

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



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 - Leslie Konizer
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- No conflicts of interest





Background

- Nationwide, nearly 290,000 in-hospital cardiac arrests (IHCA) occur¹
- Expansive research supports following the American Heart Association's (AHA) cardiopulmonary resuscitation (CPR) guidelines^{1,2}
 - One of the AHA's pillars of high-quality CPR recommends compressing the chest at 100-120 beats per minute⁴
- A popular strategy taught HCPs to sing a song while compressing the chest such as "Stayin' Alive" by the Bee Gees³



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 events⁴
- 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

P

- Cardiac arrest patients residing in ChristianaCare's three EDs

I

- Audible metronome CPR feedback tool

C

- No CPR feedback tool

O

- Maintain AHA's recommended 100-120 compressions/minute

- 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.



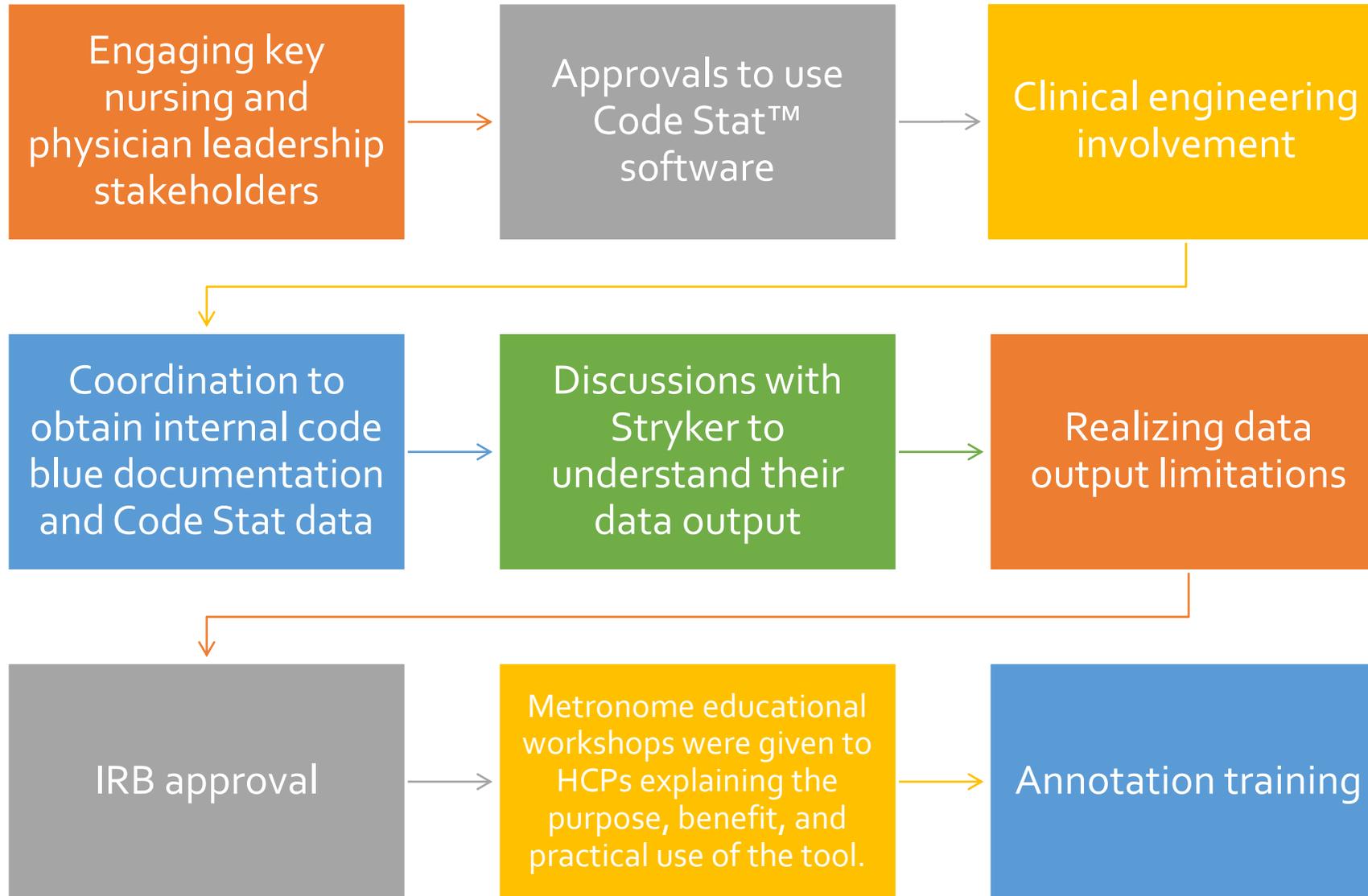
Evaluating the evidence

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?			
Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings Evidence That Answers the EBP Question
Level I <ul style="list-style-type: none"> ▪ Experimental study ▪ Randomized controlled trial (RCT) ▪ Systematic review of RCTs with or without meta-analysis ▪ Explanatory mixed method design that includes only a Level I quantitative study 	4	B	<ul style="list-style-type: none"> • Compressions of either rate with metronome produce better end-tidal CO₂ (p<0.01), • Ventilation and compression rates improved with metronome (p<0.01) • Guideline rates achieved more with metronome than without (p<0.001) • Statistically significant improvement in the mean percentage of compressions delivered within adequate rate with metronome on compared to off
Level II <ul style="list-style-type: none"> ▪ Quasi-experimental studies ▪ Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis ▪ Explanatory mixed method design that includes only a Level II quantitative study 	2	B	<ul style="list-style-type: none"> • Chest compressions rates closer to 85 to 100 bpm are significantly associated with improved survival from cardiac arrest • Compression rate increased with metronome (p<0.01) and ETCO₂ levels increased with metronome use (p.<0.01)
Level III <ul style="list-style-type: none"> ▪ Nonexperimental study ▪ Systematic review of a combination of RCTs, quasi-experimental and nonexperimental studies, or nonexperimental studies only, with or without meta- analysis ▪ Qualitative study or meta- synthesis ▪ Exploratory, convergent, or multiphasic mixed-methods studies ▪ Explanatory mixed method design that includes only a level III Quantitative study 	6	B	<ul style="list-style-type: none"> • 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<0.0001) • Chest compression rates 100-120 had highest survival, compression rates lower than 100 bpm or 120 bpm or higher were associated with decreased survival. • Variability in chest compression rate and depth was significantly greater during transport and in the ED compared to scene (p<0.01) • AHA Guideline rates achieved more with metronome than without (p<0.001) • Higher chest compression rates >100 were significantly correlated with initial return of spontaneous circulation • The quality of parameters of CPR such as chest compression rates, were inconsistent and often did not meet published AHA guideline recommendations when performed by well-trained hospital staff.



Prior to Translation



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

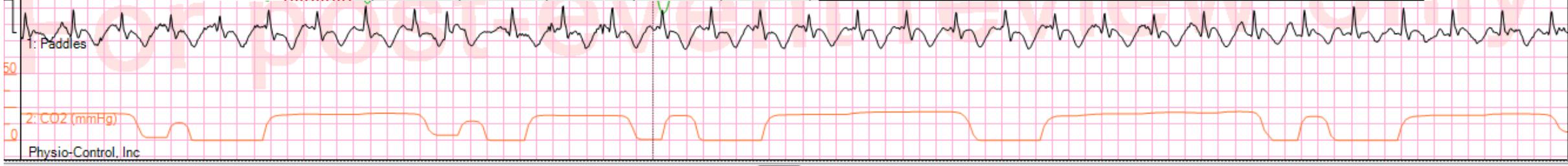
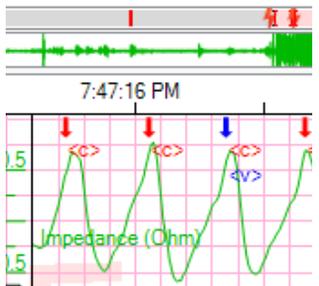
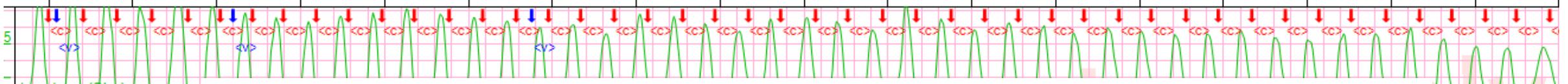
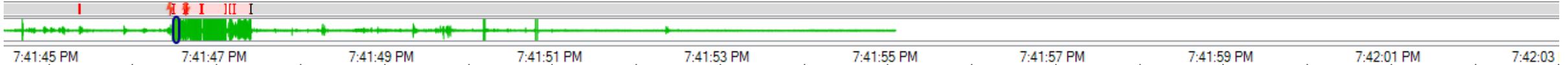
How will it be measured?

- Code Stat CPR report – minute by minute chest compression rate after initiation of metronome feature

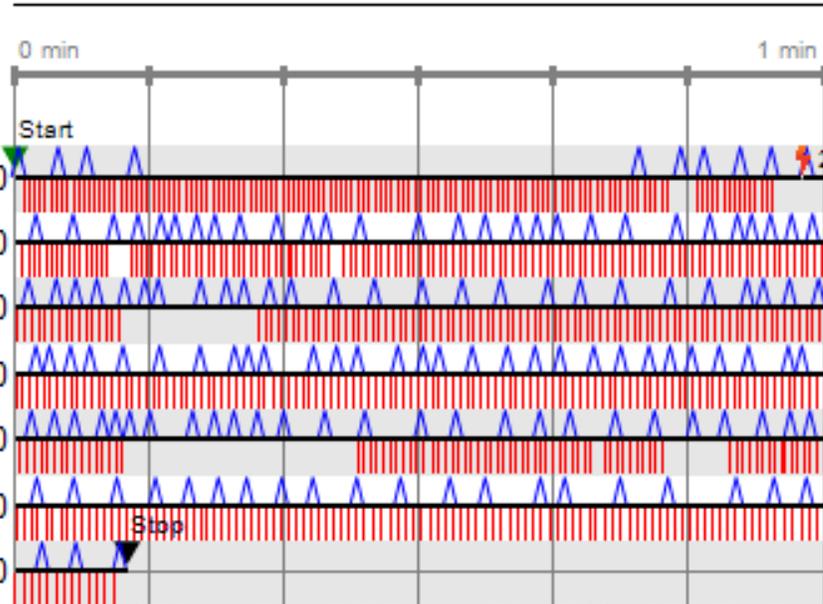
How often will it be measured?

- Entire length of the resuscitation – minute by minute in every code in the emergency department



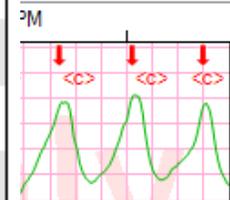


CPR QUIK-VIEW



Interval Statistics

	Compr. ratio, %	Compr. rate
0:00 - 1:00	94	145
1:00 - 2:00	100	125
2:00 - 3:00	85	120
3:00 - 4:00	100	116
4:00 - 5:00	66	125
5:00 - 6:00	100	105
6:00 - End	94	99



Practice Change Outcomes

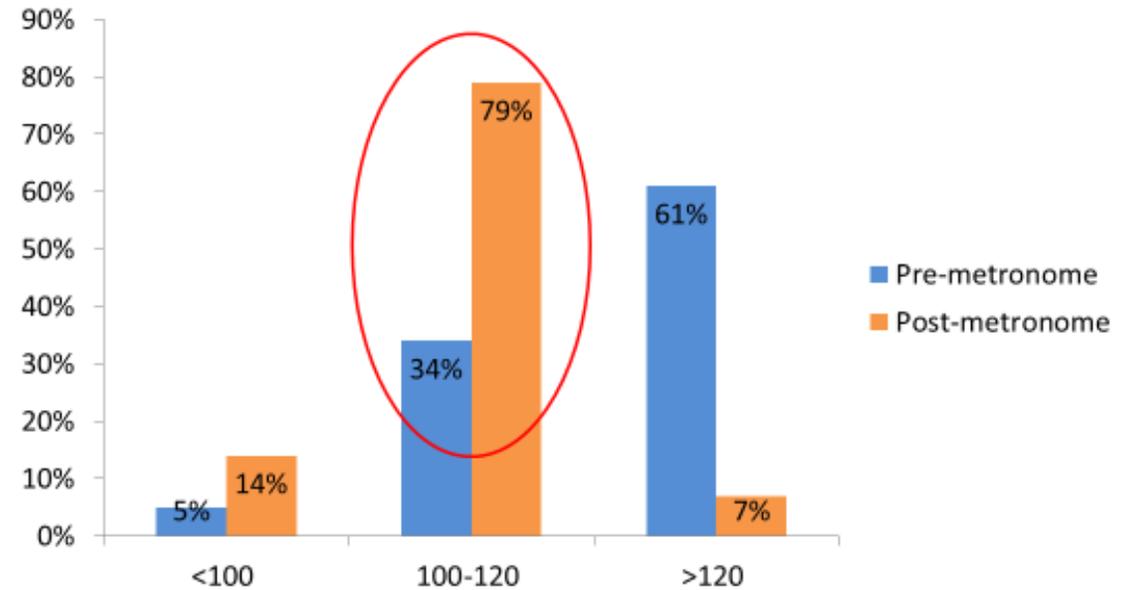
- **Pre-metronome**

- 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%).

Chest Compressions per Minute



Practice Change Outcomes

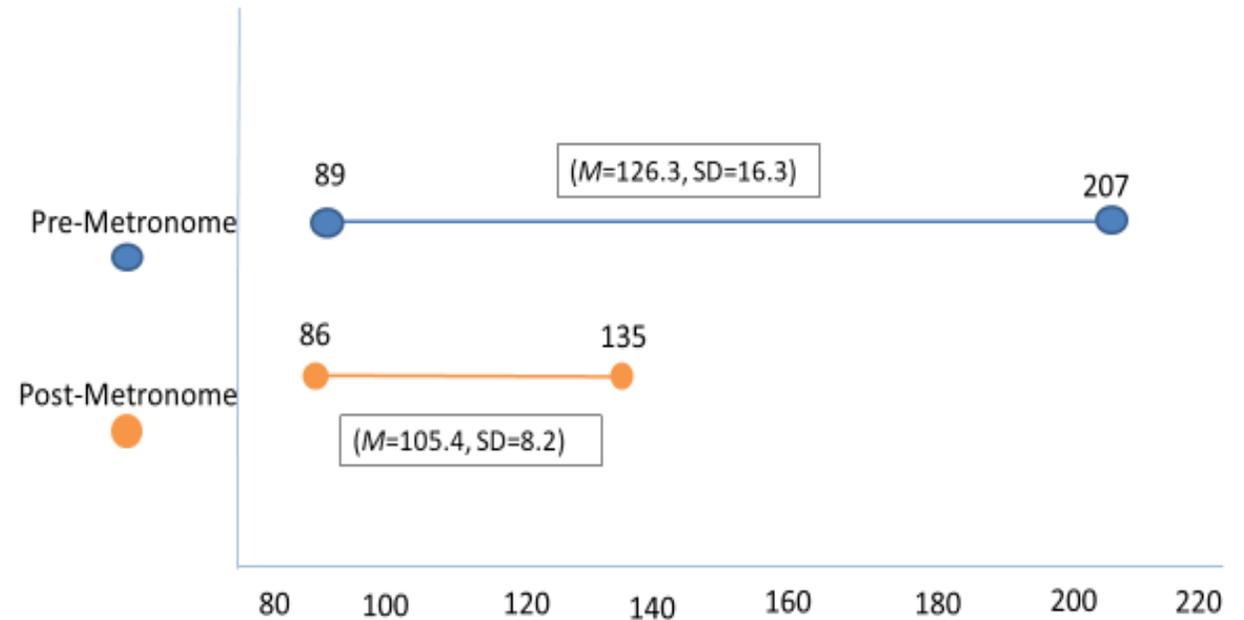
- **Pre-metronome**

- Substantial chest compression range from 89-207.

- **Post-metronome**

- Vast improvement and less variation in range from 86-135.

Chest Compression Range



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
- 3. Hafner, Sturgell, Matlock, Bockewitz & Barker, 2012
- 4. American Heart Association. (2015). Highlights of the 2015 American heart association guidelines update for CPR and ECC. Retrieved from: <https://eccguidelines.heart.org/wp-content/uploads/2015/10/2015-AHA-Guidelines-Highlights-English.pdf>