OUT OF THE (FEEDBACK) LOOP: WHAT THE BIG APPLE HAS LEARNED ABOUT QUALITY CPR

John Freese, MD
Chief Medical Director
Fire Department of New York (FDNY)
Background

NYC Cardiac Arrest Survival
- PHASE study
- Dr. Gary Lombardi
- 1994, JAMA
Background

PHASE Study
- Dr. Gary Lombardi
- 1994, JAMA
- Overall survival = 1.4%
- Survival (witnessed, cardiac)
  - ROSC: 28.2%
  - admission: 15.5%
  - discharge: 2.1%
NYC Cardiac Arrest Survival
- PHENYCS study
- Dr. Neal Richmond
- merger of EMS and FDNY
- cost > $1 billion
- increased AEDs
- 2-3x increase in ambulances
Background

PHENYCS Study

- Dr. Neal Richmond
- response time 11.4 minutes → 4.7 minutes
### Background

<table>
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<tr>
<th>PHASE</th>
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<td>Overall Survival</td>
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Feedback Loop

NYC Cardiac Arrest Survival
Background

Chain of survival

- Early recognition and call for help
  - to prevent cardiac arrest

- Early CPR
  - to buy time

- Early Defibrillation
  - to restart the heart

- Post resuscitation care
  - to restore quality of life
Background
## Background

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**Bystander Witnessed, Cardiac Etiology**

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Background
Background
Feedback Loop

What defines quality CPR (compressions)?
Quality CPR

- compression rate
  + limited interruptions
  + compression fraction
  - compression depth
  - complete release
  - limited ventilation
Q: “There’s been a lot of talk about compression fraction, and I’m wondering – can you tell us how quickly you get that information back to your providers?”
# Feedback Loop

### Episode Summary:
- **Episode start time**: 1/14/2011 17:57:58 PM
- **Total length of episode**: 01:07:10.4
- **Total number of shocks**: 0
- **Time device on**: 1/14/2011 17:56:52 PM
- **Time device off**: 1/14/2011 18:49:42 PM
- **Total time excluded from statistical calculations**: 00:00:00.0

### Compression Data
- **Total number of compressions**: 578
  - Total compressions with adequate depth: 414
  - Total compressions with insufficient depth: 164
  - Total compressions with incomplete release: 43
- **Average compression rate [1/min] [90-100]**: 134
- **Average compression depth [1/mm] [30-38]**: 45
- **Adequate depth [%]**: 71.5
- **Average compression counts [1/min]**: 86

### No Flow Time:
- **Flowtime [%]**: 63.7
- **Average no flow time before shock [s]**: 00:00:00.0
- **Average no flow time after shock [s]**: 00:00:00.0
- **No flowtime**: 00:00:24.8

### Defibrillation Data:
- **Time from power on to first shock**: 00:00:00.0
- **Total analyses and shock delivery time**: 00:00:00.0
- **Average analyses and shock delivery time**: 00:00:00.0
## Episode Summary:

- **Episode start time**: 1/1/2011 4:47:16 PM
- **Total length of episode**: 00:35:53.2
- **Total number of shocks**: 0
- **Time device on**: 1/1/2011 4:47:12 PM
- **Time device off**: 1/1/2011 5:56:51 PM
- **Total time excluded from statistical calculations**: 00:00:00.0

## Compression Data:

- **Total number of compressions**: 3517
- **Total compressions with adequate depth**: 3311
- **Total compressions with insufficient depth**: 206
- **Total compressions with incomplete release**: 129
- **Average compression rate [1/min] [90-120]**: 120
- **Average compression depth [mm] [38-51]**: 43
- **Adequate depth [%]**: 94.1
- **Average compression counts [1/min]**: 98

## No Flow Time:

- **Flow time [%]**: 81.3
- **Average no flow time before shock [s]**: 00:00:00.0
- **Average no flow time after shock [s]**: 00:00:00.0
- **No flow time**: 00:06:43.5

## Defibrillation Data:

- **Time from power on to first shock**: 00:00:00.0
- **Total analysis and shock delivery time**: 00:00:00.0
- **Average analysis and shock delivery time**: 00:00:00.0
**Feedback Loop**

### Episode Summary:
- Total length of episode: 00:31:22.7
- Total number of shocks: 0
- Time device off: 1/8/2011 4:33:08 PM
- Total time excluded from statistical calculations: 00:00:00.0

### Compression Data:
- Total number of compressions: 2350
- Total compressions with adequate depth: 161
- Total compressions with insufficient depth: 2189
- Total compressions with incomplete release: 157
- Average compression rate [1/min] [90-120]: 145
- Average compression depth [mm] [38-51]: 25
- Adequate depth [%]: 6.9
- Average compression counts [1/min]: 75

### No Flow Time:
- Flow time [%]: 50.6
- Average no flow time before shock [s]: 00:00:00.0
- Average no flow time after shock [s]: 00:00:00.0
- No flow time: 00:15:30.8

### Defibrillation Data:
- Time from power on to first shock: 00:00:00.0
- Total analysis and shock delivery time: 00:00:00.0
- Average analysis and shock delivery time: 00:00:00.0
# Feedback Loop

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Feedback Loop

Case ID: 11012017103560
Case date: 1/30/2011
Device: HeartStart MRx: US00545193

Patient ID:
First name: 
Last name: 

**Episode Summary:**
- Episode start time: 1/30/2011 5:31:41 PM
- Total length of episode: 00:39:56:6
- Total number of shocks: 7
- Time device on: 1/30/2011 5:31:41 PM
- Time device off: 1/30/2011 5:39:41 PM
- Total time excluded from statistical calculations: 00:00:00:0

**Compression Data:**
- Total number of compressions: 2866
- Total compressions with adequate depth: 121
- Average compression rate [rpm] [30-120]: 67
- Adequate depth [%]: 74
- Average compression depth [mm] [38-51]: 31
- No Flow Time:
  - Flow time [%]: 70.1
  - Average no flow time before shock [s]: 00:00:04:2
  - Average no flow time after shock [s]: 00:00:04:2
  - No flow time: 00:00:04:2

---

Case ID: 11012017103560
Case date: 1/30/2011
Device: HeartStart MRx: US00545193

Patient ID:
First name: 
Last name: 

**Episode Summary:**
- Episode start time: 1/30/2011 10:29:51 AM
- Total length of episode: 00:11:36:9
- Total number of shocks: 1
- Time device on: 1/30/2011 10:28:49 AM
- Time device off: 1/30/2011 10:45:08 AM
- Total time excluded from statistical calculations: 00:00:00:0

**Compression Data:**
- Total number of compressions: 780
- Total compressions with adequate depth: 222
- Total compressions with insufficient depth: 558
- Total compressions with incomplete release: 14
- Average compression rate [rpm] [30-120]: 121
- Average compression depth [mm] [38-51]: 31
- Adequate depth [%]: 29.5
- Average compression counts [rpm]: 67
- No Flow Time:
  - Flow time [%]: 54.2
  - Average no flow time before shock [s]: 00:00:16:2
  - Average no flow time after shock [s]: 00:00:16:2
  - No flow time: 00:00:16:2
Feedback Loop
CPR Feedback

“The quality of unprompted CPR in both in-hospital and out-of-hospital cardiac arrest events is often poor, and methods should be developed to improve the quality of CPR delivered to victims of cardiac arrest. Several studies have demonstrated improvement in chest compression rate, depth, chest recoil, ventilation rate, and indicators of blood flow such as end-tidal CO2 (PETCO2) when real-time feedback or prompt devices are used to guide CPR performance. However, there are no studies to date that demonstrate a significant improvement in patient survival related to the use of CPR feedback devices during actual cardiac arrest events. Other CPR feedback devices with accelerometers may overestimate compression depth when compressions are performed on a soft surface such as a mattress because the depth of sternal movement may be partly due to movement of the mattress rather than anterior-posterior (AP) compression of the chest. Nevertheless, real-time CPR prompting and feedback technology such as visual and auditory prompting devices can improve the quality of CPR (Class IIa, LOE B).”
Q: “There’s been a lot of talk about compression fraction, and I’m wondering – can you tell us how quickly you get that information back to your providers?”

A: Immediately
Feedback Loop
Background
Feedback Loop

One Final Note – Voice Prompts

GO AHEAD, YOU SON-OF-A-BITCH,
GIVE IT A TURN!
I WORK BETTER UNDER PRESSURE!
Feedback Loop

Voice Prompts
Feedback Loop

One Final Note – Voice Prompts
Conclusions

- measuring CPR performance is critical for quality improvement
- call review / post-event summaries / resuscitation rounds are fantastic
  …but don’t help the patient in question
- quality compressions require attention to more than compression fraction
- real-time CPR feedback improves immediate outcomes
- voice prompts may further improve performance (peer pressure)
Thank you