An evidence-based review: Distracted driver

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BACKGROUND: Cell phone use and texting are prevalent within society and have thus pervaded the driving population. This technology is a growing concern within the confines of distracted driving, as all diversions from attention to the road have been shown to increase the risk of crashes. Adolescent, inexperienced drivers, who have the greatest prevalence of texting while driving, are at a particularly higher risk of crashes because of distraction.

METHODS: Members of the Injury Control Violence Prevention Committee of the Eastern Association for the Surgery of Trauma performed a PubMed search of articles related to distracted driving and cell phone use as a distractor of driving between 2000 and 2013.

RESULTS: A total of 19 articles were found to merit inclusion as evidence in the evidence-based review. These articles provided evidence regarding the relationship between distracted driving and crashes, cell phone use contributing to automobile accidents, and/or the relationship between driver experience and automobile accidents. (Adjust methods/results sections to the number of articles that correctly corresponds to the number of references, as well as the methodology for reference inclusion.)

CONCLUSION: Based on the evidence reviewed, we can recommend the following. All drivers should minimize all in-vehicle distractions while on the road. All drivers should not text or use any touch messaging system (including the use of social media sites such as Facebook and Twitter) while driving. Younger, inexperienced drivers should especially not use cell phones, texting, or any touch messaging system while driving because they pose an increased risk for death and injury caused by distractions while driving. (*J Trauma Acute Care Surg*. 2015;78: 147–152.

KEY WORDS: Distraction; driver; motor vehicle.

Motor vehicle driving demands constant vigilance and the use of visual, auditory, and tactile senses for ultimate safety. These senses are routinely hampered by inherent vehicle constructs: the roof posts obstructing the field of view, soundproofing materials hampering auditory input, and stabilizing mechanisms mitigating road vibrations. As a driver advances in experience, these constructs are incorporated into the overall safe use of the vehicle. However today, two common driver-imposed distractions are posing serious threats to on-the-road safety: cell phone use and texting (which includes use of any type of tactile messaging system such as Twitter or Facebook messaging) while driving. The overarching problem is that the driver removes attention from the road, while the vehicle remains in motion during these distractions.

Cell phone use during driving necessitates temporary loss of attention and, if making a call, full control of the wheel. In 2008, this practice was estimated to account for up to 22% of vehicular crashes;[1] in fact, 75% of adults and 52% of teens have admitted to talking on cell phones while driving.[2–5]

Texting is a related technology that further compromises the driver. The first text message was sent December 1992,[6] and as technology advanced, total use steadily rose. However, not until the marriage of this technology and ubiquitous social adoption did a dramatic increase of overall texting occur. Pew Research Center studies reveal that the median number of teen texts per day is 50, and a third of teens text more than 100 times per day. In comparison with cell phone use while driving, 47% of adults and more than 50% of teens admit to texting while driving.[3,5]

According to the National Highway Traffic Safety Administration, motor vehicle crashes (MVCs) remain the Number 1 cause of death and disability for adolescents. Inexperience and distracted driving are common contributing factors for the teen driver involved in collisions, with statistics indicating that the highest incidence of collisions occurs within the first 6 months after licensure.[7–10]

Collisions caused by distracted driving have captured the attention of the US Government and professional medical organizations. In 2009 and 2010, Distracted Driving Summits took place in Washington, District of Columbia, and highlighted the dangers of distractions while behind the wheel. Although currently there are no federal laws regarding distracted vehicle operation, several states have implemented restrictions or bans on certain activities while driving. According to the Governors Highway Safety Association, 10 states and 3 territories prohibit all drivers from using cell phones while driving including California, Connecticut, Delaware, District

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of Columbia, Guam, Maryland, Nevada, New Jersey, New York, Oregon, Virgin Islands, Washington, West Virginia, while 32 states ban novice drivers from cell phone use, and 39 states, District of Columbia, Guam, and Virgin Islands ban text messaging for all drivers. The National Conference of State Legislatures reported in 2011 that legislators in 37 states considered 160 driver distraction bills. The importance of driver safety was also noted by the Oval Office when, on September 30, 2009, President Obama signed an executive order banning federal employees from texting while in government vehicles or while driving on official government business.[10–14]

Several organizations have also addressed distracted driving. The American College of Emergency Physicians advocates that teens should not text while driving, and the American Academy of Pediatrics recommended several physician actions to curb the increasing threats to teenage drivers, including discouraging distractions when driving. The Orthopaedic Trauma Association and American Academy of Orthopedic Surgery both endorse no texting while driving as well.[15,16]

STATEMENT OF PROBLEM

MVCs remain the main source of morbidity and mortality in the United States, with distracted driving becoming an increasing source of injury in these circumstances. With the advent of certain technologies, namely cell phones and texting, this issue has been heightened. National attention has been focused on this new threat to public safety.

Questions to be Addressed

1. What is the evidence that all distractions contribute to MVCs?
2. What is the specific evidence that texting or cell phone use contributes to MVCs and affects vehicle control?
3. Does driver experience mitigate MVCs caused by distractions?

METHODS AND PROCESS

A computerized search of the world's literature was undertaken using PubMed, courtesy of the US National Library of Medicine. Key search words used were: texting and/or distraction + driving during the time frame 2000 to 2013. This time frame was used because there is strong evidence to suggest that during this period, the penetration of wireless devices exceeded 50% of the US population.[17] State legislation that aimed at addressing the dangers of this technology was also introduced during this time frame.[11–15,18]

Initial computerized search identified 39 citations. The abstract for each citation was reviewed, and 33 candidate articles having possible applicability to the guideline topic were retrieved. Each article was further scrutinized to ensure topic focus by the authors of this evidence-based review (EBR). General reviews, letters to the editor, single-case reports, and retrospective reviews of poor quality were excluded, providing 19 articles with sufficient merit to form the basis for this EBR.

The articles were reviewed in detail by the authors, and the attached tables were then created (Tables 1– 3).

RECOMMENDATIONS

Level II

- All drivers should minimize all in-vehicle distractions while on the road.
- All drivers should not text or use any touch messaging system (such as Facebook or Twitter) while driving.
- Younger, inexperienced drivers should not use cell phones, text, or use any touch messaging system while driving because they are at increased risk for death and injury caused by distractions while driving.

SCIENTIFIC FOUNDATION

The development of these guidelines greatly benefited from peer-reviewed published analyses of national databases. The three most uniformly used were the Fatality Analysis Reporting System (FARS), the National Automotive Sampling Systems General Estimate System (GES), and the National Motor Vehicle Crash Causation Survey. FARS is a census of all fatalities associated within 30 days of a crash; sources include police reports, death certificates, hospital medical records, and coroners' reports. GES uses sampling techniques to extrapolate trends using police-reported crashes, and National Motor Vehicle Crash Causation Survey consists of on-the-scene investigation of more than 6,000 crashes.

The most comprehensive analysis of precrash behavior was undertaken in the 100-Car Naturalistic Driver Study by Dingus in 2006. Analysis of this robust database found that more than 23% of drivers experienced some form of distraction while driving. Drowsiness, tasks requiring greater than two glances away from the road, or greater than two button presses significantly increased crash/near-crash risk with odd ratios of 38.7, 26.4, and 2.3, respectively.[19]

Reviewed articles fell again into two categories: the first reviewed individual data, either in simulated environments or in surveys, and the second group considered database analysis. The findings of the former showed that distraction is prevalent in significant driving injuries and that level of distraction affects younger drivers more specifically.[20–33] The second group correlated distraction and driver crashes as well as providing a near-linear relationship with fatalities and texting volume from 1999 to 2008.[34–38] These articles were then subdivided into groups that addressed each of the three following questions posed in this EBR:

What Is the Evidence That All Distractions Contribute to MVCs?

In a study involving digital photography of New Jersey Turnpike drivers, 4% of nonspeeding and 3.4% of speeding drivers showed evidence of distraction.[37] The most common distraction noted was cell phone use. Donmez et al.[23] found visual distraction more detrimental than auditory distractions in their 2006 study of mitigation strategies, as well as a marginal increase in erratic steering and delayed braking. These results, however, only hint at the true danger of distracted driving. More than 30% of drivers admitted that distraction caused an accident severe enough to have them hospitalized.[29] Driver distraction was found to contribute to more than 13% of all

TABLE 1. Distracted Driver Reviewed Articles—Distractions Contribute to MVCs

Author	Year	Class	Summary	Conclusion
Stutts et al.[30]	2001	III	NHTSA Crashworthiness Data System records from 1995–1999. Key word, *driver's distraction,* noted on report.	8.3% of total crashes caused by distraction. Drivers age < 20 y had 11.7% distracted status.
Johnson et al.[37]	2004	III	Random sample of drivers on the New Jersey Turnpike from March to July 2001, including a sample during the same period of drivers going faster than the speed limit by 15 mph.	1.5% of drivers were using a cell phone while driving at high speeds (Turnpike Highway). There was less frequent cell phone use at night and on weekends while driving over the speed limit, or if there was a passenger in the car, compared with surveys of low-speed, daylight hour driving.
Donmez et al.[23]	2006	III	Middle aged (35–55 y) and older drivers (65–75 y)with a valid driver's license, and 5 y driving experience. (n = 28)	Distraction undermined driving performance; visual distraction more prominent than auditory distraction. Mitigating strategies to assist drivers reduced abrupt braking and improved response time in those with auditory distractions.
McEvoy et al.[29]	2007	II	All legal drivers in Perth, Australia, involved in a car crash requiring transfer to a hospital (n = 1,367).	433 (32%) cited distraction at the time of crash. Conversation with other passengers was the most common (155, 11%), followed by lack of concentration (148, 11%), and outside factors (121, 9%). Age was not an independent predictor, but years of driving experience was: those with <10 y were more likely to be distracted (for each additional year of experience, a driver was 2% less likely to have a crash involving a distraction). Cell phone use nearly reached statistical significance as a distracting cause of a crash ($p = 0.06$). It must be noted that this was due to self-reporting; subjects were told that the information they provided could be subpoenaed by authorities.
Wilson and Stimpson[34]	2010	III	FARS database 1999–2008. Cell phone subscriber data.	Fatality caused by distraction on an upward rise to 15.8% between 2005 and 2008. The increase mirrored cell phone subscription and, specifically, texting volume. Fatality caused by distraction in age group of 16–29 y equals 39%. Authors postulate that increased texting resulted in >16,000 additional deaths from 2001 to 2007.
Hoff et al.[32]	2013	II	Electronic survey to employees over 1-mo period. Surveyed distracted driving behavior, N = 1,838	72% "always, frequently, or sometimes" distracted while driving. Cell phone use in 79% of distraction and 29% texting; 9% reported MVC related to distracted driving behavior.

crashes[29] and recently accounted for nearly 6,000 deaths per year.[30,34] A recent electronic survey found distracted drivers to make up 72% of the population and distractions were causative in 9% of crashes.[32] It was found that distracted drivers were less likely to pick up inherent dangers on the road, posing a potential increase to injury and death because of distractions.[32]

What Is the Specific Evidence That Texting or Cell Phone Use Contributes to MVCs and Affects Vehicle Control?

A recent survey found that 40% of adults used a cell phone at least a "few times per week" while driving.[21] A similar study of high school drivers found that 79% had "ever" used a cell phone while driving and 48% had either placed or answered a call during their most recent trip. In the same study, 71% had "ever" texted while driving, and 60% had either placed or answered a text during their most recent trip.[35] While these studies do not indicate the relationship between cell phone use and decline in driving ability, they set the foundation for the prevalence of this potential distraction. Surprisingly, perceived detrimental aspects of cell phone use is not readily apparent to the driver, although driver performance profile is significantly affected by cell phone and texting.[22,26] In young drivers, texting caused more than 0.5 seconds off-road glance, 50% more swerving, a 140% increase in missed lane changes, and a sixfold increase in crashes during simulated driving.[24,25] Cell phone use while driving has also been shown to cause lane change frequency, mean speed, and an increase in the chance of being behind a slower vehicle, mimicking traffic conditions of congested traffic.[21] This behavior is indicative of distracted driving, and such road deviations have been associated with an increase in motor vehicle collision rates. In a crash culpability analysis comparing crashes with and without cell phones, it

TABLE 2. Distracted Driver Reviewed Articles—Cell Phone and Texting Contribute to MVCs

Author	Year	Class	Summary	Conclusion
Lesch and Hancock[26]	2004	III	Young (20–36 y) and older drivers (55–55 y) holding a valid driver's license, with an equal distribution of males and females across both groups (N = 36).	(1) Younger drivers expressed more confidence to perform during distractions than older drivers, but there was no correlation across sexes. (2) Only males had a strong association between increased confidence and reduced impairment during distractions. In older females, the opposite was observed—older females' increased confidence was associated with increased performance decrements during distractions. (3) Performance was compared across age and sex for drivers who expressed the same level of confidence; only older drivers, in particular older females, stated a discrepancy between their level of comfort to deal with a distraction and their actual performance during a distraction.
Strayer et al.[36]	2006	III	Experienced drivers were placed in two scenarios: one while using cell phones, and another while inebriated (N = 40).	Cell phone use, either handheld or hands free, had 9% decreased initial reaction, 24% more variable following distance, and took 19% longer to recover speed. More accidents occurred when participants conversed on phone than when driving legally intoxicated.
Cooper et al.[22]	2009	III	36 undergraduates from a local university, with a mean age of 21.5 y and a valid driver's license.	Driver distraction and traffic congestion significantly affected driving behaviors. Lag distance, lane change frequency, following ratio, forward following distance, and driving speed were influenced by cell phone use. The subsequent compensatory behavior may have consequences for traffic efficiency.
Drews et al.[24]	2009	III	Young adults (19–23 y) with normal or corrected-to-normal visual acuity and a valid driver's license (n = 40).	Dual-task conditions decreased response time and increased crashes. The negative impact of text messaging while driving seems to exceed conversing on a cell phone while driving.
Hosking et al.[25]	2009	II	Young novice drivers—volunteer college graduates between the age of 18 y and 25 y who were paid $20; provisional driving license only with <6 mo of driving experience.	Participants showed statistically affected performance in the following tasks during texting as opposed to conditions of no texting: increased time looking inside the car (frequency, duration. and proportion of in-vehicle glances); increased mean, minimum, and average variance of the time headway (car following task); increased frequency of lane excursions; number of missed lane changes; increased variability in lane position. Texting did not affect driving performance measures during the hazard tasks (traffic light, pedestrian, and right-turning car).
Braitman and McCartt[21]	2010	III	Random survey of >16,000 landline and 12,000 cell phone numbers obtained from an industry supplier (n = 1,219) in 48 US states and the District of Columbia. Age range: 18–24 (7%), 25–29 (6%), 30–59 (52%), >60 y (33%), and did not report age (2%).	40% of all drivers report talking on phones; 13% of drivers reported some texting while driving; the percentage was highest among drivers ages 18–24 y (43%). 12% of drivers in states with all-driver texting bans reported texting while driving; among drivers ages 18–24 y, the percentages were 45%; 14% reported texting in states with no texting ban; among drivers ages 18–24 y, the total was 48%.
O'Brien et al.[35]	2010	III	North Carolina high school–aged drivers (N =1,947 with 28% response rate).	79% talked while driving, while 71% sent/received text while driving. 52% "always or usually" answer cell phone; 52% "often or sometimes" read text, while 34% reply to text "often or sometimes." Perceived "very dangerous" behavior for talking on cell phone, reading text, and sending text were 16%, 40%, and 60%, respectively.
Holland and Rathod[31]	2013	II	27 young drivers (age, 18–29 y) drove simulated highway route multiple times. During some of the drives, a cell phone would ring, participants did not answer the phones.	Found that ignoring phone calls impairs driving ability and that phone ringing and the cognitive component of intending to answer affects the ability to focus on the road.

was found that the risk of a culpable crash was increased by 70% when a cell phone was present. To help put into context the degree of distraction cell phone use while driving can cause, it was noted that drunk drivers had similar performance profiles to cell phone users.[36] While drivers using their cell phones had delayed braking times and increased accident rates, intoxicated drivers were found to drive more aggressively, which constituted driving closer to the car in front of the driver, and applying the brake more forcefully.[36] Although showing different driving patterns, it was found that both displays yielded comparable impairments. While most research has looked at the effects of cell phone calls or texts on the impairment of driving, it was found that driving with cell phone merely ringing interfered with normal driver performance.[31] Compared with control, driving with a cell phone ringing showed significant prevalence of road infractions, including a greater

TABLE 3. Distracted Driver Reviewed Articles—Younger Inexperienced Drivers' Use of Cell Phones and Texting Contribute to MVCs

Author	Year	Class	Summary	Conclusion
McKnight and McKnight[27]	2000	III	Young, inexperienced drivers from California and Maryland (age, 17 y and 16 y, respectively) compared with younger experienced drives (age, 18 y and 19 y, respectively) (n = 2,128).	The majority of car crashes seem to result from failure to use routine safe operating practices and inability to recognize the danger in doing so, rather than what might be viewed as thrill seeking or other forms of risk-taking activities. While there were subtle differences in the behavioral contributors, there was no significant area that could be targeted as an intervention between young inexperience vs. experienced drivers.
Neyens and Boyle[38]	2007	II	Drivers aged 16–19 y (n = 449,049), GES data from 2003.	Teenage drivers distracted by cell phones were more than 11 times more likely to be involved in a rear-end collision than with a fixed object, and approximately 3 times more likely than with an angular collision. When distracted cognitively, they were 2.8 times as likely to be involved in a rear-end collision than with a fixed object and 1.8 times more likely than an angular collision. Passenger-related distractions did not influence crash type; however, when they were distracted by a passenger at an intersection, drivers were more likely to be in a rear-end or angular collision. When an in-vehicle distraction caused a crash, it was likely a rear-end or fixed object collision.
Neyens and Boyle[28]	2008	III	Drivers aged 16–19 y, and their passengers (n = 1,225,163). An ordered logit model was created.	Considering in-vehicle passenger and cell phone categories, these distractions were related to 1.6%, 0.7%, and 0.4% of crashes, respectively. Drivers have 1.3 times more likelihood and passengers have 1.2 times more likelihood of severe injury in crashes caused by cell phone distraction when compared with in-vehicle distractions, being inattentive, or no distraction at all. When drivers were distracted by cell phones or in-vehicle devices, passengers' odds of sustaining a severe injury were 4.7 times and 3.9 times greater, respectively. When crashes occur from drivers being distracted by the passengers, the passengers themselves are 2.7 times more likely to sustain a severe injury. Inattentive causes of crashes were less likely to cause passenger injuries (adjusted odds ratio, 0.8).
Atchley et al.[20]	2011	III	Undergraduate students were recruited from an introductory psychology course. They owned cars and cell phones and were between the ages of 18 y and 30 y (M = 18.44). (n = 348)	70% report initiating texts while driving; 81% reply to texts while driving; 92% read texts while driving; 2% never text and drive under any circumstances. Respondents' likelihood of initiating, replying to, and reading text messages were not affected by their perception of how dangerous such activities might be, and the perceived risk may be reduced over time as the behavior persists.
Stravrinos et al.[33]	2013	II	75 participants (age, 16–25 y) were divided into novice (age, 16–18 y) and young (age, 19–25 y). Drivers then drove in 3 levels of congested highway simulation under 3 different distractions: texting, cell phone, or none.	Found that texting or cell phone use resulted in more lane deviations, more fluctuations in speed, and overall less safe driving conditions. Texting was specifically found to distract drivers significantly, although it affected both age groups equally.

frequency of pedestrian collisions and speed exceedances,[31] suggesting that drivers should keep their phones turned off while driving.

Does Driver Experience Mitigate MVCs Caused by Distractions?

A study of drivers younger than 20 years found that crashes were a result of lack of adherence to routine safe practices and failure to recognize clear dangerous situations.[27] Perception is key to novice driver crashes. Atchley et al. underscored this in their work with students: 92% "ever texted" while driving, 70% believed that they could easily text without looking, and a majority felt texting was "more dangerous" than cell phone use while driving. These perceptions led to some dramatic outcomes: teen drivers were more likely to be involved in rear-end collisions, experience more severe injuries, and be responsible for severe injuries to passengers.[28,38] Stravrinos et al.[33] found that young or novice drivers were significantly affected by both cell phone calls or texting, compared with their baseline in simulated highway driving.

Study Limitations

This EBR was undertaken to answer the three questions generated; however, there are limitations. First, most published studies were retrospective, database analyses, and their results can be regarded as less than optimal. Second, some articles were based on self-reporting and/or questionnaires and therefore pose potential threats to their internal validity. Also noteworthy is that because of the nature of this research, many empirical studies were conducted using driving simulators. While the quality of simulation has improved, these results may not be indicative of real driving behavior, as driving in a simulator lacks generalizability compared with distracted driving on the road.

SUMMARY

Competent driving involves dedicated attention to road conditions using all senses; dangerously, both the novice and the distracted drivers fail to appreciate their responsibility. Elimination of distraction is key to preventing further mortality. Data from this EBR suggest the following key points:

A. Driver distractions contribute significantly to MVCs across all age groups.
B. Cell phone use and texting cause significant distraction to motorists across the population. Their ubiquitous use in society has increased their role in MVCs.
C. Novice and teen drivers are less prepared to deal with the demands of driving; their use of cell phones while driving and subsequent morbidity and mortality are therefore higher than other groups of drivers.

FUTURE DIRECTIONS

Further investigation and emerging technologies will assist in our understanding of working models for injury prevention. These technologies will come in the form of hands-free vehicle communication technologies, early warning systems for drivers, improved vehicle parameters, and community education.

Prevention programs and legislation directed toward decreasing distracted driving will need to carefully scrutinized for overall impact. Ultimately, public awareness and emphasis from trauma organizations on distracted driving may prevent further harm.

AUTHORSHIP

L.E.L., K.A., J.B., M.B., S.S., and A.S. conducted the literature search. L.E.L., K.A., J.B., M.B., and S.S. collected the data. L.E.L., K.A., J.B., M.B., S.S., and W.G. performed the data analysis. L.E.L., K.A., J.B., M.B., S.S., and W.G. wrote the manuscript. L.E.L., A.H., and A.S. contributed to critical revision.

DISCLOSURE

The authors declare no conflicts of interest.

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