International Journal of Paramedicine

Published by the National EMS Management Association (USA)

RESEARCH REPORTS

EVALUATING AUDITORY FEEDBACK FOR ACCURATE COMPRESSION RATES

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Recommended Citation: Horan Jr, P., Breneman, K., & Martin, V. (2026). Evaluating auditory feedback for accurate compression rates. *International Journal of Paramedicine*. (14). 44-48. https://doi.org/10.56068/VXSH5619

Keywords: CPR, compressions, feedback, auditory, metronome, music, resuscitation, simulation, CRM, emergency medical services, EMS, paramedicine

Disclosures: None.

Funding: No external funding was used for this project.

Received: September 9, 2025
Revised: November 28, 2025
Revised: December 20, 2025
Revised: February 5, 2026
Accepted: February 22, 2026
Published: April 14, 2026

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ABSTRACT

The American Heart Association (AHA) updated its recommendations for resuscitation science in 2015. Among several updates, the use of audiovisual feedback during real-time CPR was considered reasonable, receiving a Class IIb recommendation based on weak clinical evidence (Saving American Hearts, Inc., 2020). Evidence regarding the effectiveness of audio feedback in improving chest compression rate has been mixed, with disparities observed between lay persons, hospital personnel, and professional rescuers (Kleinman et al., 2015).

This study investigated whether different forms of auditory feedback influence chest compression rates among professional rescuers. Participants were screened and randomized into four groups: A control with no feedback, a metronome at 110 beats per minute (BPM), a music track at 104 BPM, and a music track at 114 BPM. Music selections were chosen for tempo, recognizability, and prior association with AHA training materials. Chest compression rates were measured using a Laerdal QCPR manikin.

No clinically significant differences were observed between groups. While all feedback groups achieved compression rates within current AHA recommendations, none demonstrated statistically significant improvement compared with control.

These findings suggest that routine auditory feedback may not enhance chest compression performance among professional rescuers. Although music and metronome cues supported maintenance of appropriate rates, they conferred no advantage over standard practice. Furthermore, background noise introduced by auditory feedback may disrupt team communication, a factor associated with medical errors in high-stakes environments. Strategies emphasizing crew resource management, such as preserving a "sterile cockpit" during critical phases of resuscitation, may provide greater benefit in optimizing team function and patient safety.

Video Interview:
https://youtu.be/U8tXvjJV74I

THE USAGE OF AUDITORY FEEDBACK DURING CPR IN THE PROFESSIONAL RESCUER

In 2015, the American Heart Association (AHA) recommended that all rescuers consider using audiovisual feedback devices to improve chest compression performance (Kleinman et al., 2015). During this period, the AHA also mandated the use of feedback devices during the training of professional rescuers (American Heart Association, n.d.-b). Despite limited supporting evidence,

the AHA reaffirmed in 2020 its 2015 recommendation that audiovisual feedback devices be used during CPR, citing one study showing improved hospital discharge rates after cardiac arrest. Given the limited and somewhat conflicting evidence, we aimed to evaluate whether auditory feedback, such as a metronome or music, effectively helps professional rescuers maintain an appropriate chest compression rate during simulated resuscitation. For the purpose of this study, a professional rescuer was defined as an individual who is 18 years of age or older, holds current Basic Life Support (BLS) certification adhering to American Heart Association standards, and possesses an active emergency medical service license.

Data points explicitly excluded from analysis in this research included subject compensation status (compensated or uncompensated employee), gender, years of service, chest compression depth, and chest compression recoil. The primary objective of this study was solely to evaluate chest compression rate and determine if auditory feedback influenced the participant's ability to maintain that rate.

METHODS

This study was designed as a randomized controlled trial. We recruited professional rescuers with backgrounds in firefighting and emergency medical services from South Central Pennsylvania and Northern Maryland. Data collection began in March 2025 and concluded in April 2025. In total, we evaluated 57 professionally trained rescuers across various auditory feedback conditions. Chest compression performance was measured using Laerdal QCPR manikins.

Each participant performed two minutes of continuous chest compressions on a manikin positioned on a firm surface at an appropriate height. Chest compressions commenced once the participant heard the assigned auditory feedback cue, except for participants in the control group who performed compressions without audio feedback. At the conclusion of the two minutes, the manikin provided a report detailing the number of chest compressions delivered during that period.

Randomization and Audio Feedback Selection

Following eligibility screening, participants were randomly assigned to one of four auditory feedback conditions. Each then entered the testing area and performed two minutes of chest compressions under their assigned condition. Upon completion, manikin data were immediately recorded on a standardized form, and the setup was reset for the next participant.

RESULTS

Across all four groups, professionally trained rescuers were generally able to perform chest compressions within the expected standards. The metronome group exhibited the lowest variability, with a standard deviation of 8 compressions per minute, while the Music A group had the highest deviation at 12. Both the metronome and silence (control) groups had the same number of participants fall outside the acceptable compression range.

To assess performance accuracy, each group was evaluated within a predefined tolerance: ±1 BPM of the auditory feedback for the metronome and music groups, and a target

range of 100–120 BPM for the silence group, consistent with American Heart Association guidelines (Kleinman et al., 2015).

Despite the lower standard deviation, only 42% of participants in the metronome group matched the auditory cue's exact rate. The Music A and Music B groups achieved match rates of 33% and 36%, respectively. In contrast, 84% of participants in the silence group maintained compression rates within the recommended 100–120 BPM range.

These findings indicate that, in this sample, the silence (control) group more consistently adhered to guideline-compliant chest compression rates than any of the auditory feedback groups.

DISCUSSION

This randomized controlled trial evaluated the effectiveness of auditory feedback—including a metronome and music on the ability of professional rescuers to maintain appropriate chest compression rates during simulated cardiac arrest. Despite prior recommendations by the American Heart Association (AHA) endorsing the use of audiovisual feedback during CPR, our results indicate that auditory feedback alone does not enhance performance in this specific domain (Kleinman et al., 2015).

While the metronome group exhibited the lowest variability in compression rate, only 42% of its participants matched the target beat rate. The music groups performed similarly, with 33% and 36% match rates. In contrast, the silence (control) group demonstrated superior performance, with 84% of participants maintaining compression rates within the AHA-recommended range of 100–120 compressions per minute. These findings suggest that professional rescuers may not derive additional benefit from external auditory cues in achieving guideline-compliant chest compression rates.

One possible explanation for the control group's superior performance is that trained professionals may rely more effectively on internalized pacing, developed through repeated training and field experience, rather than external feedback. Additionally, external auditory cues may introduce cognitive distraction or interfere with team communication.

Our findings are consistent with the mixed evidence regarding auditory feedback described in prior guidelines. While certain studies cited by the AHA have demonstrated improved outcomes with audiovisual feedback (Kleinman et al., 2015), these often-included visual elements, longer training interventions, or layperson participants. By contrast, our study isolated auditory cues and assessed their impact in a controlled, real-time simulation environment among certified EMS professionals.

LIMITATIONS

This study has several limitations. First, it was conducted in a simulated environment, which, although standardized, may not fully replicate the stress and dynamic conditions of real-world cardiac arrest scenarios. Second, chest compression quality was assessed only in terms of rate; other critical metrics such as depth, recoil, and hand positioning were excluded from analysis. Third, while auditory cues were standardized, individual differences in music recognition or preference could have influenced performance in the music groups.

Additionally, the relatively short duration of compressions (two minutes) may not fully capture the effects of fatigue or long-term auditory feedback utility. Finally, the study was limited to a geographically specific cohort of EMS professionals, which may affect the generalizability of findings to broader populations. A study limitation was post-randomization data loss, which reduced the analyzable sample from 57 to 47 participants and may have affected statistical power.

CONCLUSION

In this study, auditory feedback in the form of a metronome or music did not improve—and in some cases may have hindered professional rescuers' ability to maintain guideline-compliant chest compression rates. Given the potential for auditory distractions and the lack of demonstrated benefit in this setting, our findings suggest that the routine use of auditory feedback devices during professional resuscitation efforts may not be necessary. Future research should further explore how feedback modalities influence team performance, communication, and overall resuscitation outcomes in both simulated and clinical settings.

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APPENDIX

Characteristic	Category	N	Percentage (%)
Age Group (Mean Age: 37)	18 - 20	3	5.3
	21 - 30	18	31.6
	31 - 40	18	31.6
	41 - 50	9	15.8
	51 - 60	6	10.5
	61 - 65	3	5.3
Primary Background	Fire	24	42.1
	EMS	30	52.6
	Combined	3	5.3
EMS License	EMR	0	0.0
	EMT	39	68.4
	AEMT	9	15.8
	Paramedic	7	12.3
	PHRN	1	1.8
	Physician	1	1.8
Note: Percentages may not total 100 because of rounding. Ten cases were excluded from final analysis because of data loss related to recording failure / incomplete capture / file corruption.			

Table 1. Participant demographics and background characteristics (N = 57).

Group	Compression Count	Mean	Standard Deviation	% Out of Range
Silence	233, 252, 219, 227, 209, 202, 222, 219, 216, 188, 210, 220	201	10	16.67%
Metronome	221, 229, 222, 195, 207, 220, 220, 220, 220, 212, 216, 256	203	8	16.67%
Music A	219, 209, 209, 208, 195, 207, 216, 210, 215, 230, 197, 186	192	12	25.00%
Music B	232, 260, 221, 226, 216, 232, 225, 186, 224, 223, 226	206	11	18.18%
Note: Music A utilized "Stayin' Alive" by the Bee Gees. Music B utilized "Never Gonna Give You Up" by Rick Astley. "Out of range" was defined as performance outside the predefined target for each study condition. Percentages may not total 100 because of rounding. Ten cases were excluded from final analysis because of data loss related to recording failure / incomplete capture / file corruption.				

Table 2. Chest compressions counts by auditory feedback group.

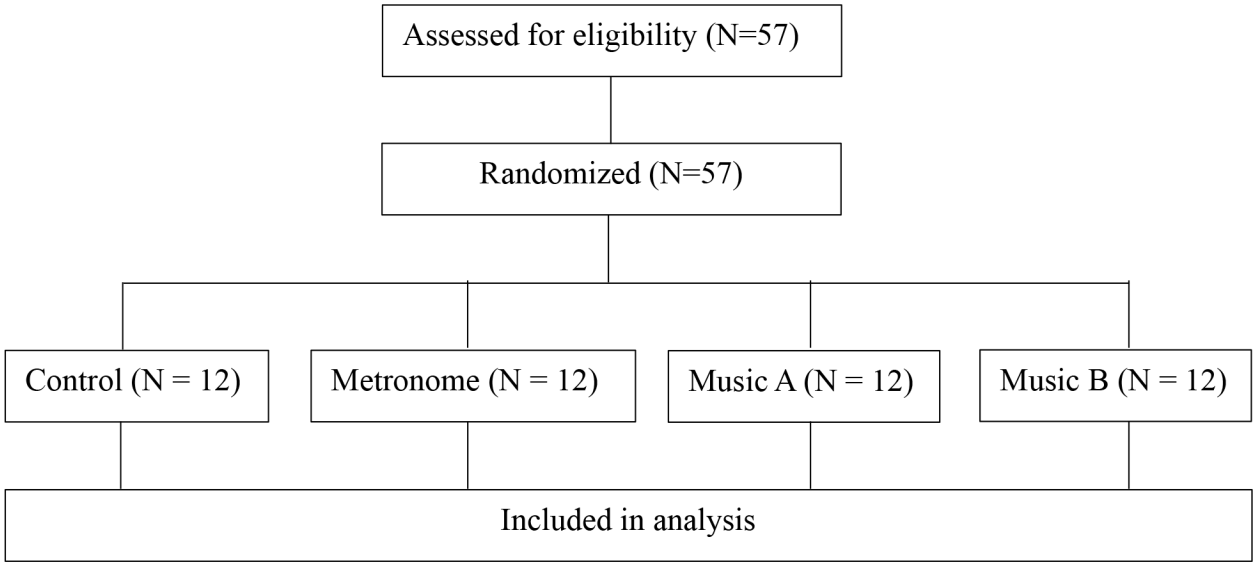

Figure 1. Participant flow through randomization and analysis.

- ☑ COMPLIANCE
- ☑ SCHEDULING
- ☑ EDUCATION
- ☑ QI TRACKING
- ☑ COMMUNICATION

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