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Short communication

Should dispatchers instruct lay bystanders to undress patients before performing CPR? A randomized simulation study☆

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ABSTRACT

Objective: Dispatch-assisted CPR instructions frequently direct bystanders to remove a cardiac arrest patient's clothing prior to starting chest compressions. Removing clothing may delay compressions and it is uncertain whether CPR quality is influenced by the presence of clothing. We measured how instructions to remove clothing impacted the time to compressions and CPR performance by lay responders in a simulated arrest.
Subjects and methods: We conducted a randomized dispatch-assisted CPR simulation trial. Fifty two lay participants were instructed to remove the manikin's clothing (3 layers: a t-shirt, button-down shirt, and fleece vest) prior to starting chest compressions as part of dispatcher instructions, while 47 individuals received no instruction about clothing removal. Instructions were otherwise identical.
Results: The two groups were comparable with regard to demographic characteristics and prior CPR training. Time to first compression was 109 s among the group randomized to instruction to remove clothing and 79 s among those randomized to forgo instruction regarding clothing removal, ($p < 0.001$). Among those randomized to remove clothing instructions, mean compression depth was 41 mm, compression rate was 97 per minute, and the percentage with complete compression release was 95%. Among those randomized to forgo clothing removal instruction, mean compression depth was 40 mm, compression rate was 99 per minute, and the percentage with complete compression release was 91% ($p > 0.05$ for each CPR metric comparison).
Conclusion: These findings suggest that eliminating instruction to remove a victim's clothing in dispatcher-assisted CPR will save time without compromising performance, which may improve survival from cardiac arrest.

1. Introduction

Dispatchers strengthen the chain of survival[1–3] by helping bystanders recognize cardiac arrest and by providing instructions to start CPR before EMS arrives. Dispatcher-assisted CPR instructions (DA-CPR) are most effective when the need for CPR is recognized early and when callers begin chest compressions as soon as possible.[4] Time delays to the start of bystander CPR increase mortality.[5–8] Dispatchers usually identify a need for CPR within 2–4 min.[9,10]

A potential time delay to the start of CPR is the instruction for lay bystanders to remove clothing prior to starting compressions. One rationale for inclusion of this instruction is that clothing layers might reduce compression depth and/or chest recoil. The few simulation studies that have compared CPR quality on dressed vs. undressed manikins have involved professional responders or participants tested immediately after completing a 4-h CPR course.[11,12] However, lay responders and professionals bring different training, experience, tools (such as scissors) and expectations, so the consequences of leaving clothing in place may differ between these groups. We evaluated the extent to which dispatcher instruction to remove clothing to bare the chest would delay onset of chest compressions or affect CPR performance.

2. Methods

2.1. Design, population, and setting

We conducted a randomized trial of simulated cardiac arrest to measure how dispatcher instructions to remove clothing impacted the time to onset of chest compressions and CPR performance for lay responders. All study procedures were reviewed and approved by Human Subjects at the University of Washington. Participants

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were recruited from local community centers in Seattle and King County, Washington. All participants provided informed written consent and received a $25 gift card.

2.2. Study procedures

Participants were told that the purpose of the study was to test new 9-1-1 instructions for first-aid skills. CPR was not mentioned as part of recruitment or study procedures. Participants were asked to imagine they had come across a person (a Laerdal Skill Reporter™ CPR manikin) who was "not breathing and unconscious – not able to respond to you." Participants were told to call a local study number "pretend 9-1-1" but "The person answering the phone is a real 911 dispatcher, who will treat you as if are reporting a real emergency." At the start of all simulations, the manikin was propped against a wall, dressed in three layers of upper torso clothing: a cotton t-shirt, a button-up dress shirt with 4 buttons buttoned, and a medium-weight fleece zip-up vest zipped to the neck. The dispatcher opened a sealed envelope just prior to the simulated call to determine randomization. She proceeded with CPR instructions once the caller affirmed that that the patient was unconscious and not breathing. Participants were instructed to move the patient to the floor, flat on their back. One group was told to "quickly open the shirt so you can see skin" prior to instructions to place the hands in the center of the chest. The other group received no instructions regarding the victim's clothing. The study coordinator measured time intervals (starting when the participant completed dialing) and the manikin recorded CPR components of compression depth, full chest recoil, and compression rate. Following the formal study, participants were invited to review their CPR skill performance.

Sample size was calculated to achieve 80% power to detect a difference of 30 s between groups in the time to first compression, and was calculated using an estimate of the within-group standard deviation of 1 min.

2.3. Analyses

To compare the two instruction groups we used the 2-sample *t*-test to compare the time to initial chest compressions. We used a one-sided 95% confidence interval to evaluate non-inferiority of CPR metrics with the instructions that bypass clothing removal (no instruction – instruction to remove clothing). All statistical analyses were performed in R version 2.13.

3. Results

Analyses were based on Skill Reporter manikin data and observed time intervals for 96 lay people based on 3 min of participant CPR. Participants were either randomized to forgo instruction regarding clothing removal and instead proceed directly to hand placement for chest compressions ($n = 47$), or were randomized to remove clothing prior to initiating chest compressions ($n = 52$). Comparisons were made as intention-to-treat.

Demographic characteristics were similar between the two instruction groups (Table 1). Although 99 participants were enrolled in the study, time data was missing for 2 participants and in 3 instances the Skill Reporter manikin did not record data so these participants were excluded from analysis.

For those randomized to do compressions over clothing, 44 (94%) did compressions over 3 layers of clothing and 3 (6%) performed compressions over 2 layers of clothing. Among those randomized to remove clothing, 39 (75%) performed compressions on the manikin's completely-bared chest, 8 (15%) performed compressions over 1 layer of clothing (t-shirt), 1 (2%) performed compressions over 2 layers of clothing (button-down shirt and t-shirt) and 4 (8%) individuals performed compressions over all 3 layers of clothing. No differences were detected between the two instruction groups regarding CPR metrics of compression depth, compression rate, or proportion with full release (Table 2).

Table 1
Study population according to randomization status.

	No dispatch instruction to remove clothing ($n = 47$)	Dispatch instruction to remove clothing ($n = 52$)
Age, mean years (SD)	54	58
Gender		
N, % Female	39 (83%)	39 (75%)
N, % Male	6 (13%)	13 (25%)
Unknown	2 (4%)	0 (0%)
Race		
White	31 (66%)	29 (56%)
African-American	13 (28%)	18 (35%)
Other	3 (6%)	5 (9%)
Prior CPR class		
Yes	40 (85%)	40 (77%)
No	7 (15%)	11 (21%)
Unsure	0 (0%)	1 (2%)

The average time to first compression was 30 s quicker in the group randomized to forgo clothing removal instruction (79 s versus 109 s, $p < 0.001$, Table 2). Results were similar when the median was used to compare the time to compressions (76 s for the group randomized to bypass clothing removal instruction and 100 s for group receiving instruction to remove clothing, $p < 0.001$). Among those randomized to clothing removal, the time required to provide the clothing removal instruction was 14 s (SD 11 s), the time required to remove layers 1 and 2 was 11 s (SD 6 s), and the time required to remove the third layer was 5 s (SD 4 s).

4. Discussion

In this trial, lay participants randomized to forgo dispatch instructions to remove a manikin's clothing were able to start compressions 30 s sooner than those who were randomized to receive instructions to remove clothing. The 30 s advantage is clinically meaningful and could translate to measureable improvement in survival.[7] Time saved was not at the expense of CPR quality: both groups performed similarly with regard to chest compression depth, rate, and release during the 3 min of CPR evaluation.

DA-CPR increases bystander CPR and improves community survival from cardiac arrest, and yet CPR is difficult for bystanders. In a clinical trial of dispatcher-assisted CPR, approximately one fifth could not progress to deliver chest compressions when provided compression-only instructions.[13] In the current study, we observed that 25% of the group randomized to undress the manikin did not remove all 3 layers of clothing, suggesting that this instruction might be challenging.

Although clothing will eventually need to be removed to place defibrillator patches, EMS professionals may be better suited to undress victims and so minimize CPR interruption. Moreover, the requirement to remove clothing may inhibit initial action by the bystander and decrease willingness to perform any CPR, particularly when the person in cardiac arrest is a stranger or when there are cultural reasons prohibiting clothing removal. Additionally, providing compressions on a clothed person avoids direct skin contact and may be psychologically more comfortable. Although this study did not find compression depth differences when the manikin was dressed versus undressed, Del Rossi et al., reported deeper compressions when responders performed compressions over protective athletic equipment.[12] Touching skin (or even seeing a victim's bare chest) may make that victim appear more vulnerable which in turn may inhibit appropriate compression force. Lay bystanders (who have variable knowledge about why they need to

Table 2
Time to first compression and CPR performance according to randomization status.

Means	No dispatch instruction to remove clothing	Dispatch instruction to remove clothing	Difference (95% CI)	*p* = value
Time to first compression, seconds (SD)[a]	79 (17)	109 (34)	30 (19, 41)	$p < 0.001$
Compression depth, mm (SD)[b]	40 mm (11)	41 mm (14)	−1.3 (>−5.6)	$p > 0.05$
Compression rate, per min (SD)[b]	99/min (19)	97/min (16)	1.6 (>−4.5)	$p > 0.05$
Complete release, % (SD)[b]	91% (25)	95% (9)	−4.2 (>−9.7)	$p > 0.05$

[a] 95% two-sided confidence interval for no instruction – instruction to remove clothing.
[b] One-sided statistical comparison.

push deeply) might worry about hurting victims given that even experienced first responders have expressed concerns that compression depths as recommended by guidelines may be injurious to patients.[14]

5. Limitations

The present study was limited by virtue of being a manikin simulation study; citizen bystanders in a real cardiac arrest situation might behave differently. This study tested a scenario using 3 layers of clothing for the simulated victim and findings may not apply to other clothing combinations. The study chose to focus on CPR metrics as opposed to hand position. Although hand position can be important, we focused on quantitative CPR metrics that may be associated with resuscitation outcome and are a downstream consequence of hand position.[15,16] The study had limited power to detect differences in CPR performance and only evaluated the first 3 min of single rescuer compression-only CPR. Missing outcomes can bias results. In this study, only about 3% of participants were missing outcomes (time to chest compression and/or CPR metrics) so that the risk of bias is small. However, a larger sample size or more extended measurement could produce different results. Finally, the current study does not address best practice for clothing removal when a public access AED is on scene.

6. Conclusion

Each year in North America, hundreds of thousands of individuals suffer out-of-hospital cardiac arrest and receive attempted resuscitation. Fewer than 10% survive.[1] This randomized trial of simulated cardiac arrest found that time to first compression was 30 s faster and compression depth, rate, and release were not worse when performed over three layers of a manikin's clothing compared to a bared chest. These findings suggest that eliminating the instruction to remove a victim's clothing as part of dispatcher-assisted CPR instruction will save time without compromising performance, which in turn may improve survival from cardiac arrest.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.resuscitation.2012.12.010.

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