Metronome Implementation in Emergency Department Cardiac Arrest Patients: an Evidence Based Initiative

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- Leslie Konizer

• No conflicts of interest
Background

- Nationwide, nearly 290,000 in-hospital cardiac arrests (IHCA) occur\(^1\)

- Expansive research supports following the American Heart Association’s (AHA) cardiopulmonary resuscitation (CPR) guidelines\(^2\)
  - One of the AHA’s pillars of high-quality CPR recommends compressing the chest at 100-120 beats per minute\(^4\)

- A popular strategy taught HCPs to sing a song while compressing the chest such as “Stayin’ Alive” by the Bee Gees\(^3\)
There are 5 critical components to high quality CPR

1) provide chest compressions of adequate rate between 100-120 beats/min
2) minimize interruptions in chest compressions
3) provide chest compressions of adequate depth
4) avoid leaning between compressions/proper recoil
5) avoid excessive ventilation (Meaney et al., 2013)

BLS > ACLS
Metronome

• In 2015, AHA updated their CPR guidelines recommending use of a CPR feedback device or tool to provide real-time guidance during cardiac arrest events.

• CPR feedback tool that produces an audible ticking sound at regular intervals.
Clinical Problem/Significance

Chest compression rates vary greatly

Clinical inquiry by one of the ED nurses

Research has demonstrated a metronome's audible cues improve chest compression rates and decrease chest compression variability

The metronome was not used during cardiac arrest events in ChristianaCare’s Emergency Department prior to 2019.
Opportunity for a practice change

Based on clinical observations and familiarity of metronome evidence, an interprofessional practice change initiative was started.

The John Hopkins Nursing Evidence-Based Practice model guided the steps involved with this change.
Practice Question

<table>
<thead>
<tr>
<th>P</th>
<th>Cardiac arrest patients residing in ChristianaCare’s three EDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Audible metronome CPR feedback tool</td>
</tr>
<tr>
<td>C</td>
<td>No CPR feedback tool</td>
</tr>
<tr>
<td>O</td>
<td>Maintain AHA’s recommended 100-120 compressions/minute</td>
</tr>
</tbody>
</table>

The purpose of this *nurse-led interdisciplinary* EBP initiative was to standardize HCP chest compression delivery during IHCA events in alignment with the AHA’s recommended chest compressions rate of 100-120 beats per minute by incorporating auditory cues from a metronome.
## Evaluating the evidence

### Appendix H

**Synthesis Process and Recommendations Tool**

**EBP Question:** In adult cardiac arrest patients residing in the emergency department, does an audible metronome maintain compliance of current AHA recommended chest compression rates delivered by health care providers?

<table>
<thead>
<tr>
<th>Category (Level Type)</th>
<th>Total Number of Sources/Level</th>
<th>Overall Quality Rating</th>
<th>Synthesis of Findings Evidence That Answers the EBP Question</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level I</strong></td>
<td></td>
<td></td>
<td>• Compressions of either rate with metronome produce better end-tidal CO₂ (p&lt;0.01).</td>
</tr>
<tr>
<td>• Experimental study</td>
<td></td>
<td></td>
<td>• Ventilation and compression rates improved with metronome (p&lt;0.01)</td>
</tr>
<tr>
<td>• Randomized controlled trial (RCT)</td>
<td></td>
<td></td>
<td>• Guideline rates achieved more with metronome than without (p&lt;0.001)</td>
</tr>
<tr>
<td>• Systematic review of RCTs with or without meta-analysis</td>
<td>4</td>
<td>B</td>
<td>• Statistically significant improvement in the mean percentage of compressions delivered within adequate rate with metronome vs. compared to off</td>
</tr>
<tr>
<td>• Explanatory mixed method design that includes only a Level I qualitative study</td>
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<tr>
<td><strong>Level II</strong></td>
<td></td>
<td></td>
<td>• Chest compressions rates closer to 85 to 100 bpm are significantly associated with improved survival from cardiac arrest</td>
</tr>
<tr>
<td>• Quasi-experimental studies</td>
<td></td>
<td></td>
<td>• Compression rates increased with metronome (p=0.01) and ETCO₂ levels increased with metronome use (p=0.01)</td>
</tr>
<tr>
<td>• Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis</td>
<td>2</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>• Explanatory mixed method design that includes only a Level II qualitative study</td>
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<tr>
<td><strong>Level III</strong></td>
<td></td>
<td></td>
<td>• In control group with no metronome use, there was large variability in median chest compression rate and in proportion of CC with appropriate rate (p&lt;0.0001)</td>
</tr>
<tr>
<td>• Nonexperimental study</td>
<td></td>
<td></td>
<td>• Chest compression rates 100-120 had highest survival, compression rates lower than 100 bpm or 120 bpm or higher were associated with decreased survival</td>
</tr>
<tr>
<td>• Systematic review of a combination of RCTs, quasi-experimental and nonexperimental studies, or nonexperimental studies only, with or without meta-analysis</td>
<td>6</td>
<td>B</td>
<td>• Variability in chest compression rate and depth was significantly greater during transport and in the ED compared to scene (p&lt;0.01)</td>
</tr>
<tr>
<td>• Qualitative study or meta-synthesis</td>
<td></td>
<td></td>
<td>• AHA Guideline rates achieved more with metronome than without (p&lt;0.001)</td>
</tr>
<tr>
<td>• Exploratory, convergent, or multiphasic mixed-methods studies</td>
<td></td>
<td></td>
<td>• Higher chest compression rates &gt;100 were significantly correlated with initial return of spontaneous circulation</td>
</tr>
<tr>
<td>• Explanatory mixed method design that includes only a level III quantitative study</td>
<td></td>
<td></td>
<td>• The quality of parameters of CPR such as chest compression rates, were inconsistently and often did not meet published AHA guideline recommendations when performed by well-trained hospital staff.</td>
</tr>
</tbody>
</table>
Prior to Translation

- Engaging key nursing and physician leadership stakeholders
- Approvals to use Code Stat™ software
- Clinical engineering involvement
- Coordination to obtain internal code blue documentation and Code Stat data
- Discussions with Stryker to understand their data output
- Realizing data output limitations
- IRB approval
- Metronome educational workshops were given to HCPs explaining the purpose, benefit, and practical use of the tool.
- Annotation training
Translation

Patient Population
• All cardiac arrest patients in all 3 EDs ranging from 0-110 years old

Exclusion criteria:
• Attending physician decision to opt out of metronome use on Physio-Control monitor during resuscitation
• Use of a mechanical CPR device (LUCAS)

What will be measured?
• Chest compression rates delivered by health care providers during the length of resuscitation
• Pre-metronome data October 2018 – May 2019
• Post-metronome data May 2019-November 2019

How will it be measured?
• Code Stat CPR report – minute by minute chest compression rate after initiation of metronome feature

How often will it be measured?
• Entire length of the resuscitation – minute by minute in every code in the emergency department
Practice Change Outcomes

• **Pre-metronome**
  - Only 34% (n=95) of chest compressions delivered within the AHA’s recommended guidelines
    - Majority of chest compressions were greater than 120 beats per minute (n=167, 61%).

• **Post-metronome**
  - 78.8% (n=372) of chest compressions delivered within the AHA’s recommended guidelines
    - Majority of chest compressions delivered were within 100-120 beats/minute, with a considerable decrease in compressing the chest faster than 120 beats per minute (n=33, 7%).
Practice Change Outcomes

• **Pre-metronome**
  • Substantial chest compression range from 89-207.

• **Post-metronome**
  • Vast improvement and less variation in range from 86-135.
Current Metronome Compliance:

Utilizing metronome **100%** of the time!
Lessons Learned

What has worked
- Hands on educational sessions
- Reminders to turn on metronome were listed on monitor and code carts
- Giving timely feedback to every code blue team member
- Using ED data to change practice hospital-wide

Areas for improvement
- Standardized education for new staff and/or yearly competency
- Nurse advocacy for metronome use with every HCP giving chest compressions

Barriers
- Knowledge of best practice
- Perceptions to change
Path Forward

- Sustained behavior and culture change in all three EDs
- **Compliance rate** using the metronome has remained at **100%**.
- Approved for hospital-wide implementation across both Christiana and Wilmington campuses.
- Continued education for staff and providers
Nursing Implications

• Metronome implementation was a *practical* and *cost-effective* tool improving CPR compression rates for ICHA patients.

• Metronome use decreased chest compression rate variability and greatly improved the ability for HCPs to hit target chest compression range of 100-120 beats per minute.

• Evidence-based practice is a pillar of professional practice – not just a project

• Incorporating the best evidence into practice is a profound way to help an exponential number of patients

• This initiative showcased to multiple disciplines throughout the health system how front-line nurses can be at the vanguard of cardiac arrest care - leading by example, assessing gaps in practice, and applying best evidence to clinical practice.
QUESTIONS?

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References

1. Anderson, Holmberg, Berg, Donnino, & Grandfeldt, 2019
2. Wallace, Abella and Becker, 2013