

Circulation

Cardiovascular Quality and Outcomes

American Heart Association 

Learn and Live

JOURNAL OF THE AMERICAN HEART ASSOCIATION

The Effectiveness of Ultrabrief and Brief Educational Videos for Training Lay Responders in Hands-Only Cardiopulmonary Resuscitation : Implications for the Future of Citizen Cardiopulmonary Resuscitation Training

Bentley J. Bobrow, Tyler F. Vadeboncoeur, Daniel W. Spaite, Jerald Potts, Kurt Denninghoff, Vatsal Chikani, Paula R. Brazil, Bob Ramsey and Benjamin S. Abella

Circ Cardiovasc Qual Outcomes published online March 8, 2011;

DOI: 10.1161/CIRCOUTCOMES.110.959353

Circulation: Cardiovascular Quality and Outcomes is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75214

Copyright © 2011 American Heart Association. All rights reserved. Print ISSN: 1941-7705. Online ISSN: 1941-7713

The online version of this article, along with updated information and services, is located on the World Wide Web at:

Data Supplement (unedited) at:

<http://circoutcomes.ahajournals.org/content/suppl/2011/02/23/CIRCOUTCOMES.110.959353.DC1.html>

Advance online articles have been peer reviewed and accepted for publication but have not yet appeared in the paper journal (edited, typeset versions may be posted when available prior to final publication). Advance online articles are citable and establish publication priority; they are indexed by PubMed from initial publication. Citations to Advance online articles must include the digital object identifier (DOIs) and date of initial publication.

Subscriptions: Information about subscribing to *Circulation: Cardiovascular Quality and Outcomes* is online at
<http://circoutcomes.ahajournals.org/site/subscriptions/>

Permissions: Permissions & Rights Desk, Lippincott Williams & Wilkins, a division of Wolters Kluwer Health, 351 West Camden Street, Baltimore, MD 21201-2436. Phone: 410-528-4050. Fax: 410-528-8550. E-mail:
journalpermissions@lww.com

Reprints: Information about reprints can be found online at
<http://www.lww.com/reprints>

The Effectiveness of Ultrabrief and Brief Educational Videos for Training Lay Responders in Hands-Only Cardiopulmonary Resuscitation

Implications for the Future of Citizen Cardiopulmonary Resuscitation Training

Bentley J. Bobrow, MD; Tyler F. Vadeboncoeur, MD; Daniel W. Spaite, MD; Jerald Potts, PhD; Kurt Denninghoff, MD; Vatsal Chikani, MPH; Paula R. Brazil, MA; Bob Ramsey, MA; Benjamin S. Abella, MD, MPhil

Background—Bystander cardiopulmonary resuscitation (CPR) improves survival from out-of-hospital cardiac arrest (OHCA) but often is not performed. We hypothesized that subjects viewing very short Hands-Only CPR videos will (1) be more likely to attempt CPR in a simulated OHCA scenario and (2) demonstrate better CPR skills than untrained individuals.

Methods and Results—This study is a prospective trial of 336 adults without recent CPR training randomized into 4 groups: (1) control (no training) (n=51); (2) 60-second video training (n=95); (3) 5-minute video training (n=99); and (4) 8-minute video training, including manikin practice (n=91). All subjects were tested for their ability to perform CPR during an adult OHCA scenario using a CPR-sensing manikin and Laerdal PC SkillReporting software. One half of the trained subjects were randomly assigned to testing immediately and the other half after a 2-month delay. Twelve (23.5%) controls did not even attempt CPR, which was true of only 2 subjects (0.7%; $P=0.01$) from any of the experimental groups. All experimental groups had significantly higher average compression rates (closer to the recommended 100/min) than the control group ($P<0.001$), and all experimental groups had significantly greater average compression depth (>38 mm) than the control group ($P<0.0001$).

Conclusions—Laypersons exposed to very short Hands-Only CPR videos are more likely to attempt CPR and show superior CPR skills than untrained laypersons.

Clinical Trial Registration—URL: <http://www.clinicaltrials.gov>. Unique identifier: NCT01191736. (*Circ Cardiovasc Qual Outcomes*. 2011;4:220-226.)

Key Words: cardiopulmonary resuscitation ■ heart arrest ■ resuscitation

JOURNAL OF THE AMERICAN HEART ASSOCIATION

Approximately 300 000 people suffer out-of-hospital cardiac arrest (OHCA) in the United States annually.¹ Survival rates from OHCA vary widely among locations but have been extremely low in most environments.²⁻⁷ Numerous investigations have shown that bystander CPR (BCPR) results in a doubling or tripling of survival from OHCA, yet BCPR rates across the country have remained unacceptably low at around 26%.⁸⁻¹⁶ Chest compression-only CPR, also known as Hands-Only CPR, has been shown in clinical trials to be at least as effective as standard CPR with mouth-to-mouth ventilation for adults with primary

cardiac arrest and may actually improve outcomes through a number of mechanisms.¹⁷⁻²³ Because of its inherent simplicity, Hands-Only CPR may be quicker and easier for lay rescuers to learn, remember, and perform than conventional CPR.^{23,24}

We hypothesized that lay rescuers without recent training would be more likely to attempt CPR and could demonstrate acquisition of Hands-Only CPR skills during an adult cardiac arrest simulation after viewing an ultrabrief (60-second) Hands-Only CPR video. We also hypothesized that adding manikin skill practice to a slightly

Received July 15, 2010; accepted January 6, 2011.

From the Department of Emergency Medicine (B.J.B., P.R.B.) and Resuscitation Science Center (B.J.B.), Maricopa Medical Center, Phoenix, AZ; Arizona Department of Health Services (B.J.B., V.C., P.R.B.), Bureau of EMS and Trauma System, Phoenix, AZ; Arizona Emergency Medicine Research Center (B.J.B., D.W.S., K.D.), Department of Emergency Medicine, University of Arizona, Tucson, AZ; Department of Emergency Medicine (T.F.V.), Mayo Clinic, Jacksonville, FL; The American Heart Association (J.P.), Dallas, TX; PMT Ambulance Company (B.R.), Tempe, AZ; and Department of Emergency Medicine (B.S.A.), University of Pennsylvania, Philadelphia, PA.

The online-only Data Supplement is available at <http://circoutcomes.ahajournals.org/cgi/content/full/CIRCOUTCOMES.110.959353/DC1>.

Correspondence to Bentley J. Bobrow, MD, Department of Emergency Medicine, Maricopa Medical Center, 2601 E Roosevelt St, Phoenix, AZ 85008. E-mail bobrowb@azdhs.gov

© 2011 American Heart Association, Inc.

Circ Cardiovasc Qual Outcomes is available at <http://circoutcomes.ahajournals.org>

DOI: 10.1161/CIRCOUTCOMES.110.959353

longer video training would further improve the quality of chest compressions.

WHAT IS KNOWN

- Bystander cardiopulmonary resuscitation (CPR) is strongly associated with improved survival from out-of-hospital cardiac arrest, but the rates of its performance remain unacceptably low.
- Despite ubiquitous availability of conventional CPR classes for lay citizens, only a minority of the public accesses CPR training, and those who do experience rapid skills deterioration after training.
- The relatively new discovery and American Heart Association guideline integration of Hands-Only (compression-only) CPR may obviate the need for lay rescuers to perform rescue breathing for adults who suffer a sudden, witnessed collapse.

WHAT THE STUDY ADDS

- Adults without previous formal CPR training can learn, demonstrate, and retain effective Hands-Only CPR skills with a single viewing of an ultrabrief, 60-second training video.
- Because of its brevity, the ultrabrief Hands-Only CPR video creates opportunities for frequent, recurrent training in multiple venues and the potential to increase the likelihood of lay citizens being recurrently and effectively trained in this technique.

Methods

Study Design, Setting, and Participants

This randomized controlled study was conducted in 2009 in greater Phoenix, Arizona. The study was approved by the Institutional Review Board of Maricopa Integrated Health System (Phoenix, AZ). Written informed consent was obtained from all subjects.

Subjects were verbally recruited by the co-investigators and a study coordinator in a large group setting at a church in Chandler, Arizona. Participation was voluntary, and no personal incentive for participation was given, although subjects were told that they would receive an American Heart Association (AHA) CPR Anytime kit after completion of the study. Exclusion criteria were (1) age <18 years, (2) formal CPR training within the previous 2 years, and (3) lack of fluency in English (by self-report) because the training videos were available only in English.

The study used an experimental design, with subjects randomized to 1 of the following 4 groups:

1. C-group (control): subjects received no training intervention.
2. UBV-group (ultrabrief video): subjects viewed a 60-second ultrabrief video produced by the AHA without skill practice.
3. BV-group (brief video): subjects viewed a 5-minute AHA video without skill practice.
4. BVP-group (brief video with practice): subjects viewed an 8-minute AHA video with CPR practice during the viewing.

All subjects randomized to the C-group underwent testing without any training. They did not return for follow-up testing on the basis of the assumption that they did not have newly acquired skills at risk of degradation. All subjects who had viewed a CPR video (on study day 1) were randomized to either undergo immediate testing that day or to return 2 months later for testing (study day 2). Approximately one

half of each of the 3 video training groups was in the immediate testing cohort and one half in the delayed testing cohort.

The video training sessions were supervised by volunteers. Volunteers also were selected to be performance recorders on the basis of their computer experience. Performance was measured by the Laerdal PC SkillReporting software (Laerdal Medical Corporation; Stavanger, Norway). Validity of this device has been reported previously.²⁵ All performance recorders participated in a special training session on the day before the study. During this session, they were educated about their role in the simulation, standardized verbiage, the Laerdal CPR testing manikin, the computer software, and the data recording procedure.

All trained groups were compared to the C-group. The BV- and BVP-groups were compared to the UBV-group to identify potential differences between an extremely short format and a longer format. The BVP-group was added specifically to assess whether psychomotor skill practice with a manikin would provide additional benefit over video training alone.

Measures were taken to minimize exposure of subjects and performance recorders to inappropriate information about the study. Subjects and recorders were not aware of the study hypothesis or design. Performance recorders were blinded to the type of training, if any, study subjects received. Testing was performed at 12 discrete, sound-attenuated, identical stations. As soon as subjects in the training groups viewed their video, they were immediately escorted from the training building and not allowed to return. The testing stations were distant from the training stations. Subjects were asked not to discuss the training, testing, or other aspects of the study at any time during the 2-month study period.

Interventions

On study day 1, all subjects were entered into the study, and all training occurred. Each enrolled subject completed a written questionnaire that included baseline demographics, education level, and information about any previous CPR training (online-only Data Supplement). Subjects received color-coded wristbands that directed their flow throughout the study. A select group of volunteers (specifically excluding the performance recorders) were aware of the color coding and were able to direct the study subjects. Subjects in the C-group proceeded directly to the staging area for testing and then immediately to their testing stations. Subjects in the 3 training groups proceeded to a dedicated training waiting area and then were guided to their respective video training rooms.

Video Training

The 3 different videos (http://www.heart.org/HEARTORG/CPRAndECC/Science/Science_UCM_321217_SubHomePage.jsp) were shown in separate, sound-attenuated rooms. Subjects were prevented from communicating with those in other study groups. Subjects were scheduled to show up for registration and training at various times throughout the day. The video training room supervisors read the following standard script before starting the video: "I'm going to show you a video. I can't answer any questions or discuss the video. I won't be able to help. I will let you know what you need to do and where you need to go when it is finished."

The UBV, entitled "Rocket Science," was 60 seconds in duration. It showed an adult with a sudden collapse and a rescuer performing Hands-Only CPR. The caption instructed the viewer to "call 911, push hard, push fast." The 5-minute BV showed a trainer describing and demonstrating Hands-Only CPR for adults who suddenly collapse. The first 5 minutes of the BVP was identical to the BV video; the trainer then provided 3 minutes of psychomotor skill practice, and each subject was asked to perform chest compressions on an inflatable half-torso manikin (CPR Anytime kit manikin).

Testing Scenario

Trained subjects in the immediate testing cohort were assessed within 3 hours of viewing the video. For testing, individual subjects entered a partitioned testing room where they encountered an examiner, a prop cell phone, and a Laerdal Resusci Anne recording

manikin (Laerdal Medical Corporation) on the floor. All groups were given an identical, adult sudden collapse scenario and asked to demonstrate what they would do if this were to happen in real life. The performance recorder read the following script to each subject: "Imagine that this manikin is a real person who just collapsed in front of you. You are the only other person in the immediate area besides this person. Do whatever you think is best to help. I cannot answer any questions about how to help. I will tell you when to stop. Please begin now."

The performance recorders allowed exactly 2 minutes for each subject to demonstrate the actions he or she would take (or to document that the subject took no action at all). If a subject asked questions about what to do, the recorders were instructed to reply, "Just do whatever you think is best to help this person."

Outcome Measures and Performance Assessment

Outcomes measures were recorded as follows:

1. Was CPR attempted? Recorded by the Laerdal PC Skill-Reporting software.
2. Was responsiveness assessed? Recorded by performance recorders.
3. Was 911 called? Recorded by performance recorders.
4. Chest compression rate. Recorded by the software.
5. Chest compression depth. Recorded by the software.

Delayed Assessment

The trained subjects randomized into the delayed testing cohort were not tested immediately but returned for assessment 2 months after their training. The delay was specifically designed to capture skill degradation. Although it would have allowed same-subject comparison, the delayed testing group did not undergo immediate performance assessment because the assessment experience itself may have provided additional surrogate training and improved testing performance during a second assessment. The delayed performance assessment on study day 2 was identical to that described for study day 1.

Sample Size and Random Assignment

The estimated sample size required to measure the smallest difference in expected primary outcome between the C-group and experimental groups (with 80% power, $\alpha=0.05$, and a 2-sided test) was 45 subjects in each training group (for each testing day) for a total of 270 subjects for training. With an estimated 10% attrition rate at 2 months, our goal was to recruit at least 100 subjects into each experimental group for a total of 300.

There were 410 subjects recruited for participation: 233 randomly assigned to the immediate evaluation group (including 51 C-group subjects) and 177 randomly assigned to the delayed (2-month) evaluation group. Forty of the immediate evaluation subjects and 34 of the delayed evaluation subjects were excluded because of medical reasons, missing evaluations, ineligibility, or no show. A total of 336 evaluations were recorded: 193 in the immediate evaluation group and 143 in the delayed evaluation group.

Statistical Analysis

Microsoft Excel for Windows (Microsoft Office; Microsoft Corp; Redmond, Washington) was used for database management, and SAS version 9.1.3 (SAS Institute Inc; Cary, NC) was used for statistical analysis. The actions called 911 and assessed responsiveness were compared across groups using χ^2 tests. Results for each skill are shown as box plots of group medians or median percentages because the data are not normally distributed. The upper and lower limits of the box plots denote third quartile and first quartile, respectively, and the whiskers denote minimum and maximum values. The Kruskal-Wallis test for multiple comparisons was used to identify potential differences among groups. When comparing groups within the immediate testing and delayed testing, 2-tailed tests with $\alpha<0.05$ as the criterion for significance were used. A decline in all skills was assumed when comparing the immediate

testing versus the delayed testing groups. Thus, for these comparisons, 1-tailed tests were used.

Mann-Whitney tests with Bonferroni correction were used to follow-up the Kruskal-Wallis test findings. Thus, all effects for these comparisons are reported at $P=0.008$. The Wilcoxon rank sum test was used to analyze the difference between the immediate testing and delayed testing experimental groups.

Results

Three hundred and thirty-six subjects completed the study. They were randomized to 1 of 4 groups as follows: (1) 51 in the C-group; (2) 95 (47/48 immediate/delayed testing) in the UBV-group; (3) 99 (49/50) in the BV-group; and (4) 91 (46/45) in the BVP-group. Table 1 shows the demographic characteristics of the subjects. There were no differences in demographic characteristics (age, sex, education, race) between the experimental groups and the C-group.

Twelve (23.5%) subjects in the C-group did not make any attempt to perform CPR in the evaluation scenario (ie, total compression count for these 12 participants was 0). This result compares to only 2 (4.2%) subjects in the delayed UBV-group ($P<0.01$). All subjects in all other groups (UBV-immediate testing, BV-immediate/delayed testing, BVP-immediate/delayed testing) attempted CPR ($P<0.0001$ in all groups).

Figure 1 shows the manikin-measured median compression rate for each group. All medians from each experimental group, including both testing time frames, came very close to meeting the 100-per-minute criterion; the lowest median rate was 90 compressions/min. For the immediate testing groups, all 3 experimental groups (UBV median, 96/min; $P<0.0001$; $r=0.43$; BV median, 95/min; $P<0.0001$; $r=0.40$; BVP median, 99.5/min; $P<0.0001$; $r=0.42$) had significantly higher median compression rates per minute than the C-group (median, 62/min) on the basis of Mann-Whitney tests with Bonferroni correction at $P=0.008$. Similar results were found for the delayed time frame, where all 3 experimental groups (UBV median, 94/min; $P=0.002$; $r=0.31$; BV median, 92.5/min; $P<0.001$; $r=0.35$; BVP median, 90/min; $P<0.001$; $r=0.32$) had significantly higher median compression rates per minute than the C-group. For the compression rate criterion, there were no significant differences among the UBV-, BV-, or BVP-groups for both testing time frames.

Figure 2 shows the manikin-measured median compression depth (millimeters) for each group. All medians from each experimental group, including both testing time frames, were greater than the target depth of ≥ 38 mm. For the immediate testing groups, all 3 experimental groups (UBV median, 41 mm; $P=0.0006$; $r=0.35$; BV median, 42 mm; $P=0.0004$; $r=0.36$; BVP median, 48 mm; $P<0.0001$; $r=0.51$) had a significantly higher median compression depth than the C-Group (median, 30 mm). For the delayed testing groups as well, all 3 experimental groups (UBV median, 43 mm; $P=0.004$; $r=0.28$; BV median, 42.5 mm; $P=0.0002$; $r=0.37$; BVP median, 46 mm; $P<0.0001$; $r=0.40$) had a significantly higher median compression depth than the C-group. For the compression depth criterion, there were no significant differences among the UBV-, BV-, or BVP-groups for both testing time frames.

Table 1. Subject Characteristics (N=336)

	Control (n=51)	Immediate (n=142)	Delayed (n=143)	P
Mean age, y (SD)	44.8 (11.8)	48.0 (14.8)	46.9 (13.4)	0.35
Male sex	23 (45.1)	63 (44.4)	69 (48.3)	0.79
Education				0.11
Eighth grade or lower	0	0	2 (1.4)	
Some high-school, no diploma	6 (11.8)	12 (8.4)	14 (9.4)	
High-school diploma or GED	1 (2.0)	2 (1.4)	1 (0.7)	
Some college	20 (39.2)	65 (45.8)	43 (30.1)	
Bachelor's degree	17 (33.3)	52 (36.6)	52 (36.4)	
Master's or higher degree	7 (13.7)	11 (7.7)	31 (21.7)	
Race				0.48
White	45 (88.2)	119 (83.8)	116 (81.8)	
Black, not Hispanic	0	3 (2.1)	2 (1.4)	
Hispanic	2 (3.9)	12 (8.5)	15 (10.5)	
Asian or Pacific Islander	0	3 (2.1)	6 (4.2)	
American Indian or Alaskan Native	2 (3.9)	3 (2.1)	1 (0.7)	
Other or multiple races	2 (3.9)	2 (1.4)	3 (2.1)	
Profession, provides patient care	10 (19.6)	17 (12.0)	20 (14.0)	0.37
CPR training, past 24 months	0	0	0	
CPR training, ever	32 (62.7)	92 (64.8)	101 (70.6)	0.39
Self/family history of heart disease	28 (54.9)	73 (51.4)	82 (57.3)	0.53
Self/family of heart attack	30 (58.8)	66 (46.5)	59 (41.3)	0.09
Self high risk for a heart attack	4 (7.8)	16 (11.3)	17 (11.9)	0.73
Living with anyone at high risk for a heart attack	10 (19.6)	14 (9.9)	20 (14.0)	0.19

Data are presented as n (%), unless otherwise indicated. GED indicates general educational development.

Figure 3 shows the manikin-measured, median percentage of all compressions performed with depth of ≥ 38 mm for each group. All 3 experimental groups in the immediate testing time frame (UBV median, 76.6%; $P=0.0003$; $r=0.36$; BV median, 82.1%; $P<0.0001$; $r=0.40$; BVP median, 91.7%; $P<0.0001$; $r=0.48$) had a significantly higher percentage of compressions with depth ≥ 38 mm than the C-group (median, 3.3%). In the delayed testing time frames, except for the UBV-group (median, 69.8%; $P=0.009$; $r=0.26$), the experimental BV-group (median, 82%; $P<0.001$; $r=0.32$)

and BVP-group (median, 88.1%; $P<0.001$; $r=0.33$) differed significantly from the C-group.

Experimental groups from the immediate testing to the delayed testing time frames were compared. Wilcoxon rank sum test showed no significant skill deterioration in any of the experimental groups for the median compression rate, the median compression depth, or the median percentage of compressions with depth ≥ 38 mm.

After removing subjects who did not perform any chest compressions, the median compression rate in the C-group

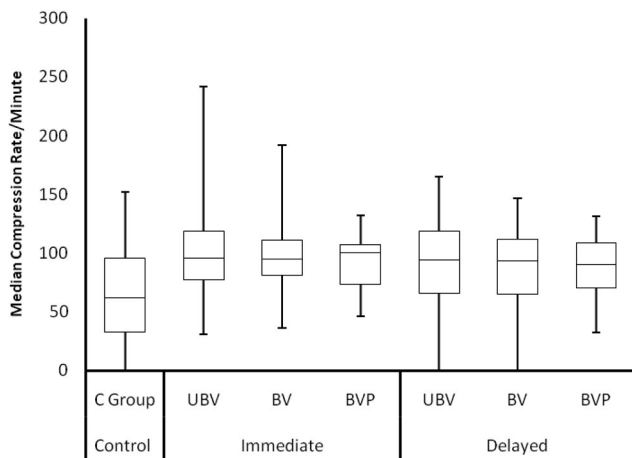


Figure 1. Average compression rate.

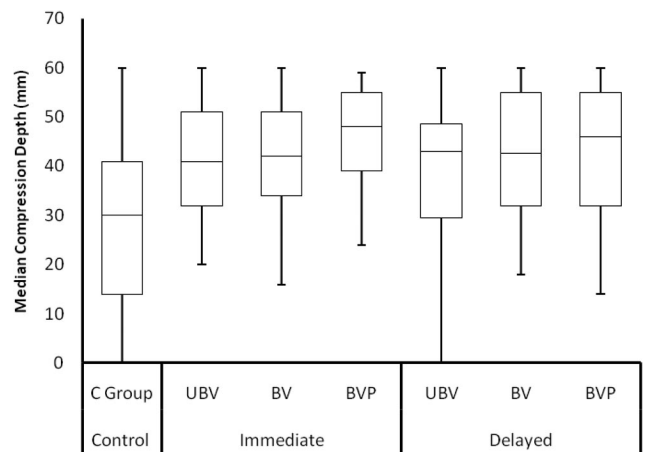


Figure 2. Average compression depth (millimeters).

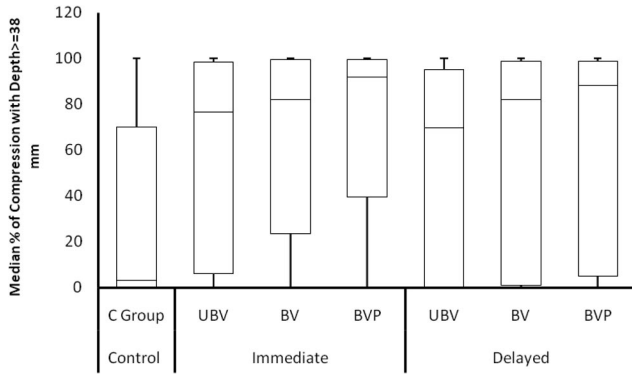


Figure 3. Median percentage of compressions with depth ≥ 38 mm.

increased to 74/min. The mean compression rate for the immediate UBV-group continued to be significantly higher than the C-group ($P=0.007$). There was a strong trend toward increased rates in the immediate BV- and BVP-groups ($P=0.015$ and $P=0.010$, respectively). The median compression depth was 39 mm in the C-group after excluding those who did not perform chest compressions. The immediate BVP-group had a significantly greater mean compression depth than the C-group ($P=0.0003$), and both the immediate BV- and BVP-groups had a greater percentage of chest compression ≥ 38 mm ($P=0.0082$ and $P=0.0004$, respectively).

Table 2 shows for each group the percentage of subjects who called 911 and who assessed responsiveness, as recorded by the performance recorders. The BV subjects and the BVP subjects who were evaluated immediately were more likely to call 911 than the controls. However, in the delayed evaluation cohort, only BVP subjects were more likely to call 911 than controls. There was no significant decline on this skill between the immediate evaluation group and the delayed evaluation group.

Table 2. Called 911 and Assessed Responsiveness as Measured by Performance Recorders

Groups and Time Frame	Called 911, %	Assessed Responsiveness, %
Control	74.5 (62.6–86.5)	85.4 (75.4–95.4)
UBV		
Immediate	83.0 (72.2–93.7)	18.2 (6.8–29.6)*
Delayed	89.6 (80.9–98.2)	54.2 (40.1–68.3)†
5-minute BV		
Immediate	95.9 (90.4–100.0)‡	80.0 (68.3–91.7)
Delayed	84.0 (73.8–94.2)	78.0 (66.5–89.5)
5-minute BVP		
Immediate	100†	97.8 (93.6–100.0)§
Delayed	97.8 (93.5–100.0)†	82.2 (71.1–93.4)

Data are presented as percent (95% CI). P values are based on χ^2 , and all values are compared to the C-group.

* $P < 0.0001$

† $P < 0.001$

‡ $P < 0.01$

§ $P < 0.05$

Discussion

Despite enormous efforts to increase BCPR, it continues to be performed in $<30\%$ of OHCA cases in most settings.^{3,8–16} There are a number of well-known barriers to CPR performance, such as fear of causing harm, fear of litigation, complexity of performing mouth-to-mouth rescue breathing, reluctance to make mouth-to-mouth contact, rescuer’s physical limitations, and panic.^{16,19,20,26–30} In addition to these factors, there are obstacles to attending traditional CPR classes, including issues related to the time and cost involved as well as to avoidance of testing situations.^{31,32}

In an attempt to address the barriers to learning CPR, the AHA has produced the CPR Anytime kit, featuring a 22-minute instruction video to be watched at the viewer’s convenience. Lynch et al²⁹ demonstrated that the 22-minute video self-instruction program was as effective in training subjects as a 4-hour course. To mitigate both the obstacles associated with learning CPR and some of the barriers involved with performing it, the AHA has advocated Hands-Only CPR for adults with witnessed collapse in which the bystander either is not trained in CPR or is not confident in his or her ability to perform both chest compressions and rescue breathing.¹⁹ Clinical studies have shown that Hands-Only CPR is at least as effective as conventional CPR with mouth-to-mouth ventilation for adults in primary cardiac arrest.^{17,18,20–22} The Hands-Only CPR approach not only negates the concerns associated with mouth-to-mouth contact, but also markedly simplifies the technique for lay rescuers.^{16,19,23} Finally, a Hands-Only CPR strategy for public training may create the opportunity for highly abbreviated, novel methods to expose the public to this new approach, thereby increasing public awareness of the importance of lay rescuers immediately identifying an adult in cardiac arrest and taking appropriate action.

To our knowledge, this controlled, randomized investigation is the first to evaluate the efficacy of UBV training for teaching Hands-Only CPR to the lay public. Given that the UBV training in our study is only 60 seconds and that our subjects only viewed the videos a single time, the CPR performance results are striking in several respects. First, the subjects who viewed a single Hands-Only CPR training video were significantly more likely in both the immediate and delayed evaluation groups to attempt any resuscitation compared to those in the control group. This finding has enormous public health implications because of the documented hesitancy of untrained rescuers to even attempt CPR^{3,11} and because it is known that any bystander resuscitation attempt improves outcomes compared to no CPR.^{3,8,10,14,15,33–36} The present study also demonstrates that all video training groups successfully performed chest compressions within the target rate (Figure 1). This finding was consistent in both the immediate and delayed evaluations. Although none of the video groups (UBV, BV, BVP) differed significantly in the median depth (mm), all the video groups had a median compression depth significantly greater than the C-group (Figure 2).

We hypothesized that the video-trained subjects would perform Hands-Only CPR skills better than the controls, and indeed, that is what we found. Our final hypothesis was that the addition of psychomotor skill practice to the BV would further improve skill performance; however, we did not show

a benefit in Hands-Only CPR skill performance or retention with the addition of psychomotor skill practice.

Although not a primary outcome measure, we recorded whether each study subject called 911 and assessed responsiveness. Consistent with the training materials used, the UBV subjects did not assess responsiveness as often as the viewers of the 2 other training videos or even the C-group (Table 2). The ultrabrief, 60-second video does not direct a rescuer to assess responsiveness; it simply states, "If an adult suddenly collapses, call 911 and push hard and fast in the middle of the chest." Although speculative, differences between groups in assessing victim responsiveness may be due to the fact that the trained subjects (consistent with their video training) were focused on initiating chest compressions as soon as possible, whereas the untrained subjects knew of no other action besides checking the person.

It is well established that skill retention is an issue as the time from training increases.^{37–41} Multiple studies have documented rapid skill degradation after CPR training in all formats,^{38,39,42–47} suggesting that frequent exposures may be needed to refresh rescuers. Because of time constraints, this goal cannot be realized through traditional training but could be accomplished with frequent brief exposures. UBV training has the potential to reach enormous portions of the public through conventional and novel media and social networks. One possible explanation for the observed skills retention over a 2-month period with all the video groups is that the straightforwardness and brevity of the videos allowed the rescuers to focus on the most fundamental aspects of CPR, regardless of whether they had skill practice. UBV training also may be an adjunct to all forms of CPR training to enhance retention by reinforcing skills through multiple viewings. Such venues could include physicians' offices, movie theaters, airports, mass gatherings, gas stations, departments of motor vehicles, theme parks, or any place where people wait. Television, Internet, e-mail, screen savers, personal communication devices, and social media could serve as personal forums for recurrent exposure to Hands-Only CPR. Some individuals may be motivated to expand their knowledge of CPR (eg, taking a formal class) after multiple exposures to a UBV. These potential benefits of UBV training remain unknown and were not evaluated in this analysis.

Limitations

The evaluations in this study were made on the basis of a simulated scenario. We do not know what lay rescuers would do during a real emergency with the inherent confusion, stress, and panic involved. Although we did assess retention at 2 months after video viewing, we did not assess longer-term retention, which is important because a rescuer would likely encounter a cardiac arrest >2 months after viewing a video. Additionally, the arrest scenario was anticipated by study subjects. The fact that they would be exposed to an OHCA scenario had to be disclosed for them to be truly informed in the consent process. Our study included subjects with and without prior training, so we are unable to determine the videos' specific benefit for initial versus refresher training. Only adults were assessed in our study; the impact of the

videos on children's ability and likelihood of performing these skills remains unknown. Finally, although the subjects represented a variety of demographic characteristics, these results may not be generalizable to the entire population.

Conclusions

Laypersons exposed to an ultrabrief AHA Hands-Only CPR video were more likely to attempt Hands-Only CPR and showed superior skills compared to untrained laypersons. Because the UBV is short enough to be used in a myriad of media venues, this method of public education holds promise for increasing bystander Hands-Only CPR rates and survival from OHCA.

Acknowledgments

We thank Pastor Curt Gentry, Joni Castle, and the entire congregation at CrossRoads Nazarene Church in Chandler, Arizona, for the use of their church and for providing volunteers for this study. We thank Orlando Alcorido and PMT Ambulance for help with equipment and logistics. Sami Langley and Bill Kaye with Laerdal Medical gave us invaluable assistance with setting up the manikins and the SkillReporter system for our study.

Sources of Funding

This research was funded by the American Heart Association.

Disclosures

Dr Bobrow was the principal investigator for this study and serves as a volunteer on the AHA Basic Life Support Subcommittee. Drs Bobrow and Spaite disclose that the University of Arizona receives support from the Medtronic Foundation involving community-based translation of resuscitation science. Dr Potts is employed by the AHA, which produces and markets CPR training materials. Ms Brazil was the study coordinator on this study. Dr Abella receives research support from the AHA, honoraria from Medivance Corporation and Gaymar Industries, and research support and honoraria from Philips Healthcare. The University of Pennsylvania receives support from the Medtronic Foundation involving community-based translation of resuscitation science.

References

- Lloyd-Jones D, Adams R, Carnethon M, De Simone G, Ferguson TB, Flegal K, Ford E, Furie K, Go A, Greenlund K, Haase N, Hailpern S, Ho M, Howard V, Kissela B, Kittner S, Lackland D, Lisabeth L, Marelli A, McDermott M, Meigs J, Mozaffarian D, Nichol G, O'Donnell C, Roger V, Rosamond W, Sacco R, Sorlie P, Stafford R, Steinberger J, Thom T, Wasserthiel-Smoller S, Wong N, Wylie-Rosett J, Hong Y. Heart disease and stroke statistics—2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*. 2009;119:480–486.
- Rea TD, Eisenberg MS, Sinibaldi G, White RD. Incidence of EMS-treated out-of-hospital cardiac arrest in the United States. *Resuscitation*. 2004;63:17–24.
- Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, Rea T, Lowe R, Brown T, Dreyer J, Davis D, Idris A, Stiell I. Regional variation in out-of-hospital cardiac arrest incidence and outcome. *JAMA*. 2008;300:1423–1431.
- Lombardi G, Gallagher J, Gennis P. Outcome of out-of-hospital cardiac arrest in New York City. The Pre-Hospital Arrest Survival Evaluation (PHASE) Study. *JAMA*. 1994;271:678–683.
- Eckstein M, Stratton SJ, Chan LS. Cardiac Arrest Resuscitation Evaluation in Los Angeles: CARE-LA. *Ann Emerg Med*. 2005;45:504–509.
- Bobrow BJ, Clark LL, Ewy GA, Chikani V, Sanders AB, Berg RA, Richman PB, Kern KB. Minimally interrupted cardiac resuscitation by emergency medical services for out-of-hospital cardiac arrest. *JAMA*. 2008;299:1158–1165.

7. Becker LB, Ostrander MP, Barrett J, Kondos GT. Outcome of CPR in a large metropolitan area—where are the survivors? *Ann Emerg Med.* 1991;20:355–361.
8. Sasson C, Rogers MA, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes.* 2010;3:63–81.
9. Vadeboncoeur T, Bobrow BJ, Clark L, Kern KB, Sanders AB, Berg RA, Ewy GA. The Save Hearts in Arizona Registry and Education (SHARE) program: who is performing CPR and where are they doing it? *Resuscitation.* 2007;75:68–75.
10. Holmberg M, Holmberg S, Herlitz J. Effect of bystander cardiopulmonary resuscitation in out-of-hospital cardiac arrest patients in Sweden. *Resuscitation.* 2000;47:59–70.
11. Gallagher EJ, Lombardi G, Gennis P. Effectiveness of bystander cardiopulmonary resuscitation and survival following out-of-hospital cardiac arrest. *JAMA.* 1995;274:1922–1925.
12. Van Hoeyweghen RJ, Bossaert LL, Mullie A, Calle P, Martens P, Buylaert WA, Delooy H, Belgian Cerebral Resuscitation Study Group. Quality and efficiency of bystander CPR. *Resuscitation.* 1993;26:47–52.
13. Wik L, Steen PA, Bircher NG. Quality of bystander cardiopulmonary resuscitation influences outcome after prehospital cardiac arrest. *Resuscitation.* 1994;28:195–203.
14. Valenzuela TD, Roe DJ, Cretin S, Spaite DW, Larsen MP. Estimating effectiveness of cardiac arrest interventions: a logistic regression survival model. *Circulation.* 1997;96:3308–3313.
15. Larsen MP, Eisenberg MS, Cummins RO, Hallstrom AP. Predicting survival from out-of-hospital cardiac arrest: a graphic model. *Ann Emerg Med.* 1993;22:1652–1658.
16. Abella BS, Aufderheide TP, Eigel B, Hickey RW, Longstreth WT Jr, Nadkarni V, Nichol G, Sayre MR, Somargren CE, Hazinski MF. Reducing barriers for implementation of bystander-initiated cardiopulmonary resuscitation: a scientific statement from the American Heart Association for healthcare providers, policymakers, and community leaders regarding the effectiveness of cardiopulmonary resuscitation. *Circulation.* 2008;117:704–709.
17. Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. *Lancet.* 2007;369:920–926.
18. Iwami T, Kawamura T, Hiraide A, Berg RA, Hayashi Y, Nishiuchi T, Kajino K, Yonemoto N, Yukioka H, Sugimoto H, Kakuchi H, Sase K, Yokoyama H, Nonogi H. Effectiveness of bystander-initiated cardiac-only resuscitation for patients with out-of-hospital cardiac arrest. *Circulation.* 2007;116:2900–2907.
19. Sayre MR, Berg RA, Cave DM, Page RL, Potts J, White RD. Hands-Only (compression-only) cardiopulmonary resuscitation: a call to action for bystander response to adults who experience out-of-hospital sudden cardiac arrest: a science advisory for the public from the American Heart Association Emergency Cardiovascular Care Committee. *Circulation.* 2008;117:2162–2167.
20. Hallstrom A, Cobb L, Johnson E, Copass M. Cardiopulmonary resuscitation by chest compression alone or with mouth-to-mouth ventilation. *N Engl J Med.* 2000;342:1546–1553.
21. Waalewijn RA, Tijssen JG, Koster RW. Bystander initiated actions in out-of-hospital cardiopulmonary resuscitation: results from the Amsterdam Resuscitation Study (ARRESUST). *Resuscitation.* 2001;503:273–279.
22. Bohm K, Rosenqvist M, Herlitz J, Hollenberg J, Svensson L. Survival is similar after standard treatment and chest compression only in out-of-hospital bystander cardiopulmonary resuscitation. *Circulation.* 2007;116:2908–2912.
23. Bobrow BJ, Spaite DW, Berg RA, Stolz U, Sanders AB, Kern KB, Vadeboncoeur TF, Clark LL, Gallagher JV, Stapeczynski JS, LoVecchio F, Mullins TJ, Humble WO, Ewy GA. Chest compression-only CPR by lay rescuers and survival from out-of-hospital cardiac arrest. *JAMA.* 2010;304:1447–1454.
24. Assar D, Chamberlain D, Colquhoun M, Donnelly P, Handley AJ, Leaves S, Kern KB. Randomised controlled trials of staged teaching for basic life support. 1. Skill acquisition at bronze stage. *Resuscitation.* 2000;45:7–15.
25. Trowbridge C, Parekh JN, Ricard MD, Potts J, Patrickson WC, Cason CL. A randomized cross-over study of the quality of cardiopulmonary resuscitation among females performing 30:2 and hands-only cardiopulmonary resuscitation. *BMC Nurs.* 2009;8:6.
26. Locke CJ, Berg RA, Sanders AB, Davis MF, Milander MM, Kern KB, Ewy GA. Bystander cardiopulmonary resuscitation. Concerns about mouth-to-mouth contact. *Arch Intern Med.* 1995;155:938–943.
27. McCormack AP, Damon SK, Eisenberg MS. Disagreeable physical characteristics affecting bystander CPR. *Ann Emerg Med.* 1989;18:283–285.
28. Michael AD, Forrester JS. Mouth-to-mouth ventilation: the dying art. *Am J Emerg Med.* 1992;10:156–161.
29. Lynch B, Einspruch EL, Nichol G, Becker LB, Aufderheide TP, Idris A. Effectiveness of a 30-min CPR self-instruction program for lay responders: a controlled randomized study. *Resuscitation.* 2005;67:31–43.
30. Woollard M, Smith A, Whitfield R, Chamberlain D, West R, Newcombe R, Clawson J. To blow or not to blow: a randomised controlled trial of compression-only and standard telephone CPR instructions in simulated cardiac arrest. *Resuscitation.* 2003;59:123–131.
31. Wik L, Brennan RT, Braslow A. A peer-training model for instruction of basic cardiac life support. *Resuscitation.* 1995;29:119–128.
32. Flint LS Jr, Billi JE, Kelly K, Mandel L, Newell L, Stapleton ER. Education in adult basic life support training programs. *Ann Emerg Med.* 1993;22:468–474.
33. Stiell IG, Wells GA, Field BJ, Spaite DW, De Maio VJ, Ward R, Munkley DP, Lyver MB, Luinstra LG, Campeau T, Maloney J, Dagnone E. Improved out-of-hospital cardiac arrest survival through the inexpensive optimization of an existing defibrillation program: OPALS study phase II. Ontario Prehospital Advanced Life Support. *JAMA.* 1999;281:1175–1181.
34. De Maio VJ, Stiell IG, Wells GA, Spaite DW; OPALS Study Group. Cardiac arrest witnessed by emergency medical services personnel: descriptive epidemiology, prodromal symptoms, and predictors of survival. *Ann Emerg Med.* 2000;35:138–146.
35. Becker L, Gold LS, Eisenberg M, White L, Hearne T, Rea T. Ventricular fibrillation in King County, Washington: a 30-year perspective. *Resuscitation.* 2008;79:22–27.
36. Rea TD, Helbock M, Perry S, Garcia M, Cloyd D, Becker L, Eisenberg M. Increasing use of cardiopulmonary resuscitation during out-of-hospital ventricular fibrillation arrest: survival implications of guideline changes. *Circulation.* 2006;114:2760–2765.
37. Berden HJ, Bierens JJ, Willems FF, Hendrick JM, Pijls NH, Knappe JT. Resuscitation skills of lay public after recent training. *Ann Emerg Med.* 1994;23:1003–1008.
38. Chamberlain D, Smith A, Colquhoun M, Handley AJ, Kern KB, Woollard M. Randomised controlled trials of staged teaching for basic life support: 2. Comparison of CPR performance and skill retention using either staged instruction or conventional training. *Resuscitation.* 2001;50:27–37.
39. Einspruch EL, Lynch B, Aufderheide TP, Nichol G, Becker L. Retention of CPR skills learned in a traditional AHA Heartsaver course versus 30-min video self-training: a controlled randomized study. *Resuscitation.* 2007;74:476–486.
40. Kaye W, Mancini ME. Retention of cardiopulmonary resuscitation skills by physicians, registered nurses, and the general public. *Crit Care Med.* 1986;14:620–622.
41. Kaye W, Rallis SF, Mancini ME, Linhares KC, Angell ML, Donovan DS, Zajano NC, Finger JA. The problem of poor retention of cardiopulmonary resuscitation skills may lie with the instructor, not the learner or the curriculum. *Resuscitation.* 1991;21:67–87.
42. Choa M, Cho J, Choi YH, Kim S, Sung JM, Chung HS. Animation-assisted CPR II program as a reminder tool in achieving effective one-person-CPR performance. *Resuscitation.* 2009;80:680–684.
43. Roppolo LP, Pepe PE, Campbell L, Ohman K, Kulkarni H, Miller R, Idris A, Bean L, Bettes TN, Idris AH. Prospective, randomized trial of the effectiveness and retention of 30-min layperson training for cardiopulmonary resuscitation and automated external defibrillators: the American Airlines Study. *Resuscitation.* 2007;74:276–285.
44. Niles D, Sutton RM, Donoghue A, Kalsi MS, Roberts K, Boyle L, Nishisaki A, Arbogast KB, Helfaer M, Nadkarni V. “Rolling Refreshers”: a novel approach to maintain CPR psychomotor skill competence. *Resuscitation.* 2009;80:909–912.
45. Sarac L, Ok A. The effects of different instructional methods on students’ acquisition and retention of cardiopulmonary resuscitation skills. *Resuscitation.* 81:555–561.
46. Smith KK, Gilcreast D, Pierce K. Evaluation of staff’s retention of ACLS and BLS skills. *Resuscitation.* 2008;78:59–65.
47. Woollard M, Whitfield R, Newcombe RG, Colquhoun M, Vetter N, Chamberlain D. Optimal refresher training intervals for AED and CPR skills: a randomised controlled trial. *Resuscitation.* 2006;71:237–247.

SUPPLEMENTAL MATERIAL

MS ID#: CIRCCVOQ/2010/959353

MS TITLE: *The Effectiveness of Ultra-Brief and Brief Educational Videos for Training Lay Responders in Hands-Only Cardiopulmonary Resuscitation: Implications for the Future of Citizen CPR Training*

APPENDIX

CPR Study Volunteer Questionnaire

Please provide information about yourself by completing the following items. Please do not leave any item blank. If you have a question or concern about any of the items, ask the study coordinator.

Name _____

Address _____

Best phone number _____

Best email address _____

Your birth date (month/day/year): _____

Your gender:

Male

Female

Your race/ethnicity:

White, not Hispanic

Black, not Hispanic

Hispanic

Asian or Pacific Islander

American Indian or Alaskan Native

Other or multiple races

Your highest education level:

8th grade or lower

Some high school, but no diploma or GED

High school diploma or GED

Some college

Bachelor's degree

Master's, Ph.D., or other graduate-level degree

- | | Yes | No | Don't Know |
|---|--------------------------|--------------------------|--------------------------|
| 1. Have you ever been in a profession where you provided patient care?
If YES, how long ago? _____

What profession? _____ | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Have you received training in CPR and/or been CPR certified within the past 24 months? (If YES, skip Question 3 - Go to Question 4.) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Have you ever had CPR training?

If yes, approx. how many years ago? _____ | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Do you or anyone in your family have a history of heart disease or heart disorder? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Have you or anyone in your family ever had a heart attack? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Have you been told that you are at high risk for a heart attack? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |