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The challenges of enforcing cellphone use while driving laws among police in the United States: a cross-sectional analysis

Journal:	BMJ Open
Manuscript ID	bmjopen-2021-049053
Article Type:	Original research
Date Submitted by the Author:	14-Jan-2021
Complete List of Authors:	Rudisill, Toni; West Virginia University, Epidemiology Zhu, Motao; Nationwide Children's Hospital, Center for Injury Research and Policy
Keywords:	PUBLIC HEALTH, EPIDEMIOLOGY, LAW (see Medical Law)





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TITLE: The challenges of enforcing cellphone use while driving laws among police in the United States: a crosssectional analysis

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Word Count: Abstract: 261; Manuscript: 3,017

Key Words: Cellphone, Enforcement, Policy, Challenges, Traffic

ABSTRACT

Objectives: Research suggests that cellphone use while driving laws may be difficult for police to enforce in the United States, but this is unknown. A national survey of police officers was conducted to determine whether barriers to enforcing these laws exist, what aspects of laws make them easier to enforce, and ways to discourage the behavior among drivers. **Design:** Cross-sectional survey

Setting: United States

Participants: Individuals >18 years of age employed as a law enforcement officer from all 50 states were recruited via convenience sampling through multiple modalities from November 2019-April 2020. Officers (N=353) from 31 states participated.

Primary and secondary outcome measures: Descriptive statistics and multi-level logistic regression analyses were run to assess the responses.

Results: The most common barriers to enforcing texting bans (i.e. the most prevalent law) were drivers concealing their phone use (78%) and the officer not being able to determine what the driver was doing on their phone (65%). If a universal hand-held cellphone ban was in effect in their state, officers were 77% less likely (adjusted OR=0.23; 95% CI 0.08, 0.70) to report that a texting ban was difficult to adjudicate. The majority of officers (86%) agreed that having one general law that prohibits any type of hand-held cellphone use would aid with enforcement, and that laws must be a primary offense (87%), and be applicable to all licensed drivers (91%). Most officers felt that driver education is needed. **Conclusions:** While numerous barriers to enforcement were identified, opportunities exist to improve current legislation to aid enforcement efforts and to prevent the behavior among drivers.

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- No national studies have surveyed officers to determine if barriers to cellphone law enforcement exist
- Officers from 31 states participated in the survey
- The response rate was low especially from officers from the northeastern United States
- Officers who chose to participate may be fundamentally different from those who did not

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• As this was a survey, socially acceptable responses may have been provided

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INTRODUCTION

Over the past 20 years, a multitude of cellphone use while driving (CPWD) laws have been enacted throughout the United States (US) to protect road users. The most common law passed among states is a universal texting ban (UTB), which prohibits any licensed driver from sending or reading text-based messages on a hand-held device; fortyeight states have a UTB.[1] The second most common law enacted is a young driver cellphone ban (YDB). This law typically applies to drivers who are under a particular age (i.e. under 18, 19, or 21 years of age) or licensure status (i.e. individuals who hold a learner's permit or intermediate driver's license) and prohibits them from any hand-held cellphone use except in emergency situations; currently, 38 states have a YDB.[1] The third most common law passed is a universal hand-held cellphone ban (UHB). This law generally forbids any licensed driver from conducting a hand-held cellphone conversation while driving; 22 states have a UHB.[1] While these are the most common types of laws passed, there are some variations between states.[1]

While the enactment of such laws is important for public safety, legislation is only effective if it is enforced by police. Research indicates that active enforcement can deter drivers from engaging in adverse behaviors.[2, 3] Very few studies have investigated the enforcement of CPWD laws; among such studies, most have determined that CPWD violations make up only 1-8% of all traffic citations written.[4-7] Because the frequency of citation issuance for these violations appears low, it is believed that these laws may be difficult for police to enforce. Previous research has shown that laws with fewer perceived barriers are enforced more frequently by police.[8] However, to the authors' knowledge, only two studies have actually consulted police on the potential barriers to enforcing CPWD laws in the US.[9, 10] These qualitative studies were conducted separately with police in West Virginia and Washington states, which have all three CWPD laws in effect.[1, 9, 10] Despite the states' geographic distance from one another, both studies found that numerous but similar barriers to CPWD enforcement were experienced by officers. Officers from both states claimed that the is often difficult to discern what drivers are actually doing on their phones (i.e. calling, texting, using the internet, etc.) and proving their observation in court should the citation be contested. Officers noted that using a cellphone while driving is socially accepted by the public, and many drivers engage in these behaviors. Additionally, individuals tend to overestimate their driving ability and believe they can safely drive while using a cellphone. Officers claimed that the manner in which laws are written is also problematic. Laws can be written very specifically, which can be difficult for

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officers because they have to identify a particular behavior that a driver is performing often from a distance. Laws can also be written in such a manner where certain behaviors are permitted, while other behaviors are not.[9, 10] An example would be if the law prohibits drivers from texting but allows them to operate a global positioning system (GPS), which is often a cellphone application. It would be nearly impossible for the officer to identify whether the driver is texting or using GPS. Thus, if the officer pulls the driver over, the driver could claim they were using GPS to avoid a citation. Many state-laws have these "legal exceptions/loop-holes".

Because states can have different combinations of CPWD laws in effect, it is entirely unknown whether officers in other states experience challenges similar to those noted in the Washington and West Virginia studies. Thus, the purpose of this study was to conduct a national survey of police officers to determine whether similar barriers to enforcing CPWD laws exist, what aspects of CPWD laws make them easier for police to enforce, and potential ways to reduce CPWD from an officers' perspective. If common barriers are identified among states—especially those with comparable laws, current CPWD legislation could be amended to make enforcement easier for police.

METHODS

Ethics Approval

Approval to conduct this study was garnered from West Virginia University's Institutional Review Board (Protocol #1906609479).

Study Population

The study population included any individual employed as a law enforcement officer in the United States who was ≥ 18 years of age at time of survey.

Survey Development, Validity and Reliability

The survey, which was found valid and reliable, has been described in detail elsewhere.[11] Briefly, the survey contained 33 questions total including skip logic and was constructed using Qualtrics software. The survey asked questions pertaining to how often the officer issued citations for CPWD infractions, factors which influenced their decision to apprehend a driver, how easy or difficult the adjudication process was in their jurisdiction for CPWD offenses,

potential challenges encountered when enforcing the CPWD laws in effect in their patrol area, aspects of CPWD laws that do or could aid in their enforcement, ways to prevent CPWD among drivers, in addition to demographics. Most questions were comprised of a series of statements in which the respondent could agree or disagree with. The responses mainly consisted of a 5-point Likert scale ranging from, "Strongly disagree (1)" to "Strongly agree (5)". The survey was designed to be completed in <20 minutes. To encourage participation, the survey was anonymized (i.e. the officers' names, department affiliations, or any personally identifying information were not collected).

Survey Sampling and Distribution

Officers were recruited via convenience sampling. The survey was released mid-November 2019 thru April 2020 In order to distribute the survey, police agencies were randomly selected throughout the US and all 50 states were engaged. The agencies were contacted via their social media pages, websites, email addresses or listed phone numbers. The agencies were briefly informed about the survey, its purpose, and provided an electronic link to participate. Respondents were encouraged to share the electronic link with anyone that met the inclusion criteria. In addition to randomly contacting individual departments, the survey was posted to police-affiliated social media pages and organizations. The National Fraternal Order of Police also provided their state lodges a link to the survey, who in turn, passed the information on to individual officers who were members of the organization. The survey was also distributed among members of the International Association of Campus Law Enforcement. To encourage participation, respondents who completed the survey could enter into a drawing to receive a \$100 gift card. BMJ Open: first published as 10.1136/bmjopen-2021-049053 on 30 June 2021. Downloaded from http://bmjopen.bmj.com/ on June 7, 2025 at Agence Bibliographique de l Enseignement Superieur (ABES).

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Statistical Analyses

All data management and analyses were conducted using SAS version 9.4. Descriptive statistics were calculated for responses. Because UTBs were in effect in 48 states (96%), additional analyses were conducted to determine if any demographic factors (i.e. age, sex, race, education level or years of experience in law enforcement) or other CPWD laws (i.e. YDB or UHB) were independently associated with an officer responding that a UTB law was difficult to adjudicate. Officers' responses, which were on a 5-point Likert scale, were collapsed and made binary (i.e. the responses for, 'Very difficult to adjudicate', and 'Difficult to adjudicate', were combined and compared to the other possible responses). Because the dependent variable was binary and officers could be from the same states (i.e. they could be correlated), a

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multi-level logistic regression model with an exchangeable correlation matrix was utilized.[12] Additional analyses were undertaken to determine if any of these demographic factors or other laws were potential confounders of one another in their relationship with the dependent variable. This was accomplished by first running the crude models and seeing if any of the variables were statistically associated with an officer reporting that a UTB was difficult to adjudicate. The other demographic factors were each separately added to the model and the crude and adjusted models were compared. If there was a 10% change in the odds ratio between the crude and adjusted model, confounding was suspected. Hypothesis tests were two-sided with the *a priori* level of significance set at α =0.05.

Patient and Public Involvement

It was not possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

from is shown in the Appendix. The majority of officers were 35-54 years of age (65%), male (88%), of white race (89%), and from the southern US (67%) (Table 1). Most were from states with UTB (94%) or YDB (86%) in effect. Only 21% of respondents came from states with UHB. Table 1. Demographic characteristics of police officers who participated in national survey (N=353)^a Characteristics N % Age (in years) 18-34 47 16.2 35-44 68 23.5 45-54 120 41.4 >55 55 19.0 Missing 63 Sex Male 254 97.0 Officers (N=353) from 31 states participated in the national survey. A map indicating which states officers were

Table 1. Demographic characteristics of police officers who participated in national survey (N=353) ^a				
Characteristics	Ν	%		
Age (in years)				
1	8-34 47	16.2		
3	5-44 68	23.5		
4	5-54 120	41.4		
	>55 55	19.0		
Mi	ssing 63			
Sex	•			
	Male 254	87.9		
Fe	male 35	12.1		
Mi	ssing 64			
Race	C			
V	White 255	88.5		
(Other 33	11.5		

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Missing	65	
Education		
High school or equivalency	55	19.0
Associate degree	66	22.8
Bachelor's degree	115	39.8
Graduate degree	53	18.3
Missing	64	
Law enforcement experience (years)		
<15	101	34.7
15-24	84	28.9
>25	106	36.4
Missing	62	
Census region ^b		
Northeast	8	2.8
Midwest	42	14.7
South	192	67.4
West	43	15.1
Missing	68	10.1
State-level universal texting ban in		
effect ^b		
Yes	267	93.7
No	18	6.3
Missing	68	
State-level universal hand-held cellphone		
ban in effect ^b		
Yes	59	20.7
No	226	79.3
Missing	68	
State-level young driver all cellphone		
ban in effect ^b		
Yes	244	85.6
No	41	14.4
Missing	68	
a: Percentages may not add to 100% due to	rounding.	
b: 'Missing' means the officer did not indic	ate their sta	te of
employment		

Numerous barriers to enforcing UTB were reported by officers (Table 2). Nearly 78% of respondents agreed that drivers often try to conceal their texting behaviors. A majority of officers (i.e. >60%) also agreed that their laws have exceptions which permit drivers to perform some behaviors but not others and that they cannot often tell what the driver is actually doing on their phone. Nearly half of the officers agreed that drivers do not seem supportive of the law (49%) and do not fully understand what the law permits (57%).

	abre 2. Damers experienced by officers when enforcing texting white driving laws (Dercont	_
Ва	arrier	Percent	
		this harrier	
D			-
	rivers try to conceal texting	/8.3	
otl	hers (example: drivers are not permitted to text, but they may use GPS, or manually al a phone number)	00.2	
Of	fficer cannot prove what the driver is actually doing on their phone (i.e. texting vs.	64.5	
Dr	rivers do not fully understand what the law permits	57.3	
Dr	rivers are not supportive of this law	49.2	
Su	irrounding states have different laws which confuse inter-state drivers	40.5	
C	urrent law is too narrowly focused	35.9	
La	aw is outdated because technology advanced faster	24.4	
Cu	urrent law is unclear	23.5	
Ju	dges or courts are not supportive of law	23.3	
Of	fficer does not fully understand what the law permits	16.0	
Of	fficer wants to maintain a positive relationship with the public	13.7	
Fe	ellow officers are not supportive of law	12.0	
De	epartment management is not supportive of law	4.3	
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89 86

87

Male	1.43	0.62, 3.32		
Female	1.00	Referent		
Race				
White	1.37	0.69, 2.70		
Other	1.00	Referent		
Education				
High school or equivalency	0.69	0.40, 1.19		
Associate degree	1.00	0.58, 1.74		
Bachelor's degree	1.01	0.55, 1.84		
Graduate degree	1.00	Referent		
Law enforcement experience (in years)				
<15	1.03	0.55, 1.93		
15-24	1.24	0.62, 2.48		
≥25	1.00	Referent		
State-level universal hand-held cellphone				
ban in effect				
Yes	0.32	0.12, 0.84	0.23	0.08, 0.70
No	1.00	Referent	1.00	Referent
State-level young driver all cellphone ban in				
effect				
Yes	1.10	0.27, 4.58	2.73	0.59, 12.69
No	1.00	Referent	1.00	Referent
Abbraviation: CI-confidence interval: OB- a	dda ratic			

Abbreviation: CI=confidence interval; OR= odds ratio

a: A multi-level logistic regression model which accounted for the correlation of state was utilized to estimate odds ratios. The dependent variable was whether or not an officer perceived that universal texting bans were difficult to adjudicate. Separate crude models were run between each characteristic noted and the outcome. Multivariable models were adjusted for confounders of the relationship between statistically significant independent variables (i.e. the presence of a universal hand-held ban) and the outcome.

There were numerous aspects of CPWD laws that do or could make them easier for police to enforce. Among respondents, 91% agreed that laws must be applicable to all licensed drivers (Table 4). The majority of officers also agreed that laws must be made a primary offense, which means they can pull a driver over if they observe that specific behavior (87%). Additionally, 86% of respondents agreed that having one general law that prohibits hand-held cellphone use of any kind would help with enforcement.

Table 4. Aspects of cellphone use while driving laws which does of enforce $(N=304)^a$	or could make them easie	r for police to)
Aspect	Percent who	Mean	SD
	strongly	response	
	agreed or		
	agreed		
Making these laws applicable to all licensed drivers	90.7	4.5	0.8
Making these laws a primary offense	86.5	4.4	0.9

Having one general law that prohibits hand-held cellphone use kind	e of any	85.8	4.3	0.9
Eliminating age or license requirements (i.e. the law does not	iust apply	78.3	42	1.0
to drivers under a certain age or licensure types).	J	,		
Eliminating legal exceptions, which permit some behaviors be	ut not	72.3	4.0	1.1
Writing these laws more broadly and including all distracting	behaviors	66.1	3.9	1.2
(e.g. personal grooming, eating, pets sitting in the driver's lap	o, etc.)			
Abbreviations: SD=standard deviation				
a: This question asked which aspects of cellphone laws do or	could make them ea	asier to enforce a	and the	
officers were presented with these options. Responses were	on a 5-point Likert	scale ranging fro	om "Stro	ngly
disagree (1)" to "Strongly agree (5)". The mean value along	with the percentage	of respondents	who	
"Strongly agreed" or "Agreed" with the statement were comb	ined and shown. T	he response rate	for this	
question was 86%.				
Officers were also asked what prevention measures could a	ubstantially raduas	allnhana usa an	nona dri	uora
Officers were also asked what prevention measures could se		compliance use an	liong un	VUIS
5) Nearly 88% agreed that educating the public on what current trat	ffic laws do or do n	ot permit would	ha hanaf	ficial
5). Nearry 8876 agreed that educating the public of what current that		or permit would	De Denei	liciai
Nearly 85% of respondents also agreed that educating the public on	the dangers of CPV	WD or changing	the cultu	ira ta
Treating 0570 of respondents also agreed that educating the public of	the dangers of Cr v	v D of changing	the cultu	
CDWD loss socially accorted would also halp reduce the behavior	A large majority of	officers also ag	road that	adu
Cr wD less socially accepted would also help reduce the behavior.	A large majority of	officers also ag	ieeu illai	euu
the public on how to use hands-free technology (78%) could help.				
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the public on how to use hands-free technology (78%) could help. Table 5 Officers' opinions regarding prevention measu	rres which could sul	bstantially reduc	e	-
the public on how to use hands-free technology (78%) could help. Table 5. Officers' opinions regarding prevention measu cellphone use among drivers (N=290) ^a	rres which could sul	bstantially reduc	e	-
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No single measure will reduce cellphone use among drivers	64.4	3.7	1.2
Abbreviations: SD=standard deviation			

a: This question asked which prevention measures could substantially reduce cellphone use among drivers. The prevention measures listed above were posed. Responses were on a 5-point Likert scale ranging from "Strongly disagree (1)" to "Strongly agree (5)". The mean value along with the percentage of respondents who "Strongly agreed" or "Agreed" with the statement were combined and shown. The response rate to this question was 82%.

DISCUSSION

This study is the first to investigate the potential barriers to enforcing CPWD among police officers across the US The findings showed that there are numerous challenges that officers face when enforcing CPWD laws, especially UTB which are the most common law in effect. The study also found that ample opportunities exist to amend legislation or improve public health efforts from an officers' perspective. One of the biggest challenges for officers noted in this study and others is determining what the driver is actually doing on their cellphone.[9, 10] Given the vast technological capabilities of cellphones, the driver could easily be engaging in a myriad of behaviors (i.e. dialing a phone number, terminating a call, sending/reading texts, browsing the internet, etc.). If the driver is concealing their behavior, which was another common barrier, then officers may not be able to determine what the driver is doing. The uncertainty of the drivers' activity coupled with how most of the CPWD laws are written complicate enforcement efforts. A majority of officers agreed that some CPWD laws are written too specific or they are written in such a manner where some behaviors are permitted, while others are not. These barriers to enforcement were also noted in previous studies conducted with officers in Washington and West Virginia.[9, 10] For example, if the law specifically states that a driver cannot send or read text-based messages, it may not necessarily cover other activities such as watching a video, making a cellphone call. etc. Also, if a law states that a driver cannot conduct a hand-held phone conversation, but is allowed to end a call or utilize GPS, these essentially create "legal loopholes" for drivers. These situations not only complicate enforcement for officers, but can confuse drivers' understanding of what the law does and does not permit.

From a policy perspective, several opportunities exist to amend or implement CPWD laws to make them easier
for police to enforce. First, this study found that UHB may help with enforcement of UTB. This situation is likely due to
the fact that some UHB state that drivers cannot hold a phone in their hand. Thus, if a driver is texting on a hand-held

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device, it may be easier to cite them for a UHB infraction as opposed to texting. This has been seen in previous study where UHB violations were written much more frequently than UTB or YDB violations in multiple states.[4] While most states have a UTB, less than half have a UHB.[1] States or municipalities with UTB may want to consider implementing UHB to aid enforcement efforts. Secondly, these findings suggest that YDB may have limited utility in the presence of other CPWD laws. The majority of officers agreed that removing age or licensure requirements from CPWD laws could make them easier to enforce. Additionally, this study also found that states seeking to amend their laws may want to consider neighboring states' legislation. Differences in state laws was also a barrier to enforcement as it can confuse interstate drivers. While most states have a UTB, fewer states have UHB or YDB. Lastly, while existing laws could be clarified, states could consider implementing a law that permits no hand-held cellphone use of any kind for drivers as nearly 86% of officers stated that this would be beneficial to enforcement.

In addition to potential policy changes, the study has public health implications. From an officer's perspective, there may be several viable options to reduce this dangerous and prevalent behavior among drivers.[13] The majority of officers agreed that drivers need more education on the CPWD laws and how to use hands-free technology. Many also agreed that increasing penalties, changing the culture surrounding CPWD, and technological solutions may also reduce CPWD. However, it is not entirely clear if these prevention measures would actually be effective in reducing CPWD as the intervention literature is severely lacking. Very few studies have investigated whether educational interventions can reduce CPWD behaviors; the results of extant studies are mixed.[14-17] The relationship between increased penalties and ≥ behavioral changes among drivers has been investigated with other traffic safety infractions such as red light running, speeding, laxed seatbelt use, and impaired driving recidivism in the US and abroad; the findings of these studies have also varied.[18-24] As for technology, various cellphone applications have already been developed and are freely or commercially available to disable certain cellphone functions while a vehicle is in motion, but rigorous evaluations of these have not been conducted. [25, 26] Two studies conducted in younger drivers found that they will override this technology to use the cellphone. [27, 28] As for cultural norms, research has shown that distracted driving campaigns have been less effective than anti-drunk driving campaigns, particularly among younger drivers. [29] Cultural norms are known to influence individuals' behavior. [30, 31] Changing the culture surrounding CPWD is likely needed but will require a substantial, sustained effort in order it to be effective. Thus, more research and rigorous evaluations are clearly needed.

Page 15 of 21

BMJ Open

60

Limitations

While the findings of this study are important to the extant traffic safety literature, they are not without limitation. Even though the survey was distributed to throughout all 50 states, the response rate was low and could not realistically be determined. Research has shown that surveys involving police typically have low response rates.[32] This is attributed to Protected by copyright, including for the multifaceted nature of their job where they have competing demands, emergency calls to respond to, active patrols to make, court appearances to attend, etc. Secondly, the response rate from northeastern states, which often have UHB in effect, was also much lower than the other regions. The lower response rate in this area may have been partially attribute to the COVID-19 pandemic. Also, officers for this survey were recruited by convenience sampling. While many departments were given an electronic link to the survey and were encouraged to distribute it to anyone who met the inclusion criteria, there was no guarantee that it was circulated. Additionally, the survey was designed to be anonymous so officers would not fear potential repercussion from giving their opinions; this was done to increase participation rates. Thus, it was unknown whether officers who responded were from different departments. Because officers from the same department could be correlated and department affiliation was not collected to protect anonymity, regression models were adjusted for state correlation instead. It is also possible that those who participated may be fundamentally different from those who did not participate. This could lead to a selection bias. Lastly, as this was a survey, it is entirely plausible that reporting or recall biases existed. Officers could have chosen to give more socially appropriate responses or may have not , Al training, and similar technologies accurately recalled certain behaviors or situations.

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Conclusion

CPWD is a dangerous and prevalent behavior among drivers in the United States.[13] In order to mitigate the risk drivers can only be convinced to change their behavior through intervention or encouraged to do so through legislation. However, active enforcement is crucial to this equation. Traffic safety studies have shown that drivers will change their behavior if they perceive that there is an increased risk of being apprehended (i.e. risk vs. reward).[33, 34] As this study has shown, numerous barriers to enforcement exist particularly for UTB which is the most common law in effect. Laws with more barriers to enforcement are less likely to be enforced.[8] This study identified numerous opportunities to

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236 strengthen existing or future CPWD laws. These policy changes will not only make traffic safety enforcement easier for police, but may also protect road users from unintentional morbidity and mortality.

LIST OF ABBREVIATIONS

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CI=Confidence interval; CPWD=Cellphone use while driving; GPS=Global positioning system; OR=Odds ratio;

SD=Standard deviation; US=United States; UHB=Universal hand-held cellphone ban; UTB=Universal texting ban; YDB=Young driver cellphone ban

DECLARATIONS

Funding: TMR received support from the Centers of Disease Control and Prevention grant R49CE002109 and from the National Institutes of General Medical Sciences grant 5U54GM104942-04. MZ received support from National Institutes of Health grants R01AG050581 and R01HD074594. The funding agencies had no role in the design of the study, collection, analysis, or interpretation of the results, or in the writing of this manuscript.

Ethics Approval: Institutional Review Board approval was obtained for this project from West Virginia University.

88

Data Sharing: No additional data are available.
Competing Interests: On behalf of all authors, the corresponding author states that there is no conflict of interest.
Authors' Contributions: TMR and MZ contributed to the design of the study. TMR obtained the data and performed the analysis. TMR and MZ interpreted the data. All authors had full access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors contributed to the manuscript preparation and approved the final version.

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SUPPLEMENTARY MATERIAL



Appedix Figure 1. Location of officers who responded to the national survey regarding the enforcement of cellphone use while driving. Officers from states which are shaded participated in the survey.

	No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the
The and abstract	1	abstract PAGE 1
		(b) Provide in the abstract an informative and balanced summary of what was d
		(b) Hower found DACE 2
		and what was found PAGE 2
Introduction Background/rationales	2	Explain the scientific background and rationals for the investigation being report
	2	PAGE 4-5
Objectives√	3	State specific objectives, including any prespecified hypotheses PAGE 5
Methods		
Study design√	4	Present key elements of study design early in the paper PAGE 5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitm
U		exposure, follow-up, and data collection PAGE 5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of
	-	participants PAGE 5
Variables	7	Clearly define all outcomes exposures predictors potential confounders and
v unuoios v	,	effect modifiers. Give diagnostic criteria, if applicable PAGE 6-7
Data sources/	Q*	For each variable of interest, give sources of data and details of methods of
1/maggurament	0	assassment (managurament). Describe comparability of assassment methods if the
Ineasurement		is more than one group PACE 6.7
Diaci	0	Describe any efforts to address notantial sources of hiss DACE 6 .7
Study sizes	9	Explain how the study size was arrived at DACE 6.7
Occurtitation annial land	10	Explain now the study size was arrived at PAGE 6-7
Quantitative variables V	11	Explain now quantitative variables were handled in the analyses. If applicable,
	10	describe which groupings were chosen and why PAGE 6-7
Statistical methods V	12	(a) Describe all statistical methods, including those used to control for confound
		PAGE 6-7
		(b) Describe any methods used to examine subgroups and interactions PAGE 6-
		(c) Explain how missing data were addressed PAGE 6-7
		(d) If applicable, describe analytical methods taking account of sampling strateg
		PAGE 6-7
		(e) Describe any sensitivity analyses NOT APPLICABLE
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentiall
		eligible, examined for eligibility, confirmed eligible, included in the study,
		completing follow-up, and analysed PAGE 7
		(b) Give reasons for non-participation at each stage NOT APPLICABLE
		(c) Consider use of a flow diagram NOT APPLICABLE
Descriptive data $$	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) a
		information on exposures and potential confounders PAGE 7-8
		(b) Indicate number of participants with missing data for each variable of interest
		PAGE 7-8
Outcome data	15*	Report numbers of outcome events or summary measures TABLES 1-5 ON
		PAGES 7-12
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates
		(.,

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		adjusted for and why they were included PAGE 9-10 TABLE 3
		(b) Report category boundaries when continuous variables were PAGE 9-10
		TABLE 3
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a
		meaningful time period NOT APPLICABLE
Other analyses√	17	Report other analyses done-eg analyses of subgroups and interactions, and
		sensitivity analyses NOT APPLICABLE
Discussion		
Key results√	18	Summarise key results with reference to study objectives PAGE 12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or
		imprecision. Discuss both direction and magnitude of any potential bias PAGE 14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations,
		multiplicity of analyses, results from similar studies, and other relevant evidence
		PAGE 14
Generalisability√	21	Discuss the generalisability (external validity) of the study results PAGE 14
Other information		
Funding√	22	Give the source of funding and the role of the funders for the present study and, if
		applicable, for the original study on which the present article is based PAGE 15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

The challenges of enforcing cellphone use while driving laws among police in the United States: a cross-sectional analysis

Journal:	BMJ Open
Manuscript ID	bmjopen-2021-049053.R1
Article Type:	Original research
Date Submitted by the Author:	25-May-2021
Complete List of Authors:	Rudisill, Toni; West Virginia University, Epidemiology Zhu, Motao; Nationwide Children's Hospital, Center for Injury Research and Policy
Primary Subject Heading :	Epidemiology
Secondary Subject Heading:	Health policy, Public health
Keywords:	PUBLIC HEALTH, EPIDEMIOLOGY, LAW (see Medical Law), Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PREVENTIVE MEDICINE





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TITLE: The challenges of enforcing cellphone use while driving laws among police in the United States: a cross-

sectional analysis

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Word Count: Abstract: 260; Manuscript: 3,380

Key Words: Cellphone, Enforcement, Policy, Challenges, Traffic, Cellphone Use While Driving

ABSTRACT

Objectives: Research suggests that cellphone use while driving laws may be difficult for police to enforce in the United States, but this is unknown. A national survey of police officers was conducted to determine whether barriers to enforcing these laws exist, what aspects of laws make them easier to enforce, and ways to discourage the behavior among drivers. **Design:** Cross-sectional survey

Setting: United States

Participants: Individuals >18 years of age employed as a law enforcement officer from all 50 states were recruited via convenience sampling through multiple modalities from November 2019-April 2020. Officers (N=353) from 31 states participated.

Primary and secondary outcome measures: Descriptive statistics and multi-level logistic regression analyses were run to assess the responses.

Results: The most common barriers to enforcing texting bans (i.e., the most prevalent law) were drivers concealing their phone use (78%) and the officer not being able to determine what the driver was doing on their phone (65%). If a universal hand-held cellphone ban was in effect in their state, officers were 77% less likely (adjusted OR=0.23; 95% CI 0.08, 0.70) to report that a texting ban was difficult to adjudicate. The majority of officers (86%) agreed that having one general law that prohibits any type of hand-held cellphone use would aid with enforcement, and that laws must be a primary offense (87%), and be applicable to all licensed drivers (91%). Most officers felt that driver education is needed. **Conclusions:** While numerous barriers to enforcement were identified, opportunities exist to improve current legislation to aid enforcement efforts and to prevent the behavior among drivers.

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Strengths and Limitations of this Study:

- No national studies have surveyed officers to determine if barriers to cellphone law enforcement exist
- Officers from 31 states participated in the survey
- The response rate was low especially from officers from the northeastern United States
- Officers who chose to participate may be fundamentally different from those who did not
- As this was a survey, socially acceptable responses may have been provided

INTRODUCTION

Over the past 20 years, a multitude of cellphone use while driving (CPWD) laws have been enacted throughout the United States (US) to protect road users. The most common law passed among states is a universal texting ban (UTB), which prohibits any licensed driver from sending or reading text-based messages on a hand-held device; fortyeight states have a UTB.[1] The second most common law enacted is a young driver cellphone ban (YDB). This law typically applies to drivers who are under a particular age (i.e., under 18, 19, or 21 years of age) or licensure status (i.e., individuals who hold a learner's permit or intermediate driver's license) and prohibits them from any hand-held cellphone use except in emergency situations; currently, 38 states have a YDB.[1] The third most common law passed is a universal hand-held cellphone ban (UHB). This law generally forbids any licensed driver from conducting a hand-held cellphone conversation while driving; 22 states have a UHB.[1] While these are the most common types of laws passed, there are some variations between states.[1]

While the enactment of such laws is important for public safety, legislation is only effective if it is enforced by police. Research indicates that active enforcement can deter drivers from engaging in adverse behaviors.[2, 3] Very few studies have investigated the enforcement of CPWD laws; among such studies, most have determined that CPWD violations make up only 1-8% of all traffic citations written.[4-7] Because the frequency of citation issuance for these violations appears low, it is believed that these laws may be difficult for police to enforce. Previous research has shown that laws with fewer perceived barriers are enforced more frequently by police.[8] However, to the authors' knowledge, only two studies have actually consulted police on the potential barriers to enforcing CPWD laws in the US.[9, 10] These qualitative studies were conducted separately with police in West Virginia and Washington states, which have all three CWPD laws in effect.[1, 9, 10] Despite the states' geographic distance from one another, both studies found that numerous but similar barriers to CPWD enforcement were experienced by officers. Officers from both states claimed that it is often difficult to discern what drivers are actually doing on their phones (i.e., calling, texting, using the internet, etc.)

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1d2 and proving their observation in court should the citation be contested. Officers noted that using a cellphone while **0**3 driving is socially accepted by the public, and many drivers engage in these behaviors. Additionally, individuals tend to **0**4 overestimate their driving ability and believe they can safely drive while using a cellphone. Officers claimed that the 1085 manner in which laws are written is also problematic. Laws can be written very specifically, which can be difficult for officers because they have to identify a particular behavior that a driver is performing often from a distance. Laws can also be written in such a manner where certain behaviors are permitted, while other behaviors are not.[9, 10] An example would be if the law prohibits drivers from texting but allows them to operate a global positioning system (GPS), which is often a cellphone application. It would be nearly impossible for the officer to identify whether the driver is texting or using GPS. Thus, if the officer pulls the driver over, the driver could claim they were using GPS to avoid a citation. Many state-laws have these "legal exceptions/loop-holes". Because states can have different combinations of CPWD laws in effect, it is entirely unknown whether officers in other states experience challenges similar to those noted in the Washington and West Virginia studies. Thus, the purpose of this study was to conduct a national survey of police officers to determine whether similar barriers to enforce. **2** 111 21

CPWD laws exist, what aspects of CPWD laws make them easier for police to enforce, and potential ways to reduce CPWD from an officers' perspective. If common barriers are identified among states-especially those with comparable laws, current CPWD legislation could be amended to make enforcement easier for police.

METHODS

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116

137

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22

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Ethics Approval

Approval to conduct this study was garnered from West Virginia University's Institutional Review Board (Protocol #1906609479).

Study Population

The study population included any individual employed as a law enforcement officer in the United States who was ≥ 18 years of age at time of survey.

Survey Development, Validity and Reliability

126 The survey, which was found valid and reliable, has been described in detail elsewhere.[11] Briefly, the survey contained 33 questions total including skip logic and was constructed using Qualtrics software. The survey asked questions pertaining to how often the officer issued citations for CPWD infractions, factors which influenced their decision to apprehend a driver, how easy or difficult the adjudication process was in their jurisdiction for CPWD offenses, potential challenges encountered when enforcing the CPWD laws in effect in their patrol area, aspects of CPWD laws that do or could aid in their enforcement, ways to prevent CPWD among drivers, in addition to demographics. Most questions were comprised of a series of statements in which the respondent could agree or disagree with. The responses mainly consisted of a 5-point Likert scale ranging from, "Strongly disagree (1)" to "Strongly agree (5)". The survey was designed to be completed in <20 minutes. To encourage participation, the survey was anonymized (i.e., the officers' names, department affiliations, or any personally identifying information were not collected). Survey Sampling and Distribution Officers were recruited via convenience sampling. The survey was released mid-November 2019 thru April 2020 In order to distribute the survey, police agencies were randomly selected throughout the US and all 50 states were

In order to distribute the survey, police agencies were randomly selected throughout the US and all 50 states were engaged. The agencies were contacted via their social media pages, websites, email addresses or listed phone numbers. The agencies were briefly informed about the survey, its purpose, and provided an electronic link to participate. Respondents were encouraged to share the electronic link with anyone that met the inclusion criteria. In addition to randomly contacting individual departments, the survey was posted to police-affiliated social media pages and organizations. The National Fraternal Order of Police also provided their state lodges a link to the survey, who in turn, passed the information on to individual officers who were members of the organization. The survey was also distributed among members of the International Association of Campus Law Enforcement. To encourage participation, respondents who completed the survey could enter into a drawing to receive a \$100 gift card.

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Statistical Analyses

All data management and analyses were conducted using SAS version 9.4. Descriptive statistics were calculated for responses. Because UTBs were in effect in 48 states (96%), additional analyses were conducted to determine if any demographic factors (i.e., age, sex, race, education level or years of experience in law enforcement) or other CPWD laws (i.e., YDB or UHB) were independently associated with an officer responding that a UTB law was difficult to adjudicate.

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Officers' responses, which were on a 5-point Likert scale, were collapsed and made binary (i.e., the responses for, 'Very difficult to adjudicate', and 'Difficult to adjudicate', were combined and compared to the other possible responses). Because the dependent variable was binary and officers could be from the same states (i.e., they could be correlated), a multi-level logistic regression model with an exchangeable correlation matrix was utilized.[12] Additional analyses were undertaken to determine if any of these demographic factors or other laws were potential confounders of one another in their relationship with the dependent variable. This was accomplished by first running the crude models and seeing if any of the variables were statistically associated with an officer reporting that a UTB was difficult to adjudicate. The other demographic factors were each separately added to the model and the crude and adjusted models were compared. If there was a 10% change in the odds ratio between the crude and adjusted model, confounding was suspected. Hypothesis tests were two-sided with the *a priori* level of significance set at α =0.05.

Patient and Public Involvement

It was not possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Officers (N=353) from 31 states participated in the national survey. A map indicating which states officers were from is shown in the Appendix. The majority of officers were 35-54 years of age (65%), male (88%), of white race (89%), and from the southern US (67%) (Table 1). Most were from states with UTB (94%) or YDB (86%) in effect. Only 21% of respondents came from states with UHB.

Table 1. Demographic characteristics of porticipated in national survey (N=353) ^a	olice officer	s who
Characteristics	N	%
Age (in years)		
18-34	47	16.2
35-44	68	23.5
45-54	120	41.4
>55	55	19.0
Missing	63	
Sex		
Male	254	87.9
Female	35	12.1
Missing	64	
Race		

 $1 \frac{41}{42}$ 43 $1 \frac{4}{45}$ $1 \frac{4}{45}$ $1 \frac{4}{45}$ $1 \frac{4}{45}$ $1 \frac{4}{45}$ $1 \frac{4}{45}$ $1 \frac{4}{5}$ $1 \frac{5}{5}$ $1 \frac{5}{5}$

	White	255	88.5		
	Other	33	11.5		-
	Missing	65	11.5		
	Education	00			
	High school or equivalency	55	19.0		-
	Associate degree	66	22.8		
	Bachelor's degree	115	39.8		
	Graduate degree	53	18.3		
	Missing	64			-
	Law enforcement experience (years)				rot
	<15	101	34.7		ect
	15-24	84	28.9		ed
	≥25	106	36.4		Å
	Missing	62			င်္ဂ
	Census region ^b				руг
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	Midwest	42	14.7		ţ,
	South	192	67.4		าะเ
	West	43	15.1		Jdi
	Missing	68			Bu
	State-level universal texting ban in				ōŗ
	effect ^b				и Б
	Yes	267	93.7		nse es r
	No	18	6.3		ign.
	Missing	68			ited
	State-level universal hand-held cellphone				to
	ban in effect ^b	50	20 5		te S
	Yes	59	20.7		t a
	No	226	/9.3		nd
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	State-level young driver all cellphone				a B
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	Yes	244	85.0		ng.
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	o. Missing means the officer did not main	cate then	state of		ng,
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Numerous barriers	to enforcing UTB were reported by officers ((Table 2).	Nearly 78% of	respondents agreed that	art
					lec
drivers often try to conceal	their texting behaviors. A majority of office	rs (i.e., >6	60%) also agreed	l that their laws have	hnc
					log
exceptions which permit dri	ivers to perform some behaviors but not othe	rs and tha	t they cannot of	ten tell what the driver is	jies
actually doing on their phor	ne. Nearly half of the officers agreed that driv	vers do no	t seem supportiv	ve of the law (49%) and	

do not fully understand what the law permits (57%).

Table 2. Barriers experienced by officers when enforcing texting while driving laws (N=258)

Barrier				Percent experiencing this barrier
Drivers try to conceal texting				78.3
Current law has exceptions which allow drivers to others (example: drivers are not permitted to text dial a phone number)	b perform but they	certain behavior may use GPS, or	rs but not manually	66.2
Officer cannot prove what the driver is actually d watching a video, surfing the internet, dialing a n	oing on th umber, etc	eir phone (i.e., t	exting vs.	64.5
Drivers do not fully understand what the law peri	nits	,		57.3
Drivers are not supportive of this law				49.2
Surrounding states have different laws which con	fuse inter-	state drivers		40.5
Current law is too narrowly focused				35.9
Law is outdated because technology advanced fa	ster			24.4
Current law is unclear				23.5
Judges or courts are not supportive of law				23.3
Officer does not fully understand what the law pe	rmits			16.0
Officer wants to maintain a positive relationship	with the p	ublic		13.7
Fellow officers are not supportive of law	, ion one p			12.0
Department management is not supportive of law				43
a: This question asked if the officer experienced :	ny of the	perceived barrie	rs listed	1.5
above when enforcing texting while driving laws	Respons	es consisted of	"Ves"	
"No" or "Unsure" The percentage shown is the	se who ind	licated that they	105,	
experienced this barrier when enforcing this law	f it was in	effect in their i	urisdiction	
The response rate for this question was 73%	1 It was II	f effect in their j		
The response rule for this question was 7570.				
The results from the multi-level logistic regression	analyses s	showed that mos	t demograp	hic factors (i.e.
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1	Race				
2	White	1 37	0.60 2.70		
3	White	1.57	0.09, 2.70 Defenset		
4	Other	1.00	Referent		
5	Education				
6	High school or equivalency	0.69	0.40, 1.19		
7	Associate degree	1.00	0.58, 1.74		
8	Bachelor's degree	1.01	0.55, 1.84		
9	Graduate degree	1.00	Referent		
10	Law enforcement experience (in years)				
11	<15	1.03	0.55, 1.93		
12	15-24	1.24	0.62, 2.48		
13	≥25	1.00	Referent		
14	State-level universal hand-held cellphone				
15	ban in effect				
16	Yes	0.32	0.12, 0.84	0.23	0.08, 0.70
17	No	1.00	Referent	1.00	Referent
18	State-level young driver all cellphone bans				
19	in effect				
20	Vec	1 10	0 27 4 58	2 73	0 59 12 69
21	I CS No	1.10	0.27, 4.50	1.00	0.57, 12.07
22		1.00	Kelerent	1.00	Kelerent
23	Abbreviation: CI=confidence interval; OR= o	dds ratio			

a: A multi-level logistic regression model which accounted for the correlation of state was utilized to estimate odds ratios. The dependent variable was whether or not an officer perceived that universal texting bans were difficult to adjudicate. Separate crude models were run between each characteristic noted and the outcome. Multivariable models were adjusted for confounders of the relationship between statistically significant independent variables (i.e., the presence of a universal hand-held ban) and the outcome.

There were numerous aspects of CPWD laws that do or could make them easier for police to enforce. Among respondents, 91% agreed that laws must be applicable to all licensed drivers (Table 4). The majority of officers also agreed that laws must be made a primary offense (87%). In the US, traffic offenses can be designated as primary or secondary. A primary offense means an officer can pull a driver over if they observe that specific behavior. Secondary offenses are violations in which an officer cannot pull a driver over for solely. A driver can only be cited for a secondary 189 offense if they were originally pulled over for committing a primary offense. Additionally, 86% of respondents agreed 47 that having one general law that prohibits hand-held cellphone use of any kind would help with enforcement.

Agroaph	Dana ant wik a	Maan	CD
Aspeci	Percent who	Mean	SL
	strongly	response	
	agreed or	_	
	agreed		
Making these laws applicable to all licensed drivers	90.7	4.5	0.8
Making these laws a primary offense	86.5	4.4	0.9
85.8	4.3	0.9	
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78.3	4.2	1.0	
72.3	4.0	1.1	
66.1	3.9	1.2	
	85.8 78.3 72.3 66.1	85.8 4.3 78.3 4.2 72.3 4.0 66.1 3.9	

Having one general law that prohibits hand-held cellpho kind	pen				ł
	ne use of any		85.8	4.3	0.9
Eliminating age or license requirements (i.e., the law do to drivers under a certain age or licensure types).	es not just appl	у	78.3	4.2	1.0
Eliminating legal exceptions, which permit some behavi others	ors but not		72.3	4.0	1.1
Writing these laws more broadly and including all distra (e.g., personal grooming, eating, pets sitting in the drive	cting behaviors r's lap, etc.)	3	66.1	3.9	1.2
a: This question asked which aspects of cellphone laws of officers were presented with these options. Responses of disagree (1)" to "Strongly agree (5)". The mean value a "Strongly agreed" or "Agreed" with the statement were question was 86%. Officers were also asked what prevention measures co arly 88% agreed that educating the public on what current way 85% of respondents also agreed that educating the public of the public officers were also asked what educating the public officers were also asked that educating the public officers were also agreed that educating the public officers were agreed	lo or could mal were on a 5-poi long with the p combined and s uld substantiall nt traffic laws c lic on the dange	te them ea nt Likert s ercentage of shown. Th y reduce c lo or do no ers of CPW	sier to enforce a cale ranging fro of respondents e response rate ellphone use an t permit would D or changing	and the om "Stro who for this nong driv be benef the cultu	ngly vers (ĩcial re to
blic on how to use hands-free technology (78%) could he Table 5. Officers' opinions regarding prevention t	elp.	agoild sub	stantially radua		
cellphone use among drivers (N=290) ^a					
Prevention Measure	a	vho strongly greed or agreed	Mean Response	SD	
Educating the public on what the current traffic law do not permit	vs do or	87.6	4.3	0.8	
Educating the public on the dangers of cellphone u driving	se while	84.8	4.2	1.0	
Changing the current culture to make cellphone us driving more socially unacceptable	e while	84.1	4.2	0.9	
Educating the public on how to use hands-free tech (e.g., Bluetooth, external hands-free devices)	nology	78.3	4.1	1.0	
Increasing the fines for cellphone infractions		77.9	4.2	1.0	
Technological advances made by car manufacturer	s that Iriving	72.4	3.9	1.2	
restrict cellphone capabilities at certain speeds or c conditions	、 ,	70.0	• •		
restrict cellphone capabilities at certain speeds or c conditions Technological advances made by cellphone manuf that restrict cellphone capabilities at certain speeds driving conditions	or	12.3	3.9	1.2	
restrict cellphone capabilities at certain speeds or c conditions Technological advances made by cellphone manuf that restrict cellphone capabilities at certain speeds driving conditions Increasing the number of points for cellphone infra	or or	72.3	3.9	1.2	
restrict cellphone capabilities at certain speeds or c conditions Technological advances made by cellphone manuf that restrict cellphone capabilities at certain speeds driving conditions Increasing the number of points for cellphone infra No single measure will reduce cellphone use amon drivers	ictions	70.0 64.4	4.0 3.7	1.2 1.1 1.2	

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Abbreviations: SD=standard deviation

a: This question asked which prevention measures could substantially reduce cellphone use among drivers. The prevention measures listed above were posed. Responses were on a 5-point Likert scale ranging from "Strongly disagree (1)" to "Strongly agree (5)". The mean value along with the percentage of respondents who "Strongly agreed" or "Agreed" with the statement were combined and shown. The response rate to this question was 82%.

DISCUSSION

This study is the first to investigate the potential barriers to enforcing CPWD among police officers across the US The findings revealed that there are numerous challenges that officers face when enforcing CPWD laws, especially UTB which are the most common law in effect. The study also found that ample opportunities exist to amend legislation or improve public health efforts from an officers' perspective. One of the biggest challenges for officers noted in this study and others is determining what the driver is actually doing on their cellphone.[9, 10] Given the vast technological capabilities of cellphones, the driver could easily be engaging in a myriad of behaviors (i.e., dialing a phone number, terminating a call, sending/reading texts, browsing the internet, etc.). If the driver is concealing their behavior, which was another common barrier, then officers may not be able to determine what the driver is doing. The uncertainty of the drivers' activity coupled with how most of the CPWD laws are written complicate enforcement efforts. A majority of officers agreed that some CPWD laws are written too specific, or they are written in such a manner where some behaviors are permitted, while others are not. These barriers to enforcement were also noted in previous studies conducted with officers in Washington and West Virginia.[9, 10] For example, if the law specifically states that a driver cannot send or read text-based messages, it may not necessarily cover other activities such as watching a video, making a cellphone call, etc. Also, if a law states that a driver cannot conduct a hand-held phone conversation, but is allowed to end a call or utilize GPS, these essentially create "legal loopholes" for drivers. These situations not only complicate enforcement for officers, but can confuse drivers' understanding of what the law does and does not permit.

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read text-based messages, it may not necessarily cover other activities such as watching a video, making a cellphone call,
etc. Also, if a law states that a driver cannot conduct a hand-held phone conversation, but is allowed to end a call or
utilize GPS, these essentially create "legal loopholes" for drivers. These situations not only complicate enforcement for
officers, but can confuse drivers' understanding of what the law does and does not permit.
From a policy perspective, several opportunities exist to amend or implement CPWD laws to make them easier
for police to enforce. First, this study found that UHB may help with enforcement of UTB. This situation is likely due to
the fact that UHBs state that drivers cannot hold a phone in their hand. Thus, if a driver is texting on a hand-held device,
it may be easier to cite them for a UHB infraction as opposed to texting. This has been seen in previous study where UHB
violations were written much more frequently than UTB or YDB violations in multiple states.[4] While most states have a

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UTB, less than half have a UHB.[1] States or municipalities with UTB may want to consider implementing UHB to aid enforcement efforts. Secondly, these findings suggest that YDB may have limited utility in the presence of other CPWD laws. The majority of officers agreed that removing age or licensure requirements from CPWD laws could make them easier to enforce. Additionally, this study also found that states seeking to amend their laws may want to consider neighboring states' legislation. Differences in state laws was also a barrier to enforcement as it can confuse interstate drivers. While most states have a UTB, fewer states have UHB or YDB. Lastly, while existing laws could be clarified, states may consider implementing a law that permits no hand-held cellphone use of any kind for drivers as nearly 86% of officers stated that this would be beneficial to enforcement.

In addition to potential policy changes, the study has public health implications. From an officer's perspective, there may be several viable options to reduce this dangerous and prevalent behavior among drivers.[13] The majority of officers agreed that drivers need more education on the CPWD laws and how to use hands-free technology. Many also agreed that increasing penalties, changing the culture surrounding CPWD, and technological solutions may also reduce CPWD.

However, it is not entirely clear if these prevention measures suggested by police would actually be effective in reducing CPWD as the intervention literature is severely lacking. Very few studies have investigated whether educational interventions reduce CPWD behaviors; the results of extant studies are mixed.[14-18] The relationship between increased penalties and behavioral changes among drivers has been investigated with other traffic safety infractions such as red light running, speeding, laxed seatbelt use, and impaired driving recidivism in the US and abroad; the findings of these studies are also varied.[19-25] As for cultural norms, research has shown that distracted driving campaigns are less effective than anti-drunk driving campaigns, particularly among younger drivers.[26] Cultural norms are known to influence individuals' behavior.[27, 28] Changing the culture surrounding CPWD is likely needed but will require a substantial, sustained effort in order it to be effective.

As for technology, various cellphone applications already exist and are freely or commercially available for drivers to use to disable certain cellphone functions while a vehicle is in motion; however, rigorous evaluations of this technology have not been conducted.[29, 30] One concern with this technology is acceptability as drivers may be reluctant to use it if the functions of their phones are altered. Few studies have investigated the acceptability of this

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246 technology.[31-33] A study conducted among teen drivers in the US found that participants were unwilling to use this 247 247 technology if it impeded the navigation or music functionality on their phones; the study also determined that those who 248 frequently engaged in texting while driving were less accepting of the technology.[31] An Australian study of drivers 7 249 (N=712) 18-90 years of age determined that females were more likely to use this technology and that most drivers did not 9 250 want their calls blocked along with their music, GPS, or Bluetooth capabilities.[32] In actual field tests, a study 11 conducted among a small group of US employees (N=44) found that most disliked the technology after using it for several 252 13 25**2** weeks even though it appeared to reduce their calls.[33] Two studies which investigated the efficacy of this technology 15 299 among younger drivers found that they will override the technology to use a cellphone while driving. [34, 35] One of 17 294 these studies did report that calls and texts were decreased when this technology was enabled.[35] Another technological 19 255 21 solution that could potentially aid law enforcement is automated traffic enforcement. Automated traffic enforcement is 255 when cameras or monitors are installed at intersections and citations are automatically issued to drivers (via license plate tracking) who appear to violate laws. It is currently used in limited locations in the US mainly for red light running and/or 2<u>24</u> 255 26 258 speeding.[36] Even though automated traffic enforcement can deter risky driver behavior and the American public is 28 mildly in favor of it for enforcing certain traffic violations, it is highly politicized and illegal in several states. [36-46] As 259 30 this was not specifically asked in the survey, it is not clear if this technology would help with cellphone law enforcement 260 32 as a picture may not reveal what the driver is doing on their cellphone at the time of the infraction. Thus, more research 263 34 262 and rigorous evaluations of interventions are clearly needed. 36

While the findings of this study are important to the extant traffic safety literature, they are not without limitation. 263 39 Even though the survey was distributed throughout all 50 states, the response rate was low and could not realistically be 264 263 determined. Research shows that surveys involving police typically have low response rates. [47] This is attributed to the 43 2₿₿ multifaceted nature of their job where they have competing demands, emergency calls to respond to, active patrols to 2**69** 47 make, court appearances to attend, etc. Secondly, the response rate from northeastern states, which often have UHB in 268 268 effect, was also much lower than the other regions. The lower response rate in this area was partially attributed to the 259 COVID-19 pandemic. Also, officers for this survey were recruited by convenience sampling. While many departments 2<u>79</u> were given an electronic link to the survey and were encouraged to distribute it to anyone who met the inclusion criteria, 54 273 there was no guarantee that it was circulated. Additionally, the survey was designed to be anonymous so officers would 56 not fear potential repercussion from giving their opinions; this was done to increase participation rates. Thus, it was 2757 58 14

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unknown whether officers who responded were from different departments. Because officers from the same department could be correlated and department affiliation was not collected to protect anonymity, regression models were adjusted for state correlation instead. It is also possible that those who participated may be fundamentally different from those who did not participate. This could lead to a selection bias. Lastly, as this was a survey, it is entirely plausible that reporting or recall biases existed. Officers could have chosen to give more socially appropriate responses or may have not accurately recalled certain behaviors or situations.

Conclusion

CPWD is a dangerous and prevalent behavior among drivers in the United States.[13] In order to mitigate the risk drivers can only be convinced to change their behavior through intervention or encouraged to do so through legislation. However, active enforcement is crucial to this equation. Traffic safety studies have shown that drivers will change their behavior if they perceive that there is an increased risk of being apprehended (i.e., risk vs. reward).[48, 49] As this study has shown, numerous barriers to enforcement exist particularly for UTB which is the most common law in effect. Laws with more barriers to enforcement are less likely to be enforced.[8] This study identified numerous opportunities to strengthen existing or future CPWD laws. These policy changes will not only make traffic safety enforcement easier for police, but may also protect road users from unintentional morbidity and mortality.

LIST OF ABBREVIATIONS

CI=Confidence interval; CPWD=Cellphone use while driving; GPS=Global positioning system; OR=Odds ratio;
 SD=Standard deviation; US=United States; UHB=Universal hand-held cellphone ban; UTB=Universal texting ban;

YDB=Young driver cellphone ban

DECLARATIONS

Funding: TMR received support from the Centers of Disease Control and Prevention grant R49CE002109 and from the National Institutes of General Medical Sciences grant 5U54GM104942-04. MZ received support from National Institutes of Health grants R01AG050581 and R01HD074594. The funding agencies had no role in the design of the study, collection, analysis, or interpretation of the results, or in the writing of this manuscript.

Ethics Approval: Institutional Review Board approval was obtained for this project from West Virginia University. Data Sharing: No additional data are available.

Competing Interests: On behalf of all authors, the corresponding author states that there is no conflict of interest.

Protected by copyright, inclu Authors' Contributions: TMR and MZ contributed to the design of the study. TMR obtained the data and performed the Authors' Contributions: TMR and MZ contributed to the design of the study. TMR obtained the data and performed the analysis. TMR and MZ interpreted the data. All authors had full access to the data in the study and take responsibility for for the integrity of the data and the accuracy of the data analysis. All authors contributed to the manuscript preparation and approved the final version.

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Page 22 of 23

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SUPPLEMENTARY MATERIAL



Appedix Figure 1. Location of officers who responded to the national survey regarding the enforcement of cellphone use while driving. Officers from states which are shaded participated in the survey.

	Item No	Performandation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the
The and abstract y	1	abstract PAGE 1
		(b) Provide in the abstract an informative and halanced summary of what was de
		and what was found PAGE 2
Introduction		and what was found I AOL 2
Background/rationale	2	Explain the scientific background and rationale for the investigation being report
Duenground/rutionale (2	PAGE 4-5
Objectives√	3	State specific objectives, including any prespecified hypotheses PAGE 5
Methods		
Study design√	4	Present key elements of study design early in the paper PAGE 5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitme
		exposure, follow-up, and data collection PAGE 5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of
		participants PAGE 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and
		effect modifiers. Give diagnostic criteria, if applicable PAGE 6-7
Data sources/	8*	For each variable of interest, give sources of data and details of methods of
√measurement		assessment (measurement). Describe comparability of assessment methods if the
		is more than one group PAGE 6-7
Bias√	9	Describe any efforts to address potential sources of bias PAGE 6-7
Study size	10	Explain how the study size was arrived at PAGE 6-7
Quantitative variables \checkmark	11	Explain how quantitative variables were handled in the analyses. If applicable,
		describe which groupings were chosen and why PAGE 6-7
Statistical methods $$	12	(a) Describe all statistical methods, including those used to control for confound
		PAGE 6-7
		(b) Describe any methods used to examine subgroups and interactions PAGE 6-
		(c) Explain how missing data were addressed PAGE 6-7
		(d) If applicable, describe analytical methods taking account of sampling strategy
		PAGE 6-7
		(e) Describe any sensitivity analyses NOT APPLICABLE
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentiall
		eligible, examined for eligibility, confirmed eligible, included in the study,
		completing follow-up, and analysed PAGE 7
		(b) Give reasons for non-participation at each stage NOT APPLICABLE
		(c) Consider use of a flow diagram NOT APPLICABLE
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and
		information on exposures and potential confounders PAGE 7-8
		(b) Indicate number of participants with missing data for each variable of interest
		PAGE 7-8
Outcome data√	15*	Report numbers of outcome events or summary measures TABLES 1-5 ON
		PAGES 7-12
Main results√	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates a
		their precision (eg. 95% confidence interval) Make clear which confounders we

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		adjusted for and why they were included PAGE 9-10 TABLE 3		
		(b) Report category boundaries when continuous variables were PAGE 9-10		
		TABLE 3		
		(c) If relevant, consider translating estimates of relative risk into absolute risk for		
		meaningful time period NOT APPLICABLE		
Other analyses√	17	Report other analyses done-eg analyses of subgroups and interactions, and		
		sensitivity analyses NOT APPLICABLE		
Discussion				
Key results√	18	Summarise key results with reference to study objectives PAGE 12		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or		
		imprecision. Discuss both direction and magnitude of any potential bias PAGE 14		
Interpretation√	20	Give a cautious overall interpretation of results considering objectives, limitations		
		multiplicity of analyses, results from similar studies, and other relevant evidence		
		PAGE 14		
Generalisability√	21	Discuss the generalisability (external validity) of the study results PAGE 14		
Other information				
Funding√	22	Give the source of funding and the role of the funders for the present study and, if		
		applicable, for the original study on which the present article is based PAGE 15		

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

The challenges of enforcing cellphone use while driving laws among police in the United States: a cross-sectional analysis

Journal:	BMJ Open
Manuscript ID	bmjopen-2021-049053.R2
Article Type:	Original research
Date Submitted by the Author:	03-Jun-2021
Complete List of Authors:	Rudisill, Toni; West Virginia University, Epidemiology Zhu, Motao; Nationwide Children's Hospital, Center for Injury Research and Policy
Primary Subject Heading :	Epidemiology
Secondary Subject Heading:	Health policy, Public health
Keywords:	PUBLIC HEALTH, EPIDEMIOLOGY, LAW (see Medical Law), Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PREVENTIVE MEDICINE





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TITLE: The challenges of enforcing cellphone use while driving laws among police in the United States: a cross-

sectional analysis

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Word Count: Abstract: 260; Manuscript: 3,380

Key Words: Cellphone, Enforcement, Policy, Challenges, Traffic, Phone Use While Driving

ABSTRACT

Objectives: Research suggests that cellphone use while driving laws may be difficult for police to enforce in the United States, but this is unknown. A national survey of police officers was conducted to determine whether barriers to enforcing these laws exist, what aspects of laws make them easier to enforce, and ways to discourage the behavior among drivers. **Design:** Cross-sectional survey

Setting: United States

Participants: Individuals >18 years of age employed as a law enforcement officer from all 50 states were recruited via convenience sampling through multiple modalities from November 2019-April 2020. Officers (N=353) from 31 states participated.

Primary and secondary outcome measures: Descriptive statistics and multi-level logistic regression analyses were run to assess the responses.

Results: The most common barriers to enforcing texting bans (i.e., the most prevalent law) were drivers concealing their phone use (78%) and the officer not being able to determine what the driver was doing on their phone (65%). If a universal hand-held cellphone ban was in effect in their state, officers were 77% less likely (adjusted OR=0.23; 95% CI 0.08, 0.70) to report that a texting ban was difficult to adjudicate. The majority of officers (86%) agreed that having one general law that prohibits any type of hand-held cellphone use would aid with enforcement, and that laws must be a primary offense (87%), and be applicable to all licensed drivers (91%). Most officers felt that driver education is needed. **Conclusions:** While numerous barriers to enforcement were identified, opportunities exist to improve current legislation to aid enforcement efforts and to prevent the behavior among drivers.

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Strengths and Limitations of this Study:

- No national studies have surveyed officers to determine if barriers to cellphone law enforcement exist
- Officers from 31 states participated in the survey
- The response rate was low especially from officers from the northeastern United States
- Officers who chose to participate may be fundamentally different from those who did not
- As this was a survey, socially acceptable responses may have been provided

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INTRODUCTION

Over the past 20 years, a multitude of cellphone use while driving (CPWD) laws have been enacted throughout the United States (US) to protect road users. The most common law passed among states is a universal texting ban (UTB), which prohibits any licensed driver from sending or reading text-based messages on a hand-held device; fortyeight states have a UTB.[1] The second most common law enacted is a young driver cellphone ban (YDB). This law typically applies to drivers who are under a particular age (i.e., under 18, 19, or 21 years of age) or licensure status (i.e., individuals who hold a learner's permit or intermediate driver's license) and prohibits them from any hand-held cellphone use except in emergency situations; currently, 38 states have a YDB.[1] The third most common law passed is a universal hand-held cellphone ban (UHB). This law generally forbids any licensed driver from holding a cellphone in their hand; 22 states have a UHB.[1] While these are the most common types of laws passed, there are some variations between states.[1]

While the enactment of such laws is important for public safety, legislation is only effective if it is enforced by police. Research indicates that active enforcement can deter drivers from engaging in adverse behaviors. [2, 3] Very few studies have investigated the enforcement of CPWD laws; among such studies, most have determined that CPWD violations make up only 1-8% of all traffic citations written.[4-7] Because the frequency of citation issuance for these violations appears low, it is believed that these laws may be difficult for police to enforce. Previous research has shown that laws with fewer perceived barriers are enforced more frequently by police.[8] However, to the authors' knowledge, only two studies have actually consulted police on the potential barriers to enforcing CPWD laws in the US.[9, 10] These qualitative studies were conducted separately with police in West Virginia and Washington states, which have all three CWPD laws in effect. [1, 9, 10] Despite the states' geographic distance from one another, both studies found that numerous but similar barriers to CPWD enforcement were experienced by officers. Officers from both states claimed that it is often difficult to discern what drivers are actually doing on their phones (i.e., calling, texting, using the internet, etc.) and proving their observation in court should the citation be contested. Officers noted that using a cellphone while driving is socially accepted by the public, and many drivers engage in these behaviors. Additionally, individuals tend to overestimate their driving ability and believe they can safely drive while using a cellphone. Officers claimed that the manner in which laws are written is also problematic. Laws can be written very specifically, which can be difficult for

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2 officers because they have to identify a particular behavior that a driver is performing often from a distance. Laws can **0**3 also be written in such a manner where certain behaviors are permitted, while other behaviors are not. [9, 10] An example **0**4 would be if the law prohibits drivers from texting but allows them to operate a global positioning system (GPS), which is 1085 often a cellphone application. It would be nearly impossible for the officer to identify whether the driver is texting or using GPS. Thus, if the officer pulls the driver over, the driver could claim they were using GPS to avoid a citation. Many Protected by copyright, including for uses related state-laws have these "legal exceptions/loop-holes". 10Z

Because states can have different combinations of CPWD laws in effect, it is entirely unknown whether officers in other states experience challenges similar to those noted in the Washington and West Virginia studies. Thus, the purpose of this study was to conduct a national survey of police officers to determine whether similar barriers to enforcing CPWD laws exist, what aspects of CPWD laws make them easier for police to enforce, and potential ways to reduce CPWD from an officers' perspective. If common barriers are identified among states—especially those with comparable laws, current CPWD legislation could be amended to make enforcement easier for police.

METHODS

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Ethics Approval

Approval to conduct this study was garnered from West Virginia University's Institutional Review Board (Protocol #1906609479).

Study Population

The study population included any individual employed as a law enforcement officer in the United States who was ≥ 18 years of age at time of survey.

Survey Development, Validity and Reliability

40 The survey, which was found valid and reliable, has been described in detail elsewhere.[11] Briefly, the survey contained 33 questions total including skip logic and was constructed using Qualtrics software. The survey asked questions pertaining to how often the officer issued citations for CPWD infractions, factors which influenced their decision to apprehend a driver, how easy or difficult the adjudication process was in their jurisdiction for CPWD offenses,

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potential challenges encountered when enforcing the CPWD laws in effect in their patrol area, aspects of CPWD laws that do or could aid in their enforcement, ways to prevent CPWD among drivers, in addition to demographics. Most questions were comprised of a series of statements in which the respondent could agree or disagree with. The responses mainly consisted of a 5-point Likert scale ranging from, "Strongly disagree (1)" to "Strongly agree (5)". The survey was designed to be completed in <20 minutes. To encourage participation, the survey was anonymized (i.e., the officers' names, department affiliations, or any personally identifying information were not collected).

Survey Sampling and Distribution

Officers were recruited via convenience sampling. The survey was released mid-November 2019 thru April 2020 In order to distribute the survey, police agencies were randomly selected throughout the US and all 50 states were engaged. The agencies were contacted via their social media pages, websites, email addresses or listed phone numbers. The agencies were briefly informed about the survey, its purpose, and provided an electronic link to participate. Respondents were encouraged to share the electronic link with anyone that met the inclusion criteria. In addition to randomly contacting individual departments, the survey was posted to police-affiliated social media pages and organizations. The National Fraternal Order of Police also provided their state lodges a link to the survey, who in turn, passed the information on to individual officers who were members of the organization. The survey was also distributed among members of the International Association of Campus Law Enforcement. To encourage participation, respondents who completed the survey could enter into a drawing to receive a \$100 gift card.

Statistical Analyses

All data management and analyses were conducted using SAS version 9.4. Descriptive statistics were calculated for responses. Because UTBs were in effect in 48 states (96%), additional analyses were conducted to determine if any demographic factors (i.e., age, sex, race, education level or years of experience in law enforcement) or other CPWD laws (i.e., YDB or UHB) were independently associated with an officer responding that a UTB law was difficult to adjudicate. Officers' responses, which were on a 5-point Likert scale, were collapsed and made binary (i.e., the responses for, 'Very difficult to adjudicate', and 'Difficult to adjudicate', were combined and compared to the other possible responses). Because the dependent variable was binary and officers could be from the same states (i.e., they could be correlated), a multi-level logistic regression model with an exchangeable correlation matrix was utilized.[12] Additional analyses were 6

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undertaken to determine if any of these demographic factors or other laws were potential confounders of one another in their relationship with the dependent variable. This was accomplished by first running the crude models and seeing if any of the variables were statistically associated with an officer reporting that a UTB was difficult to adjudicate. The other demographic factors were each separately added to the model and the crude and adjusted models were compared. If there was a 10% change in the odds ratio between the crude and adjusted model, confounding was suspected. Hypothesis tests were two-sided with the *a priori* level of significance set at α =0.05.

Patient and Public Involvement

It was not possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Officers (N=353) from 31 states participated in the national survey. A map indicating which states officers were from is shown in the Appendix. The majority of officers were 35-54 years of age (65%), male (88%), of white race (89%), and from the southern US (67%) (Table 1). Most were from states with UTB (94%) or YDB (86%) in effect. Only 21% of respondents came from states with UHB.

Table 1. Demographic characteristics of police officers who				
Characteristics	N	%		
Age (in years)		, , ,		
18-34	47	16.2		
35-44	68	23.5		
45-54	120	41.4		
>55	55	19.0		
Missing	63			
Sex				
Male	254	87.9		
Female	35	12.1		
Missing	64			
Race				
White	255	88.5		
Other	33	11.5		
Missing	65			
Education				
High school or equivalency	55	19.0		
Associate degree	66	22.8		
Bachelor's degree	115	39.8		
Graduate degree	53	18.3		

1		Missing	64		
2	Law e	nforcement experience (years)			
3		<15	101	34.7	
4		15-24	84	28.9	
5		>25	106	36.4	
6		 Missing	62	2011	
7	Congu	ragion ^b	02		
8	Cellsu	Northoast	Q	20	
9		Northeast	0	2.0	
10		Midwest	42	14.7	
11		South	192	67.4	
12		West	43	15.1	
13		Missing	68		
14	State-1	evel universal texting ban in			
15	effect ^b				
16		Yes	267	93.7	
17		No	18	63	
18		Missing	68	0.0	
19	State	aval universal hand held cellphone	00		
20	State-I	offootb			
21	ban in		50	20.7	
22		Yes	39	20.7	
 23		No	226	79.3	
22		Missing	68		
27 25	State-1	evel young driver all cellphone			
25 26	bans i	n effect ^b			
20		Yes	244	85.6	
27		No	41	14.4	
28		Missing	68	1	
29	a: Dar	ventages may not add to 100% due to	rounding	<u> </u>	
30 31 22	a. Pere b: 'Mi	ssing' means the officer did not indicate	ate their st	ate of	
66 34 35 66 37	Numerous barriers to enfor	eing UTB were reported by officers (7	Table 2). N	Jearly 78% of	respondents a
38 39	drivers often try to conceal their tex	ting behaviors. A majority of officers	s (i.e., >60	%) also agree	d that their lay
9 1	exceptions which permit drivers to	perform some behaviors but not other	s and that	they cannot of	ften tell what t
ð	actually doing on their phone. Near	y half of the officers agreed that drive	ers do not	seem supporti	ve of the law
1	do not fully understand what the law	v permits (57%).			
5 6					
7	Table 2. Barriers experier	nced by officers when enforcing textin	ng while d	riving laws (N	V=258)
8	Barrier				Percent
9	-				experiencing
0					this harrier
1	Drivers two to some sel to	ing			70.2
2	Drivers try to conceal text			1 4 4	/8.3
3	Current law has exception	s which allow drivers to perform cert	ain behavi	ors but not	00.2
4	others (example: drivers a	re not permitted to text, but they may	use GPS,	or manually	
5	dial a phone number)				
6	Officer cannot prove what	the driver is actually doing on their p	hone (i.e.	, texting vs.	64.5
-	watching a video surfing	the internet, dialing a number, etc.)			
7	watching a video, suring	/			
7 8	watching a video, surning	0			
7 8 9	watching a video, suring	8			
57 58 59	For peer re	8 view only - http://bmiopen.bmi.com/sit	e/about/ou	uidelines.xhtml	

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Drivers do not fully understand what the law permits	57.3
Drivers are not supportive of this law	49.2
Surrounding states have different laws which confuse inter-state drivers	40.5
Current law is too narrowly focused	35.9
Law is outdated because technology advanced faster	24.4
Current law is unclear	23.5
Judges or courts are not supportive of law	23.3
Officer does not fully understand what the law permits	16.0
Officer wants to maintain a positive relationship with the public	13.7
Fellow officers are not supportive of law	12.0
Department management is not supportive of law	4.3
a: This question asked if the officer experienced any of the perceived barriers listed	
above when enforcing texting while driving laws. Responses consisted of, "Yes",	
"No", or "Unsure". The percentage shown is those who indicated that they	
experienced this barrier when enforcing this law if it was in effect in their jurisdiction.	
The response rate for this question was 73%.	

Table 3.	Characteristics of officers that were associated v	with reporting that a universal
texting ba	an was difficult to adjudicate	

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Duissans do so the fully surdans to a dark the lass some	:4~			57.2	
Drivers are not supportive of this law	ns			37.5	
Surrounding states have different laws which confi	ica intor	state drivers		49.2	
Surrounding states have different laws which conit	use inter-	state drivers		40.5	
L and is contracted because tacking locused				33.9	
Law is outdated because technology advanced fast	er			24.4	
Current law is unclear				23.5	
Judges or courts are not supportive of law	•.			23.3	
Officer does not fully understand what the law peri	mits	1.1.		16.0	
Officer wants to maintain a positive relationship w	ith the pu	iblic		13.7	
Fellow officers are not supportive of law				12.0	
Department management is not supportive of law	0.1			4.3	
a: This question asked if the officer experienced an	iy of the p	perceived barrier	rs listed		
above when enforcing texting while driving laws.	Response	es consisted of,	Yes",		
"No", or "Unsure". The percentage shown is those	e who ind	icated that they			
The response rate for this question was 73%.	it was in	effect in their ju	risdiction.		
0,					
The results from the multi-level logistic regression a	nalyses sl	howed that most	: demograp	ohic factors (i.e	e., officers
ice, years of experience, or education) were not associa	ated with	officers perceiv	ed difficul	ty of adjudicat	ing UTBs,
UHB were associated (Table 3). Through the confoun	ding anal	yses, YDB were	e identified	as the only co	ontounder of
ationship between the presence of a UHB and an office ing for YDB, if a UHB was in effect in their state, office that a UTB was difficult to adjudicate.	er reporti cers were	ng that UTB wa 77% less likely	s difficult (OR 0.23;	to adjudicate. 95% CI 0.08,	After 0.70) to
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<15	1.03	0.55, 1.93			
15-24	1.24	0.62, 2.48			
≥25	1.00	Referent			
State-level universal hand-held cellphone					
ban in effect					
Yes	0.32	0.12, 0.84	0.23	0.08, 0.70	
No	1.00	Referent	1.00	Referent	
State-level young driver all cellphone bans					
in effect					
Yes	1.10	0.27, 4.58	2.73	0.59, 12.69	
No	1.00	Referent	1.00	Referent	

Abbreviation: CI=confidence interval; OR= odds ratio

a: A multi-level logistic regression model which accounted for the correlation of state was utilized to estimate odds ratios. The dependent variable was whether or not an officer perceived that universal texting bans were difficult to adjudicate. Separate crude models were run between each characteristic noted and the outcome. Multivariable models were adjusted for confounders of the relationship between statistically significant independent variables (i.e., the presence of a universal hand-held ban) and the outcome.

There were numerous aspects of CPWD laws that do or could make them easier for police to enforce. Among respondents, 91% agreed that laws must be applicable to all licensed drivers (Table 4). The majority of officers also agreed that laws must be made a primary offense (87%). In the US, traffic offenses can be designated as primary or secondary. A primary offense means an officer can pull a driver over if they observe that specific behavior. Secondary offenses are violations in which an officer cannot pull a driver over for solely. A driver can only be cited for a secondary offense if they were originally pulled over for committing a primary offense. Additionally, 86% of respondents agreed that having one general law that prohibits hand-held cellphone use of any kind would help with enforcement.

Aspect	Percent who strongly agreed or agreed	Mean response
Making these laws applicable to all licensed drivers	90.7	4.5
Making these laws a primary offense	86.5	4.4
Having one general law that prohibits hand-held cellphone use of any kind	85.8	4.3
Eliminating age or license requirements (i.e., the law does not just apply to drivers under a certain age or licensure types).	78.3	4.2
Eliminating legal exceptions, which permit some behaviors but not others	72.3	4.0
Writing these laws more broadly and including all distracting behaviors (e.g., personal grooming, eating, pets sitting in the driver's lap, etc.)	66.1	3.9

Abbreviations: SD=standard deviation a: This question asked which aspects of cellphone laws do or could r officers were presented with these options. Responses were on a 5- disagree (1)" to "Strongly agree (5)". The mean value along with th "Strongly agreed" or "Agreed" with the statement were combined ar question was 86%.	nake them ea point Likert s e percentage ad shown. Th	sier to enforce a cale ranging fro of respondents v le response rate	and the om "Strongly who for this
Officers were also asked what prevention measures could substant	ially reduce c	ellphone use an	nong drivers (T
5). Nearly 88% agreed that educating the public on what current traffic law	vs do or do no	t permit would	be beneficial.
Nearly 85% of respondents also agreed that educating the public on the dat	ngers of CPW	D or changing	the culture to n
CPWD less socially accepted would also help reduce the behavior. A larg	e majority of	officers also agi	reed that educa
he public on how to use hands-free technology (78%) could help.			
Table 5. Officers' opinions regarding prevention measures wh cellphone use among drivers $(N=290)^a$	ich could sub	stantially reduc	e
Prevention Measure	Percent	Mean	SD
	who	Response	
	strongly		
	agreed or		
Educating the public on what the current traffic laws do or	agreed 87.6	13	0.8
do not permit	87.0	4.5	0.8
Educating the public on the dangers of cellphone use while	84.8	4.2	1.0
driving			
Changing the current culture to make cellphone use while	84.1	4.2	0.9
driving more socially unacceptable			
Educating the public on how to use hands-free technology	78.3	4.1	1.0
(e.g., Bluetooth, external hands-tree devices)	77.0	1 2	1.0
Technological advances made by car manufacturers that	72.4	4.2	1.0
restrict cellphone capabilities at certain speeds or driving conditions	/2.4	5.9	1.2
Technological advances made by cellphone manufacturers that restrict cellphone capabilities at certain speeds or driving conditions	72.3	3.9	1.2
Increasing the number of points for cellphone infractions	70.0	4.0	1.1
No single measure will reduce cellphone use among	64.4	3.7	1.2
drivers			
Abbreviations: SD=standard deviation			
a: This question asked which prevention measures could substa	antially reduc	e cellphone use	among
the percentage of respondents who "Strongly agreed" or "Agree combined and shown. The response rate to this question was 8	(5)". The mean of	e on a 5-point Li an value along v statement were	with
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194 DISCUSSION

This study is the first to investigate the potential barriers to enforcing CPWD among police officers across the US. The findings revealed that there are numerous challenges that officers face when enforcing CPWD laws, especially UTB which are the most common law in effect. The study also found that ample opportunities exist to amend legislation or Protected by copyright, including improve public health efforts from an officers' perspective. One of the biggest challenges for officers noted in this study and others is determining what the driver is actually doing on their cellphone.[9, 10] Given the vast technological capabilities of cellphones, the driver could easily be engaging in a myriad of behaviors (i.e., dialing a phone number, terminating a call, sending/reading texts, browsing the internet, etc.). If the driver is concealing their behavior, which wa another common barrier, then officers may not be able to determine what the driver is doing. The uncertainty of the drivers' activity coupled with how most of the CPWD laws are written complicate enforcement efforts. A majority of officers agreed that some CPWD laws are written too specific, or they are written in such a manner where some behaviors are permitted, while others are not. These barriers to enforcement were also noted in previous studies conducted with officers in Washington and West Virginia.[9, 10] For example, if the law specifically states that a driver cannot send or read text-based messages, it may not necessarily cover other activities such as watching a video, making a cellphone call. etc. Also, if a law states that a driver cannot conduct a hand-held phone conversation, but is allowed to end a call or utilize GPS, these essentially create "legal loopholes" for drivers. These situations not only complicate enforcement for ining, officers, but can confuse drivers' understanding of what the law does and does not permit.

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From a policy perspective, several opportunities exist to amend or implement CPWD laws to make them easier for police to enforce. First, this study found that UHB may help with enforcement of UTB. This situation is likely due to the fact that UHBs state that drivers cannot hold a phone in their hand. Thus, if a driver is texting on a hand-held device, it may be easier to cite them for a UHB infraction as opposed to texting. This has been seen in previous study where UHB_{a} violations were written much more frequently than UTB or YDB violations in multiple states.[4] While most states have a UTB, less than half have a UHB.[1] States or municipalities with UTB may want to consider implementing UHB to aid enforcement efforts. Secondly, these findings suggest that YDB may have limited utility in the presence of other CPWD laws. The majority of officers agreed that removing age or licensure requirements from CPWD laws could make them easier to enforce. Additionally, this study also found that states seeking to amend their laws may want to consider

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neighboring states' legislation. Differences in state laws was also a barrier to enforcement as it can confuse interstate drivers. While most states have a UTB, fewer states have UHB or YDB. Lastly, while existing laws could be clarified, states may consider implementing a law that permits no hand-held cellphone use of any kind for drivers as nearly 86% of officers stated that this would be beneficial to enforcement.

In addition to potential policy changes, the study has public health implications. From an officer's perspective, there may be several viable options to reduce this dangerous and prevalent behavior among drivers.[13] The majority of officers agreed that drivers need more education on the CPWD laws and how to use hands-free technology. Many also agreed that increasing penalties, changing the culture surrounding CPWD, and technological solutions may also reduce CPWD.

Protected by copyright, including However, it is not entirely clear if these prevention measures suggested by police would actually be effective in reducing CPWD as the intervention literature is severely lacking. Very few studies have investigated whether educational interventions reduce CPWD behaviors; the results of extant studies are mixed.[14-18] The relationship between increased penalties and behavioral changes among drivers has been investigated with other traffic safety infractions such as red light **a** running, speeding, laxed seatbelt use, and impaired driving recidivism in the US and abroad; the findings of these studies are also varied.[19-25] As for cultural norms, research has shown that distracted driving campaigns are less effective than mining, AI training, and similar technologies anti-drunk driving campaigns, particularly among younger drivers.[26] Cultural norms are known to influence individuals' behavior.[27, 28] Changing the culture surrounding CPWD is likely needed but will require a substantial, sustained effort in order it to be effective.

As for technology, various cellphone applications already exist and are freely or commercially available for drivers to use to disable certain cellphone functions while a vehicle is in motion; however, rigorous evaluations of this technology have not been conducted. [29, 30] One concern with this technology is acceptability as drivers may be reluctant to use it if the functions of their phones are altered. Few studies have investigated the acceptability of this technology.[31-33] A study conducted among teen drivers in the US found that participants were unwilling to use this technology if it impeded the navigation or music functionality on their phones; the study also determined that those who frequently engaged in texting while driving were less accepting of the technology.[31] An Australian study of drivers (N=712) 18-90 years of age determined that females were more likely to use this technology and that most drivers did not

want their calls blocked along with their music, GPS, or Bluetooth capabilities.[32] In actual field tests, a study conducted among a small group of US employees (N=44) found that most disliked the technology after using it for several weeks even though it appeared to reduce their calls.[33] Two studies which investigated the efficacy of this technology among younger drivers found that they will override the technology to use a cellphone while driving.[34, 35] One of these studies did report that calls and texts were decreased when this technology was enabled.[35] Another technological solution that could potentially aid law enforcement is automated traffic enforcement. Automated traffic enforcement is when cameras or monitors are installed at intersections and citations are automatically issued to drivers (via license plate tracking) who appear to violate laws. It is currently used in limited locations in the US mainly for red light running and/or speeding.[36] Even though automated traffic enforcement can deter risky driver behavior and the American public is mildly in favor of it for enforcing certain traffic violations, it is highly politicized and illegal in several states.[36-46] As this was not specifically asked in the survey, it is not clear if this technology would help with cellphone law enforcement as a picture may not reveal what the driver is doing on their cellphone at the time of the infraction. Thus, more research and rigorous evaluations of interventions are clearly needed.

While the findings of this study are important to the extant traffic safety literature, they are not without limitation. Even though the survey was distributed throughout all 50 states, the response rate was low and could not realistically be determined. Research shows that surveys involving police typically have low response rates.[47] This is attributed to the multifaceted nature of their job where they have competing demands, emergency calls to respond to, active patrols to make, court appearances to attend, etc. Secondly, the response rate from northeastern states, which often have UHB in effect, was also much lower than the other regions. The lower response rate in this area was partially attributed to the COVID-19 pandemic. Also, officers for this survey were recruited by convenience sampling. While many departments were given an electronic link to the survey and were encouraged to distribute it to anyone who met the inclusion criteria, there was no guarantee that it was circulated. Additionally, the survey was designed to be anonymous so officers would not fear potential repercussion from giving their opinions; this was done to increase participation rates. Thus, it was unknown whether officers who responded were from different departments. Because officers from the same department could be correlated and department affiliation was not collected to protect anonymity, regression models were adjusted for state correlation instead. It is also possible that those who participated may be fundamentally different from those who did not participate. This could lead to a selection bias. Lastly, as this was a survey, it is entirely plausible that reporting 14

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or recall biases existed. Officers could have chosen to give more socially appropriate responses or may have not accurately recalled certain behaviors or situations.

Conclusion

CPWD is a dangerous and prevalent behavior among drivers in the United States.[13] In order to mitigate the risk, drivers can only be convinced to change their behavior through intervention or encouraged to do so through legislation. However, active enforcement is crucial to this equation. Traffic safety studies have shown that drivers will change their behavior if they perceive that there is an increased risk of being apprehended (i.e., risk vs. reward).[48, 49] As this study has shown, numerous barriers to enforcement exist particularly for UTB which is the most common law in effect. Laws with more barriers to enforcement are less likely to be enforced.[8] This study identified numerous opportunities to strengthen existing or future CPWD laws. These policy changes will not only make traffic safety enforcement easier for police, but may also protect road users from unintentional morbidity and mortality.

LIST OF ABBREVIATIONS

CI=Confidence interval; CPWD=Cellphone use while driving; GPS=Global positioning system; OR=Odds ratio; SD=Standard deviation; US=United States; UHB=Universal hand-held cellphone ban; UTB=Universal texting ban; YDB=Young driver cellphone ban

DECLARATIONS

Funding: TMR received support from the Centers of Disease Control and Prevention grant R49CE002109 and from the National Institutes of General Medical Sciences grant 5U54GM104942-04. MZ received support from National Institutes

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of Health grants R01AG050581 and R01HD074594. The funding agencies had no role in the design of the study,

297 297 5 collection, analysis, or interpretation of the results, or in the writing of this manuscript.

2**9**8 7 Ethics Approval: Institutional Review Board approval was obtained for this project from West Virginia University.

299 Data Sharing: No additional data are available.

зфв Competing Interests: On behalf of all authors, the corresponding author states that there is no conflict of interest.

39<u>1</u>3 Authors' Contributions: TMR and MZ contributed to the design of the study. TMR obtained the data and performed the analysis. TMR and MZ interpreted the data. All authors had full access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors contributed to the manuscript preparation and approved the final version. Authors' Contributions: TMR and MZ contributed to the design of the study. TMR obtained the data and performed the 14 39**3** 16 3Q3 18

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SUPPLEMENTARY MATERIAL



Appedix Figure 1. Location of officers who responded to the national survey regarding the enforcement of cellphone use while driving. Officers from states which are shaded participated in the survey.
	Item No	Performandation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the
The and abstract v	1	abstract PAGE 1
		(b) Provide in the abstract an informative and halanced summary of what was de
		and what was found PAGE 2
Introduction		and what was found I AOL 2
Background/rationale	2	Explain the scientific background and rationale for the investigation being report
Suckeround/rationale V	2	PAGE 4-5
Objectives√	3	State specific objectives, including any prespecified hypotheses PAGE 5
Methods		
Study design√	4	Present key elements of study design early in the paper PAGE 5-6
Setting√	5	Describe the setting, locations, and relevant dates, including periods of recruitme
		exposure, follow-up, and data collection PAGE 5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of
		participants PAGE 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and
		effect modifiers. Give diagnostic criteria, if applicable PAGE 6-7
Data sources/	8*	For each variable of interest, give sources of data and details of methods of
√measurement		assessment (measurement). Describe comparability of assessment methods if the
		is more than one group PAGE 6-7
Bias√	9	Describe any efforts to address potential sources of bias PAGE 6-7
Study size	10	Explain how the study size was arrived at PAGE 6-7
Quantitative variables \checkmark	11	Explain how quantitative variables were handled in the analyses. If applicable,
		describe which groupings were chosen and why PAGE 6-7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confound
		PAGE 6-7
		(b) Describe any methods used to examine subgroups and interactions PAGE 6-7
		(c) Explain how missing data were addressed PAGE 6-7
		(d) If applicable, describe analytical methods taking account of sampling strategy
		PAGE 6-7
		(e) Describe any sensitivity analyses NOT APPLICABLE
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially
		eligible, examined for eligibility, confirmed eligible, included in the study,
		completing follow-up, and analysed PAGE 7
		(b) Give reasons for non-participation at each stage NOT APPLICABLE
		(c) Consider use of a flow diagram NOT APPLICABLE
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and
		information on exposures and potential confounders PAGE 7-8
		(b) Indicate number of participants with missing data for each variable of interest
· · · · · · · · · · · · · · · · · · ·		PAGE 7-8
Outcome data√	15*	Report numbers of outcome events or summary measures TABLES 1-5 ON
		PAGES 7-12
Main results√	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates a
		their precision (eg. 95% confidence interval) Make clear which confounders we

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17 18 19	 (b) Report category boundaries when continuous variables were PAGE 9-10 TABLE 3 (c) If relevant, consider translating estimates of relative risk into absolute risk for meaningful time period NOT APPLICABLE Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NOT APPLICABLE Summarise key results with reference to study objectives PAGE 12 Discuss limitations of the study, taking into account sources of potential bias or
17 18 19	TABLE 3 (c) If relevant, consider translating estimates of relative risk into absolute risk for meaningful time period NOT APPLICABLE Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NOT APPLICABLE Summarise key results with reference to study objectives PAGE 12 Discuss limitations of the study, taking into account sources of potential bias or
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19	Discuss limitations of the study, taking into account sources of potential bias or
	imprecision. Discuss both direction and magnitude of any potential bias PAGE 14
20	Give a cautious overall interpretation of results considering objectives, limitations
	multiplicity of analyses, results from similar studies, and other relevant evidence
	PAGE 14
21	Discuss the generalisability (external validity) of the study results PAGE 14
22	Give the source of funding and the role of the funders for the present study and, if
	applicable, for the original study on which the present article is based PAGE 15
	21

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.