Establishing In Situ Simulation Programs...

How to link patient safety, process of care and patient outcomes

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Endowed Chair, Center for Simulation, Advanced Education and Innovation
Department of Anesthesia, Critical Care, and Pediatrics
Vinay Nadkarni, MD, FAAP, FCCM

Endowed Chair, Critical Care Medicine
The Children’s Hospital of Philadelphia

Associate Director,
Center for Resuscitation Science
University of Pennsylvania School of Medicine

Chair, International Liaison Committee on Resuscitation (ILCOR)
Past Chair, AHA Pediatric Subcommittee

• Expertise:
  • Resuscitation Science Research
  • Simulation-based Education
  • Just-in-Time Training
Disclosure

NO RELEVANT CONFLICTS

Employment: University of Pennsylvania

- Research Grants:
  - NIH (Cardiac Arrest, Cardiopulmonary bypass, Glucose Control)
  - Canadian Institute of Healthcare Research (CPR)
  - Laerdal Foundation (Simulation and Resuscitation)

- Science Advisory Board (Volunteer)
  - International Liaison Committee on Resuscitation (ILCOR)
  - Co-chair, Society of Critical Care Medicine 2014 Conference
  - World Federation of Pediatric and ICU Societies (WFPICCS)
  - Data Safety Monitoring Board (adult CPR device)
  - AHA National Registry of CPR/Get with the Guidelines
Workshop Discussion

• Selection of Scenarios
  – Simulation to Safety….Safety to Simulation
  – Outcome metrics
• Practical Aspects
  – Champions
  – Train the trainers
  – Scheduling and TIME / $$ Support
• Debriefing approach
• Integration of Simulation / Real Care and Metrics
Simulation-Based Education

- Emerging innovation

- Improves:
  - Knowledge
  - Technical skills
  - Behavioral performance

McGaghie W, Med Educ, 2010
Simulation-based education - Effectiveness

**Self-efficacy**
(improvement in learner’s self-confidence)

**Competence**
(Skill improvement in simulation settings)

**Operational Performance**
(Skill improvement in clinical settings)

**Improved Outcome**
(Improvement in patient outcome)
Promising Solutions

Real-Time Feedback

Just-in-Time Training

Performance Debriefing
Developing A Culture Of High Quality Performance
Patient Care Process and Outcomes

Patient \( \rightarrow \) Interventions \( \rightarrow \) Outcomes

Data

- Patient Factors
- System Factors

System/Quality

- Technique
- Drugs
- Devices
- Education

Data

- Quality of Life
- Favorable Neurologic Survival
- Short term Outcomes
- Long Term Outcomes

Patient Factors

Event Factors

System Factors
Fact! $80\% \times 50\% \times 50\% = 20\%$
How Simulation Addresses the Challenges of 21st Century Medicine

- Maximize training
- Minimize patient risk
- Maximize efficiency
- Enhance communication
- Control cost
Opportunity of improved educational methods

Teaching

- Lectures
- Skill-training
- Skill workshops
- Megacode

Alternative learning

- Individual Pre-qualification
- Individual skill-training
- Case-based training in teams
- Relearning customized to the individual needs

- e-learning (PC simulators)
- Skill-laboratories
- Simulation, Distant learning?
- Interactive self-learning
Team Training...building competence to Excellence!

“Just-in-time....Just-in-place”
CHOP Center for Simulation Advanced Education, and Innovation

- Classes
- Supervised training
- Orientation Technology
Contact Hours: Fiscal Year Totals

- FY 2007: 3028
- FY 2008: 4508
- FY 2009: 10947
- FY 2010: 16352
Scenario planning template

Scenario Title: 
Reason for development: 
Intended Learners: 
Target Duration: 
Developer; responsible person(s): 
Date: 
Learning Objectives: 
Objective 1: 
Objective 2: 
Objective 3: 
Objective 4: 

Clinical Setting: 
Patient Information: Age, Gender, Weight, Height/Length 
Equipment Needs (Checklist at right, indicate additional needs): 
1. Fluids/medications: 
2. Equipment (in addition to checklist): 
3. Papework: 
4. Additional supplies: 
5. Manikin set-up (clothing, IV, moulage, etc.): 

Updated July 21, 2011
Detail: links to objectives

Link curricular objectives to:
CHOP Safety/Organization Objectives

- Reducing Hospital Infections
  - Hand Hygiene
  - Central Line-associated bloodstream infection principles
  - Sepsis recognition and response
- Reducing Medication Errors
  - Medication Safety principles
  - Two professional checks for high risk medications
  - Verbal orders
  - Allergy verification
- Management of anaphylaxis
- Other: management of needlestick injury, recognition of deterioration and call for assistance, AHRQ culture of safety concepts, protected health information concepts; concepts related to recent serious events, near misses, or observed latent (potential) errors.

Systems Improvements
- Describe

CHOP Safety Behaviors and Error Prevention Tools
- Support each other – Crosscheck, coach, speak up for safety using ARCC
- Practice with questioning attitude – Reflect and resolve
- Pay attention to details – Self check using STAR
- Communicate clearly – Read back/repeat back, clarifying questions, ISBAR-Q

ACGME Core Competencies (Resident and Fellows)
- Patient Care
- Practice-based Learning
- Professionalism
- Medical Knowledge
- Interpersonal & Communication Skill
- System-based Practice
## Dashboard

<table>
<thead>
<tr>
<th>HOSPITAL GOAL</th>
<th>SIM TEAM GOAL</th>
<th>YTD RESULTS</th>
<th>YTD STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce hospital acquired infections</td>
<td>Embed central line access into at least 12 simulation events</td>
<td>5 events addressed central line insertion</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Develop simulator models for qualified overseers to use during skills revalidation</td>
<td>Models developed at end of FY 2011 and have been distributed to specified units</td>
<td>100%</td>
</tr>
<tr>
<td>Implement qualified observer training program for urinary catheter insertion skills revalidation</td>
<td>Qualified observer training completed and units now functioning independently</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Incorporate Foley insertion procedures into nursing orientation and preceptor sessions</td>
<td>Foley insertion procedures incorporated into nursing orientation and preceptor class</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Increase hand hygiene performance to 93%</td>
<td>84 events had hand hygiene addressed in the debriefing</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>% of Milestones Complete for Sepsis recognition &amp; response</td>
<td>56 events addressed sepsis recognition and response</td>
<td></td>
<td>100%</td>
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</tbody>
</table>
- Self-Confidence
- Competence
- Operational Performance
- Patient Outcome
- Effectiveness/Efficiency
Lectures and Classroom
Orientation to Procedures in the Classroom:
Orientation to Procedures at the bedside
CCM Fellow Skill Training: Central Line Insertion
High Risk Fetal Cardiac Intervention

Courtesy of Masayuki Endo
Moulage and Innovation
...(an olive is a fetal heart!)

Courtesy of
Masayuki
Endo
Neonatal ECMO
Probing for problems in new Radiation Oncology Center
Debriefing

- Delayed debriefing of arrests held weekly
- Baseline cohort – feedback only
- Study cohort – feedback + debriefing
Performance Debriefing

![Graph showing performance comparison](image)

- **Ventilation Rate**: Baseline 38, RAPID 49
- **Compression Rate**: Baseline 65, RAPID 82
- **Compression Depth**: Baseline 70, RAPID 86

**p < 0.01**

*Edelson, Archives of Internal Medicine 2008*
Performance Debriefing

p = 0.03

Edelson, Archives of Internal Medicine 2008
Pediatric Quality of CPR: The CHOP Experience

The Pediatric Quality of CPR Research Team

Department of Anesthesia and Critical Care Medicine
The Children’s Hospital of Philadelphia, Philadelphia PA USA
Laerdal Medical, Stavanger, Norway
18 March 2010
Pediatric Provider Answers

1) Rolling Refreshers: 2+x/month
- Rotating bi-monthly BLS recertification curriculum
- Practice chest compressions every 3 months

Document performance within guideline compliance by unit BLS instructor

2) Simulation: Sign up in advance
Any scenario involving performance of chest compressions, ventilations, choking, AED use

Document performance within guideline compliance by facilitator/ BLS instructor

3) Actual patient care events: Ad hoc
Examples: Cardiac arrest with chest compressions and ventilation performance

Document performance within guideline compliance by reviewer/ present BLS instructor
<table>
<thead>
<tr>
<th>Curriculum module</th>
<th>Month 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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<tbody>
<tr>
<td>Adult</td>
<td>CC-vent</td>
<td>1 rescuer</td>
<td>x</td>
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<td>Adult</td>
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<td>2 rescuer</td>
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<td>1 rescuer</td>
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</tbody>
</table>
Pediatric Provider Answers

**Rolling Refreshers 2+x/month**
- Follow rotating bi-monthly BLS recertification
  - **Practice chest compressions every 90 days**
- Document performance within guideline compliance by unit BLS instructor

**Simulation Sign up in advance**
- Any scenario involving performance of chest compressions, ventilations, choking, AED use
- Document performance within guideline compliance by facilitator/ BLS instructor

**Actual patient care events Ad hoc**
- Examples: Cardiac arrest with chest compressions, ventilation performance
- Document performance within guideline compliance by reviewer/ present BLS instructor

**AHA BLS objectives Hospital Issues not addressed**
- Adult CPR – 1 and 2 rescuer
- Pediatric CPR – 1 and 2 rescuer
- Infant CPR – 1 and 2 rescuer
- AED (adult, pediatric)
- Choking (adult/pediatric, infant)
- How to call for HELP
- Access at head of bed
- Backboard use
- Stepstool use

Example: Chest Compressions in any venue would qualify
Pediatric ICU Provider Answers

Simulation
- Sign up in advance in 7S Treatment Room (or equivalent)
- Examples:
  - Central Line Insertion: Ultrasound
  - Difficult Airway Intubation
  - Anaphylaxis/hypotension
  - Pneumothorax → Brady/asystole
  - Trauma: Immobilized neck with ↓BP
  - “Unknown” Case
- Special cases:
  - “Unknown case” Simulation addressing recognition as well as management

“Code Bell” Simulations
- Multidisciplinary
- Examples:
  - Central Line Insertion: Complication
  - Difficult Airway Intubation
  - Anaphylaxis/hypotension
  - Decannulation → Brady/asystole
  - Trauma: Immobilized neck with ↓BP

Actual patient care events
- Single or Multidisciplinary
- Examples:
  - Central Line Insertion: Ultrasound/CLABSI
  - Difficult Airway Intubation
  - Fluid resuscitation for shock
  - Management of airway obstruction (OR or PACU)
  - Trauma intubation: immobilized neck
  - Assessment and management of high ICP
- Need cadre of trained reviewers

AHA PALS objectives

<table>
<thead>
<tr>
<th>Airway</th>
<th>Institutional requirements “mandatory” topics; credentialing, other?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular Access</td>
<td>Fire in the ICU</td>
</tr>
<tr>
<td>Shock</td>
<td>CLABSI: line insertion credentialing</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>Basic Life Support (CPR)</td>
</tr>
<tr>
<td>Team management</td>
<td>Credentialing</td>
</tr>
</tbody>
</table>

Additional considerations
1. Metrics
2. PALS/AHA interface
3. Video policies
4. Video technology
BLS Rolling Recertification

Frequent technical/psychomotor skills “overtraining” with BLS instructor, BLS manikins and Q-CPR feedback

Assess technical/psychomotor skills following traditional BLS recert:
- Baseline - 6 mos post recert; pre RR
- 12, 18 and 24 mos after beginning RR education
Central Venous Catheter Dress Rehearsal: Every Line Counts

Amy Scholtz, MSN, RN
AnneMarie Monachino, MSN, RN
Akira Nishisaki, MD, Dana Niles, MS
Vinay Nadkarni, MD, Evie Lengetti, MSN, RN

The Children’s Hospital of Philadelphia
The Center for Simulation, Advanced Education and Innovation
Methods
CLABSI Rates Decrease!

Rates per 1000 Line Days

After Implementation
Simulation success!

• 6 key units received carts and training for “just in time” “just in place” education
• All nurses in hospital received hands on simulation based education
• 85 days without a CLABSI in PICU
• 2008 vs. 2009
  – 40 fewer patients with infections
  – 3200 fewer catheter line days
  – Estimated Cost savings = $3,920,593
Just-in-Time Training on Patient Safety in pediatric airway management

IRB protocol No 2006-8-4931  Key name: Just-In-Time
Supported by Agency for Healthcare Research and Quality (AHRQ) Grant 1U18HS 01667801

Akira Nishisaki, MD
Critical Care Medicine, CHOP
Non-technical Skills

<table>
<thead>
<tr>
<th>Severe TIAE*</th>
<th>Minor TIAE**</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotension requiring treatment</td>
<td>3 (1.5%)</td>
<td>22 (11.2%)</td>
</tr>
<tr>
<td>Vomit with aspiration</td>
<td>2 (1.0%)</td>
<td>11 (5.6%)</td>
</tr>
<tr>
<td>Cardiac arrest (patient survived)</td>
<td>1 (0.5%)</td>
<td>5 (2.5%)</td>
</tr>
<tr>
<td>Cardiac arrest (patient died)</td>
<td>0</td>
<td>2 (1.0%)</td>
</tr>
</tbody>
</table>

** Failed First Attempt or Adverse Event = 41%**

** Adverse Event = 21%**

** Failed First Attempt = 33%**

* Two courses had both severe TIAE and minor TIAE

** 6 courses had more than one minor TIAEs
CHOP PICU (7 South and & East)

7 South Team with Just-in-time training
N=50

7 East Team without Just-in-time training
N=50

High Fidelity Training
N=25

Traditional Training
N=25
Team with ≥ 2 JIT-simulation trained members performed better vs. team with 0 or 1 JIT-simulation trained members

Number of simulation-trained providers in a PICU bedside airway team
Resuscitation Performance Over Time With Various Training Techniques

A

Ideal Performance

Resuscitation Performance

ACLS Training

Time

B

Ideal Performance

Resuscitation Performance

ACLS Training

Time

C

Ideal Performance

Resuscitation Performance

ACLS Training

Time

D

Ideal Performance

Resuscitation Performance

ACLS Training

Time
## The Future: Translation

### Contributions of medical education interventions to $T_1$, $T_2$ and $T_3$ outcomes

<table>
<thead>
<tr>
<th>Medical education interventions</th>
<th>$T_1$</th>
<th>$T_2$</th>
<th>$T_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved</td>
<td>Knowledge, skill, attitudes and professionalism</td>
<td>Patient care practices</td>
<td>Patient outcomes</td>
</tr>
<tr>
<td>Target</td>
<td>Individuals and teams</td>
<td>Individuals and teams</td>
<td>Individuals and public health</td>
</tr>
<tr>
<td>Setting</td>
<td>Simulation lab</td>
<td>Clinic and bedside</td>
<td>Clinic and community</td>
</tr>
</tbody>
</table>

$T_1$ - Simulation Lab  ---  $T_2$ - Patient Bedside  ----  $T_3$ - Patient Safety and Population Health
Pre-arrest
Identification
High Risk
Clinical Indicators
Parshuram 2009
Bonafide 2011

“In Rolling Refreshers”
Hands-on practice with defibrillator, chest compressions and ventilations

Intra-arrest
Real-time CPR Feedback
• MRx/Q-CPR Audio + visual feedback
• ETCO2
• Arterial BP

CSI: Code Scene Investigation
• Code scene forensics
• Mattress Reconstruction
Moltese 2008
Nishisaki 2009

CSD: Code Scene Debriefing
• Quality of CPR
• Clinical issues
• Latent and obvious hazards
• Examples of excellence
Edelson 2008
Dine 2008

Post-Resuscitation Care
Temperature control, Blood pressure/Hemodynamics, Oxygen, CO₂
PCA, ECMO, Glucose, pH, electrolytes, Fluid management
Sunde 2007
Sunde 2008
Sunde 2009

0  Day 1  Day 2-3  Day 4

Post-Resuscitation “Dress Rehearsals”
Anticipate Challenges, Rehearse Interventions, Review Protocols, Clarify Communication, Document Competence
Scholtz 2011

Case Debriefing
• Quality of Care
• Clinical issues
• Latent and obvious hazards
• Barriers to process
• Examples of excellence
Edelson 2008
Dine 2008

Primary Outcome:
Return of Spontaneous Circulation

Primary Outcome:
Survival to discharge
Secondary Outcome: Survival to One Year
Workshop Discussion

• Selection of Scenarios
  – Simulation to Safety….Safety to Simulation
  – Outcome metrics

• Practical Aspects
  – Champions
  – Train the trainers
  – Scheduling and TIME / $$ Support

• Debriefing approach

• Integration of Simulation / Real Care and Metrics
Workshop Discussion
Workshop Discussion
Scenario planning template

The Children's Hospital of Philadelphia
The Center for Simulation, Advanced Education, and Innovation

Scenario Title: ______________________
Reason for development: ______________________
Intended Learners: ______________________
Target Duration: ______________________
Developer; responsible person(s): ______________________
Date: ______________________
Learning Objectives:
Objective 1: ______________________
Objective 2: ______________________
Objective 3: ______________________
Objective 4: ______________________

Clinical Setting: ______________________
Patient Information: Age ______ Gender ______ Weight ______ Height/Length ______

Equipment Needs (Checklist at right, indicate additional needs):
1. Fluids and medications: ______________________
2. Equipment (in addition to checklist): ______________________
3. Paperwork: ______________________
4. Additional supplies: ______________________
5. Manikin set-up (clothing, IV, moulage, etc.): ______________________

Link curriculum to perspectives:
CHOP Safety/Organization Objectives
Requiring Antimicrobial Use
Recognition of Critical Events
Identification of safety hazards
Identification of allergies
Identification of adverse events
Identification of patient needs
Identification of patient confidentiality

Systems improvements

CHOP Safety Behaviors and Error Prevention Tools
support each other - Classroom and clinical setting for safety
using ARCC
practice with complementary activities - Reflect and practice
pay attention to details - Soften using STAR
Core Competencies - Read back, feedback, clarifying questions

ASSM Core Competencies (Resident and Fellows)
- Patient Care
- Practice-based Learning
- Professionalism
- Systems-based Practice

Additional:
Object 1: ______________________
Object 2: ______________________
Object 3: ______________________
Object 4: ______________________
Object 5: ______________________

Updated July 21, 2011
Detail: links to objectives

**Link curricular objectives to:**

**CHOP Safety/Organization Objectives**

*Reducing Hospital Infections*
- Hand Hygiene
- Central Line-associated bloodstream infection principles
- Sepsis recognition and response

*Reducing Medication Errors*
- Medication Safety principles
- Two professional checks for high risk medications
- Verbal orders
- Allergy verification

- Management of anaphylaxis
- Other: management of needlestick injury, recognition of deterioration and call for assistance; AHRQ culture of safety concepts; protected health information concepts; concepts related to recent serious events, near misses, or observed latent (potential) errors.

**Systems Improvements**

☐: Describe

**CHOP Safety Behaviors and Error Prevention Tools**

- Support each other – Crosscheck, coach, speak up for safety using ARCC
- Practice with questioning attitude – Reflect and resolve
- Pay attention to details – Self check using STAR
- Communicate clearly – Read back/repeat back, clarifying questions, ISBAR-Q

**ACGME Core Competencies (Resident and Fellows)**

- Patient Care
- Practice-based Learning
- Professionalism
- Medical Knowledge
- Interpersonal & Communication Skill
- System-based Practice
Pediatric Advanced Life Support (PALS) on Demand

Simulation-based modular-based PALS recertification training for pediatric ICU providers

Presentation for IPSSW/INSPIRE webinar session on May 2\textsuperscript{nd}, 2012

Akira Nishisaki, MD, MSCE
The children’s Hospital of Philadelphia
Investigator team

- Takanari Ikeyama, MD
- Hiroshi Kurosawa, MD
- Silvia De Rosa, MD
- Daphne Remy, MD
- Annemarie Monachino, MSN, RN, CPN
- Grace Good, RN, BSN, MA
- Roberta Hales, MHA, RRT-NPS, RN
- David Rodgers, EdD, NREMT-P
- Rita Giordano, BS, RRT-NPS

- Patricia Achuff, MBA, RRT-NPS
- Madeline Perkel, MSN, CRNP
- Christine Watson, BSN, RN
- Ellen Deutsch, MD
- Vinay Nadkarni, MD, MS
- JoDee Anderson, MD, MEd
- Akira Nishisaki, MD, MSCE

All PICU and RRT staff and leadership
Conflict of interest

Nadkarni (PI), Nishisaki (Co-I):
Resuscitation Center of Excellence Grant
Supported by Laerdal Foundation for Acute Care Medicine

Nadkarni (PI):
AHA Emergency Cardiovascular Care Education Grant

Nadkarni (PI), Nishisaki (Co-I):
Just-in-Time Simulation training
Supported by AHRQ U18 HS16678-01 (complete)
Identified current problems with PALS certification

1. Once in 2 year recertification schedule
   - DOES NOT scientifically address knowledge and skill degradation
   - DOES NOT specifically address teamwork skill degradation

2. Generic materials for all PALS providers
   - Some materials deemed too basic for experienced ICU providers
   - Cases used are NOT relevant to everyday practice
**Delays in Pediatric Emergency Mock Code**

<table>
<thead>
<tr>
<th>Resuscitation Maneuver</th>
<th>n</th>
<th>Median Elapsed Time, min</th>
<th>Interquartile Range (25%–75%), min</th>
<th>Time Goal for Maneuvers, min</th>
<th>Teams That Met Time Goal, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compared with time 0&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>1.3</td>
<td>0.5–1.5</td>
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<td>9 (26)</td>
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<td>Circulation assessment</td>
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<td>2.0–7.0</td>
<td>0.5</td>
<td>1 (3)</td>
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<tr>
<td>Oxygen administration</td>
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<td>2.0</td>
<td>1.0–2.5</td>
<td>1.0</td>
<td>9 (26)</td>
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<td>Physician arrival</td>
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<td>3.0</td>
<td>1.0–5.0</td>
<td>3.0</td>
<td>19 (61)</td>
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<tr>
<td>Code team arrival</td>
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<td>6.0</td>
<td>4.5–8.0</td>
<td>5.0</td>
<td>7 (26)</td>
</tr>
<tr>
<td>Compared with when required&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BVM ventilation</td>
<td>28</td>
<td>1.0</td>
<td>0.5–5.0</td>
<td>1.0</td>
<td>6 (19)</td>
</tr>
<tr>
<td>Chest compressions</td>
<td>15&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.5</td>
<td>1.0–5.0</td>
<td>1.0</td>
<td>4 (27)</td>
</tr>
<tr>
<td>Defibrillator requested&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6</td>
<td>4.3</td>
<td>3.0–5.0</td>
<td>0.5</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Need for IO recognized</td>
<td>5</td>
<td>3.0</td>
<td>1.0–5.0</td>
<td>1.5</td>
<td>2 (40)</td>
</tr>
</tbody>
</table>

Hunt EA, et al. Pediatrics 2008;121;e34-e43
PALS knowledge declining

TABLE 1: Proportion of Subjects With Excellent CPR Performance at Pretraining (Retention) and Posttraining Evaluations (Training Success)

<table>
<thead>
<tr>
<th>Instructor-only training</th>
<th>Retained Pretraining Excellent CPR</th>
<th>Training Success: Posttraining Excellent CPR</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial training</td>
<td>17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>65</td>
<td>&lt;.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>1 mo</td>
<td>59</td>
<td>82</td>
<td>.13</td>
</tr>
<tr>
<td>3 mo</td>
<td>73</td>
<td>82</td>
<td>.73</td>
</tr>
<tr>
<td>6 mo</td>
<td>74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>84&lt;sup&gt;d&lt;/sup&gt;</td>
<td>.63</td>
</tr>
<tr>
<td>Automated feedback only</td>
<td>26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>65</td>
<td>&lt;.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Initial training</td>
<td>48</td>
<td>81</td>
<td>.04</td>
</tr>
<tr>
<td>1 mo</td>
<td>57</td>
<td>67</td>
<td>.77</td>
</tr>
<tr>
<td>6 mo</td>
<td>65&lt;sup&gt;c&lt;/sup&gt;</td>
<td>90&lt;sup&gt;d&lt;/sup&gt;</td>
<td>.18</td>
</tr>
</tbody>
</table>
| Instructor training combined with automated feedback | 9<sup>a</sup> | 61 | <.01<sup>b</sup> |}

3 months

Sutton RM. Pediatrics 2011;128;e145
How can we address those issues?

• Knowledge and skill degradation
  → Frequent refresher training

• Focus on performance, not just knowledge (T2 than T1)
  → Highly realistic simulation environment

• Emphasis on teamwork and communication
  → simulation environment with confederates
How can we address those issues?

• Engagement using adult learning theory
  → Realistic pediatric ICU scenarios

• Using actual cases for learning session
  → Debriefing by PALS instructors

• Standardized measures of training effectiveness
  → Standardized evaluation scenario
Hypothesis

The subjects receiving modular simulation-based PALS training ("PALS on Demand") for recertification are NOT INFERIOR to the traditional PALS recertification training in performing clinical tasks and teamwork skills immediately after PALS recertification.
Pediatric ICU Provider PALS on DEMAND training

Planned Simulation
- Septic Shock
- Difficult Airway
- DOPE
- Anaphylaxis
- PTX->Brady/asystole
- Trauma

“Code Bell” Simulation
- Septic Shock
- Difficult Airway
- DOPE
- Anaphylaxis
- Trauma

Actual patient care events
- Septic Shock
- Difficult Airway
- DOPE
- Anaphylaxis
- Shock
- Trauma

AHA PALS objectives
- Airway/Vascular Access
- Shock
- Arrhythmias
- Team management

Institutional requirements
- “mandatory” topics
- Fire in the ICU
- CLABSI: line insertion credentialing
- Hand washing
- BLS Credentialing, etc...

Uncle Sam figure

Legend
- Red topics are “mandatory” for simulation.
- Blue topics are planned for simulation.
- Green topics are actual patient care events.
Study Design

Population

PALS-certified ICU clinical providers (respiratory therapists, nurses, nurse practitioners) scheduled for renewal in next 12 months

Intervention

PALS on Demand (debriefed in simulation and real PALS events)

Comparison

Traditional PALS renewal (didactic/sim training /written test)

Outcomes

Primary: CPT skills specific to the scenario in simulated PALS events immediately after PALS recertification
Secondary: Teamwork skills in simulated PALS events
Course satisfaction, Self confidence after training
Study Design: Timeline

Randomization

Pre-test | Intervention | Post-test

6-8 months

R: conventional PALS recertification
A: Simulation based assessment
W: written test of PALS recertification
PALS-on Demand Training (6 mo)

Six simulation-based PALS core case scenarios

-PALS defines 12 core case scenarios
-for PICU providers, we made two core cases into one complex scenario
-we made all scenarios to PICU relevant
PALS core cases

Respiratory
- Upper/Lower airway obstruction
- Lung tissue disease
- Disordered control of breathing

Shock
- Hypovolemic
- Obstructive
- Distributive (septic)
- Cardiogenic

Cardiac
- Supraventricular tachycardia (SVT)
- Bradycardia
- Asystole/Pulseless electrical activity
- V fib (Ventricular fibrillation)
PALS-on Demand Training (6 mo)

- Lower airway obstruction + SVT
- Upper airway obstruction (croup) + Bradycardia
- Septic shock + lung tissue disease (ARDS)
- Disordered control of breathing (benzodiazepine for seizure) + hypovolemic shock (hemorrhagic shock)
- Obstructive shock (tension pneumothorax) + PEA
- Cardiogenic shock + Ventricular fibrillation
PALS-on Demand Training (6 mo)

RAPID (Resuscitation with actual performance integrated debriefing) to replace actual modular simulation sessions
– Clinical Event observation/video-recording
– Debriefing by PALS instructor
– PALS checklist for each core case with emphasis on teamwork skills
– Local PICU specific safety/practice issues will be addressed

Measurement

• Scenario-based measures using a complex simulation with scripted and trained confederates

• Two major outcome measures of interest

- CPT: cognitive performance scale

- BAT: behavioral assessment tool
Script for Confederates

VFib

Subject said “Vi Fib and defibrillation” during report

Yes

No

What is the rhythm on EKG monitor?

V Fib

Then what should we do for that?

Defibrillation

How much?

Dosage clarified

Sure. Let’s do it.

Wrong answer

To me, it looks like V Fib...

V Fib is shockable rhythm... Let’s defibrillate

No Idea

Let’s give 20J
Clinical Performance Tool

- Trichotomous checklist score: “Done”, “Not done”, “Partially done”
- Scenario-specific
- Easy to demonstrate Content and Construct validity
- Reasonably good inter-rater reliability in previous studies
Clinical Performance Tool

• Multiple pilot scenarios using expert raters
  – ICU providers, scripted orientation
  – systematic errors in knowledge, clinical skills, and communication by confederates
  – scripted debriefing
  – revised using consensus methodology

• Inter-rater reliability measure by independent raters (without knowledge of participants’ background)
Behavioral Assessment Tool

• Criterion referenced scale
  – derived from a well-defined domain of behavior (CRM)
  – scores characterize levels of expertise (Dreyfus scale)
  – anchors are concrete behaviors at each level (novice, competent, expert)

Courtesy of JoDee Anderson at Oregon Health and Science University
Behavioral Assessment Tool

- Subject matter experts identified 10 key behavioral skills
- Anchors representing levels of competency determined via Delphi process
- Validity and reliability
  - Cronbach’s alpha 0.82-0.98
  - Inter-rater reliability 0.95

Courtesy of JoDee Anderson at Oregon Health and Science University
Behavioral Assessment Tool

- know your environment
- anticipate and plan
- assume the leadership role
- communicate effectively
- distribute work load optimally
- allocate attention wisely
- utilize all available information
- utilize all available resources
- call for help early enough
- maintain professional behavior

Courtesy of JoDee Anderson at Oregon Health and Science University
# Behavioral Assessment Tool

**1. Knowledge of the Environment**

<table>
<thead>
<tr>
<th></th>
<th>Poor (0 points) Novice</th>
<th>Partially Acceptable (1 point) Advanced beginner</th>
<th>Acceptable (2 points) Competent</th>
<th>Above Average (3 points) Proficient</th>
<th>Excellent (4 points) Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appears disoriented; is unfamiliar with equipment; fails to ask questions of others in the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seems somewhat familiar with equipment, asks questions of others in the environment after struggling on their own, appears somewhat familiar with environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appears familiar with surroundings; appears thoroughly familiar with all equipment; readily queries others in the environment when questions arise.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**2. Anticipation of and Planning for Potential Problems**

<table>
<thead>
<tr>
<th></th>
<th>Poor (0 points) Novice</th>
<th>Partially Acceptable (1 point) Advanced beginner</th>
<th>Acceptable (2 points) Competent</th>
<th>Above Average (3 points) Proficient</th>
<th>Excellent (4 points) Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not appear prepared for the case; does not inquire of others to gather information; fails to assemble appropriate personnel; fails to react to changing circumstances as case evolves.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May ask 2 to 3 important questions regarding the patient; displays some understanding of possible problems and consequences; may not recognize predictable situations but adapts to changing circumstances; insures presence of necessary personnel and equipment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asks pertinent questions indicating an in-depth understanding of potential problems and subsequent consequences of the evolving case; does not appear surprised by predictable situations; insures presence of all necessary personnel and equipment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Courtesy of JoDee Anderson at Oregon Health and Science University
Sample Size and Power

- Powered for non-inferiority study
- Using one-tailed alpha = 0.05, power = 0.8, estimated effect size 0.737 for CPT
- Estimated drop-out rate of subjects: 20%
- Intention-to-Treat analysis

- 30 each subjects will generate 24 compliant subjects
Challenges

• Logistical issues
  – High patient census, high acuity
  – Training scheduling
  – Challenge to get ‘Control group’ back to assessment
  – Needs of well-trained confederates
  – Raters blinded to participants’ background and training levels
  – Rater training for BAT and CPT (on going)
Challenges

• Recruitment of subjects (currently we have n=41)

• Control group training became ‘better’
  Sim Center started to take over the PALS recertification training using high fidelity simulation

• Participants are ‘afraid of’ coming to the assessment session
  Especially after they went through an initial assessment scenario (which could not be debriefed)
Challenges

• RAPID intervention was difficult to implement
  – Loss of Simulation Fellow
  – No efficient way to capture and debrief real events at the bedside
  – Logistics to video-capture the event
• Expectation for RRT seems beyond the current scope of practice
• T1 study: improved care processes in simulation without an assessment on bedside performance
Strength of PALS on DEMAND study

• A new way to conduct PALS recertification study
  Modular-base, intermittent schedule to prevent skill decay
  High fidelity simulation using adult learning theory

• Assessment on performance (showing ‘how’ level), not knowledge based (knowing ‘how’ level)
Conclusions

• A new way of recertifying PALS was sought using
  – Adult learning theory
  – High fidelity simulation
  – Modular periodic training (every 1-2 months)
  – Debrief using actual clinical events
• The effectiveness of PALS on DEMAND training is being evaluated in simulation using CPT and BAT
Future direction

• Evaluation of PALS on DEMAND training on actual clinical performance

• Video-capture of actual clinical event for bedside debriefing

• Implementation of unit-wide PALS on DEMAND training for all PICU Nurses and Respiratory therapists
Background

- Measurement of performance in resuscitation

Wayne et al., Chest 2008
### Sim-PICO: Example (Salvoldelli et al., 2006)

<table>
<thead>
<tr>
<th>WHO</th>
<th>WHAT</th>
<th>WHEN</th>
<th>WHERE</th>
<th>WHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Debriefer)</td>
<td>(Methods/Content)</td>
<td>(Timing)</td>
<td>(Environment)</td>
<td>(Theory)</td>
</tr>
<tr>
<td>Sim:</td>
<td>Randomized, Controlled trial, Blinded review, Cardiac arrest scenarios</td>
<td></td>
<td>No industry funding</td>
<td></td>
</tr>
<tr>
<td>P:</td>
<td>42 Anesthesia resident trainees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C:</td>
<td>No Debrief</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I:</td>
<td>Oral or Video debrief</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O:</td>
<td>ANTS assessment of performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sim:</td>
<td>Randomized, Controlled trial, Blinded review, Cardiac arrest scenarios</td>
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</table>