

# Graduated Driver Licensing Decal Law Effect on Young Probationary Drivers

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**Background:** Decal laws have been implemented internationally to facilitate police enforcement of graduated driver licensing (GDL) restrictions (e.g., passenger limit, nighttime curfew) but have not been evaluated. New Jersey implemented the first decal law in the U.S. on May 1, 2010.

**Purpose:** The aim of this study was to evaluate the effect of New Jersey's law on the rate of citations issued for violation of GDL restrictions and police-reported crashes among probationary drivers aged <21 years and to estimate the number of probationary drivers whose crashes were prevented by the law.

**Methods:** New Jersey's licensing and crash databases were linked from January 1, 2008 to May 31, 2011, and each driver's license status, age, and outcome status were ascertained for each month. Monthly rates were calculated as the proportion of probationary drivers who experienced the outcome in that month. The pre-law period was defined as January 2008–January 2010 and the post-law period as May 2010–May 2011. Negative binomial regression models with robust SEs were used to determine the law's effect on crash and citation rates (adjusted for gender, seasonal trends, and overall trends) and estimate prevented crashes. Analyses were conducted in 2012.

**Results:** In the first year post-law, there was a 14% increase in the GDL citation rate (adjusted rate ratio 1.14 [95% CI=1.05, 1.24]); a 9% reduction in the police-reported crash rate (adjusted rate ratio 0.91 [95% CI=0.86, 0.97]), and an estimated 1624 young probationary drivers for whom a crash was prevented.

**Conclusions:** Findings suggest that the law is positively affecting probationary drivers' safety. Results contribute to building the evidence base for the effectiveness of decal laws and provide valuable information to U.S. and international policymakers who are considering adding decal laws to enhance existing GDL laws.

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## Introduction

Motor vehicle crashes are the leading cause of death among U.S. adolescents, with men/boys accounting for over 70% of all deaths.<sup>1,2</sup> Graduated driver licensing (GDL) laws are a cornerstone of public policy aimed at reducing the burden of crashes on adolescent health. All U.S. states have GDL laws in place, designed to phase adolescents into licensure by delaying

and/or extending the learning period and by introducing a “probationary” phase between the permit and the full-privilege (basic) driver license phases. During the probationary phase, young drivers are restricted from engaging in certain behaviors known to increase their crash and resultant fatality risk, including carrying passengers, driving at night, and using electronic devices.

Evaluations of GDL laws and specific GDL restrictions have consistently shown reductions in the prevalence of teen driver crashes.<sup>3–6</sup> However, the effectiveness of current laws has been limited by the inability of police officers to enforce them, given that identifying a probationary driver requires a traffic stop and visual inspection of the license.<sup>7,8</sup> Thus, the potential for GDL laws to have an even greater impact on reducing crashes in part hinges on efforts to enhance police enforcement of these restrictions.

To facilitate GDL enforcement efforts, several European and Asian countries, as well as jurisdictions in Australia and Canada, require novice teen drivers to display highly visible decals on their cars. The theory behind decal laws is that they enhance police enforcement, im-

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prove compliance with GDL restrictions, reduce risky driving among probationary drivers, and ultimately reduce the prevalence of young driver crashes.<sup>9</sup> However, previously implemented decal laws have not been rigorously evaluated. New Jersey recently implemented the first-in-the-nation GDL decal law (Kyleigh's Law), requiring permitted and probationary drivers aged <21 years to display small decals on their license plates, regardless of when their license was issued (i.e., even if they initially obtained their license prior to implementation of the law). This implementation provides a unique opportunity to conduct an evaluation of this novel intervention.

The primary objective of this study was to examine the effect of New Jersey's decal law on the monthly rate of: (1) citations issued to probationary drivers for violation of a GDL restriction; and (2) police-reported crashes among New Jersey probationary teen drivers during the first year following the law's implementation. Secondary crash outcome measures included injury, nighttime, single-vehicle, multiple-vehicle, and peer-passenger crashes. Finally, a goal of the current study was to estimate the number of probationary drivers for whom a crash was prevented by the decal law.

## Methods

### Data Sources

The New Jersey Motor Vehicle Commission's Licensing and Registration Database contains information on all New Jersey drivers' progression through the licensing process, as well as the type and date of driver "events" (e.g., moving violations, citations, crashes). Identifiable data were obtained for all individuals who had a license at some point from January 1, 2008 through May 31, 2011 ( $n=6,714,288$  drivers). These data were linked to New Jersey Crash Record data over the same time period ( $n=1,908,511$  crash-involved drivers). Crash data included information recorded on the New Jersey Police Crash Investigation Report for all police-reported crashes (e.g., injury status, time of crash, passenger status).

**Table 1.** Summary of New Jersey's Graduated Driver Licensing law, as of May 1, 2010

License phase and restrictions	Age, years <sup>a</sup>	Period, months <sup>b</sup>
<b>Permit</b>	16	6
<b>Probationary</b>	17	12
One-passenger limit, regardless of family affiliation, unless a parent/guardian is in the vehicle (excludes dependents)	—	—
Ban on driving between 11:01PM and 5:00AM	—	—
Mandatory seat belt use for all vehicle occupants at all times	—	—
Ban on driver use of hand-held or hands-free interactive wireless communication device	—	—
A citation can also be issued for any other violation of a condition of a probationary license (e.g., accumulation of >2 motor vehicle points, or driving while intoxicated)	—	—
<b>Basic (full privilege)</b>	18	—

Note: Restrictions listed are those that are relevant to the current study.

<sup>a</sup>Minimum age of obtainment

<sup>b</sup>Minimum holding period

### New Jersey's Graduated Driver Licensing Law

New Jersey has one of the most comprehensive GDL laws in the U.S. (enacted in 2001), with the highest age of licensure, and one of the lowest teen crash fatality rates.<sup>10</sup> At the time of the decal law's implementation, specific restrictions related to passengers, nighttime driving, electronic device use, and seat belt use existed for probationary drivers aged <21 years. Table 1 provides a summary of current GDL restrictions.

Under Kyleigh's Law, enacted in April 2009 and effective May 1, 2010, all probationary drivers aged <21 years are required to display a reflectorized decal on the front and back license plates of any motor vehicle they operate.<sup>11</sup> This law was accompanied by two changes in GDL restrictions: (1) the start time for the nighttime driving ban was changed from 12:01AM to 11:01PM; and (2) family members were no longer exempt from passenger restrictions. Violation of any GDL restriction, including failure to display the decal, carries a \$100 fine.

Intensive outreach efforts began in February 2010, and decals became available for purchase in April 2010. Thus, the pre-law period was defined as January 1, 2008 through January 31, 2010 and the post-law period as May 1, 2010 through May 31, 2011.

### Data Linkage and Preparation

To estimate monthly rates, the monthly age and license status of each New Jersey driver had to be identified. However, the New Jersey crash report does not contain information on license status. Thus, the crash database was linked to the licensing database. This linkage was accomplished first by using exact matching based on the New Jersey driver license number (92.7% match rate), followed by matching on exact or partial combinations of: driver's first, middle, and last names; driver license number; date of birth; address of residence; gender; and date of crash. A total of 98.1% of crash-involved New Jersey drivers were matched to a unique record in the licensing database,

including 98.9% of those aged 17–20 years. To assess linkage quality, a random sample of records from each phase (N=1038) were hand-reviewed, and the true match rate (i.e., number of true matches/number of original matches) was estimated to be 99.96%.

Each driver's progression through the license phases was then constructed. No specific variable indicated the end date of the probationary period (i.e., start of the basic licensing period). However, given that the minimum holding period for a probationary license is 1 year, the end of the probationary period was defined for the current paper as the earliest license transaction that occurred at least 365 days after the probationary period began (downgrades and duplicates excluded). Periods of license suspension and restoration and date of death were also identified.

## Outcome Measures

The main crash-related outcome measure was the monthly rate of police-reported crash involvement among New Jersey probationary drivers aged <21 years. Secondary outcomes included: drivers' monthly involvement in a crash resulting in a fatal, incapacitating, or moderate injury; time of occurrence of crash between 12:01AM and 5:00AM; involvement of only a single vehicle; involvement of multiple vehicles; and transportation of only peer passengers (i.e., aged 14–20 years). To adjust for overall crash trends, pre-to-post law changes in probationary drivers' crash rates were compared with those of licensed drivers aged 35–54 years. The citation-related outcome measure was the monthly rate of probationary drivers cited in New Jersey for violation of a GDL restriction (as listed in Table 1, excluding the decal law itself). A GDL-related citation was defined as a citation issued for either NJSA 39:3-13.4, Probationary Driver's License or 39:3-13.8 B-F, Fines for Violations of Probationary Driver's License.

## Data Analysis

Gender-specific estimates of outcome rates (per 10,000 drivers) were calculated for each month for probationary drivers (as well as older licensed drivers for crash outcomes). Specifically, a monthly rate was defined as the number of probationary/licensed drivers who experienced a specified outcome in a given month, divided by the number of probationary/licensed drivers on the 15th of that month. Drivers whose probationary or basic license was suspended or who were unlicensed or deceased on the 15th of a specific month were not included in that month's rates.

Rates were graphed over time using smoothing techniques (SAS's PROC LOESS). Multivariate modeling (PROC GENMOD) was used to estimate the effect of the decal law on monthly outcome counts; investigation of the data indicated that the negative binomial distribution was the most appropriate fit.<sup>12</sup> Poisson models were also fit to determine the robustness of results to model specification, and estimates were extremely similar. The mid-month number of probationary drivers was specified as the offset to estimate per-driver monthly rates, and robust variance estimates were used to account for overdispersion and non-independence of counts.

Initial regression equations included indicators for the law period (pre vs post); gender; seasonal variation (January–March, June–August, other) and, for crash-related outcomes, license status (probationary vs older driver). An interaction term between license status and law period was included to compare the rate ratio (post-law vs pre-law) for probationary drivers with

that of older drivers (i.e., to fully adjust for older-driver trends). Two- and three-way interactions of period, gender, and license status were also included and their significance determined by likelihood ratio tests.

Further, to account for trends in probationary driver crashes that may have occurred prior to the date the law became effective (e.g., trends due to economic conditions and other contextual factors), piecewise negative binomial regression modeling was conducted for crash-related outcomes.<sup>13</sup> The slope of the regression line for the natural logarithm of estimated crash rates was allowed to differ in the pre-law compared to the post-law period; a significant downward change in the slope coinciding with the date the law became effective indicated an intervention effect. The use of a quadratic term to reflect potential nonlinearity of post-law slopes was explored and found to be nonsignificant in all models; for this reason, the post-law slopes were described as linear. Finally, the number of probationary drivers for whom a crash was prevented by Kyleigh's Law was estimated by subtracting the estimated number of crash-involved probationary drivers in each post-law month from the number of probationary drivers predicted to be involved in a crash in that month under pre-law conditions (i.e., the counterfactual condition) and summing across months ( $\sum_{\text{post-law months}} [\text{rate predicted under pre-law conditions} * \# \text{ of probationary drivers}] - [\text{estimated post-law rate} * \# \text{ of probationary drivers}]$ ).

Analyses were conducted in 2012 using SAS 9.2. This study was approved by The Children's Hospital of Philadelphia IRB.

## Results

### Number of Probationary and Licensed Drivers

The number of probationary drivers aged 17 years remained stable at approximately 65,000 throughout the study period (Figure 1). The median number of new probationary licenses issued per month was also similar before and after the law became effective (pre-law: 8718/month; post-law: 8418/month), as was the median age of the driver (17.1 years for both) at the start of the probationary license period. The number of probationary drivers aged 18–20 years who were not yet eligible to obtain a basic license (i.e., held a probationary license for <365 days) also remained stable.

Conversely, the number of probationary drivers aged 18–20 years who were eligible for a basic license, which had been decreasing steadily in the pre-law period, decreased 13.4% from April ( $n=65,597$ ) to May 2010 ( $n=56,825$ ). A reciprocal increase was observed in the number of drivers aged 18–20 years with a basic license, indicating a rapid movement of teens from the probationary to the basic license phase in the first few months after the law's implementation. The effect appeared to be transient, however, as numbers began to approach pre-law levels 1 year after the law's implementation.

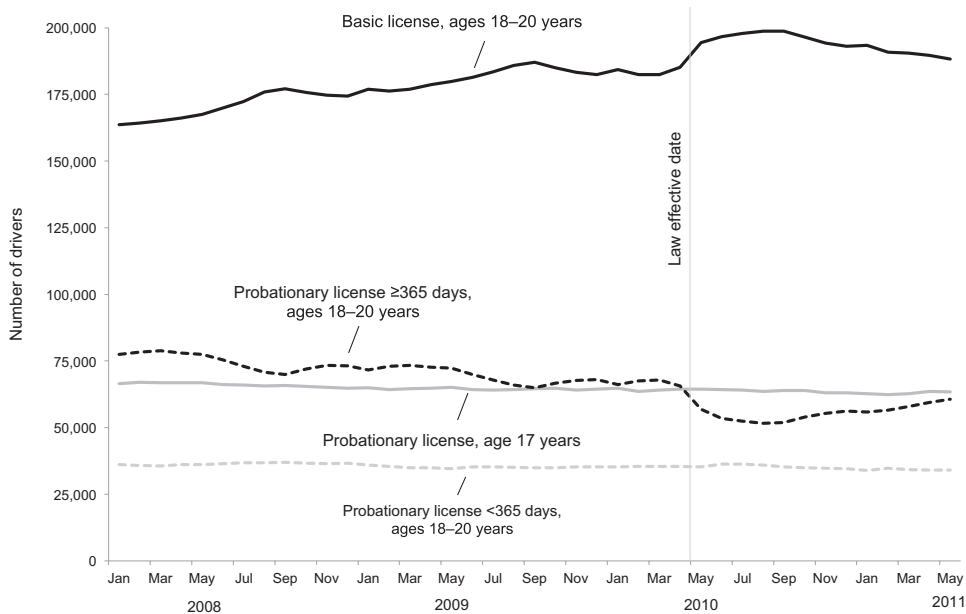
### Effect of Decal Law on Citation Rates

A rapid increase in the monthly rate of GDL citations issued to young probationary drivers occurred at two points: from March to April 2009 (32.3 to 48.5 per 10,000 drivers) when

Kyleigh's Law was signed, and again from February to May 2010 as the law took effect (22.7 to 46.4 per 10,000 drivers; Figure 2). Table 2 presents the mean monthly pre- and post-law GDL citation rates and adjusted rate ratios (aRR) controlling for gender and seasonal trends, as appropriate. GDL citation rates were significantly higher for male than for female drivers (aRR=2.61 [95% CI=2.41, 2.82]); however, the effect of the decal law on citation rates did not differ by gender. Overall, the rate of GDL citations increased 14% in the year after the law's implementation (32.5 to 37.8 per 10,000 probationary drivers, aRR=1.14 [95% CI=1.05, 1.24]).

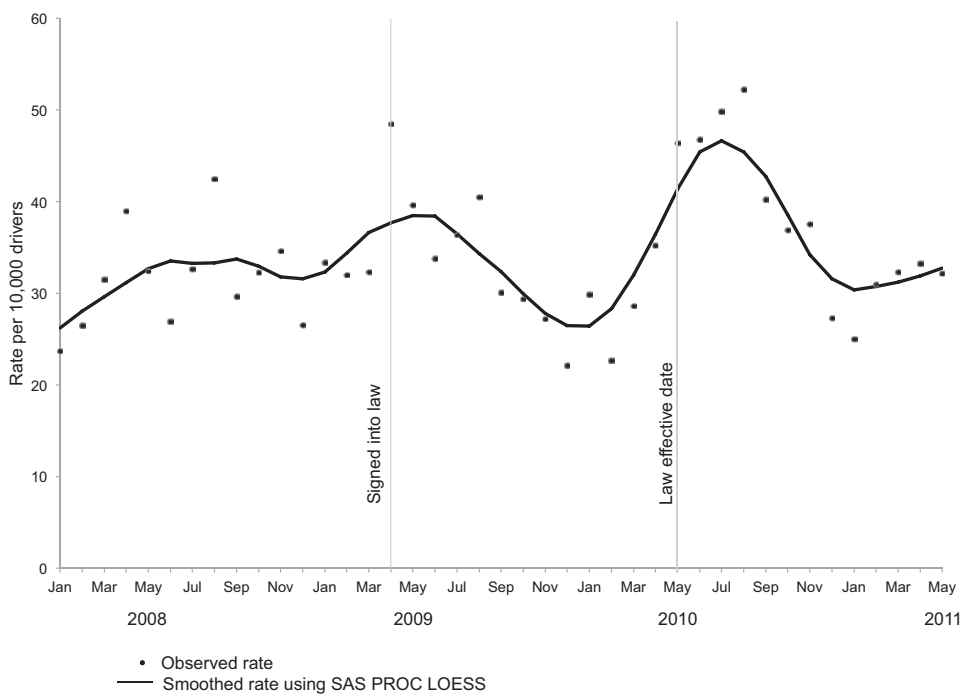
**Effect of Decal Law on Crash Rates**

The rate of probationary driver involvement in police-reported crashes decreased from 140.9 per 10,000 drivers in the pre-law period to 128.3 per 10,000 in the post-law period, a 9% reduction that remained even after fully accounting for overall New Jersey crash trends, gender, and seasonal variation (aRR=0.91 [95% CI=0.86, 0.97]; Table 2). Similarly, the rate of crashes occurring between 12:01AM and 5:00AM decreased 13% (aRR=0.87 [95% CI=0.78, 0.97]), and the rate of multiple-vehicle crashes decreased 8% (aRR=0.92 [95% CI=0.87, 0.97]). Rate ratios for injury and single-vehicle crashes were borderline significant after adjusting for older-driver trends. Sensitivity analyses were conducted with data from February through April



**Figure 1.** Monthly frequencies of New Jersey drivers aged <21 years with probationary and basic licenses

Note: Data are for January 2008 through May 2011.



**Figure 2.** Monthly rate of citations issued for a GDL violation to New Jersey probationary drivers aged <21 years

Note: Data are for January 2008 through May 2011.

GDL, graduated driver licensing

2010 included in the pre-law period, and results were very similar.

Results of piecewise regression models, which take into account already-existing trends in probationary driver

**Table 2.** Citation and crash-related rates by law period and adjusted rate ratios for effect of law

Outcome	Mean monthly rate <sup>a</sup>						aRR <sup>b</sup> (95% CI)	Ratio of aRRs <sup>b</sup> (95% CI)
	Overall		Men/boys		Women/girls			
	Pre	Post	Pre	Post	Pre	Post		
<b>Citation outcome</b>								
All GDL-related citations <sup>c</sup>	32.5	37.8	47.5	54.4	18.1	21.3	1.14 (1.05, 1.24)	—
<b>Crash outcome</b>								
All police-reported crashes	140.9	128.3	147.5	133.6	134.6	123.0	0.90 (0.87, 0.94)	0.91 (0.86, 0.97)
Injury crashes	7.6	6.6	8.3	7.2	6.8	6.0	0.86 (0.80, 0.92)	0.91 (0.84, 1.00)
Crashes occurring between 12:01AM and 5:00AM	5.4	4.6	6.9	5.6	3.9	3.5	0.84 (0.77, 0.91)	0.87 (0.78, 0.97)
Single-vehicle crashes	21.8	18.3	26.6	21.7	17.1	14.8	0.84 (0.78, 0.90)	0.89 (0.80, 1.00)
Multiple-vehicle crashes	119.4	110.2	121.3	112.1	117.7	108.3	0.92 (0.88, 0.95)	0.92 (0.87, 0.97)
Peer-passenger crashes <sup>d</sup>	126.9	116.0	134.5	122.5	119.5	109.5	0.91 (0.87, 0.94)	—

Note: "Pre" indicates pre-law period: January 1, 2008 through January 31, 2010; "Post" indicates post-law period: May 1, 2010 through May 31, 2011. aRR is for post- vs pre-law among probationary drivers. Ratio of aRRs=aRR post- vs pre-law among probationary drivers/aRR post- vs pre-law among older drivers.

<sup>a</sup>Per 10,000 probationary drivers

<sup>b</sup>Initial regression model:  $\ln(\text{rate}) = \beta_0 + \beta_1 \text{law period} + \beta_2 \text{license status} + \beta_3 \text{gender} + \beta_4 \text{summer} + \beta_5 \text{winter} + \beta_6 (\text{law period} * \text{license status}) + \beta_7 (\text{gender} * \text{license status})$ . Parameters of interest:  $e^{\beta_1 + \beta_6}$  = aRR post- vs pre-law among probationary drivers;  $e^{\beta_1}$  = aRR post- vs pre-law among older drivers;  $e^{\beta_6}$  = aRR post- vs pre-law among probationary drivers/aRR post- vs pre-law among older drivers. Note that terms involving license status (probationary vs older driver) are not included for citation or peer-passenger crash outcomes.

<sup>c</sup>GDL-related citations include NJSA 39:3-13.4, Probationary Driver's License; and NJSA 39:3-13.8 B-F, Fines for Violations of Probationary Driver's License (Table 1 provides a list of restrictions); citations for the decal law itself (NJSA 39:3-13.8G) are excluded.

<sup>d</sup>Carrying only passengers aged 14–20 years. This was a very rare event for older licensed drivers.

aRR, adjusted rate ratio; GDL, graduated driver licensing; ln, natural log

crash rates, are presented in Appendixes A–F (available online at [www.ajpmonline.org](http://www.ajpmonline.org); trends for male drivers are shown; trends for female drivers were identical but at a lower rate). Although the rate of probationary drivers' involvement in police-reported crashes did not decrease over the pre-law period (monthly decrease in rate: 0.19% [95% CI=0%, 0.42%],  $p=0.11$ ), it did decrease throughout the post-law period (monthly decrease: 1.22% [95% CI=0.60%, 1.84%],  $p<0.01$ ); this equates to a 1.04% per month decrease (95% CI=0.24% decrease, 1.82% decrease;  $p=0.01$ ) in the slope of the adjusted rate of probationary driver involvement in police-reported crashes from the pre-law to the post-law period.

Similar decreases in slopes were noted for single-vehicle crashes (2.39% decrease [95% CI=0.77% decrease, 3.98% decrease];  $p<0.01$ ), multiple-vehicle crashes (0.84% decrease [95% CI=0.03% decrease, 1.64% decrease];  $p=0.04$ ), and peer-passenger crashes (0.95% decrease [95% CI=0.11% decrease, 1.79% decrease];  $p=0.03$ ). The rate of the slope did not significantly change for injury crashes (0.54% decrease [95% CI=2.11% decrease, 1.02% increase]) or nighttime crashes (0.32% decrease [95% CI=2.08% decrease, 1.47% increase]), although point estimates were lower in the post-law period.

Finally, it was estimated that police-reported crash involvement of 846 male and 778 female New Jersey probationary drivers was prevented in the first year after the law's implementation.

## Discussion

By making probationary drivers easily identifiable to police, decal laws have been theorized to both enhance enforcement of GDL restrictions and increase the likelihood that drivers comply with GDL restrictions, thereby reducing their crash risk. Although decals have existed for more than a decade in other countries, there is very little previous evidence to support this theory.<sup>9</sup> This study adds valuable initial evidence for the impact of a decal law on enforcement of GDL provisions by police, as well as crash rates among probationary drivers. In the first year after New Jersey's decal law implementation, there was a 14% increase in the rate of GDL-related citations issued to young probationary drivers, a 9% reduction in the rate of police-reported crashes among such drivers, and an estimated 1624 probationary drivers for whom crashes were prevented. Notably, the increase in GDL enforcement appears to be concentrated in the first few months after the law's implementation.

Fully interpreting patterns in enforcement rates, and further identifying the specific causal pathway(s) from the decal law to crash reduction, also requires an understanding of the law's effect on teen drivers' compliance with GDL restrictions. Preliminary evidence on compliance with the decal law has been reported in a recent study based on telephone surveys with families of probationary license holders just before the law became effective ( $n=655$  parents, 404 teens) and again 1-year post-law ( $n=700$  parents, 401 teens), and on direct observations of teens at four New Jersey high schools.<sup>14</sup> Although 83% of surveyed parents of probationary license holders disapproved of the decal requirement approximately 1 year after the law, nearly half (46%) noted that they had obtained the decal and that their teen "always" used it. In addition, data from direct observation indicated that over half of probationary drivers displayed either the decal or its backing (indicating that they had obtained the decal) by approximately 1 year after law implementation. Observation data also showed significant increases over time at two schools and maintenance of relatively high rates ( $\geq 70\%$ ) over time at the other two schools.

Self-report data from teens in the telephone survey indicated a similar or significantly higher proportion of probationary license holders reported violating specific GDL restrictions 1 year after the decal law was implemented. However, these data should be interpreted with caution, given the relatively low cooperation rate for the survey ( $\approx 20\%$ ) and the pre-post design, which is subject to response-shift bias. This bias may occur when there is a change during the study period in the subject's assessment and understanding of the concept being measured.<sup>15</sup> Indeed, there was evidence of important awareness shifts pre- to post-law, including substantial changes in teens' awareness of the decal requirement (69% pre-law vs 95% post-law). Hence, compliance should be further explored with alternative methodologies that overcome these limitations.

Implementation of New Jersey's decal law has not been without controversy. New Jersey state representatives have introduced legislation to repeal it, in response to parental fears about child predators using the decals to identify teens on the road. These concerns have not been substantiated by other countries' experiences with the decals, and a report released by the New Jersey Division of Criminal Justice in April 2011 found that teen safety has not been jeopardized.<sup>16</sup> New Jersey's law was implemented without a "facilitated" educational program such as a parent orientation (as originally proposed), which may have left parents unaware of the justification for the law and contributed to low approval rates. Thus, policymakers may want to consider facilitated parent education

programs to accompany future public policy involving GDL.

Two other changes to New Jersey's GDL law took effect on May 1, 2010: inclusion of family members (e.g., siblings) in the one-passenger limit, and a change in the curfew from 12:01AM to 11:01PM. A proportion of the increase in citations may thus be due to an expanded pool of eligible violators. However, neither change aimed to enhance enforceability. In addition, there was a similar increase in the citation rate coinciding with the law's signing, 1 year before curfew and passenger-limit changes went into effect. Thus, these data suggest a genuine shift in police enforcement behaviors. With respect to crashes, analysis was restricted to the curfew period in effect during both the pre- and post-law periods (i.e., 12:01AM to 5:00AM) to better isolate effects of the decal law; sensitivity analyses revealed similar piecewise regression results for 11:01PM-5:00AM. Further, crashes that occurred during this time period comprised only 6% of all probationary drivers' crashes and therefore cannot be solely responsible for the 9% reduction observed in overall crashes.

Given that all U.S. states have GDL restrictions in place, further crash reductions among probationary drivers will likely hinge on efforts to enhance police officers' ability to enforce restrictions and probationary drivers' willingness to comply with them. These findings suggest that New Jersey's novel decal law is positively affecting the safety of probationary drivers, even with less-than-ideal driver compliance with GDL restrictions and the decal law itself. Further, the fact that significant crash reductions were observed in New Jersey, a state that already has a strong GDL law and one of the lowest teen crash fatality rates,<sup>10</sup> suggests that implementation of a decal law in states with higher teen crash fatality rates may lead to more marked reductions.

Future analyses should be conducted to determine the law's effect on enforcement and crashes beyond the 1-year post-law period included in this study (i.e., once media attention has declined). These results provide valuable information to the ongoing policy debate in New Jersey and serve to guide U.S. and international policymakers as they consider adding a decal law to enhance their existing GDL programs.

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## Appendix

### Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.amepre.2012.09.041>.