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## COMMERCIAL DRIVER LICENSE EXAMINEES' MISREPORT ON THEIR FEDERAL MOTOR CARRIER SAFETY ADMINISTRATION CERTIFICATION EVALUATION

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Adam Pascoe, Student

Dr. Timothy Prince, Committee Chair

Dr. Sarah Wackerbarth, Director of Graduate Studies

**UKY CAPSTONE FOR MPH DEGREE:****COMMERCIAL DRIVER LICENSE EXAMINEES' MISREPORT ON THEIR FEDERAL MOTOR CARRIER SAFETY ADMINISTRATION CERTIFICATION EVALUATION****ADAM PASCOE, MD MPH CANDIDATE****CAPSTONE COMMITTEE:****KATHLEEN HARP PHD, DAVID MANNINO MD, AND SCOTT PRINCE MD MPH****AND WITH INPUT FROM****SUSAN SPENGLER, MD MSPH AND THEODORE THEM, MD PHD MS MPH***Successfully defended on May 25, 2018***ABBREVIATIONS AND ACRONYMS USED**

BP	Blood pressure
CDL	Commercial driver's license
CMV	Commercial motor vehicle
<i>Disease</i>	disease and/or condition (in context of FMCSA Regulations)
DM	Diabetes mellitus
EMR	Electronic medical record
FE	Fleet employee (examinee)
FMCSA	Federal Motor Carrier Safety Administration (regulation body)
HTN	Hypertension
IOO	Independent owner-operator (examinee)
ME	Medical examiner
<i>Misreport</i>	Misreport and/or failure to report (in the context of examinee report during FMSCA evaluation)
OSA	Obstructive sleep apnea
RMV	Rheumatic, arthritic, orthopedic, muscular, neuromuscular, or vascular (condition)
US	United States (of America)

**ABSTRACT**

Commercial Driver's License (**CDL**) examinees report their medical history during their Federal Motors Carriers Safety Administration (**FMCSA**) medical certification exams  $\leq 2$  years. When the examinees report diagnoses which may impact the control and operation of commercial motor vehicles (**CMV**), they face scrutiny with decreased medical certification or may be

considered unfit to control and operate a CMV. Medical examiners may have access to the examinees' electric medical records (EMRs) to generate a deeper appreciation, independent from the examinees' self-report, of their risk for sudden and/or gradual incapacitation. We do not know how often diagnoses are omitted from the history given to medical examiners and how competent medical examiners can determine diagnoses not reported by the examinee.

We reviewed the EMRs for 210 examinees, whom presented to an Occupational-Medicine clinic in the Northeast (USA), specifically for any diagnoses that may potentially affect the routine control and operation of a CMV. We recorded their demographic information (including employment type), specific diagnoses, and the certification outcome. We also noted which diagnoses were reported to the medical examiner and which diagnoses were elucidated either by review of the medical records or during physical exam.

The 210 examinees in our sample had a mean age of 44.74 yrs [95% CI: 42.97-46.52 yrs], were 5.24% [2.91-9.25%] female, and 19.05% [14.26-24.98%] presented for a new medical certification. There was no statistical significance between the correlation between employment type (*i.e.*, fleet-employee *vs.* independent owner-operator) and misreport on the examinee ( $n = 201$ )- or the diagnosis ( $n = 630$ )-level. The examinees failed to report 53% of their diagnosis, and medical examiners were only aware of 17% of additional diagnoses (*i.e.*, those diagnoses not reported by the examinee).

The medical examiner is often making the decision to certify an examinee with an incomplete appreciation of the examinee's medical history.

## INTRODUCTION

There are an estimated 3 million commercial truck drivers in the US [BLS 2015], providing an ever-important role in the delivery of goods to our nation. Each of these drivers involved in the interstate delivery of goods and peoples, by law, needs to have a Federal Motors Carriers Safety Admistration (**FMCSA**) medical evaluation at least every 2 years to maintain her/his Commercial Driver's License (**CDL**) [FMCSA Regulations, Part 391]. The overarching goal of the FMSCA is to reduce crashes, injuries, and fatalities involving large trucks and buses [FMCSA 2016]. Due to the high volume of trucks, 17% of all occupational fatalities in the United States (**US**) were driver/ sales workers and truck drivers [Chen *et al.* 2014]. These drivers had an average annual fatality rate of 27.5 per 100,000 full-time workers, 7 times higher than the national average (3.9/ 100,000 full-time workers) for all workers [Chen *et al.* 2014].

During each evaluation by a FMCSA-registered medical examiner (**ME**), the CDL examinee must provide her/his medical history – any diagnosis and/or condition (henceforth, truncated to diagnosis) that could affect her/his ability to control and operate a commercial motor vehicle (**CMV**). Irrespective of their current job description, to be physically qualified to operate a CMV, these examinees must be physically able to do all duties of truck hauling, including, but not exclusive to, undercarriage inspection and roadway placard placement during emergencies. The history is coupled to objective data: an exam, dipstick urinalysis, height, weight, blood pressure measurement(s), and any other diagnostic procedure(s) ordered by a suspecting ME. Certain findings may preclude a driver from having a CDL or shorten the duration of the medical certification; *e.g.*, reporting diabetes mellitus (**DM**) without insulin limits one's certification to  $\leq 1$  year, whereas DM with insulin would necessitate the examinee to obtain a medical exemption

(*i.e.*, unqualified to drive without doing so) to be considered fit for CMV control and operation. The two most common findings for preventing full (*i.e.*, 2-year) certification are hypertension (HTN) (90%) and DM (6%) [Abt 2017].

Electronic medical records (EMRs) have been incented by the Centers for Medicare & Medicaid Services and are now increasingly more common for medical offices and medical systems. The ME is now benefited from this wealth of information, at times supplementing the examinee's medical history. However, a recent meta-analysis (2015) showed that these systems have inherent problems, including effective information presentation, customization principles, and minimization of cognitive load, among others [Zahabi *et al.* 2015]. In an American Medical Association-funded study, there was large rates of job dissatisfaction; 42% of physicians opined their EMR systems were inefficient and difficult to operate [Marla 2015]. In a separate confidential survey of 1,800 practicing physicians in Arizona, the majority opined that their current EMRs had a 1-3 rating on 1 (awful)-to-5 (outstanding) scale regarding ease of use and effect on their own productivity [Butler & Johnson 2016]. These systems often detail an abundance of information, but sections of the history can only be accessed through multiple mouse clicks done in sequence. As these certification exams are commonly done in a matter of minutes, this information may only be sparsely reviewed before a decision to certify is finalized.

We propose that health-history misreporting and failure to report (henceforth, truncated to misreport(ing)) is a prevalent problem among examinees and detrimental to FMSCA's goal of keeping the roadways safe. (i) We will examine which items on the self-history form are most often omitted from histories given to certifying MEs. We want to determine if there is (ii) a

difference in misreport prevalence for truck drivers employed by a carrier service (*i.e.*, fleet) compared to self-employed (*i.e.*, independent) owner-operators and (*iii*) how complete MEs are in reviewing the examinees' EMR to determine if there are potentially disqualifying or certification-limiting problems. We have made the following hypotheses for this project:

H<sub>1</sub>: Obstructive sleep apnea (**OSA**), DM, and HTN are disproportionately withheld from MEs upon examinees' medical evaluations compared to other categories of concern ( $n_{total} = 13$ ), as stated in §391.41 'Physical Qualifications and Examinations,' 3b, under Subpart E. These conditions are presumed to be more commonly withheld because they require additional diagnostics (OSA), specialist evaluation (OSA, DM), and/or common (HTN) [Transportation Research Board 2014] in this population.

H<sub>2</sub>: Misreport of independent owner-operators (**IOOs**) is more prevalent than that than of fleet employees (**FEs**). Those who are employed in a fleet have additional oversight ('big brother effect'), which discourages illegal representation of their medical history. Additionally, any reported diagnosis has the potential to decrease the duration of the certification, increasing the cost for the examinee (because they would need another certification exam sooner than if they did not report the diagnosis). The charge for each exam is not insignificant for this working population (*e.g.*, the Guthrie clinic charges \$99). The IOOs were financially responsible for such a charge; the FEs were likely reimbursed by their employer for this cost.

H3: MEs are not able to effectively review the EMR or evaluate examinees via physical exam to find potentially disqualifying or certification-limiting problems that would affect FMSCA certification duration (*i.e.*, there are events found during EMR review that may have had affected certification duration.). This will be determined by how many diagnoses (with relevance to the safe operation and control of a CMV, better defined below) found during EMR review and/or exam by the ME but were not reported by the examinee. These certification exams are scheduled for 15-20 minutes at the Guthrie Section of Occupational Medicine; the information in an examinee's EMR may only be sparsely reviewed before a decision is made.

### **MATERIALS & METHODS**

The sample consisted of CDL examinees whom presented to the Section of Occupational Medicine, Guthrie Medical Group, P.C., headquartered in Sayre, PA, for their FMCSA evaluation from January 2015 to January 2016. These examinees were not inquired regarding the reason for medication certification (*i.e.*, to gain a CDL license or to serve as a level-of-fitness exam for a safety-sensitive position). In addition to their Sayre location, the Section of Occupational Medicine has satellite offices along the southern tier of upstate New York (Owego, Appalachia, Vestal). The MEs included 5 Occupational-Medicine-trained physicians and 2 physician extenders, all certified through the FMCSA National Registry of Certified MEs.

Per FMCSA Regulation, the minimum age requirement for operating a CMV in interstate commerce is 21 years of age. The examinees, by state mandate, for intrastate purposes cannot obtain a CDL until 18 years of age in the states of Pennsylvania [PA Department of Transportation] and New York [NY Department of Motor Vehicles]. Nonetheless, these individuals may present at an age younger than 18 years to gauge fitness level for safety-

sensitive work. There is no age cap (*i.e.*, maximum) for holding a CDL per the FMSCA safety regulations [Part 391], but the driver must be physically capable of safely driving, loading, and doing emergency repairs as deemed by a ME. The first visit of examinee(s) who presented more than once to the Guthrie Section of Occupational Medicine Practice was the only encounter included in the data set.

The data set was collected by the MEs upon examinees' FMSCA evaluation exams. The ME had collected demographic information (*i.e.*, name, age, sex, employment status) and information regarding potentially disqualifying conditions and deemed whether these findings impacted the examinee's ability to operate a CMV and if so, how long the medical certification was to be valid (see **ATTACHMENT 1**). Potentially disqualifying conditions, per regulation, include (i) loss and/or (ii) impairment of limb or extremity; (iii) DM requiring insulin; (iv) current cardiac and/or (v) respiratory conditions; (vi) HTN; (vii) rheumatic, arthritic, orthopedic, muscular, neuromuscular, or vascular condition (**RMV**); (viii) epilepsy or other loss-of-consciousness-causing condition; (ix) psychiatric disorder; (x) vision and/or (xi) hearing impairment; and/or current (xii) alcohol or (xiii) drug use [§391.41].

Each examinee signed an 'Acknowledgement of Understanding and Consent for Information Release' to allow the ME access to their Guthrie EMR. A more extensive review of the examinee's EMR by an Occupational Medicine resident (PGY3, author AP) was done to note whether there was additional clinical information that the ME was unaware of when certifying the examinee (*i.e.*, not documented either on the FMSCA form or on the study sheet). Diagnoses

were determined via report by the examinee (see **FIGURES 1 & 2**), documentation by the ME, and/or during record review by author AP. During record review, any potential diagnosis that may potentially impact CMV control and/or operation and fall under the 13 categories under the Regulations [Part 391] was considered. In this EMR review, complete medical history, problem list, and medication list, and most encounter notes were reviewed. The EMRs were specifically reviewed for evidence of previous FMCSA evaluations, previous encounters with any care provider, and to be informative or subjectively poor. Examples of subjectively poor EMRs were one(s) with very few encounters or without any encounters 5-10 years before the study FMSCA certification.

**FIGURE 1:**

<b>DRIVER HEALTH HISTORY</b> <i>(continued)</i>								
<b>Do you have or have you ever had:</b>	<b>Not</b>			<b>Yes</b>	<b>Not</b>			
	<b>Yes</b>	<b>No</b>	<b>Sure</b>		<b>Yes</b>	<b>No</b>	<b>Sure</b>	
1. Head/brain injuries or illnesses (e.g., concussion)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		16. Dizziness, headaches, numbness, tingling, or memory loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Seizures, epilepsy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		17. Unexplained weight loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Eye problems (except glasses or contacts)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		18. Stroke, mini-stroke (TIA), paralysis, or weakness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Ear and/or hearing problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		19. Missing or limited use of arm, hand, finger, leg, foot, toe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Heart disease, heart attack, bypass, or other heart problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		20. Neck or back problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Pacemaker, stents, implantable devices, or other heart procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		21. Bone, muscle, joint, or nerve problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. High blood pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		22. Blood clots or bleeding problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. High cholesterol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		23. Cancer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Chronic (long-term) cough, shortness of breath, or other breathing problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		24. Chronic (long-term) infection or other chronic diseases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Lung disease (e.g., asthma)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		25. Sleep disorders, pauses in breathing while asleep, daytime sleepiness, loud snoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Kidney problems, kidney stones, or pain/problems with urination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		26. Have you ever had a sleep test (e.g., sleep apnea)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Stomach, liver, or digestive problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		27. Have you ever spent a night in the hospital?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Diabetes or blood sugar problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		28. Have you ever had a broken bone?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Insulin used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		29. Have you ever used or do you now use tobacco?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Anxiety, depression, nervousness, other mental health problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		30. Do you currently drink alcohol?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Fainting or passing out	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		31. Have you used an illegal substance within the past two years?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
					32. Have you ever failed a drug test or been dependent on an illegal substance?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In addition to the specified questions above, examinees were queried regarding previous surgery, current medication use, any other health conditions not described elsewhere, and further comment on any 'yes' answers. The examinees also signed an attestation, legally verifying that their history reporting as being complete and truthful, in the form.

**FIGURE 2:**

**Vision**  
 Standard is at least 20/40 acuity (Snellen) in each eye with or without correction. At least 70° field of vision in horizontal meridian measured in each eye. The use of corrective lenses should be noted on the Medical Examiner's Certificate.

Acuity	Uncorrected	Corrected	Horizontal Field of Vision
Right Eye:	20/ <input type="text"/>	20/ <input type="text"/>	Right Eye: <input type="text"/> degrees
Left Eye:	20/ <input type="text"/>	20/ <input type="text"/>	Left Eye: <input type="text"/> degrees
Both Eyes:	20/ <input type="text"/>	20/ <input type="text"/>	
Applicant can recognize and distinguish among traffic control signals and devices showing red, green, and amber colors			<input type="radio"/> Yes <input type="radio"/> No
Monocular vision			<input type="radio"/> Yes <input type="radio"/> No
Referred to ophthalmologist or optometrist?			<input type="radio"/> Yes <input type="radio"/> No
Received documentation from ophthalmologist or optometrist?			<input type="radio"/> Yes <input type="radio"/> No

In contrast to the written reporting of other diagnoses, the presence of contact lens was a verbal report. Such presence was documented by ancillary medical staff/ MEs asking examinees if they currently had contacts in and/or by visualization of glasses.

The data were compiled in a Microsoft Access databank (version 1804); rudimentary analysis was done using Microsoft Excel (version 1804). Primary variables considered were employment status (*i.e.*, FE vs. IOO), examinee misreport of her/his diagnosis(-es), and medical examiner awareness of examinee's diagnosis. Secondary variables included age, sex, certification type (*i.e.*, new vs. recertification), and EMR wealth (*i.e.*, EMR with (i) previous FMCSA evaluation(s), and/or (ii) previous encounter(s), or (iii) judged to be selectively poor). Examinees were judged to have certification type by what was selected on the FMCSA Form MCSA-5875; an examinee was classified as recertifying if there were previous FMCSA encounters in her/his EMR despite what was marked on Form MCSA-5875 (*i.e.*, marked 'new'). Certification duration was collected for those whom misreported vs. those whom did not misreport. Three separate models were used, each using a different denominator ((i) all consenting examinees, (ii) all diagnoses, and (iii) all examiner aware diagnoses). Further

statistical analysis was done using Stata statistical package (version 15.1). Continuous variables were compared using a Student's *t*-test to determine statistical significance. Chi-square or Fisher exact tests were used to determine significant relationships for categorical variables as appropriate. A final logistic regression model was generated after addressing for multicollinearity. All tests were two-sided, and significance levels were defined at an alpha of  $\leq 0.05$ .

The research proposal was approved separately by Guthrie Institutional Review Board and the University of Kentucky Institutional Review Board.

## **RESULTS**

### **Study population statistics**

The EMRs for 210 consenting examinees were reviewed and included in our study (**TABLE 1**).

The age distribution for the entire sample was normally distributed (density plot not shown) with a mean of 44.74 years of age. Eleven percent of the sample were female. Nearly one in five examinees were noted to be new certifiers; two examinees had unknown documentation regarding the certification. In our sample, FEs ( $n = 121$ ) outnumbered IOOs ( $n = 80$ ) on a 3:2 ratio. The sample of IOOs did not statistically differ from the FEs in terms of age, female makeup, and certification type.

Approximately 10% of our sample had no prior encounters documented in the EMR. Of those examinees recertifying ( $n = 168$ ), only 19% had documentation of a prior FMCSA exam in the EMR. The medical reviewer (author AP) found 50 examinees to have subjectively poor EMRs,

of which little information was available. There was no statistically significant difference between the EMRs of the IOOs compared to the FEs in terms of prior encounters and wealth of information (*i.e.*, rated subjectively poor *vs.* not). There was no statistically significant difference between the EMRs of recertifying IOOs compared to recertifying FEs in terms of prior FMCSA evaluations.

<b>Table 1: All consenting examinees</b>			
	<b>Total<sup>1</sup></b> ( <i>n</i> =210)	<b>Independent Owner-Operator<sup>2</sup></b> ( <i>n</i> = 80)	<b>Fleet- Employee<sup>2</sup></b> ( <i>n</i> = 121)
Mean Age (yrs [range]) 95% CI (yrs)	44.74 [18-73] 42.97-46.52	46.45 [18-73] 43.20-49.70	43.84 [20-67] 41.71-45.98
Standard Deviation (yrs)	13.03	14.62	11.85
Female (% ( <i>n</i> )) 95% CI (%)	5.24 (11) 2.91-9.25	3.75 (3) 1.20-11.24	6.61 (8) 3.31-12.78
New Certification <sup>3</sup> (% ( <i>n</i> )) 95% CI (%)	19.05 (40) 14.26-24.98	18.75 (15) 11.51-29.06	19.01 (23) 12.90-27.11
Unknown Certification (% ( <i>n</i> )) 95% CI (%)	0.95 (2) 0.24-3.77	1.25 (1) 0.168-8.68	0.83 (1) 0.11-0.58
No prior visits in EMR (% ( <i>n</i> )) 95% CI (%)	9.05 (19) 5.82-13.79	8.75 (7) 4.16-17.48	8.26 (10) 4.46-14.80
No prior FMCSA exams in EMR (% of recertifiers ( <i>n</i> )) 95% CI (%)	19.05 (32) 13.75-25.78	21.88 (14) 13.22-33.99	15.46 (15) 9.46-24.26
Subjectively Poor EMR <sup>4</sup> (% ( <i>n</i> )) 95% CI (%)	23.81 (50) 18.49-30.09	17.5 (14) 10.53-27.66	26.45 (32) 19.27-35.14

**Table 1:**

1. The number of participants also include 9 examinees who had unknown employment status.
2. As volunteered by the examinee at time of the certification exam and/or as indicated in the examinee's EMR during time of chart review
3. As indicated on the FMSCA Form MCSA-5875. If there was/ were any previous FMSCA encounter(s) in the EMR, the exam was considered to be a recertification regardless of what was documented on the Form MSCA-5875.
4. As judged during EMR review by author AP. If an EMR had no previously encounters or very few visits or no recent visits, it was judged to be 'subjectively poor.'

Of those recertifying, approximately 43% had previous restrictions, either volunteered by the examinee or detected by the ME or the record reviewer (author AP) (TABLE 2). The most common conditions restricted were ‘HTN’ ( $n = 37$ ), ‘respiratory dysfunction’ (including OSA,  $n = 22$ ), and ‘cardiovascular’ ( $n = 13$ ). There was no statistically significant difference between IOO- and FE- recertifying examinees having previous restrictions. Moreover, there was no statistically significant difference when stratified by condition type.

<b>Table 2: Recertifying Examinees</b>						
	<b>Total</b> ( $n = 168$ )		<b>Independent Owner-Operator</b> ( $n = 64$ )		<b>Fleet Employee</b> ( $n = 97$ )	
% w/ previous restrictions (n) 95% CI	43.45 (73) 36.86 - 51.12		39.06 (25) 27.67 - 51.78		47.42 (46) 37.54 - 57.51	
<b>Previous FMCSA Restrictions</b>   restrictions <sup>1A</sup>  documentations <sup>1B</sup>						
(i) Loss of Limb	1	1	0	1	1	0
(ii) Limb Impairment	0	0	0	0	0	0
(iii) Diabetes	8	1	5	0	2	1
(iv) Cardiovascular	13	4	7	2	6	2
(v) Respiratory Dysfunction	22	5	8	1	14	3
(vi) Hypertension	37	9	12	4	23	5
(vii) RMV	6	15	3	5	3	10
(viii) Epilepsy/ Syncope	0	0	0	0	0	0
(ix) Mental Disorders	8	8	3	1	4	7
(x) Vision <sup>2</sup>	3	39	0	16	3	21
(xi) Hearing	3	0	3	0	0	0
(xii) Drug Use	4	1	1	1	2	0
(xiii) Alcohol Use	0	2	0	1	0	1

**Table 2:**

A, B: Fisher’s exact test: IOOs vs. FEs calculated  $p$ -value to be 0.110 for restriction and 0.166 for documentation.

1. As documented on prior MSCA-5875 form(s) or visit notes relating to FMCSA medical certification exams in the EMR and/or volunteered to the ME and documented on the study sheet. The disease was considered a *restriction* when it was specifically written under the ‘Medical Examiner Determination (Federal)’ section. It was considered a *documentation* when it was noted elsewhere on prior MSCA-5875 form(s).

2. Inclusive of contact lens as a restriction to control and operate a CMV.

A. Two examinees were restricted without a stated condition. One examinee was previously restricted for an abnormal urinalysis. A ME knew another examinee had a history of a prior restriction, but specific reason was not documented. That examinee had HTN and DM during the time of her/his study-FMCSA evaluation.

### **Misreporting**

Most of the examinees (63%) were perceived to have misreported  $\geq 1$  item of their personal medical history which may have impacted their certification duration (**TABLE 3**). There was no statistically significant difference between the prevalence of misreporting between the IOOs and the FEs on an examinee-level.

<b>Table 3: Misreport <math>\geq 1</math> item from self-history</b>			
	<b>Total</b> ( <i>n</i> =210)	<b>Independent Owner-Operator</b> ( <i>n</i> = 80)	<b>Fleet Employee</b> ( <i>n</i> = 121)
Perceived to misreport $\geq 1$ item from self-history (%( <i>n</i> )) 95% CI	62.86 (132) 56.07- 69.17	60 (48) 48.71-70.32	66.12 (80) 57.12-74.08

The medical reviewer (author AP) found 630 potential conditions among the 210 examinees that may have potentially affected the FMCSA medical certification duration (**TABLE 4**). The most common conditions were RMV (*n* =141), presence of contact lens (*n* = 91), and respiratory dysfunction, including OSA (*n* = 79). When the examinee withheld certain diagnoses, the MEs were unable to document diagnoses of loss of limb (2 opportunities documented in the EMR), epilepsy/ syncope (14), contact lens (4), and hearing conditions (13). The MEs had dismal documentation rates for documenting diagnoses and conditions unreported by the examinee (57/

334 (17.1%)) but were most successful at OSA (15 documentations/ 23 opportunities when not reported by examinee (65.2%)), limb impairment (1/2 (50%)), and HTN (6/17 (35.3%)).

	<b>Total Diagnoses (n (%))<sup>A</sup></b>	<b>Reported by the examinee (n (% of diagnoses))<sup>B</sup></b>	<b>Misreported by the examinee (n)<sup>C</sup></b>	<b>Diagnosis which was misreported but ME-aware (n (%))<sup>D</sup></b>
(i) Loss of Limb	3 (0.5)	1 (33.3)	2	0 (0)
(ii) Limb Impairment	3 (0.5)	1 (33.3)	2	1 (50)
(iii) Diabetes	24 (3.8)	9 (37.5)	15	1 (6.7)
(iv) Cardiovascular	33 (5.2)	14 (42.4)	19	2 (10.5)
(v) Respiratory Dysfunction <sup>1</sup>	37 (5.9)	15 (40.5)	22	1 (4.5)
<i>Obstructive Sleep Apnea</i>	42 (6.7)	19 (45.2)	23	15 (65.2)
(vi) Hypertension	78 (12.4)	61 (78.2)	17	6 (35.3)
(vii) RMV	141 (22.4)	46 (32.6)	95	17 (17.9)
(viii) Epilepsy/ Syncope	17 (2.7)	3 (17.6)	14	0 (0)
(ix) Mental Disorders	55 (8.7)	15 (27.3)	40	9 (22.5)
(x) Vision <sup>2</sup>	20 (3.2)	5 (25.0)	15	2 (13.3)
<i>Contact Lens</i>	91 (14.4)	87 (95.6)	4	0 (0)
(xi) Hearing	19 (3.0)	6 (31.6)	13	0 (0)
(xii) Drug Use	33 (5.2)	3 (9.1)	30	1 (3.3)
(xiii) Alcohol Use	18 (2.9)	5 (27.8)	13	1 (7.7)
Other	16 (2.5)	6 (37.5)	10	1 (10.0)
<b>Total</b>	<b>630 (100.0)</b>	<b>296 (47.0)</b>	<b>334 (53.0)</b>	<b>57 (17.1)</b>

**Table 4:**

A: Opportunities are relevant health conditions and/or diseases, which may impact the certification and/or the duration of the certification, that were found upon reviewing the examinees' EMRs. The percentage is calculated as 'n<sub>condition</sub> / total n<sub>across all conditions</sub>'

B: Examinee-reported diagnoses are those that are documented in the 'Driver Health History' section in the FMSCA Form MCSA-5875. The percentage is calculated as 'n<sub>condition-specific, reported</sub> / n<sub>condition</sub>'

C: Calculated by 'total diagnoses<sub>condition</sub> – reported by the examinee<sub>condition</sub>'

D: These were diagnoses that the ME found during physical exam and/or review of EMR. The percentage is calculated as 'diagnosis unreported, but ME-aware condition / misreported by the examinee<sub>condition</sub>'

1. Exclusive of OSA.
2. Inclusive of visual impairment, but exclusive of corrective lens.

There were no statistically significant differences between IOOs and FEs in terms of the number of examinee-reported diagnoses and examiner-aware diagnoses (data not shown).

### **Univariate Analysis: Misreporting**

Many of the examinees ( $n = 137$ ) were deemed to have misreported  $\geq 1$  diagnosis (**TABLE 5**).

Those who misreported  $\geq 1$  diagnosis (95% CI: 46.60-50.53 years old) were found to be older than those who did not misreport (95% CI: 34.63-40.49 years old), less likely to be presenting for a new certification (misreported 95% CI of 6.67-17.47% *vs.* not misreported 24.10-46.08). Of those recertifying, those who misreported (95% CI: 37.94-55.71%) were more likely to have had previous restrictions than those whom did not misreport (95% CI: 8.90-32.37%). Those who misreported were also found to have fewer EMRs without a prior encounter, fewer EMRs without a prior FMCSA evaluation, and fewer EMRs rated as subjectively poor. There was no statistically significant difference of those whom misreported *vs.* those whom did not misreport in employment type.

<b>Table 5: Univariate Analysis. Classified on Misreporting. All 210 examinees</b>		
	<b>Those who misreported (n = 137)</b>	<b>Those who did not misreport (n = 73)</b>
Mean age (yrs) [range] 95% CI (yrs)	48.56 [23-73] <b>46.60-50.53</b>	37.56 [18-69] <b>34.63- 40.49</b>
Standard Deviation	11.63	12.55
New Certification (% (n)) 95% CI (%)	10.95 (15) <b>6.67-17.47</b>	34.25 (25) <b>24.10-46.08</b>
Unknown Certification (% (n)) 95% CI (%)	0	2.74 (2) <b>0.66-10.62</b>
% Independent (n) 95% CI	35.77 (49) 28.10-44.23	42.47 (31) 31.45-54.28
% Unknown employment (n) 95% CI	2.92 (4) 1.09-7.61	6.85 (5) 2.82-15.71
% recertifiers w/ previous restrictions 95% CI (%)	46.72 (65) <b>37.94-55.71</b>	17.78 (8) <b>8.90-32.37</b>
No prior encounters in EMR (% (n)) 95% CI (%)	0.73 (1) <b>0.10-5.11</b>	24.66 (18) <b>15.94-36.08</b>
No prior FMCSA exams in EMR (% of recertifiers (n)) 95% CI (%)	13.11 (16) <b>8.14-20.46</b>	33.33 (15) <b>20.79-48.78</b>
Subjectively poor EMR (% (n)) 95% CI (%)	10.95 (15) <b>6.67-17.47</b>	47.95 (35) <b>36.53-59.81</b>

Statistically significant relationships **emboldened**.

The examinees only reported a fraction of potential diagnoses that could have impacted their certification duration. The examinees who misreported at least once reported less than half of certification-duration-affecting diagnoses related to many conditions: DM, cardiovascular, respiratory dysfunction (including OSA), epilepsy and syncope, mental disorders, vision, hearing, drug use, and alcohol use (**DATA NOT SHOWN**).

There was a statistically significant difference of the certification outcomes between those whom misreported and those whom did not misreport (Fisher's exact  $p$ -value = 0.001, **TABLE 7**). Those who misreported had approximately 2.5 times, 1.25 times, and 6 times that of those whom did not misreport of receiving a 1-year, highly restricted ( $\leq 6$  months), and no certification (*i.e.*, found disqualified) respectively.

<b>Table 7: Certification Outcome</b>		
	<b>Those who misreported</b> ( $n = 137$ )	<b>Those who did not misreport</b> ( $n = 73$ )
Full 2-yr (% ( $n$ ))	46.72 (64)	75.34 (55)
1-yr (% ( $n$ ))	38.69 (53)	15.07 (11)
6-mo (% ( $n$ ))	2.19 (3)	0
3-mo (% ( $n$ ))	3.65 (5)	5.48 (4)
2 wk-2 mo (% ( $n$ ))	4.38 (6)	2.74 (2)
Not Issued (% ( $n$ ))	4.38 (6)	1.37 (1)

Table 7: Fisher's Exact test:  **$p$ -value = 0.001.**

### **Diagnosis-level events**

Of the 630 diagnoses that were found, there were no statistically significant differences between either the reporting of the diagnosis ( $p$ -value = 0.712) or the ME being aware of the diagnosis ( $p$ -value = 0.262) with receipt of certification (**CHI SQUARE ANALYSIS NOT SHOWN**).

The effect of examinee employment status on whether the ME was aware of a diagnosis was analyzed in both univariate analysis (top half of **TABLE 7**) and covariate analysis (*i.e.*, logistic regression, bottom half of **TABLE 7**). In the univariate analysis, there was no statistically significant correlation. There were no significant correlations of employment status, certification status, and examinees with previous FMCSA evaluation exams in their EMR and the outcome of

ME aware diagnosis. The examinees with an EMR gauged to be subjectively poor were found to have 3.5 times the odds (95% CI: 1.9-6.3) of having a diagnosis that is unbeknownst to the examiner ( $p$ -value = 0.000). Some covariates were not used in the final model due to low number of observations and/or multicollinearity. The same analysis was done for HTN and OSA (DATA NOT SHOWN). In each, no statistically significant finding for employment status's correlation in regard to medical examiner awareness of a diagnosis, or the type of certification, or the examinee having a DOT evaluation in her/his EMR, or an EMR gauged to be subjectively poor.

<b>Table 7:</b>			
Univariate Analysis- 616 opportunities to report health history which may impact certification			
	<b>Independent Owner-Operators</b>	<b>Fleet Employees</b>	<b>Chi<sup>2</sup> p-value</b>
Medical examiner unaware	110	161	0.882
Medical examiner aware	138	207	
Logistic Regression: all opportunities to report a diagnosis ( $n = 616$ )			
<b>Group of interest</b>	<b>Comparison group</b>	<b>Odds ratio (95% CI)</b>	<b>p-value</b>
Independent owner-operators	Fleet employees	1.027 (0.736-1.433)	0.876
Examinees presenting for a new certification	Examinees presenting for a recertification	0.684 (0.342-1.368)	0.283
Examinees with an EMR without previous DOT	Examinees with an EMR with a previous DOT	1.100 (0.660-1.833)	0.715
Examinees with an EMR gauged to be subjectively poor	Examinees with an EMR gauged to be informative.	<b>3.464 (1.906-6.295)</b>	<b>0.000</b>

**Table 7:** There were 14 observations that had unknown employment that were not included in the analysis. Medical examiner could not be used in the final data model due to low number of observations for specific medical examiners. Age and gender were not used in the final model due to multicollinearity.

Finally, MEs were evaluated on how well they can surmise additional diagnoses that were not reported by the examinee. Many of the diagnoses (287/345) that the ME were aware of upon issuing the certification were reported by the examinee. There was no statistically significant correlation between examinee report and employment status on a univariate (**TABLE 8** top half) or covariate basis (**TABLE 8** bottom half). The covariates of certification type, examinees with a previous DOT in her/his EMR, or an examinee with a subjectively poor DOT were all statistically insignificant. Statistically insignificant correlations were found when restricting to the diagnoses of HTN and OSA (**DATA NOT SHOWN**).

<b>Table 8:</b>			
Univariate Analysis-345 diagnoses of which the ME was aware of			
	<b>Independent Owner-Operators</b>	<b>Fleet Employees</b>	<b>Chi<sup>2</sup> <i>p</i>-value</b>
Examinee misreported	19	39	0.217
Examinee reported	119	168	
Logistic Regression- 'Examinee Reported' Model- Diagnoses ( <i>n</i> = 345)			
<b>Group of interest</b>	<b>Comparison group</b>	<b>Odds ratio (95% CI)</b>	<b><i>p</i>-value</b>
Independent owner-operators	Fleet employees	1.579 (0.859-2.903)	0.141
Examinees presenting for a new certification	Examinees presenting for a recertification	0.341 (0.105-1.107)	0.073
Examinees with an EMR without previous DOT	Examinees with an EMR with a previous DOT	0.569 (0.254-1.271)	0.169
Examinees with an EMR gauged to be subjectively poor	Examinees with an EMR gauged to be informative.	1.725 (0.719-4.138)	0.222

**Table 8:** ME-aware diagnosis of examinees without known employment status were excluded from this analysis. The sample size of diagnoses needed to detect statistical significance with an  $\alpha$  of 0.05 and power (1- $\beta$ ) of 0.80 is approximately 3,500. If the FMCSA population has a similar diagnoses prevalence as in our study (3 diagnoses per examinee), we would need 1167 examinees to show statistical significance.

## DISCUSSION

Medical certification is the responsibility of the ME. There are few objective measurements that are taken, besides the physical exam, that can elucidate a pre-existing diagnosis that might impair one's routine operation and control of a CMV. As such, the ME is dependent upon the examinee's self-reported health-history. This is the first study to document that FMSCA examinees misreport during their medical evaluation. We determined that approximately 65% of examinees were not totally forthcoming with their complete medical history; we also determined that approximately 53% of diagnoses were withheld from the ME. We caution this extrapolation to the entire FMCSA examinee population (3 million) [FMCSA], because we do not know the reason for the examinees' certification exams nor do we endorse that these results are externally valid to the entire CDL examinee/ licensee population. However, if we put these arguments aside, we estimate that 1.95 million examinees are certified by MEs unaware of an examinee's full medical history, may be unfit to safely operate and control a CMV, yet do so, on American roadways.

We did not access the reason(s) and/or motivation for the examinees' misreport of self-history. The misreporting may be unintentional, as examinees may see a health-problem as being inconsequential (*e.g.*, diagnosed diabetes improved by diet and exercise) or no current importance because the event happened long ago and now has since been intervened (*e.g.*, myocardial infarction due to cocaine many years ago, but now not using cocaine). Additionally, it was difficult to determine which diagnoses were likely to interfere with one's safe control and operation of a CMV (*e.g.*, a musculoskeletal diagnosis, consistent with a RNV condition, that is not documented as 'asymptomatic' in the EMR and DM, now resolved status post gastric bypass).

may both be inconsequential. The misreporting may alternatively be intentional (*i.e.*, prevaricated) as to prevent medical denial, further workup, and/or expenses of the examinee.

Our sample is nearly identical to the entire FMCSA examinee population in terms of their certification outcome (see **TABLE 9**). Data from 2014-2017 showed that 45.5%, 30.2%, and 7.4% of FMSCA examinees earned full (2-year), restricted (1- to 2-year certification), and highly restricted (less than 1-year) certifications respectively. Approximately one (1.1) percent of these examinees were deemed to result in medically unqualified exams [FMCSA].

<b>Table 9: Comparison between Guthrie cohort and National FMCSA examinee population</b>		
<b>Certification Outcome</b>	<b>Guthrie cohort (n =210)</b>	<b>National estimate (2015- 2017) (n = 3,000,000)</b>
Full (2 yr)	56.67	45.5
Restricted	40	30.2
Highly Restricted (1 to <2 years)	30.48	7.4
Disqualified	3.33	1.11

We did not find any statistically significant difference between the misreporting of IOOs vs. FEs on an examinee- or condition-level basis. There is additional oversight by management and human resources when one is employed in such a fleet. Per the FMSCA, the employer has the responsibility to insure that the ME is informed of the minimum medical requirements and the characteristics of the work performed. The motor carrier is also responsible for ensuring that only medically qualified drivers are operating CMVs in interstate commerce. There is little to no prior research (*i.e.*, Google and PubMed searches (May 2018) were both fruitless) on whether employment status is correlated with diagnoses and ultimately with risk of sudden or gradual incapacitation.

It does not place additional onus upon the employer when a FMSCA examinee misrepresents her/his medical history. Deliberate falsification and/or concealment of the examinee's history invalidates the exam as well as the CDL and may also involve civil penalties, not to exceed \$10,000 [FMCSA]. However, when a ME confronts a examinee on this matter, the examinee admits to a previously undisclosed diagnosis, often without penalty, other than a shorter certification period.

The most prevalent misreport in our study were those concerning drug use, epilepsy/ syncope, and vision. We did not find that DM, OSA, and HTN were misreported. Contrarily, we found that HTN was reported far more often than other diagnoses. We did not take into consideration how many of the individuals with HTN had elevated BP ( $\geq 140/\geq 90$  mm Hg) on exam, which would have triggered a more sensitive history by the ME and/or a reduced certification.

Failure to report diagnoses may enable an examinee to gain a 2-year medical certification and bypass additional requirements (*e.g.*, more frequent certifications, diagnostic testing, and/or specialist evaluations). Detection of certain problematic behaviors, such as sleepy driving (*i.e.*, due to OSA) [Smith & Phillips 2011], is often dependent upon the examinee's history. Exam findings are not sensitive and do not relate well to concurrent symptoms. A meta-analysis also determined that sleepiness at the wheel was associated with an increased risk of motor vehicle accidents (pooled OR 2.51 [95% CI: 1.87-3.39]) [Bioulac *et al.* 2017]. Due to limited number of sleep-laboratory-bed units and sleep specialist availability, as well as the increasing prevalence of those with suspected OSA, it was estimated that the (2003) waiting time for diagnosis in a

formal sleep lab, and treatment with a continuous positive airway pressure, across US was 2-10 months [Flemons *et al.* 2004]. Other, newer options like in-home-portable monitors have improved this wait time, but any delay in medical clearance is a source of frustration and concern for examinees with suspected, untreated OSA.

In a cross-sectional study of male truckers at rural truck stops in the South (US), whom answered self-administered anonymous questionnaires, the majority rated their health as good, but when specifically probed, there was substantial reporting of depression (26.9%), sleep disturbances (20.6%), problems with drugs (16.8%), problematic binge-drinking behavior (24.7%) [Shatell 2012]. In another cross-sectional study of 1265 long-haul truck drivers across 32 truck stops throughout the continental US, intake of 5+ drinks per day was documented at 21% and 13.1% for men ( $n = 1184$ ) and women ( $n = 81$ ), respectively [Birdsey 2015].

A FMSCA examinee with documented history of alcohol misuse must pass additional hurdles to obtain a medical certification. A drug-abuse professional must evaluate the examinee and determine if the examinee has a concurrent history of alcoholism and if her/his ability to operate a CMV is impaired. The responsibility to determine whether the examinee is safe to operate such a vehicle on the interstate roadways lies with her/his employer or not [FMCSA]. In our study, risky alcohol intake was retrospectively documented in 2.9% of those drivers, and, in only 7.7% of the encounters, the medical examiner was aware of such a behavior. There was no accompanying documentation from a drug abuse professional or notes referring that such an evaluation was done.

There is no current regulation preventing examinees from doctor shopping and potentially hoodwinking an unaware ME into a full medical certification. We documented that approximately 1 out of every 5 examinees had FMCSA certification exams elsewhere (not at a Guthrie clinic). Contrary to what we expected, we found that recertifying examinees whom misreported were by-large less likely to have an EMR without a prior FMCSA certification. Starting June 22, 2018, the ME who finds the examinee to be physically unqualified to operate a commercial motor vehicle must inform that individual of such and report such to the FMCSA. This will likely build examinee-ME relationship consistency, which would suppress misreporting, either nonintentional or intentional. Per the new Regulation at the time of the reporting to FMCSA, all previously issued certificates issued to the unqualified have expired, and the examinee is no longer legally allowed to operate a CMV [FMCSA 2017].

**Limitations:**

This study has several limitations. Our study population was a convenience sample from a single healthcare system along the eastern Pennsylvania-New York border; this may not be generalizable to the community of CDL examinees outside the Northeast (US).

It was difficult to determine what diagnosis in the EMR would potentially affect control and operation of a CMV. For example, some MSK diagnoses (*e.g.*, carpal tunnel) may be asymptomatic or minimally symptomatic and play no factor in any causal link ending with sudden or gradual incapacitation.

There could have been potential misclassification of employment type. Some examinees did not have an employment type marked on their study sheets; this subset's employment was determined by what was listed in the EMR, generally at a time 6-12 month after the certification exam. These individuals may have changed employment during the interim. However, we would expect this misclassification to be nondifferential as IOOs could be misclassified as FEs as often as FEs misclassified as IOOs.

The subjective determination of how valuable an EMR is a limitation in our study. There was no concrete definition of how an EMR was classified as poor vs. not poor. For future analysis, objective measurements, *e.g.*, number of encounters documented in the EMR and number of specialties documented in EMR, can serve as better proxies of EMR wealth.

In addition, undocumented does not necessarily translate to unaware in the decision-making process, except in a medico-legal application. There could have certainly been a conversation between ME and examinee at the time of the encounter that could have triggered some behavior aimed at risk prevention. This documentation of such would have been more likely for items perceived by the ME to have direct implications in the control and operation of a CMV.

In future analysis, the outcome measurement for future analysis can be based on an ordinal outcome measurement (*i.e.*, disqualified, qualified x 2wks, 1 month, 3 mos., 6 mos., 1 year, or 2 years) instead of binomial (*i.e.*, disqualified or qualified) measurement.

**Conclusion:**

In our sample, we did not detect that OSA, DM, and HTN were more commonly misreported than other diagnoses. We did not see any statistically significant difference between the misreport prevalence of FEs vs. IOOs. Most importantly, we found that  $\approx 53\%$  and  $\approx 44\%$  of diagnoses which may interfere with FMCSA certification are unreported by the examinee and are ultimately unknown to the ME.

**WORKS REFERENCED:**

Abt N [2017]. Report highlights medical certification problems *Overland Park*.

Bioulac S, Micoulaud Franchi J., Arnaud M., Sagaspe P, Moore N., Salvo F, & Philip P (n.d.) [2017]. Risk of motor vehicle accidents related to sleepiness at the wheel: A systematic review and meta-analysis. *Sleep*.

Birdsey JK, Sieber WX, Chen GM., Hitchcock EE, Lincoln JF, Nakata AH, . . . Sweeney M [2015]. National Survey of US Long-Haul Truck Driver Health and Injury: Health Behaviors. *Journal of Occupational and Environmental Medicine*, 57(2), 210-216.

Bureau of Labor Statistics, U.S. Department of Labor [2015]. Occupational Outlook Handbook, 2014-15 Edition, Heavy and Tractor trailer Truck Drivers. Website: <http://www.bls.gov/ooh/transportation-and-materialmoving/heavy-and-tractor-trailer-truck-drivers.htm>.

Butler R, Johnson W [2016]. Rating the digital help: electronic medical records, software providers, and physicians. *Int J Health Econ Manag* 16:269–283.

Chen GX, Amandus HE, & Wu N [2014]. Occupational fatalities among driver/sales workers and truck drivers in the United States, 2003–2008. *Am. J. Ind. Med.*, 57: 800–809. doi:10.1002/ajim.22320.

Federal Motor Carrier Safety Administration (U.S. Department of Transportation). Completed Driver Examinations by Result and Duration. National Registry of Certified Medical Examiners Website: <https://nationalregistry.fmcsa.dot.gov/NRPublicUI/Dashboard.seam>. Accessed November 30, 2017.

Federal Motor Carrier Safety Administration [2017]. Electronic Code of Federal Regulations. Part 391- Qualifications of Drivers and Longer Combination Vehicle (LCV) Driver Instructors. Website: <https://www.ecfr.gov/cgi->

bin/retrieveECFR?gp=1&ty=HTML&h=L&mc=true&=PART&n=pt49.5.391#se49.5.391\_147. Accessed November 30, 2017.

Federal Motor Carrier Safety Administration. Part 391: Physical qualifications for drivers Guidance Q & A. Website: <https://www.fmcsa.dot.gov/regulations/title49/section/391.41>. Accessed November 30, 2017.

Federal Motor Carrier Safety Administration. Part 391- Qualifications of drivers and longer combination vehicle (LCV) driver instructors. §391.1 Scope of the rules in this part; additional qualifications; duties of carrier-drivers. Website: [https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=1&ty=HTML&h=L&mc=true&=PART&n=pt49.5.391#se49.5.391\\_111](https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=1&ty=HTML&h=L&mc=true&=PART&n=pt49.5.391#se49.5.391_111). Accessed December 5, 2017.

Federal Motor Carrier Safety Administration. ‘What is the age requirement for operating a CMV in interstate commerce?’ Website: <https://www.fmcsa.dot.gov/faq/what-age-requirement-operating-cmv-interstate-commerce>. Accessed May 19, 2018.

Flemons WW, Douglas NJ, Kuna ST, Rodenstein DO, Wheatley J [2004]. Access to diagnosis and treatment of patients with suspected sleep apnea. *Am J Respir Crit Care Med* 169, 668–672. DOI: 10.1164/rccm.200308-1124PP.

Marla, D [2015]. AMA: Doc satisfaction with EHRs declining. Newton: Questex Media Group. Website: <https://www.fiercehealthcare.com/ehr/ama-doc-satisfaction-ehrsdeclining>.

New York State Department of Motor Vehicles. New York state driver license types and classes Website: <https://dmv.ny.gov/driver-license/nys-driver-license-classes>. Accessed November 8, 2017.

Pennsylvania Department of Transportation. License Types & Restrictions. Website: <http://www.dmv.pa.gov/Driver-Services/Driver-Information/License-Types/Pages/default.aspx>. Accessed November 8, 2017

Shattell M, Apostolopoulos Y, Collins C, Snmez S, & Fehrenbacher C [2012]. Trucking Organization and Mental Health Disorders of Truck Drivers. *Issues in Mental Health Nursing*; 33(7), 436-44.

Smith BH & Phillips B [2011]. Truckers drive their own assessment for obstructive sleep apnea: a collaborative approach to online self-assessment for obstructive sleep apnea. *J Clin Sleep Med*; 7:241–5.

U.S. Department of Transportation Federal Motor Carrier Safety Administration National Registry of Certified Medical Examiners. Completed Driver Examinations by Result and Duration. Website. Accessed November 2017.

U. S. Department of Transportation. Federal Motor Carrier Safety Administration Strategic Plan. Website:

[https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/FMCSA\\_FY2015\\_FY2018\\_Strategic\\_Plan\\_082618.pdf](https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/FMCSA_FY2015_FY2018_Strategic_Plan_082618.pdf). Updated August 2016. Accessed October 2017.

Zahabi M, Kaber D, & Swangnetr M [2015]. Usability and Safety in Electronic Medical Records Interface Design. *Human Factors: The Journal of Human Factors and Ergonomics Society*, 57(5), 805-34.

49 U.S.C. 521(b)(2)(b), either for making a false statement of or concealing a disqualifying condition. Website:

<https://www.fmcsa.dot.gov/faq/what-happens-if-driver-not-truthful-about-hisher-health-history-medical-examination>.

2014 Transportation Research Board [2014]. 93<sup>rd</sup> Annual Meeting. Federal Motor Carrier Safety Administration. National Survey of Long-Haul Truck Driver Health and Injury. Website: <https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/National%20Survey%20of%20Long-Haul%20Truck%20Driver%20Health%20and%20Injury.pdf>. Accessed June 3, 2018

