivers that have been included in NMVCCS. Older drivers have relatively higher incidences of crashes precipitated by drivers' medical emergencies when compared to young and middle-age drivers.

Eighty-four percent of the drivers in crashes precipitated by medical emergencies experienced seizures, blackouts or diabetic reactions prior to the crashes. Drivers or surrogate responses to questions about general health, use of medications and feelings on the day of the crash suggest that most of the drivers were aware of the medical conditions associated with the crash. Drivers in crashes precipitated by medical emergencies were more likely than other drivers to be more severely injured or to die as a result of the crash. An estimate of 62 percent of the drivers in crashes precipitated by medical emergencies were involved in single-vehicle crashes compared to an estimate of only 17 percent of the other drivers In an estimate of 85 percent of the drivers in crashes precipitated by medical emergencies, the driver was the only occupant in the vehicle compared to an estimate of 69 percent of the other drivers. An estimated 69 percent of the drivers in crashes precipitated by medical emergencies departed the roadway before the collision compared to only 17 percent of the other drivers. Drivers in crashes that have been precipitated by medical emergencies were more likely to be involved in crashes during the morning hours between 6 a.m. and 11:59 a.m. when compared to other drivers.

Conclusion: This analysis suggests that crashes precipitated by drivers' medical emergencies are not related to vehicle design or roadway integrity as indicated by the type of crashes and manner of collisions. Patient education by health care providers on early warning signs of a health crisis, such as warning signs before seizure attacks, diabetic or hypoglycemic comas and potential side effects of medications are recommended as the most effective countermeasure. In addition to patient education, other safety technologies such as Drowsy Driver Warning System can help in reducing the risk of crashes precipitated by medical emergencies. As indicated in this report, in most cases of the crashes that have been precipitated by medical emergencies, the drivers departed the roadway. A lane departure prevention system can help detecting positional information of a vehicle with respect to a lane of travel and alert drivers to correct their positioning on roadway.

OBJECTIVE

This analysis aims to identify and describe crashes that have been precipitated by drivers' medical emergencies while driving.

INTRODUCTION

Chronic diseases have high prevalence rates among Americans. According to the Centers for Disease Control and Prevention, in 2005, 133 million Americans lived with at least one chronic condition.[2] As a result, there is a growing concern related to risks associated with driving for people with known medical conditions. However, the association between having a chronic medical condition and being involved in a motor vehicle crash remains controversial.[3] For example; earlier studies suggest that diabetic drivers have increased crash risks while other studies found no significant differences.[1] Similar to diabetes, earlier studies showed a significant increase in crash risk among drivers with epilepsy. However, recent studies suggested that drivers with known epilepsy are not at higher risk of car crashes due to the usage of improved medications for controlling seizures. On the other hand, studies suggest that treatment with anti-epileptic drugs can impair cognitive performance.[1]

In 2005, the National Highway Traffic Safety Administration[1] conducted a comprehensive review of research on the effects of medical conditions on driving performance. The NHTSA report provided information on the effects of medical and functional conditions on driving performance such as vision, hearing, cardiovascular diseases, cerebrovascular diseases, peripheral vascular diseases, diseases of the nervous system, respiratory diseases, metabolic diseases, renal diseases, musculoskeletal disabilities, psychiatric diseases, drugs, and the effects of anesthesia and surgery. The report also provided driving guidelines from Canada and Australia for the conditions or illnesses.

This current analysis aims to present the incidence and distribution of crashes that have been precipitated by drivers' medical emergencies. The results in this report include incidence of crashes by the driver's age, gender, general health status, crash time of day, crash type and outcome.

METHODS

This report provides a retrospective analysis of the National Motor Vehicle Crash Causation Survey (NMVCCS).[4 5] NMVCCS was a nationwide survey of crashes that occurred between 6 a.m. and 12 a.m. in the period from July 3, 2005, to December 31, 2007. NMVCCS was limited to crashes involving light passenger vehicles to which EMS had been dispatched.

Each investigated crash involved at least one light passenger vehicle that was towed due to damage. Data was collected on at least 600 data elements to capture information related to the drivers, vehicles, roadways, and environment.[4 5] The NMVCCS researchers had a unique arrangement with local law enforcement and emergency responders who granted them permission to be on the scenes of the crashes. Each researcher on the scene was in an ideal position to gather timely, first-hand information related to the vehicle, the roadway, the environmental conditions, and human behavioral factors.

The selection of crashes for the NMVCCS was accomplished through a multistage sampling procedure. At each stage, samples were drawn with unequal probability based on the size of the sampling unit (PSU, time intervals, etc.), as estimated from the historical data. NMVCCS cases have case weights that give the statistical sampling weight of the case for national representation.[4 5]

Stages of NMVCCS sampling procedure:
First Stage: Geographic areas called primary sampling units (PSUs) were selected. The United States has been divided into 1,195 PSUs where each PSU is comprised of a central city, a large county, or a group of contiguous counties. The PSUs are grouped into 12 categories or strata described by a combination of geographic region (Northeast, Midwest, South, and West) and the extent of urbanization (central city, large county, and group of counties). Two PSUs were selected from each stratum (category) with a probability proportional to the 1983 population of the PSU. In order to use the NASS infrastructure, the same set of PSUs was selected as in the National Automotive Sampling System (NASS) Crashworthiness Data System (NASS-CDS).

Second Stage: A 6-hour time interval was selected between 6 a.m. and midnight during which the researchers in a selected PSU monitored the EMS/police radio frequencies to be able to reach the crash scene before it was cleared. The selection at this stage was done according to the sampling procedure, "systematic probability proportional to size," where the size was the number of crashes that occurred during the same time interval in the previous year as coded in NASS-CDS.

Third Stage: Each week four days were selected from the selected time interval during which the researchers in the PSU responded to crashes. This selection used the same procedure as the second stage, although the size was the number of crashes that occurred on the same day in the previous year as coded in NASS-CDS.

NMVCCS had strict guidelines for a crash to qualify for an on-scene investigation. Only crashes that occurred between 6 a.m. and midnight were considered for possible investigation. In order to facilitate the timely collection of on-scene crash data, a determination had to be made by the NMVCCS researcher as to whether a crash qualified to be included in the study. Taking into consideration the operational and statistical issues, NHTSA set the following criteria that a crash must meet in order to qualify for an investigation:

1. The crash must have resulted in a harmful event associated with a vehicle in transport on a trafficway.
2. EMS must have been dispatched to the crash scene.
3. At least one of the first three crash-involved vehicles must have been present at the crash scene when the NMVCCS researcher arrived.
4. The police must have been present at the scene of the crash when the NMVCCS researcher arrived.
5. At least one of the first three vehicles involved in the crash must have been a light passenger vehicle that was towed or would be towed due to damage.
6. A completed police accident report for this crash must have been available.

The priority at the scene of the crash was to conduct interviews of people involved in the crash, as well as witnesses and surrogates for the drivers who could not be interviewed due to injuries or other reasons. The objective of the interview was to obtain information about the driver's perception of the pre-crash event environment and the events leading up to the crash, as well as crash configuration and any crash avoidance actions taken. Questions were related to the driving trip, emotional state, fatigue, driving experience, vehicle-related factors, and factors related to the roadway and environment. Vehicle assessment and evaluation of the roadway infrastructure and conditions were performed where necessary. Driver-related data including distractions and recognition or decision errors were documented.

The NMVCCS data embodies pre-crash assessment of crashes in terms of the critical event, critical reasons, and associated factors. However, none of these is suggestive of the cause of the crash or an assignment of the fault to the driver, vehicle, or environment. Therefore, care needs to be taken in interpreting the results of the exploratory and descriptive analyses of the data or of the clinical investigation. NMVCCS only collected data on crashes that met the survey criteria. For this reason, estimates obtained from NMVCCS should not be compared with those from other databases such as NHTSA's NASS General Estimates System or the NASS Crashworthiness Data System.

In NMVCCS, medical conditions are coded if they are major and had the potential for influencing the performance of the driving task.

Different medical conditions are coded in NMVCCS according to the following criteria:

Heart attack
Used when the driver has a medically verified heart attack during the precrash phase.

Seizure (related to diagnosed epilepsy)
Used when the driver has a medically verified epileptic seizure during the precrash phase.

Seizure (other source)
Used when the driver has a medically verified seizure that is not related to epilepsy, during the precrash phase.

Blackout (diabetes-related)
Used when the driver has a blackout during the precrash phase and this event can be traced to a medically diagnosed diabetic condition (e.g., driver blacks out as a result of insulin shock or high/low blood sugar level).

Blackout (other source)
Used when the driver has a blackout during the precrash phase and this event is not related to a diabetic condition.

Other
Used when the driver experiences an illness or physical symptoms that is not described in preceding elements.

Other physical conditions such as hearing impairment, vision impairment, sleep apnea, paraplegia, quadriplegia, and use of prosthetic limb are not included in this analysis.

There were 138 (unweighted) drivers where the immediate critical reason (i.e., closest in time to the critical pre-crash event) for the event was identified as physical impairment of the ability to act. Crash description files for the 138 cases were further reviewed to identify the specific medical conditions that precipitated the crashes.

When reviewing the crash description files, drivers who suffered from diabetic reactions, hypoglycemia, or hyperglycemia were grouped as "Diabetic Reaction." Drivers who suffered from seizure, epilepsy were grouped as "Seizure." Drivers who suffered from dizziness, fainting spills, brief loss of consciousness or blackout were grouped and presented in this report as "Blackout."

This analysis provides estimated incidence rates of drivers who had crashes precipitated by medical emergencies and compare the results to other drivers without medical emergencies.

RESULTS

In the period July 3, 2005, to December 31, 2007, an estimated 49,868 drivers were reported to have been involved in crashes precipitated by drivers' medical emergencies. This accounts for an estimate of about 20,000 drivers annually at an estimated incidence rate of 1.3 percent of all drivers in NMVCCS crashes.

DRIVERS' PROFILE

Type of medical conditions

As shown in Table 1, seizures were the most frequently reported medical condition among drivers in crashes that have been precipitated by medical emergencies, accounting for 35 percent of all reported medical conditions in NMVCCS. Blackouts due to a variety of reasons such as side effects of medications, transient ischemic attacks (brief loss of consciousness) and dehydration, etc., were the second most common medical condition in crashes that have been precipitated by medical emergencies accounting for 29 percent of all reported medical conditions in NMVCCS. Diabetic reactions (hypoglycemia or hyperglycemia) were the third most common medical condition in crashes that have been precipitated by medical conditions, accounting for 20 percent of all reported medical conditions in NMVCCS.

Table 1: Type of medical conditions

Medical Condition	Estimated Count	Unweighted Count	Estimated Percent
Seizure	17,222	48	35%
Black Out	14,217	37	29%
Diabetic Reaction	9,963	30	20%
Heart Attack	5,288	9	11%
Stroke	1,261	7	3%
Other	1,918	7	4%
Total	**49,868**	**138**	**100%**

Source: NMVCCS July 2005 to December 2007

Drivers' age

Drivers who had crashes precipitated by medical emergencies accounted for an estimate of 1.3 percent of all drivers included in NMVCCS crashes.

Drivers 65 and older had the highest incidence rates of being involved in crashes precipitated by medical emergencies while driving, at incidence rates of 4.1 percent and 2.2 percent for drivers 65 to 74 and 75 and older, respectively (Table 2).

Table 2: Estimated distribution of drivers' age by presence of medical emergency

Driver's Age		Drivers without medical emergencies	Drivers with medical emergencies
14 to 24	Estimated Count	1,040,438	6,455
	Unweighted Count	*2,569*	*13*
	Estimated Percent	99.4%	0.6 %
25 to 44	Estimated Count	1,468,154	15,082
	Unweighted Count	*3,849*	*38*
	Estimated Percent	99.0%	1.0%
45 to 64	Estimated Count	878,544	16,152
	Unweighted Count	*2,371*	*51*
	Estimated Percent	98.2%	1.8%
65 to 74	Estimated Count	213,884	9,058
	Unweighted Count	*491*	*25*
	Estimated Percent	95.9%	4.1%
75 +	Estimated Count	138,117	3,120
	Unweighted Count	*397*	*11*
	Estimated Percent	97.8%	2.2%
Unknown	Estimated Count	55,575	0
	Unweighted Count	*164*	*0*
	Estimated Percent	100%	0%
Total	**Estimated Count**	**3,794,712**	**49,867**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**98.7%**	**1.3%**

Source: NMVCCS July 2005 to December 2007

Drivers' gender

Male drivers are overrepresented among drivers who had crashes precipitated by medical emergencies. As shown in Table 3, 67 percent of the drivers in these crashes were male, as compared to 54 percent of the drivers in other crashes.

Table 3: Estimated distribution of drivers' gender by presence of medical emergency			
Occupant gender		**Drivers without medical emergencies**	**Drivers with medical emergencies**
Male	Estimated Count	2,035,086	33,194
	Unweighted Count	*5,511*	*96*
	Estimated Percent	54%	67%
Female	Estimated Count	1,730,504	16,675
	Unweighted Count	*4,245*	*42*
	Estimated Percent	46%	33%
Unknown	Estimated Count	29,123	0
	Unweighted Count	*85*	*0*
	Estimated Percent	1%	0%
Total	**Estimated Count**	**3,794,713**	**49,869**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

Drivers' general health condition prior to crash

Drivers were asked questions related to their general health condition, use of medications and about their feelings during the day of the crash. This section compares the responses obtained from both drivers who had crashes precipitated by medical emergencies and other drivers.

As shown in Table 4, an estimate of 74 percent of the drivers in crashes precipitated by medical emergencies were aware of their preexisting diagnosed medical illnesses compared to only 17 percent of the other drivers.

Table 4: Estimate distribution of drivers' awareness of his/her preexisting medical conditions			
Pre-existing health condition(s)		**Drivers without medical emergencies**	**Drivers with medical emergencies**
No	Estimated Count	2,209,502	7,419
	Unweighted Count	*5,863*	*20*
	Estimated Percent	58%	15%
Yes	Estimated Count	638,880	36,664
	Unweighted Count	*1,840*	*96*
	Estimated Percent	17%	74%
Unknown/Not Interviewed	Estimated Count	946,330	5,786
	Unweighted Count	*2,138*	*22*
	Estimated Percent	25%	12%
Total	**Estimated Count**	**3,794,712**	**49,869**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

When asked to rate their overall general health, an estimated 44 percent of the drivers in crashes precipitated by medical emergencies rated their general health to be fair or poor, compared to an estimate of less than 7 percent of the other drivers (Table 5).

Table 5: Estimated distribution of driver's general health condition prior to crash

General health		Drivers without medical emergencies	Drivers with medical emergencies
Good	Estimated Count	2,626,372	21,854
	Unweighted Count	*7,142*	*66*
	Estimated Percent	69%	44%
Fair	Estimated Count	233,429	18,374
	Unweighted Count	*557*	*40*
	Estimated Percent	6%	37%
Poor	Estimated Count	17,270	3,719
	Unweighted Count	*49*	*10*
	Estimated Percent	<1%	7%
Unknown/Not Interviewed	Estimated Count	917,642	5,922
	Unweighted Count	*1,841*	*22*
	Estimated Percent	24%	12%
Total	**Estimated Count**	**3,794,713**	**49,869**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**

Source: NMVCCS July 2005 to December 2007

When asked about their feelings at the start of the last leg of driving preceding the crash, an estimate of 19 percent of the drivers in crashes precipitated by medical emergencies felt fatigued, drowsy or irritated prior to the crash compared to an estimate of 5 percent of other drivers (Table 6).

Table 6: Estimated distribution of driver by general health during the day of crash			
Feeling Prior to crash		**Drivers without medical emergencies**	**Drivers with medical emergencies**
Rested	Estimated Count	2,492,144	28,599
	Unweighted Count	*6,856*	*71*
	Estimated Percent	66%	57%
Fatigued	Estimated Count	118,002	8,546
	Unweighted Count	*312*	*18*
	Estimated Percent	3%	17%
Drowsy	Estimated Count	40,877	1,034
	Unweighted Count	*99*	*4*
	Estimated Percent	1%	2%
Irritated/upset	Estimated Count	25,021	0
	Unweighted Count	*80*	*0*
	Estimated Percent	1%	0%
Other	Estimated Count	34,257	1,063
	Unweighted Count	*94*	*9*
	Estimated Percent	1%	2%
Unknown/ Not Interviewed	Estimated Count	1,084,412	10,626
	Unweighted Count	*2,400*	*36*
	Estimated Percent	29%	21%
Total	**Estimated Count**	**3,794,713**	**49,868**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

Medication used by drivers prior to crash

An estimate of 85 percent of the drivers who had crashes precipitated by medical emergencies used medications on regular basis compared to only an estimate of 29 percent of the other drivers (Table 7).

Table 7: Estimated distribution of drivers by medications use in the last 24 hours			
Drugs taken last 24 hours		**Drivers without medical emergencies**	**Drivers with medical emergencies**
Yes	Estimated Count	1,093,285	42,500
	Unweighted Count	*3,003*	*112*
	Estimated Percent	29%	85%
No	Estimated Count	1,905,180	3,258
	Unweighted Count	*5,057*	*14*
	Estimated Percent	50%	7%
Unknown	Estimated Count	796,248	4,110
	Unweighted Count	*1,781*	*12*
	Estimated Percent	21%	8%
Total	**Estimated Count**	**3,794,713**	**49,868**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

Drivers' injury severity

Overall drivers who had crashes precipitated by medical emergencies sustained more severe injuries compared to other drivers. As shown in Table 8, an estimate of 85 percent of the drivers who had crashes precipitated by medical emergencies sustained injuries ranging from non-incapacitating to fatal injuries. Incidence of incapacitating injuries is estimated at 24 percent of the drivers who had crashes precipitated by medical emergencies compared to an estimate of 10 percent among other drivers. The fatality rate among drivers who had crashes precipitated by medical emergencies was estimated at 4 percent compared to an estimated fatality rate of 1 percent among other drivers.

Table 8: Estimated distribution of drivers' injury severity			
Driver's Injury Severity		**Drivers without medical emergencies**	**Drivers with medical emergencies**
No injury	Estimated Count	1,842,225	6,827
	Unweighted Count	*4,854*	*23*
	Estimated Percent	49%	14%
Possible injury	Estimated Count	837,274	11,950
	Unweighted Count	*2,522*	*46*
	Estimated Percent	22%	24%
Non-incapacitating injury	Estimated Count	534,568	13,375
	Unweighted Count	*1,466*	*35*
	Estimated Percent	14%	27%
Incapacitating injury	Estimated Count	391,905	12,134
	Unweighted Count	*546*	*19*
	Estimated Percent	10%	24%
Killed	Estimated Count	30,762	1,933
	Unweighted Count	*70*	*6*
	Estimated Percent	1%	4%
Injury severity unknown/ Unknown if injured	Estimated Count	157,978	3,649
	Unweighted Count	*383*	*9*
	Estimated Percent	4%	7%
Total	**Estimated Count**	**3,794,712**	**49,868**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

CRASH PROFILE

This section compared information related to crash characteristics of drivers who had crashes precipitated by medical emergencies with the results with other drivers. This information aims to identify scenarios that are specific for drivers who had crashes precipitated by medical emergencies. Number of occupants in the vehicle was examined to see if occupants in the vehicle would provide help to drivers or alert them to unusual behaviors associated with driving ability. Crash type was examined to assess if any on the current or proposed crash avoidance technologies would prevent these types of crashes.

Number of vehicles involved in crash

An estimate of 62 percent of the drivers who had crashes precipitated by medical emergencies were involved in single-vehicle crashes compared to an estimate of only 17 percent of the other drivers (Table 9).

Table 9: Estimated distribution of vehicles involved in crashes			
Number of Vehicles		**Drivers without medical emergencies**	**Drivers with medical emergencies**
Single Vehicle	Estimated Count	630,107	30,872
	Unweighted Count	*1,343*	*83*
	Estimated Percent	17%	62%
Multiple Vehicles	Estimated Count	3,164,606	18,997
	Unweighted Count	*8,498*	*55*
	Estimated Percent	83%	38%
Total	**Estimated Count**	**3,794,713**	**49,869**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

Number of occupants in the vehicle

Number of occupants in the vehicle was examined to see if occupants in the vehicle would provide help to drivers or alert them to unusual behaviors associated with driving ability. In an estimate of 85 percent of the drivers who had crashes precipitated by medical emergencies, the driver was the only occupant in the vehicle compared to an estimate of 69 percent of the other drivers.

Table 10: Estimated distribution of occupants in the vehicle during crashes			
No of Occupant/s		**Drivers without medical emergencies**	**Drivers with medical emergencies**
Driver Only	Estimated Count	2,603,436	42,485
	Unweighted Count	*6,677*	*117*
	Estimated Percent	69%	85%
Driver + Occupant/s	Estimated Count	1,191,277	7,383
	Unweighted Count	*3,164*	*21*
	Estimated Percent	31%	15%
Total	**Estimated Count**	**3,794,713**	**49,868**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

Time of the crash

As shown in Table 11, drivers who had crashes that have been precipitated by medical emergencies were more likely to be involved in crashes during the morning hours between 6 a.m. and 11:59 a.m. when compared to other drivers.

Table 11: Estimated distribution of the crash time			
Time of Crash		**Drivers without medical emergencies**	**Drivers with medical emergencies**
6 a.m. to 11:59 a.m.	Estimated Count	1,133,751	20,650
	Unweighted Count	2,908	44
	Estimated Percent	30%	41%
12 midday to 5:59 p.m.	Estimated Count	1,693,983	18,072
	Unweighted Count	4,709	70
	Estimated Percent	45%	36%
6 p.m. to 12 midnight	Estimated Count	966,979	11,146
	Unweighted Count	2,224	24
	Estimated Percent	25%	22%
Total	**Estimated Count**	**3,794,713**	**49,868**
	Unweighted Count	**9,841**	**138**
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

Vehicle pre-impact location

This section reports the location of the vehicle after the critical event (at the point where its pre-impact location is determined) but prior to impact. Most drivers who had crashes precipitated by medical emergencies departed the roadway before the impact. An estimated 69 percent of the drivers who had crashes precipitated by medical emergencies departed the roadway before the impact compared to 17 percent of other drivers (Table 12).

Table 12: Estimated distribution of pre-impact location on trafficway			
Pre-impact location on trafficway		**Drivers without medical emergencies**	**Drivers with medical emergencies**
Stayed in original travel lane	Estimated Count	2,747,302	6,999
	Unweighted Count	*7,331*	*21*
	Estimated Percent	72%	14%
Stayed on roadway but left original travel lane	Estimated Count	344,605	8,240
	Unweighted Count	*957*	*21*
	Estimated Percent	9%	17%
Departed roadway	Estimated Count	642,301	34,267
	Unweighted Count	*1,393*	*93*
	Estimated Percent	17%	69%
Other/Unknown	Estimated Count	60,506	362
	Unweighted Count	*160*	*3*
	Estimated Percent	2%	1%
Total	**Estimated Count**	**3,794,714**	**49,868**
	Unweighted Count	***9,841***	***138***
	Estimated Percent	**100%**	**100%**
Source: NMVCCS July 2005 to December 2007			

CONCLUSION

The percentage of drivers in crashes precipitated by medical emergencies while driving is relatively small and accounts for only 1.3 percent of all drivers who have been included in NMVCCS.

Eighty-four percent of the drivers in crashes precipitated by medical emergencies experienced seizures, blackouts, or diabetic reactions prior to the crashes.

Drivers or surrogate responses to questions about general health, use of medications and feelings on the day of the crash suggest that most of the drivers were aware of the medical conditions associated with the crash. In this analysis we attempted to quantify age group by type of medical conditions. However, due to the small, unweighted sample size, the quantification was not possible.

Older drivers 65 and older had relatively a higher percentage of crashes precipitated by medical emergencies when compared to young and middle-age drivers. Male drivers are overrepresented in crashes precipitated by medical emergencies when compared to other drivers without medical conditions.

In most cases of the crashes that have been precipitated by medical emergencies, the drivers were the only occupant in the vehicles, were involved in single-vehicle crashes, and departed the roadway before the collisions. The number of occupants in the vehicle was examined to see if occupants in the vehicle would provide help to drivers or alert them to unusual behaviors associated with driving ability. Crashes that have been precipitated by medical emergencies were more likely to occur during the morning hours between 6 a.m. and 11:59 a.m. when compared to other drivers.

Demographic and crash information provided in this report such as type of medical condition, time of the crashes, number of occupants in the vehicle, driver's gender, type of crash should serve as a guide in identifying population at risk, risk factors and when designing medical emergency related crash prevention programs.

This analysis aimed to compare the demographics and certain crash characteristics. Other crash and vehicle characteristics that could influence the crash outcome such as vehicle type, restraint use, crash delta v, rollover, etc., were not included in the current analysis.

The results of this analysis suggest that crashes precipitated by drivers' medical emergencies are not related to vehicle design or roadway integrity as indicated by the type of crashes and manner of collisions. Patient education by health care providers on early warning signs of a health crisis, such as warning signs before seizure attacks, diabetic or hypoglycemic comas, and potential side effects of medications are recommended as the most effective countermeasure. In addition to patient education, other safety technologies such as the Drowsy Driver Warning System can help in reducing the risk of crashes precipitated by medical emergencies. As indicated in this report, in most cases of the crashes that have been precipitated by medical emergencies, the drivers departed the roadway. A lane departure prevention system can help detecting positional information of a vehicle with respect to a lane of travel and alert drivers to correct their positioning on roadway.

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