

Increasing Organ Donor Designation Rates in Adolescents: A Cluster Randomized Trial

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Objectives. To evaluate the effectiveness of video messaging on adolescent organ donor designation rates.

Methods. We randomized adolescent driver education classes in Massachusetts, between July 2015 and February 2018, to receive 1 of 3 organ donation video messaging interventions (informational, testimonial, or blended). Adolescents completed questionnaires before and after the intervention and at 1-week follow-up; we compared their registration status at time of obtaining driver's license with that of a regionally matched historical comparison group.

Results. Donor designation rates were higher for those exposed to video messaging than for the historical comparison group (60% vs 50%; $P < .001$). Testimonial (64%) and blended messaging (65%) yielded higher donor designation rates than informational messaging (51%; $P = .013$). There was a statistically significant messaging \times time interaction effect for donation knowledge ($P = .03$), with blended and informational messaging showing more gains in knowledge from before to after the intervention ($P < .001$; $d = 0.69$ and $P < .001$; $d = 0.45$, respectively), compared with testimonial messaging ($d = 0.09$; $P = .22$).

Conclusions. Testimonial messaging is most effective in producing a verifiable and demonstrable impact on donor designation rates among adolescents, and driver education classes are an efficient venue for disseminating organ donation messaging to youths.

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 See also Galea and Vaughan, p. 1169.

Donor designation establishes one's organ donation intent and serves as legal authorization for donation upon death. Donor designation cannot be overruled by family members, and it allows for more transplantable organs to be procured.^{1–6} Donation authorization at the time of death is considerably less likely when surrogate permission is necessary because the deceased's donation intent is unknown.⁷ Consequently, public education campaigns increase awareness of the need for more transplantable organs and higher donor designation rates.⁸

Adolescents are an important target for donation education. In the United States, most adolescents (aged 15–18 years) will make a donor designation decision at the time of first driver's license, often without any prior education about organ donation. Additionally, donation education may trigger adolescent–parent discussions, which is important because

some states require parental authorization of their adolescent's donor designation decision. Few studies have focused on educating youths about organ donation.⁹ In their review, Li et al.⁹ concluded that most studies did not use a randomized design, none examined actual donor designation rates, and educational sessions were lengthy and conducted in high schools, posing barriers to dissemination. Most educational programs provided both factual information and testimonials, but these

different messaging strategies were not directly compared.^{10,11}

In this study, we sought to overcome these limitations by pursuing 4 aims: (1) to compare adolescent donor designations among those receiving video messaging and those in a historical comparison group; (2) to compare the differential effectiveness of 3 commonly used donation messaging strategies (informational, testimonial, and blended) on donor designations; (3) to examine the impact of donation messaging on donation engagement, knowledge, attitudes, beliefs, likelihood of donor designation, and discussion with a parent; and (4) to assess parental commitment to follow adolescents' donation wishes. Our central hypothesis was that donation messaging in driver education classes would yield higher donor designations rates compared with a historical comparison group. Additionally, on the basis of the Elaboration Likelihood Model,^{12–14} which posits that empathy arousal is more likely to trigger interest in donation and stronger donor designation intentions, we hypothesized that blended messaging (informational + testimonial) would yield a higher donor designation rate and more favorable change in secondary outcomes.

METHODS

We used a 3–group, cluster–randomized, repeated–measures design, with a regionally matched historical comparison group of

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adolescents (ClinicalTrials.gov identifier: NCT03013816). Randomization occurred at the classroom level, using 1:1:1 randomization (equal number of sealed envelopes by group drawn at random). Each classroom was an independent entity, each with a new group of students. Adolescents completed questionnaires assessing donation engagement, knowledge, attitude, beliefs, and intention before the intervention, after the intervention, and at 1-week follow-up. We assessed parents' commitment to follow their adolescents' wishes about organ donation. Donor designation status at the time first driver's license was issued was the primary outcome.

Study Location, Participants, and Recruitment

We chose driving schools as the study venue because driver education occurs around the time adolescents first have an opportunity to decide whether or not to be organ donors. Six independently owned driving schools, representing 9 locations in Massachusetts, agreed to participate in the study. We selected schools on the basis of geographic and sociodemographic diversity. Each school owner was paid \$500. Classroom eligibility criteria included (1) instruction in English and (2) instructor's agreement not to provide donation information beyond the study video. Instructors were paid \$100 per participating classroom. Massachusetts law requires that all driver's license applicants aged younger than 18 years complete driver education (30 classroom hours plus 18 hours of supervised driving). In addition, driving schools are required by law to provide donation information to students; however, the nature, timing, and amount of information are at the instructor's discretion.

Research assistants introduced the study to each class and gave adolescents a study information letter to share with parent(s). Study eligibility required adolescent assent and written parental permission. Adolescents without assent or permission were still exposed to the donation video to ensure instructor compliance with state law; however, they did not complete questionnaires and were excluded from the analysis.

Organ Donation Messaging

Donation education and messaging experts worked with the research team and media partner to script, produce, and edit 3 videos approximately 6 minutes in length and narrated by the same female adolescent.

An informational video included segments of *Organ Donation and Transplantation: How Does it Work?*¹⁵ which included information about the supply–demand problem in transplantation, common reasons for and against donor designation, donation myths, the importance of communicating with parents about donation, and how to register as a donor. The video contained no personal testimonials.

A testimonial video featured 4 personal testimonials, including those of child and adolescent transplant recipients, a young adult candidate for a kidney transplant, and the sibling of a deceased adolescent donor. This video contained few facts about transplantation or donation.

A blended video featured segments from the informational and testimonial videos, combining factual information with personal testimonials.

Assessments

The primary outcome was participant's donor designation (yes or no) when obtaining first driver's license after the intervention. We provided the Massachusetts Department of Transportation with the adolescent's name, birth date, last 4 digits of social security number, address, and study identification number. The Department of Transportation provided a data file containing the donor designation status for each study participant and for each adolescent in the regionally matched historical comparison group.

Immediately before, shortly after, and 1 week following their exposure to donation messaging, adolescents completed questionnaires assessing donation engagement (2 questions), knowledge (3 questions), attitude (1 question), beliefs (4 questions), designation likelihood (1 question), and willingness to discuss donation with parent(s) (1 question). Adolescents received a \$5 gift card for each questionnaire completed.

Following the intervention, adolescents rated message appeal (1 question) and whether the video had good facts, featured

nice people, made them think, and made them feel (4 questions).

One week after their adolescents' exposure to donation messaging, the research team mailed parents a questionnaire about their donor designation status, donation attitude, adolescent–parent communication about donation, and likelihood of following their adolescent's donation wishes.

Blinding

Classroom instructors and research assistants conducting on-site assessments were not blinded to group assignment. However, the Department of Transportation staff member who retrieved donor designation status was blinded to the study's purpose and group assignment.

Historical Comparison Group

We retrieved donor designation data for all 1575 adolescents (787 males, 788 females) who obtained a first driver's license at 1 of 6 motor vehicle offices in the 6 months preceding study enrollment. We selected offices on the basis of geographic proximity (<30 miles) to each study driving school. Considering that adolescents likely enroll at driving schools and obtain their driver's license at motor vehicle offices closest to their residence, we concluded that most adolescents in the study would get their driver's license at 1 of these 6 offices. Thus, we assume that adolescents in the study are representative (i.e., share sociodemographic characteristics) of the adolescent population visiting these motor vehicle offices. Adolescents in the historical comparison group likely were exposed to some type of donation information, as required by Massachusetts law, although its specific nature is unknown. The most common donation education includes a brochure distributed by the regional organ procurement organization.

Statistical Analysis

For the primary outcome analysis, we predicted that 45% of the historical comparison group were registered donors on the basis of adolescent designation rates in Massachusetts at the time of study inception. Representatives of the region's organ procurement organization and the Massachusetts

Advisory Council on Organ and Tissue Transplants and Donations considered a donor designation rate of 55% for study adolescents (i.e., +10 percentage-point difference) to be clinically meaningful. Participation of 390 or more adolescents in both the study and historical comparison groups was necessary to detect an effect size of 10% with 80% power and α level of 0.05. The enrollment goal was 525 adolescents, which included an increase of 10% to account for potential clustering by classroom, 20% to account for lack of participants' assent or parental permission, and 15% to account for adolescents without a donor designation status at study end. For evaluation of differences between the 3 video messaging groups, we deemed an effect size of 10% to 15% between any 2 of the groups to be clinically meaningful, which required 170 to 225 adolescents per group with 80% power and α level of 0.05.

We used the χ^2 test to assess differences in donor designation rates between the study sample and the historical comparison group. To assess the relationship between randomized allocation and donor designation, we

performed a likelihood ratio test to examine how the model including the random effect for classroom clustering compared with the null model, or single-level model, which does not account for classroom clustering. The likelihood ratio test demonstrated that the association between the messaging group and donor designation status did not vary by classroom (intraclass correlation coefficient = 0.018). Therefore, we used the χ^2 test to examine the effect of messaging on donor designation. Unadjusted logistic regression models examined the relationship between sociodemographic characteristics, donation characteristics, and donor designation status. We included in the model only adolescents whose final designation status was known.

For secondary outcomes, we performed separate linear mixed models to account for within-subject correlation to assess donation engagement, knowledge, attitude, beliefs, and donor designation likelihood. Specifically, we examined messaging \times time interaction after adjusting for the respective outcome's baseline value to determine whether outcomes differed by video

messaging or time. We performed likelihood ratio tests to determine whether models with the interaction term were better fit than models without the interaction term. Next, we used analysis of variance (and Scheffe post hoc comparison tests) to assess group differences in messaging appeal and perceptions. We used PASW 17.0 (SPSS Inc, Chicago, IL) and R 3.4.0 (R Development Core Team, Vienna, Austria) for statistical analyses.

RESULTS

We randomized 42 classes to 1 of 3 donation video messaging interventions between July 2015 and February 2018. All classroom instructors invited to participate agreed to do so. Mean number of students per class was 14.6 (SD = 8.9; median = 12; range = 3–35), totaling 729 potentially eligible adolescents. A total of 118 (16%) did not return parental permission forms (n = 108) or assent to participate (n = 10), resulting in 611 participants (Figure 1). Mean age was 15.9 years; 48% (n = 292) were female and 78% (n = 479) were White.

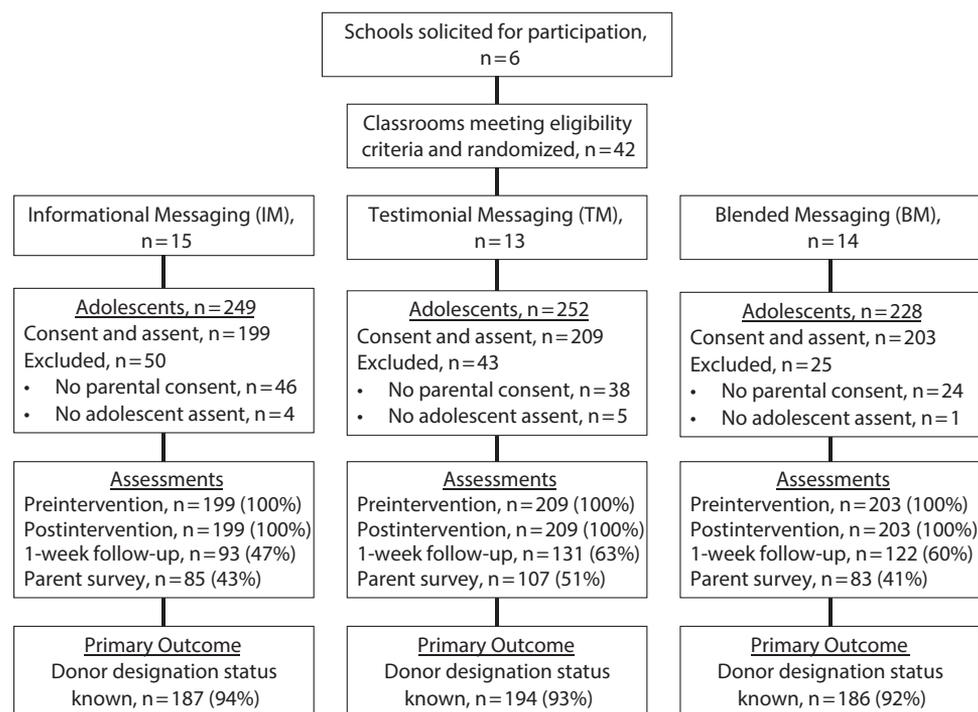


FIGURE 1—Study Flowchart of Classroom and Participant Enrollment: Massachusetts, 2018

Questionnaire completion rates were 100% (n = 611) at preintervention, 100% (n = 611) at postintervention, and 57% (n = 346) at 1-week follow-up. Compared with responders, nonresponders to the follow-up survey were more likely to be male ($P = .03$) and allocated to the informational group ($P = .002$). Surveys were returned by 275 parents (45%). Compared with responders, nonresponders were more likely to have adolescents who were older ($P = .003$) and non-White ($P = .001$) and who had not discussed donation with a parent before study participation ($P = .04$). Mean age was 48.2 years; 85% (n = 234) were female, 92% (n = 252) were White, and 73% (n = 202) were registered donors.

Primary Outcome

We obtained donor designation status for 93% (n = 567) of study participants and 100% (n = 1575) of adolescents in the historical comparison group. Study adolescents with known and unknown donor designation status did not differ significantly by age ($P = .58$), gender ($P = .22$), race ($P = .19$), or group assignment ($P = .66$).

A higher proportion of study adolescents registered as donors (60%, 340/567) compared with the historical comparison group (50%, 789/1575; $P < .001$). Both female ($P < .001$) and male ($P = .04$) adolescents in the study had higher donor designation rates compared with the historical comparison group.

Donor designation rates were significantly ($P = .013$) higher for adolescents in the testimonial (64%) or blended (65%) group, compared with those in the informational group (51%) and the historical comparison group (50%; Figure 2). Donor designation rates did not differ ($P = .75$) between adolescents in the informational group and adolescents in the historical comparison group. For male adolescents, a higher proportion in the testimonial (59%) and blended (58%) groups, compared with the informational group (43%), registered as donors ($P = .04$). Watching a video with testimonials (odds ratio [OR] = 1.76; 95% confidence interval [CI] = 1.22, 2.52; $P = .002$), White race (OR = 1.71; 95% CI = 1.06, 2.77; $P = .03$), higher donor designation likelihood after the intervention (OR = 1.48; 95% CI = 1.31, 1.67; $P < .001$), and donation discussion with

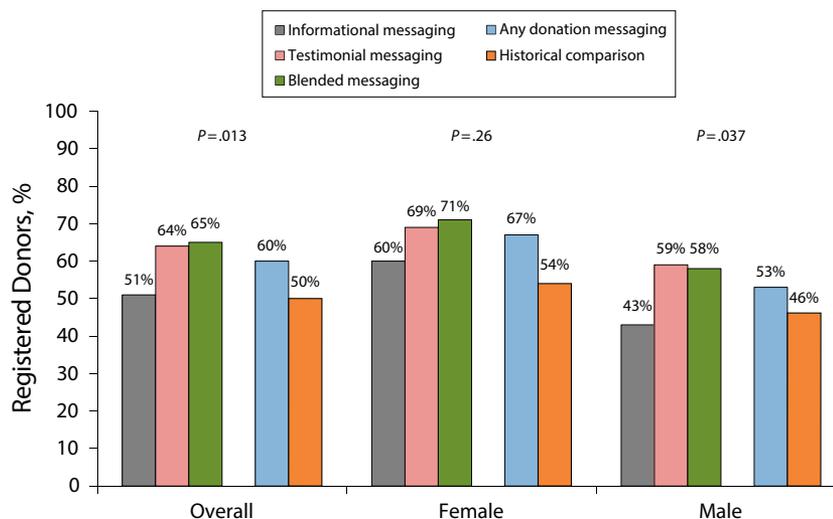


FIGURE 2—Percentage of Registered Donors Among Adolescents With Known Donor Designation Status Who Received Informational Messaging (n = 187), Testimonial Messaging (n = 194), Blended Messaging (n = 186), and Any Donation Messaging (n = 567) and a Regionally Matched Historical Comparison Group of Adolescents (n = 1575), Overall and by Gender: Massachusetts, 2018

parent(s) (OR = 1.70; 95% CI = 1.13, 2.57; $P = .01$) were significant predictors of donor registry enrollment.

Secondary Outcomes

Table 1 displays mean scores for donation engagement, knowledge, attitude, beliefs, and designation likelihood at all time points by video messaging type. There was no significant messaging \times time interaction effect for donation engagement, attitude, and beliefs or for designation likelihood. However, there was a significant interaction effect for donation knowledge ($P = .03$). Adolescents in the informational or blended group had more knowledge gains from before to after the intervention ($P < .001$; $d = 0.45$ and $P < .001$; $d = 0.69$, respectively), compared with the testimonial group ($d = 0.09$; $P = .22$).

Communication About Donation

Before the intervention, 50% (n = 306) reported telling a parent about their donor designation decision. Among those who had not discussed donation with a parent, 65% (n = 198) reported high willingness to do so. For adolescents who completed both pre-intervention and follow-up assessments

(n = 346), across all 3 groups there was a significant increase in the proportion of adolescents from before the intervention to follow-up who discussed donation with a parent (informational: 55% vs 79%; $P < .001$; testimonial: 59% vs 82%; $P < .001$; blended: 46% vs 67%; $P < .001$). Adolescents who discussed donation with a parent (before or after intervention) were more likely to register as a donor than adolescents who had not (74% vs 50%; $P < .001$).

Most parents (90%, n = 349) reported adolescent-parent donation discussions. In those discussions, adolescents reported their intention to be an organ donor (67%; n = 184), desire not to be a donor (7%; n = 18), or indecision about donation (17%; n = 46); 10% (n = 27) reported not discussing donation. Among parents whose adolescent intended to join the donor registry (n = 184), 94% reported high willingness to follow those wishes. Parents with more favorable donation attitudes ($P < .001$) and who were registered donors ($P < .001$) were more likely to have adolescents who registered as donors.

Process Outcomes

Compared with the testimonial group, adolescents in the informational and blended

TABLE 1—Scores for Donation Engagement, Knowledge, Attitudes, Beliefs, and Intention Before Intervention, After Intervention, and at 1-Week Follow-Up by Video Messaging Type: Massachusetts, 2018

Secondary Outcome	Before Intervention, Mean (SD)			After Intervention, Mean (SD)			1-Week Follow-Up, Mean (SD)		
	IM (n = 199)	TM (n = 209)	BM (n = 203)	IM (n = 199)	TM (n = 209)	BM (n = 203)	IM (n = 91)	TM (n = 130)	BM (n = 120)
Organ donation engagement ^a	10.57 (3.8)	11.33 (4.3)	11.99 (3.8)	13.21 (4.2)	14.11 (4.1)	14.91 (3.7)	13.03 (4.2)	13.50 (4.2)	14.01 (4.0)
Organ donation knowledge ^b	1.61 (0.8)	1.71 (0.8)	1.57 (0.8)	1.95 (0.7)	1.78 (0.8)	2.09 (0.7)	1.86 (0.8)	1.81 (0.8)	1.88 (0.7)
Organ donation attitudes ^c	7.21 (2.2)	7.60 (2.2)	7.60 (2.2)	8.09 (1.9)	8.50 (1.8)	8.54 (1.8)	8.13 (1.9)	8.27 (2.0)	8.26 (1.9)
Organ donation beliefs ^d	11.95 (1.6)	12.14 (1.7)	12.23 (1.7)	12.46 (1.6)	12.61 (1.7)	12.71 (1.9)	12.43 (1.5)	12.43 (1.7)	12.75 (1.8)
Donor designation intention ^e	6.22 (3.1)	7.04 (3.1)	6.98 (2.9)	7.24 (2.7)	8.01 (2.5)	8.00 (2.5)	7.64 (2.7)	8.10 (2.7)	8.13 (2.3)

Note. BM = blended messaging; IM = informational messaging; TM = testimonial messaging.

^aPossible score range = 2–20 (higher = more engagement).

^bPossible score range = 0–3 (higher = more knowledge).

^cPossible score range = 1–10 (higher = more favorable).

^dPossible score range = 4–16 (higher = more favorable).

^ePossible score range = 1–10 (higher = more likely to register).

groups were more likely to report that the videos had good facts ($P < .001$). Those in the testimonial and blended groups were more likely to say that the videos made them think ($P < .001$) and feel ($P < .001$). The blended group had higher likability ratings than the informational video group ($P = .001$).

DISCUSSION

This study yielded 3 key findings with implications for donation messaging timing, type, and venue: (1) donor designation rates are higher for adolescents exposed to testimonial and blended messaging during driver education than for adolescents in a historical comparison group; (2) donation messaging, regardless of type, increases the likelihood of adolescent–parent donation discussion; and (3) driving schools are feasible and effective venues for delivering donation messaging when following study procedures.

The donor designation rate for study adolescents was 10% higher than for adolescents in the comparison group, which is the effect size deemed clinically meaningful a priori by regional donation professionals. Annually, approximately 10 500 Massachusetts adolescents obtain a driver's license and about 5000 (48%) register as donors. Extrapolating from our study's donor designation rates, we estimate that exposing Massachusetts adolescents to testimonial or blended messaging before they get a driver's license could yield 1800 more registered donors annually. The

availability of these brief videos, the minimal impact on classroom time, and state law compelling donation education make this exposure feasible in driving schools. Organ procurement organizations could provide free videos to driving schools and guide instructors on how best to integrate them into the curriculum. Public policy efforts to require donation education in driving schools beyond Massachusetts might enhance adoption of this strategy nationally.

Prior studies focused on increasing knowledge about the need for more transplantable organ donors.^{9–11} Our findings provide support for the Elaboration Likelihood Model¹² and suggest that although factual information increases donation knowledge, this knowledge gain is not sustained over time and is not associated with higher donor designation rates. By contrast, testimonials—whether paired with factual information or not—create an emotional appeal that is sustained, suggested by lower attrition rates among adolescents who viewed videos with testimonials, a higher likelihood of adolescent–parent donation discussions, and higher donor designation rates. Notably, testimonial messaging is effective in both organ donation and other public health campaigns,^{16–19} further underscoring the importance of activating an emotional response with compelling narratives when behavioral action—such as donor designation—is the desired outcome.

Although men and women report equally favorable attitudes toward donation, donor

designation rates historically are much lower for men than women.^{20,21} Male adolescents exposed to testimonials (testimonial or blended) had higher donor designation rates than those who were not (informational). The donor designation rate for these male adolescents exceeded that of even female adolescents in the historical comparison group, supporting prior research that males of any age are responsive to emotional appeals.²² Minorities also have lower donor designation rates than Whites,^{20,21,23} which was substantiated in our study. Although the small minority sample limited power to detect significant differences, a trend emerged for higher donor designation rates among minorities exposed to testimonial (59%) versus informational (38%) messaging. Testimonials may be a promising strategy for mitigating historic gender and race disparities in donor designation rates, although more research is needed to determine the most effective messaging components.^{24–27}

Messaging type did not differentially affect the occurrence of adolescent–parent donation discussions. Regardless of messaging type, most adolescents who had not spoken to parent(s) about donation preintervention reported doing so by the 1-week follow-up. Perhaps any exposure to donation messaging triggers subsequent discussion, although its content and quality—and the eventual donation decision—may be differentially affected by messaging type, something that should be examined in future investigations. Adolescent–parent discussions provide opportunities to share donation concerns or to

confirm intentions, facilitate informed decision-making about donor registry enrollment, and ensure that any future donation decision is consistent with intentions in the event of a donation-eligible death. Targeted efforts to promote communication about one's donation intentions, particularly considering the strong association between the occurrence of such discussions and eventual donor designation, remain an important area of inquiry.^{28–30}

In the United States, most adolescents who obtain a driver's license do so after completing driver education.³¹ Driving schools, therefore, may be an efficient, practical, and economical venue for the delivery of organ donation campaigns. Several factors may have facilitated the participation of school owners and instructors, including favorable attitudes toward donation, minimal impact on classroom time (25 minutes for video + assessments), Massachusetts law requiring dissemination of donation information, and honoraria payments. Driver education is mostly privatized in Massachusetts and, consequently, the efficiencies achieved in implementing our study may not be generalizable to public driving school programs. Motor vehicle offices are another venue for organ donation campaigns, but they present challenges that are easily overcome in driving schools, if adolescents are the target population.^{32–34} Also, states are rapidly transitioning to new driver's license systems (e.g., facial recognition) that require fewer in-person license renewals over one's lifetime and to a yes-carryover designation process in which registered donors are no longer required to confirm their decision with each license renewal. These changes underscore the benefits of donation messaging prior to first driver's license.

Our study findings should be considered in the context of important limitations. First, adolescents in the historical comparison group did not view study videos and likely were exposed only to written donation information during driver education. Nevertheless, a historical comparison group does not afford the same methodological strength as a contemporaneous, randomized control group. Future randomized controlled trials are necessary to validate study findings. Second, despite recruitment of schools in diverse communities, the percentage of minorities in the study (22%) was less than for Massachusetts overall (28%). Also, the

Massachusetts Department of Transportation does not capture race or household income data from licensed drivers; therefore, we could not examine differences in donor designation rates between the study sample and the historical comparison group on these parameters. Adolescents with less household income, for instance, may not enroll in driving schools because of the cost. To the degree that lower-income students are underrepresented in the study relative to the historical comparison group, our findings may be biased toward more favorable donation outcomes. Third, considering the brief interval between pre- and postintervention assessments, there may be social desirability bias toward more favorable donation responses. Fourth, although a researcher ensured that videos were shown uninterrupted during class, we cannot be certain that adolescents attended to the video in its entirety. Fifth, we paid driving school owners and instructors for access; however, this limits sustainability and we did not assess whether financial incentives were necessary to accomplish study aims. Finally, the modest response rate for the 1-week follow-up survey may adversely affect the generalizability of the findings (i.e., responders and nonresponders may differ on important characteristics not assessed).

In conclusion, we showed that priming adolescents with testimonial messaging around the time they get their first driver's license produces a verifiable and demonstrable impact on donor designation rates. Driving schools are a feasible and efficient venue for the dissemination of brief donation messaging to youths. Considering the increasing numbers of children and adults awaiting transplantation, the superior clinical outcomes of transplantation versus medical management of end-stage organ failure, and societal costs associated with morbidity and mortality in the absence of transplantation, more population-based public health efforts are needed to expand the number of transplantable organs. Increasing adolescent donor designation rates represents one collective action approach in public health. **AJPH**

CONTRIBUTORS

J. R. Rodrigue, M. Boger, and A. Fleishman conceptualized and designed the study. M. Boger and A. Fleishman collected the data. J. R. Rodrigue and A. Fleishman performed the primary data analysis. J. R. Rodrigue and D. DuBay interpreted data. All authors prepared the article.

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Note. The contents of this study are solely the responsibility of the authors and Beth Israel Deaconess Medical Center and do not necessarily represent the official views of the HRSA.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

HUMAN PARTICIPANT PROTECTION

The protocol was approved by the Committee on Clinical Investigations at Beth Israel Deaconess Medical Center (protocol #2015P-000063).

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