Executive Summary:

Chronic Kidney Disease and Commercial Motor Vehicle Driver Safety

Presented to:

Federal Motor Carrier Safety Administration

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Prepared for

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Evidence reports are sent to the Federal Motor Carrier Safety Administration's (FMCSA) Medical Review Board (MRB) and Medical Expert Panels (MEP). The MRB and MEP make recommendations on medical topics of concern to FMCSA.

FMCSA will consider all MRB and MEP recommendations, however, all proposed changes to current standards and guidance (guidelines) will be subject to public-notice-and-comment and relevant rulemaking processes.

Policy Statement

This evidence report was prepared by ECRI Institute under subcontract to MANILA Consulting Group, Inc., which holds prime Contract No: GS-10F-0177N/DTMC75-06-F-00039 with the Department of Transportation's Federal Motor Carrier Safety Administration. ECRI Institute is an independent, nonprofit health services research agency and a Collaborating Center for Health Technology Assessment of the World Health Organization. ECRI Institute has been designated an Evidence-based Practice Center by the U.S. Agency for Healthcare Research and Quality. ECRI Institute's mission is to provide information and technical assistance to the healthcare community worldwide to support safe and cost-effective patient care. The results of ECRI Institute's research and experience are available through its publications, information systems, databases, technical assistance programs, laboratory services, seminars, and fellowships. The purpose of this evidence report is to provide information on the current state of knowledge on this topic. It is not intended as instruction for medical practice or for making decisions regarding individual patients.

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Purpose of Evidence Report

Commercial driving is a hazardous occupation. Of all occupations in the United States, workers in the trucking industry experience the third highest fatality rate, accounting for 12 percent of all worker deaths. About two thirds of fatally injured truck workers were involved in highway crashes. According to statistics from the U.S. Department of Transportation (DOT), there were 4,932 fatal crashes involving a large truck in 2005, for a total of 5,212 fatalities. In addition, there were 137,144 nonfatal crashes; 59,405 of these were crashes that resulted in an injury to at least one individual (for a total of 89,681 injuries).

The purpose of this evidence report is to address several key questions posed by the Federal Motor Carrier Safety Administration (FMCSA). FMCSA developed each of these key questions so that the answers will provide information useful in updating its current medical examination guidelines. The four key questions addressed in this evidence report are:

Key Question 1: Are individuals with kidney disease at an increased risk for a motor vehicle crash?

Key Question 2: Are medications used to treat individuals with kidney disease associated with an increased risk of motor vehicle crash among pre-dialysis patients?

Key Question 3: Are dialysis and accompanying drug treatments associated with an increased risk of motor vehicle crash?

Key Question 4: Are kidney transplantation and accompanying drug treatments associated with an increased crash risk?

Identification of Evidence Bases

We identified separate evidence bases for each of the key questions this evidence report addresses using a process consisting of a comprehensive search of the literature, an examination of abstracts of identified studies to determine which articles would be retrieved, and selection of the actual articles to be included in each evidence base.

We searched seven electronic databases (Medline, PubMed (PreMEDLINE), EMBASE, PsycINFO, CINAHL, TRIS, and the Cochrane library) (through September 12, 2007). In addition, we examined the reference lists of all obtained articles with the aim of identifying relevant articles not identified by our electronic searches. Hand searches of the "gray literature" were also performed. We admitted articles to an evidence base by formal retrieval and inclusion criteria determined *a priori.*

Grading the Strength of Evidence

Our assessment of the quality of the evidence took into account not only the quality of the individual studies that comprise the evidence base for each key question; but also the interplay between the quality, quantity, robustness, and consistency of the overall body of evidence.

Presentation of Findings

In presenting our findings, we typically make a clear distinction between qualitative and quantitative conclusions, and we assign a separate strength-of-conclusion rating to each conclusion format. The limited quantity of evidence in each evidence base and the differences in those studies precluded us from forming quantitative conclusions in this evidence report. The strength-and-stability-of-evidence ratings assigned to these different types of conclusions are defined in Table 1.

Table 1. Strength-and-Stability-of- Evidence Ratings for Qualitative and Quantitative Conclusions

Strength of Conclusion	*Interpretation*
Qualitative Conclusion	
Strong evidence	Evidence supporting the qualitative conclusion is convincing. It is highly unlikely that new evidence will lead to a change in this conclusion.
Moderate evidence	Evidence supporting the qualitative conclusion is somewhat convincing. There is a small chance that new evidence will overturn or strengthen our conclusion. ECRI Institute recommends regular monitoring of the relevant literature for moderate-strength conclusions.
Acceptable evidence	Although some evidence exists to support the qualitative conclusion, this evidence is tentative and perishable. There is a reasonable chance that new evidence will either overturn or strengthen our conclusions. ECRI Institute recommends frequent monitoring of the relevant literature.
Unacceptable	Although some evidence exists, the evidence is insufficient to warrant drawing an evidence-based conclusion. ECRI Institute recommends frequent monitoring of the relevant literature.
Quantitative Conclusion (Stability of Effect-size Estimate)	
High stability	The estimate of treatment effect in the conclusion is stable. It is highly unlikely that the magnitude of this estimate will change substantially as a result of the publication of new evidence.
Moderate stability	The estimate of treatment effect in the conclusion is somewhat stable. There is a small chance that the magnitude of this estimate will change substantially as a result of the publication of new evidence. ECRI Institute recommends regular monitoring of the relevant literature.
Low stability	The estimate of treatment effect included in the conclusion is likely to be unstable. There is a reasonable chance that the magnitude of this estimate will change substantially as a result of the publication of new evidence. ECRI Institute recommends frequent monitoring of the relevant literature.
No stability	Estimates of the treatment effect are too unstable to allow a quantitative conclusion to be drawn at this time. ECRI Institute recommends frequent monitoring of the relevant literature.

Findings

We summarize the findings of our analyses of the data pertaining to the four key questions addressed in this evidence report below.

Key Question 1: Are individuals with kidney disease at an increased risk for a motor vehicle crash?

Current direct evidence from crash studies does not demonstrate that individuals with kidney disease are at an increased risk for a crash. Indirect evidence, albeit weak, does suggest that it is plausible that individuals with kidney disease may be at increased risk for a motor vehicle crash (Strength of Conclusion: Acceptable).

Direct Evidence – Crash Studies*: Our searches identified two direct crash-risk studies with a total of 94 individuals with kidney disease. It is unclear how similar the drivers in these studies are to commercial motor vehicle (CMV) drivers because few characteristics of the drivers are reported; however, it does not appear that CMV drivers are represented. Driving exposure was not adequately controlled for in either study. For this and additional reasons, these studies were both rated low in quality. One retrospective cohort study reported on the crash rate among individuals with chronic kidney disease compared with the rate among community controls. The other study, a case-control study, reported on the proportion of individuals with kidney disease among a cohort of individuals who crashed compared with the proportion of drivers with kidney disease among a cohort of individuals who did not crash. Neither of these studies provided evidence in support of the contention that individuals with kidney disease are at an increased risk for a motor vehicle crash. On the contrary, both studies actually found that individuals with kidney disease appear to be at a reduced risk for a crash.*

Indirect Evidence—Studies of Neurocognitive Function*: Eight studies with a total of 489 patients assessed neurocognitive impairment of people with kidney disease. Overall the evidence base was of low quality. Differences among the studies included varied types of study designs, controls selected, and outcomes reported. The eight studies reported outcomes on a total of 18 neurocognitive measurements in four domains: general neurocognition, attention and concentration, visuospatial skill, and executive function. There was no consensus among studies to definitively conclude that people with kidney disease have neurocognitive impairment. However, there is a sufficient quantity of evidence that on multiple outcome measures with different groups of patients tested in different study designs, kidney disease is associated with impaired neurocognition. Therefore, the possibility that people with kidney disease experience neurocognitive impairment cannot be dismissed.*

Indirect Evidence—Studies of Sleep-Related Outcomes*: Only one study with 46 patients addressed this outcome. The study was of low quality. Generalizability to the CMV driver*

population is uncertain. The authors found that the prevalence of severe sleep-disordered breathing among enrolled patients with kidney disease was four times that of the controls from a general population, but no significant difference was found on other outcomes important to safe operation of a motor vehicle, including daytime sleepiness. However, previous systematic reviews have associated sleep-disordered breathing with an actual increase in motor vehicle crash. Therefore, this evidence suggests that people with kidney disease are at a greater risk of motor vehicle crash than people without.

Key Question 2: Are medications used to treat individuals with kidney disease associated with an increased risk of motor vehicle crash among pre-dialysis patients?

No conclusions regarding the effect of medications on crash risk in pre-dialysis kidney disease patients can be drawn at the present time.

Our searches, including both electronic and hand searches, did not identify any studies that assessed the association of medications in pre-dialysis kidney disease patients on direct or indirect crash risk.

Key Question 3: Are dialysis and accompanying drug treatments associated with an increased risk of motor vehicle crash?

There is currently no direct evidence of an association between dialysis and the risk of a motor vehicle crash. However, indirect evidence indicates that it is plausible that drivers with end-stage renal disease (ESRD) treated with dialysis and related medications may be at an increased risk of motor vehicle crash (Strength of Conclusion: Acceptable).

***Direct Evidence – Crash Studies**: No studies were identified by our searches.*

***Indirect Evidence – Studies Neurocognitive Function**: We identified 13 studies with 980 patients with unclear generalizability to CMV drivers. Overall, this evidence base was of low quality. The included studies used a variety of study designs and different control populations, limiting their comparability and compatibility for statistical analysis. Furthermore, studies infrequently reported the same outcomes. For analysis, we subdivided the studies by comparisons performed. No clear trend emerged from these 13 studies to conclude definitively that patients treated with dialysis do or do not have neurocognitive impairment compared with controls. However, a substantial number of test results suggest that patients treated with dialysis do have neurocognitive impairment in domains associated with an increased risk of motor vehicle crash. Findings also suggest that ESRD patients on hemodialysis may be more impaired than patients not on dialysis, and that patients on hemodialysis may be more impaired the day before dialysis than the day after.*

Indirect Evidence – Studies of Sleep-Related Outcomes*: Three studies with a total of 70 patients were identified for this evidence base. Each addressed different outcomes and therefore had to be considered in isolation. The findings of two studies point to an association between sleep disorders and kidney disease, indirectly suggesting an increased risk of motor vehicle crash among dialysis patients. The findings of one of those studies also suggest that overnight (nocturnal) dialysis may alleviate sleep apnea. The findings of the third study suggest that different dialysis buffers may alleviate symptoms.*

Key Question 4: Are kidney transplantation and accompanying drug treatments associated with an increased risk of motor vehicle crash?

Currently, there is no direct evidence associating kidney transplantation and motor vehicle crash risk. However, indirect evidence suggests the possibility that kidney transplant recipients may be at a lower risk for motor vehicle crash than individuals with ESRD treated with dialysis (Strength of Conclusion: Acceptable).

Direct Evidence – Crash Studies*: Our searches identified no studies.*

Indirect Evidence – Neurocognitive Function*: Two low- quality studies that enrolled a total of 43 kidney transplant recipients met the inclusion criteria for this key question and reported on neurocognitive function. One study observed significant improvements in neurocognitive function among kidney transplant recipients across several domains. The second study observed some small improvements in neurocognitive function, but these improvements were not statistically significant. Given the small size of this study, the lack of a statistically significant finding is not surprising and this finding may be an example of a type-II statistical error. Neither of these studies specifically enrolled individuals from a population of CMV drivers. Consequently, the generalizability of the findings of these two studies to CMV drivers is unclear.*

Indirect Evidence - Sleep-Related Outcomes*: One low-quality study that enrolled 841 kidney transplant recipients met the inclusion criteria for this key question and reported on a sleep-related outcome. The generalizability of this study to CMV drivers is unclear. The study findings suggest that a substantial portion of kidney transplant recipients may be at risk for sleep apnea, and therefore at an increased risk of motor vehicle crash. However, a smaller proportion of kidney transplant recipients were at risk for sleep apnea compared with similar individuals on dialysis, suggesting that the risk of motor vehicle crash among transplant recipient may be lower among transplant recipients than dialysis patients.*