Evolving CPR Training through Improved Technology

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Cognitive Models and Agents Branch
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• Suzan Kardong-Edgren, Robert Morris University, Project Coordinator, received salary support

• Schools of Nursing (study sites) received a stipend

• Nursing students received honorarium for participating
10 SON Site Coordinators

- Carroll Community College- MD-Nancy Rogers
- Chamberlain SON- Atlanta-Gina Causey
- Chamberlain SON- Chicago-Kesha Love
- Chamberlain SON- St. Louis-Erica Frost
- Chamberlain SON- Houston- Angela Willis
- Duke University- NC-Margie Molloy
- Indiana Univ of PA- PA-Julie Greenawalt
- Robert Morris Univ- RMU-Janice Sarasnick
- Seattle Univ- WA-Carrie Miller
- Springfield Technical College- MA-Jackie McColgan
CPR Training

• Standard: Fixed biennial CPR refresher training
• Goal: Individualized CPR refresher training using the Predictive Performance Optimizer (PPO)
  – Reduce patient risk
  – Reduce training time
State of the Science

• Learn fast…forget fast…

• Subjectivity of the CPR educator
  – Are compressions deep enough? Fast enough?
  – Do ventilations have enough volume? Rate?

• CPR skill decay is rapid
  – By 6-9 months skills have decayed

• How often is practice required to refresh skills?
Our Prior Study-2008

• Examined effects of monthly practice (6 mins) on students’ CPR psychomotor skill performance
  – At 3, 6, 9, and 12 months
  – After retraining in BLS at 12 months

• Compared to control group with no practice
Prior Study-Methods

- Ten schools of nursing randomized into 1 of 2 types of AHA BLS Healthcare Provider courses:
  1. HeartCode™ BLS with Voice Advisory Manikin (VAM) feedback, or
  2. Standard instructor-led training with traditional manikins
- Students (n=606) were then randomly assigned to either:
  1. Experimental (monthly practice on VAM) or
  2. Control (no practice)
Prior Study-Conclusions

• Brief monthly practice was effective for maintaining CPR skills
• Need deliberate practice of CPR skills similar to other clinical skills
• Self-directed CPR practice on manikin with some form of automated feedback was viable option for maintaining competence
Current Study-2015
Predictive Performance Optimizer (PPO)

• Tracks factors influencing learning & retention
  1. Amount of practice (frequency)
  2. Time since practice (recency)
  3. Temporal spacing of practice

• Validated across both knowledge and skill-based tasks
• Improves training efficiency
  – Shifts from calendar-based training to individualized schedule
  – Minimizes training costs/time while maximizing performance effectiveness
  – Demonstrates high predictive validity ($R^2 = 0.94$)

*U.S. Patent No. 8,568,145, 8,777,628
Predictive Performance Optimizer (PPO)

• Looks at learning trends across multiple data points
• Timing of training return varies by the individual
• Based on how well you perform CPR initially, PPO predicts individual skill decay and when to come back to refresh skills
Current Study

• 4 training sessions followed by retention session
  – CPR compressions and ventilations
  – Pretest, training, posttest design
  – Memory task (remember Japanese words)
• Spacing of Training:
  – 1 day / 1 week / 1 month / 3 months
• Retention Interval:
  – 3 months / 6 months / PPO prescribed

Research Questions
• How does spacing of training sessions affect skill retention?
• Does PPO accurately predict training needed?
Training Type Randomized

• Once a day for 4 days in a row
• Once a week for 4 weeks in a row
• Once a month for 4 months in a row
• Once a quarter for 4 quarters in a row

Randomization #1
Retention Intervals Randomized

• Every 3 months x 4
• Every 6 months x 2
• PPO group…return for practice up to 10 times

Randomization #2
RQI Simulation Compressions
RQI Simulation Ventilations

Results - Adult Ventilations

- Overall Score: 94%
- Passed

- Total Compressions: 0
- Mean stroke depth: 8 mm
- Total Ventilations: 12
- Mean Volume: 589 ml

Try again  End session

Learning Technology by Laerdal
RQI Simulation Results

- **Overall Score:** 74%
- **NOT PASSED**
- **Total Compressions:** 60
- **Mean stroke depth:** 51 mm
- **Total Ventilations:** 3
- **Mean Volume:** 467 ml

[Graph showing compression and ventilation data]
# Sample Size (In Progress)

## Retention Interval

<table>
<thead>
<tr>
<th>Training Type</th>
<th>3 Months</th>
<th>6 Months</th>
<th>PPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Day</td>
<td>24</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>7 Days</td>
<td>22</td>
<td>25</td>
<td>35</td>
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<tr>
<td>30 Days</td>
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<tr>
<td>90 Days</td>
<td>26</td>
<td>21</td>
<td>37</td>
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</tbody>
</table>

## Location

<table>
<thead>
<tr>
<th>Site</th>
<th>Enrolled</th>
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<tbody>
<tr>
<td>GA</td>
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<td>WA</td>
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<tr>
<td>PA2</td>
<td>31</td>
</tr>
</tbody>
</table>
Compressions: Aggregate Scores

**Observed**

- **Score**
- **Session**: 1, 2, 3, 4, 3MO, 6MO
- **Acquisition**
- **Retention**

**Model**

- **Score**
- **Session**: 1, 2, 3, 4, 3MO, 6MO

*Legend:*
- **1 Day**
- **7 Day**
- **30 Day**
- **90 Day**
Real-World Impact – 1 Session

First Retention Event

Score

Retention Interval

< 1 Month
1 to 5 Months
> 5 Months

PPO
Fixed 3 Month
Fixed 6 Month
Implications

• Need deliberate practice of CPR and other skills

• PPO overlay onto other low-use, high-risk skills
  – Benefits of PPO with training

• What role will skills’ instructors play in the future?

• Possible impact to healthcare education and clinical skills….
Conclusions

• CPR training is evolving
• Algorithm appears to be predictive and accurate
• Possible to predict skill decay
• Bring learners back for brief training to regain live-saving skills competency
• Research CPR outcomes using RQI system vs. traditional educational methods


• Oermann, M., Kardong-Edgren, S., McColgan, J., Hurd, D., Haus, C., Snelson, C., et al. (2010). Innovative approach to teaching basic life support to nursing students: Heartcode with

• voice advisory manikin. *International Journal of Nursing Education Scholarship, 7*(1), article 26. Doi: 10.2202/1548-923x.1949