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 = 110); (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.

Key Words: cardiopulmonary resuscitation • heart arrest • resuscitation
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.
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.
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 $\chi^2$ 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.
Figure 3 shows the manikin-measured, median percentage of all compressions performed with depth of $\geq 38$ 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 $\geq 38$ 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 $\geq 38$ mm.

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

<table>
<thead>
<tr>
<th>Table 1. Subject Characteristics (N=336)</th>
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<tr>
<td>Mean age, y (SD)</td>
</tr>
<tr>
<td>Male sex</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Eighth grade or lower</td>
</tr>
<tr>
<td>Some high-school, no diploma</td>
</tr>
<tr>
<td>High-school diploma or GED</td>
</tr>
<tr>
<td>Some college</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
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<tr>
<td>Master’s or higher degree</td>
</tr>
<tr>
<td>Race</td>
</tr>
<tr>
<td>White</td>
</tr>
<tr>
<td>Black, not Hispanic</td>
</tr>
<tr>
<td>Hispanic</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
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<tr>
<td>American Indian or Alaskan Native</td>
</tr>
<tr>
<td>Other or multiple races</td>
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<tr>
<td>Profession, provides patient care</td>
</tr>
<tr>
<td>CPR training, past 24 months</td>
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<tr>
<td>CPR training, ever</td>
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<tr>
<td>Self/family history of heart disease</td>
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<td>Self/family of heart attack</td>
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<td>Self high risk for a heart attack</td>
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<td>Living with anyone at high risk for a heart attack</td>
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Data are presented as n (%), unless otherwise indicated. GED indicates general educational development.
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 $\geq 38$ 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 BV 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

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

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

$^*P<0.0001$  
$^†P<0.001$  
$^‡P<0.01$  
$§P<0.05$  

Figure 3. Median percentage of compressions with depth $\geq 38$ mm.

Discussion

Despite enormous efforts to increase BCPR, it continues to be performed in $<30\%$ of OHCA cases in most settings. 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. 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.

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 al 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. 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. 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.

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 and because it is known that any bystander resuscitation attempt improves outcomes compared to no CPR. Lynch et al demonstrated that the 22-minute video self-instruction video to be watched at the viewer’s convenience. Lynch et al 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. 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.

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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

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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


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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

1. Have you ever been in a profession where you provided patient care?
   If YES, how long ago? ____________
   What profession? ______________________

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.)

3. Have you ever had CPR training?
   If yes, approx. how many years ago? ______

4. Do you or anyone in your family have a history of heart disease or heart disorder?

5. Have you or anyone in your family ever had a heart attack?

6. Have you been told that you are at high risk for a heart attack?