Achieving the recommended compression rate in cardiopulmonary resuscitation can be difficult, but music can help to improve skills in the short term

Using music to maintain the correct rhythm during CPR

In this article...
- Chest compression standards
- Use of music in CPR training
- Nurses’ confidence in their skills

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Background Cardiopulmonary resuscitation is a competency required of all health professionals, but they do not always meet chest compression standards.

Method Nurses received a traditional chest compression demonstration or one with music. Their compression rates were measured and compared.

Results After instruction, 66% of nurses who had received demonstration with music performed chest compressions within the recommended range, compared with 41% of those receiving traditional demonstration.

Conclusion Using music when teaching CPR can improve nurses’ performance of chest compressions at the recommended rate.

O
ver 300,000 people die of sudden cardiac arrest in the US each year (Roger et al, 2012). Within the first few minutes of cardiac arrest, cardiopulmonary resuscitation and electronic defibrillation must be delivered to improve the chance of survival (Meaney et al, 2013).

American Heart Association guidelines provide evidence-based strategies to implement during cardiovascular emergencies. The focus of the AHA guidance is to ensure that high-quality CPR is performed in all resuscitation attempts (Meaney et al, 2013).

Because CPR is a critical skill that most practitioners perform rarely, they are required to undergo recertification every two years in the US (Field et al, 2010) and annually in the UK.

However, skill and performance vary and traditional CPR education may not train practitioners adequately to meet standards (O’Connor, 2010; Preusch et al, 2010; Dine et al, 2008). Our study explored whether a music-enhanced intervention would improve nurses’ ability to perform chest compressions at the recommended rate.

Literature review

Chest compression standards

The AHA recommends a lone rescuer performs CPR at a ratio of 30:2 chest compressions to ventilations for infants, children and adults. This ratio reflects the expectation that performing chest compression at a rate of 100 beats per minute will provide systemic perfusion while allowing the heart to refill between compressions.

More specifically, the AHA recommends compressions are delivered at a rate of “at least 100bpm”. The phrase “push hard and push fast” prompts rescuers to adhere to the new compression rate recommendations. The AHA also emphasises the need to ensure full recoil after each compression (Travers et al, 2010).

Chest compression performance

Despite recommendations for certification and recertification in basic life support, our experience and that of others is that healthcare providers inconsistently meet the expected standards of chest compression performance (Carpico and Jenkins, 2011;
Aim and method
The purpose of our study was to examine the effect of music enhancement on nurses' ability to perform chest compressions at the AHA-recommended rate of at least 100bpm, and to retain this competency over time. Nurses' perceived knowledge and confidence in their ability to perform CPR correctly was also evaluated.

We recruited a convenience sample of 69 nurses from a university-affiliated community hospital. All were registered or licensed practical nurses employed in inpatient or outpatient settings who had not been recertified in CPR in the past three months. The study was approved by the institutional review board, and all participants gave informed consent.

Participants were asked to perform chest compressions as a screening measurement without music or verbal prompting for one minute (the pre-instruction measurement). Those whose results were outside the 96-104bpm range were randomly assigned to music enhancement or traditional demonstration. Music enhancement group members selected music from the AHA playlist for the CPR instruction, which has songs appealing to different generations. Participants chose six songs from the 11 available (Table 1).

In 2009, the AHA published a selection of around 40 songs of 100bpm that could be used for CPR instruction (AHA, 2009). Rawlins et al (2009) found using music increased lay people's ability to achieve compression rates close to 100bpm. Little is known about whether music can help practitioners to retain skills in adhering to chest compression standards over time.

Depth of chest compressions
Studies have examined the depth as well as the rate of chest compressions in CPR. Preusch et al (2008) noted that higher chest compression rates increase the likelihood of their being of insufficient depth. This is considered physiologically equal to a pause in CPR (Edelson et al, 2006). Although compression depth was not measured in this project, 120bpm was identified as the upper limit for compression rate.

Music to improve chest compression
Matlock et al (2008) first described the use of music enhancement in training, envisioning music as a “mental metronome”. In their study, the track Stayin’ Alive was used to exemplify the recommended chest compression rate.

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### TABLE 1. SONGS CHOSEN FROM THE AHA PLAYLIST

<table>
<thead>
<tr>
<th>Song</th>
<th>Number (%) of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stayin’ Alive (Bee Gees)</td>
<td>13 (40.6)</td>
</tr>
<tr>
<td>Girls Just Wanna Have Fun (Cyndi Lauper)</td>
<td>7 (21.9)</td>
</tr>
<tr>
<td>Dancing Queen (Abba)</td>
<td>6 (18.8)</td>
</tr>
<tr>
<td>Gives You Hell (All American Rejects)</td>
<td>4 (12.5)</td>
</tr>
<tr>
<td>Suddenly I See (KT Tunstall)</td>
<td>1 (3.0)</td>
</tr>
<tr>
<td>You Can’t Hurry Love (Phil Collins)</td>
<td>1 (3.1)</td>
</tr>
</tbody>
</table>

Source: AHA (2009)
TABLE 2. CHARACTERISTICS OF PARTICIPANTS

<table>
<thead>
<tr>
<th>Variables</th>
<th>All (n=64)</th>
<th>Music group (n=32)</th>
<th>Traditional group (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of nursing experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3</td>
<td>17 (27%)</td>
<td>9 (29%)</td>
<td>8 (25%)</td>
</tr>
<tr>
<td>4-9</td>
<td>17 (27%)</td>
<td>9 (29%)</td>
<td>8 (25%)</td>
</tr>
<tr>
<td>10+</td>
<td>29 (46%)</td>
<td>13 (42%)</td>
<td>16 (50%)</td>
</tr>
<tr>
<td>Years of CPR certification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3</td>
<td>3 (4.8%)</td>
<td>3 (9.7%)</td>
<td>0</td>
</tr>
<tr>
<td>4-9</td>
<td>24 (38.1%)</td>
<td>9 (29%)</td>
<td>15 (46.9%)</td>
</tr>
<tr>
<td>10+</td>
<td>36 (57.1%)</td>
<td>19 (61.3%)</td>
<td>17 (53.1%)</td>
</tr>
<tr>
<td>Times CPR performed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3</td>
<td>40 (62.5%)</td>
<td>16 (50%)</td>
<td>24 (75%)</td>
</tr>
<tr>
<td>4-9</td>
<td>11 (17.2%)</td>
<td>8 (25%)</td>
<td>3 (9.4%)</td>
</tr>
<tr>
<td>10+</td>
<td>13 (20.3%)</td>
<td>8 (25%)</td>
<td>5 (15.6%)</td>
</tr>
</tbody>
</table>

Note: Data are missing for years of nursing experience (ME, n=1), and years of CPR certified (ME, n=1)

For each person in the traditional group, a CPR instructor verbally reviewed the correct rate of compressions and gave a demonstration of compressions without music. All were given instructor feedback.

After the music enhancement or traditional demonstration, each participant performed chest compressions for one minute without any music or verbal prompting (the post-instruction measurement). Six weeks later, they performed a third one minute of chest compressions without music or verbal prompting (the follow-up measurement).

Two identical Little Anne CPR manikins were used for all chest compression demonstrations. For consistency, these were placed on a hard surface and at an appropriate height so each participant could imitate compressions that are done in bed or on the floor. A stopwatch was used to measure compressions for 60 seconds.

We also developed a knowledge and confidence of CPR performance questionnaire, using a five-point Likert scale (1=strongly disagree to 5=strongly agree) to evaluate participants’ perceptions of the educational sessions. Participants completed the questionnaire at the first session and again at a six-week follow-up. Those in the music enhancement group were asked to answer two additional questions about music enhancement and its perceived effect on their performance and skill retention. Mean scores were evaluated and compared between the two groups.

Characteristics of participants

Five of the 69 nurses recruited (7.2%) were excluded because their initial compression measurement fell within the predetermined range. The remaining 64 were randomised to the music enhancement (n=32) and the traditional (n=32) groups. Three in the music group withdrew because they were unable to participate in the post-education measurement. For one person in the traditional demonstration group, data was missing from the questionnaire collected at the six-week survey. We therefore collected six-week follow-up data from a total of 29 participants in the music enhancement group and 31 in the traditional demonstration group (Fig 1).

Sixty-two participants (96.9%) were registered nurses and two (3.1%) were licensed practical nurses. Twenty-nine (46%) had more than 10 years of nursing experience and 36 (57.1%) had been certified in CPR for the same length of time. Eleven participants (17.2%) had performed CPR 4-9 times previously, while 13 (20.3%) had performed it 10 times or more. There were no statistically significant differences between the groups in age, educational preparation, years of nursing experience, years certified in CPR or number of times they had performed CPR (Table 2).

Results

Achievement of target compression rate

Immediately after the education and practice session, the mean +/- standard deviation compression rate of nurses in the music enhancement group was 106.7 +/- 9bpm – well within the recommended range of 100-120bpm; in the traditional demonstration group, the mean compression rate was 99.1 +/- 8bpm (Table 3). Only 13 (41%) of traditional demonstration participants had compression rates within the target range, compared with 21 (66%) of the music enhancement subjects.

Yet, at six-week follow-up, the groups were comparable, with a mean rate of 103.9 +/-14bpm in the music group and 100.9 +/-12bpm in the traditional group. However, before the intervention, there was a difference between the groups. The music enhancement group had a mean compression rate of 121.5 +/-16, while the traditional group’s mean rate was 110.2 +/-30, even though both had the same number of subjects in the target range (10 each) (Table 3). The traditional demonstration group had a much larger variation in compression rates, with 29.6 compared with 16 standard deviations. Before instruction, there was a higher rate in those assigned to the music intervention. All participants improved, but the change in score between them was not statistically significant.

Examination of individual trajectories across the protocol showed that, before group assignment, the traditional demonstration group had the largest outliers in compression rates (30-180bpm, compared with 80-150bpm in the music enhancement group). This finding gave the traditional demonstration participants the greatest room to improve. After the intervention, more of these participants had rates below 100bpm – except for one who started far below 100bpm whose post-intervention was rate far above 120bpm – while most music enhancement participants were within the 100-120bpm target.

Knowledge and confidence of CPR performance

The mean knowledge and confidence questionnaire score did not differ between groups at pre-instruction or follow-up. The average change in score was significant, indicating that all students had more favourable attitudes about CPR instruction after the course.

Limitations

The study had several limitations. Participants were randomised to the two groups without stratifying by pre-instruction measurements. By chance, the traditional demonstration group had a greater variance in compression rates, which gave them the greatest opportunity to improve. Stratification by initial compression rates would have balanced the outliers between groups. Analysis of compression performance based on years of CPR certification and years as a nurse was not completed.

As previously noted, an increase in compression rate can inversely affect the depth of compression (Preusch et al, 2010). This study measured only chest compression rates, not their depth. To ensure that AHA (2010) recommendations are met, health professionals need to demonstrate compliance with both rate and depth standards.
Conclusion
This study found music enhancement improved nurses’ ability to demonstrate the recommended chest compression rate for CPR immediately after the education and practice session. Music enhancement may improve their ability to maintain the correct rate of compressions during recertification more than traditional instruction.

However, group differences were not sustained in the long term, in part because the traditional group had more to gain and showed continued improvement. At the six-week follow-up, compressions in the recommended range fell slightly in the music enhancement group from 65.6% to 62%, but rose in the traditional demonstration group from 40.6% to 48% (Table 3). This suggests that music enhancement did not improve retention of the recommended compression rate. Reasons for this are unclear given the relatively short interval between the initial session and retesting.

Retention of the correct chest compression rate is vital, since performing compressions at a rate outside the recommended range can limit cardiac perfusion (Edelson et al, 2006). The physical work associated with excessive compression rates can quickly lead to rescuer fatigue, which can decrease the quality of chest compressions (Jäntti et al, 2009). CPR instructors should reinforce feedback so that health professionals can accomplish the recommended compression rate and maintain their skills over time.

The baseline measurements identified in this study indicate that few experienced nurses perform chest compressions at the recommended rate despite having had CPR training. More frequent revision of chest compression skills seems necessary. The study found both groups improved dramatically from baseline, but their six-week follow-up showed performance decay and the need for ongoing training. This confirms that CPR compression performance is highly variable (Dine et al, 2008).

Recommendations
Practice sessions in a structured setting or on a self-serve basis, using equipment with self-monitoring capabilities, are necessary. We suggest employers consider providing frequent, brief practice sessions to promote accurate performance of chest compressions in CPR and to maintain these skills. Recording and feedback devices that measure rate and depth of compressions can be used to assess performance.

Practice sessions should include debriefing that supports rescuers’ self-assessment of their psychomotor skills. "Nonjudgmental" debriefing: a theory and method (Rudolph et al, 2006). The debriefing allows the instructor to share critical and appreciative insights regarding the simulation experience. The debriefing should focus not only on the rescuers’ actions but also on their cognitive frame of reference, which ultimately influences their actions. Using positive debriefing allows the rescuer to learn in a judgement-free environment (Rudolph et al, 2006).

The results of the knowledge and competence questionnaire showed initial improvement at the first measurement, but no significant differences between the groups at six weeks. This may be related to participants in both groups stating that they had high personal expectations of accurately performing compressions to provide high-quality patient care and meet the expectations of their job description.

Future subjects for study should include the measurement of chest compression depth. As the rate of compressions increases, their depth decreases, which supports the need for determining an upper level of chest compression performance. Studies should also examine the minimum frequency for compression practice and evaluation. The AHA recommendation of recertification every two years should be reviewed in the US. Repeated practice of CPR with feedback can influence performance, ensuring success in chest compression rate and depth. NT

References
American Heart Association (2009) 100bpm Hits. bethebeat.heart.org/article/pdf-257

TABLE 3: COMPARISON OF MEASUREMENTS OVER TIME

<table>
<thead>
<tr>
<th>Variable</th>
<th>Music group</th>
<th>Traditional group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression rate mean bpm (+/-standard deviation)</td>
<td>Pre-instruction 121.5 (+/-16.0) 110.2 (+/-29.6)</td>
<td>Follow-up 125.0 (+/-32.4) 112.4 (+/-25.2)</td>
</tr>
<tr>
<td></td>
<td>Post-instruction 106.7 (+/-9.1) 99.3 (+/-9.0)</td>
<td>Follow-up 103.9 (+/-14.3) 100.9 (+/-12.2)</td>
</tr>
<tr>
<td>Students in range 100-120bpm (%)</td>
<td>Pre-instruction 10 (31) 10 (31)</td>
<td>Follow-up 10 (31) 10 (31)</td>
</tr>
<tr>
<td></td>
<td>Post-instruction 21 (66) 13 (41)</td>
<td>Follow-up 18 (62) 15 (48)</td>
</tr>
<tr>
<td>CPR knowledge and confidence, mean</td>
<td>Pre-instruction 4.14 3.92</td>
<td>Follow-up 4.36 4.28</td>
</tr>
</tbody>
</table>

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