Teaching and Learning Through Simulation

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Associate Professor of Clinical Pediatrics
Perelman School of Medicine at the University of Pennsylvania
Objectives

• Learners will be able to identify how teaching through simulation is different than traditional educational models

• Learners will be able to describe how different simulation methods can be used to achieve specific learning goals

• Learners will be able to classify simulation outcomes
THE POWER OF SIMULATION

Or why I am a believer and how I convinced my colleagues
Simulation

“a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion.”

• Gaba DM, Qual Saf Health Care 2004:13(suppl 1)
Simulation Tools
Basic Design of Simulation Experiences

• Do

• Debrief
THE POWER OF SIMULATION

Why I am a believer: Reason #1
THE CHALLENGE

• Your hospital is opening up a new delivery unit — (of only high risk babies)
• Many of your RNs and RTs have never been to deliveries
• There are no opportunities for them to cross-train elsewhere
OUR SOLUTION

• Practice, practice, practice

• Only option SIMULATION

Session 2
Lecture 3
– Lung lesions

Simulation 3
– Congenital diaphragmatic hernia, Congenital cystic adenomatoid malformation

Lecture 4
– Myelomeningocele, Bladder outlet obstruction, preterm

Simulation 4
– Preterm, Bladder outlet obstruction with pulmonary hypoplasia
Question 1: I feel very comfortable participating in the resuscitation of a normal newborn in the delivery room

Question 2: I feel very comfortable participating in the resuscitation of neonates with congenital anomalies in the delivery room

Question 3: I have a complete understanding of my role in the delivery room
SO WHY DID SIMULATION PREPARE THE TEAM SO WELL

Theories Related to why Simulation works (very briefly)
Lecture 5%
Reading 10%
Audiovisuals 20%
Demonstration 30%
Discussion 50%
Practice by Doing 75%
Teaching Others 90%

Resource: Mel Silberman. Active Training 3rd Edition
Kolb’s learning styles

Concrete Experience
Feeling

Reflective Observation
Watching

Processing: how we think about things

Perception Continuum: how we do things

Active Experimentation
Doing

Accommodating
(feel and do)
CE/AE

Diverging
(feel and watch)
CE/RO

Converging
(think and do)
AC/AE

Assimilating
(think and watch)
AC/RO

Abstract Conceptualisation
Thinking

© concept david kolb, adaptation and design alan chapman 2005-06, based on kolb's learning styles, 1984
Not to be sold or published. More free online training resources are at www.businessballs.com. Sole risk with user.
WHAT IS THE EVIDENCE FOR SIMULATION
Simulation Research Consensus

• Simulation Based Medicine Translational Science
  – T1: does the educational strategy work in the lab
  – T2: does the educational strategy improve patient care delivery
  – T3: does the educational strategy improve patient/public health outcomes

Monographs from the First Research Consensus Summit for the Society for Simulation in Healthcare. Simulation in Healthcare, August 2011, supplement
FIGURE 2
Average time required for teams with and without teamwork training to complete NRP steps.
• Cord prolapse simulation based annual training
EVIDENCE

Advanced Airway Management Simulation Training in Medical Education: A Systematic Review and Meta-Analysis


<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. studies (No. trainees)</th>
<th>Favors Non-Simulation Training</th>
<th>Favors Simulation Training</th>
<th>Standardized Mean Difference (95% CI)</th>
<th>p</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction</td>
<td>2 (159)</td>
<td></td>
<td></td>
<td>0.54 (0.37, 0.71)</td>
<td>&lt;0.001</td>
<td>-</td>
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<tr>
<td>Knowledge</td>
<td>4 (272)</td>
<td></td>
<td></td>
<td>0.29 (-0.28, 0.86)</td>
<td>0.32</td>
<td>85</td>
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<tr>
<td>Time skill</td>
<td>1 (36)</td>
<td></td>
<td></td>
<td>-0.15 (-0.81, 0.50)</td>
<td>0.65</td>
<td>-</td>
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<tr>
<td>Non-time skill</td>
<td>5 (371)</td>
<td></td>
<td></td>
<td>0.64 (0.12, 1.16)</td>
<td>0.01</td>
<td>85</td>
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<tr>
<td>Behavior</td>
<td>1 (24)</td>
<td></td>
<td></td>
<td>0.85 (0.01, 1.68)</td>
<td>0.05</td>
<td>-</td>
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<tr>
<td>Patient effect</td>
<td>3 (79)</td>
<td></td>
<td></td>
<td>0.86 (0.12, 1.59)</td>
<td>0.02</td>
<td>59</td>
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</table>
# Deliberate Practice

<table>
<thead>
<tr>
<th>Research design and study</th>
<th>Correlation</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>P-Value</th>
<th>Correlation and 95% CI</th>
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<td><strong>Randomized trials</strong></td>
<td></td>
<td></td>
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<tr>
<td>1. Wayne et al, 2005</td>
<td>0.81</td>
<td>0.70</td>
<td>0.88</td>
<td>.000</td>
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<tr>
<td>2. Aihberg et al, 2007</td>
<td>0.80</td>
<td>0.56</td>
<td>0.91</td>
<td>.000</td>
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<tr>
<td>3. Andreatta et al, 2006</td>
<td>0.67</td>
<td>0.40</td>
<td>0.84</td>
<td>.000</td>
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<td>4. Korndorffer et al, 2005</td>
<td>0.62</td>
<td>0.29</td>
<td>0.82</td>
<td>.001</td>
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<td>5. Korndorffer et al, 2005</td>
<td>0.52</td>
<td>0.17</td>
<td>0.75</td>
<td>.006</td>
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<td>6. Van Sickle et al, 2008</td>
<td>0.51</td>
<td>0.17</td>
<td>0.74</td>
<td>.005</td>
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<td><strong>Cohort studies</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>7. Issenberg et al, 2002</td>
<td>0.78</td>
<td>0.73</td>
<td>0.82</td>
<td>.000</td>
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<td>8. Barsuk et al, 2009</td>
<td>0.61</td>
<td>0.29</td>
<td>0.81</td>
<td>.001</td>
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<tr>
<td>9. Butter et al 2010</td>
<td>0.59</td>
<td>0.47</td>
<td>0.69</td>
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<tr>
<td><strong>Case-control studies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10. Wayne et al, 2008</td>
<td>0.51</td>
<td>0.29</td>
<td>0.68</td>
<td>.000</td>
<td></td>
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<tr>
<td><strong>Pre-post baseline studies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>11. Wayne et al, 2008</td>
<td>0.80</td>
<td>0.72</td>
<td>0.86</td>
<td>.000</td>
<td></td>
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<tr>
<td>12. Barsuk et al, 2009</td>
<td>0.79</td>
<td>0.70</td>
<td>0.86</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>13. Barsuk et al, 2009</td>
<td>0.77</td>
<td>0.71</td>
<td>0.82</td>
<td>.000</td>
<td></td>
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<tr>
<td>14. Stefanidis et al, 2006</td>
<td>0.71</td>
<td>0.55</td>
<td>0.83</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td><strong>Overall effect size</strong></td>
<td>0.71</td>
<td>0.65</td>
<td>0.76</td>
<td>.000</td>
<td></td>
</tr>
</tbody>
</table>

McGaghie et al, Academic Medicine, 2011, 86.
T3: Patient outcomes

Barsuk JE, Archives of Internal Medicine, 2009;169.
DIFFERENT WAYS TO INTEGRATE SIMULATION INTO TEACHING AND PRACTICE

Procedural learning
NRP
Teamwork training
Maintenance
Patient safety
Integrating Simulation into Procedural Skills Training

ENDOTRACHEAL INTUBATION
The Challenge
Historical Model

• See one, Do one...

Transitional Model

• See one, Practice a few, Do
Simulation Based Model

• Learn
• See
  • Practice
  • Prove
• Do
  • Maintain

Learn, See, Practice, Prove, Do, Maintain: An Evidence-Based Pedagogical Framework for Procedural Skill Training in Medicine

Academic Medicine, 2015
LEARN

PERFORMING MEDICAL PROCEDURES
Orotracheal Intubation

Christopher Kabrhel M.D.
Todd W. Thomesen, M.D.
Gary S. Setnik, M.D.
Ron M. Walls, M.D.
Massachusetts General Hospital, Mount Auburn Hospital
(Boston and Woman's Hospital), Harvard Medical School

The NEW ENGLAND JOURNAL of MEDICINE
SEE

• Learner
  – Visualization

• Teacher
  – Expert Modeling
    • Demonstration
    • Deconstruction
  – Procedural best practice
PRACTICE

• Learner
  – Deliberate Practice
    • Repetitive performance
    • Rigorous skills assessment
    • Formative feedback

• Teacher
  – Assessment skills
  – Skilled at feedback
PROVE

• Learner
  – Objective Skills Assessment
  – Mastery Learning

• Teacher
  – Rating scale
DO

• Learner
  – Real patients
  – Graduated difficulty

• Teacher
  – Supervise
  – Assess ability

  – NEAR4NEOS
  – Procedure Log

Learn
See
Practice
Prove
Do
Maintain

DOES
SHOWS HOW
KNOWS HOW
KNOWS
MAINTAIN

Learn
See
Practice
Prove
Do
Maintain
DIFFERENT WAYS TO INTEGRATE SIMULATION INTO TEACHING AND PRACTICE

Procedural learning
NRP
Teamwork training
Maintenance
Patient safety
Neonatal Resuscitation Program

Integration of cognitive, technical and behavioral skills
The Challenge

NRP Deviations in the Delivery Room

<table>
<thead>
<tr>
<th>Maximum Intervention</th>
<th>(n)</th>
<th>Perfect Score (n)</th>
<th>Imperfect Score (n)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulation only</td>
<td>22</td>
<td>16</td>
<td>6</td>
<td>.004</td>
</tr>
<tr>
<td>Blow by oxygen</td>
<td>58</td>
<td>28</td>
<td>30</td>
<td>NS</td>
</tr>
<tr>
<td>Mask ventilation</td>
<td>7</td>
<td>2</td>
<td>5</td>
<td>NS</td>
</tr>
<tr>
<td>Intubation</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>.002</td>
</tr>
<tr>
<td>Chest compression</td>
<td>0</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Medication</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>NS</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>46</td>
<td>54</td>
<td>—</td>
</tr>
</tbody>
</table>

NS indicates not significant.

- Carbine et al, Pediatrics; 2000; 106:654-658
The Challenge

Carbine et al,
Pediatrics;2000;106:654-658
Rapid Cycle **Deliberate Practice**

- NRP Integrated Skills Station

BUT?

Hours of boredom with moments of terror

Why we aren’t perfect (yet)?
The Challenge

• Airline accidents
  – Not due to individual pilot error
  – Due to inadequate teamwork
    • Communication errors
    • Inefficient leadership
    • Faulty decision making

• Technical training not enough

• Cognitive testing not enough
In order for cockpit crewmembers to share a “mental model,” or common understanding of the nature of events relevant to the safety and efficiency of the flight, communication is critical. This is not to say that effective communication can overcome inadequate technical flying proficiency, but rather the contrary, that good “stick & rudder” skills can not overcome the adverse effects of poor communication (p.1).

Sexton & Helmreich 2000
The Challenge

- Communication breakdowns are the primary cause of more than 70% of perinatal sentinel events. (JCAHO review of perinatal sentinel events)

- Most care delivered today is done by teams of people, yet training often remains focused on individual responsibilities, leaving practitioners inadequately prepared to enter complex settings.
The Challenge

<table>
<thead>
<tr>
<th>Neonatal resuscitation program section</th>
<th>Mean %</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation and Initial steps (15 items)</td>
<td>16</td>
<td>0–50</td>
</tr>
<tr>
<td>Oxygen administered (3 items)</td>
<td>30</td>
<td>0–67</td>
</tr>
<tr>
<td>Bag/Mask ventilation (7 items)</td>
<td>26</td>
<td>0–100</td>
</tr>
<tr>
<td>First Intubation (14 items)</td>
<td>24</td>
<td>0–44</td>
</tr>
<tr>
<td>Second intubation*</td>
<td>55</td>
<td>8–40</td>
</tr>
</tbody>
</table>

*Six infants had a second intubation attempt

Significant correlations between lack of team behaviors and non-compliance to NRP

- EJ Thomas, J Perinatol, 2006; 26:163-169
DIFFERENT WAYS TO INTEGRATE SIMULATION INTO TEACHING AND PRACTICE

Procedural learning
NRP
Teamwork training
Maintenance
Patient safety
PRACTICE Teamwork

<table>
<thead>
<tr>
<th>NRP 10 Key Behavioral Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Know the environment</td>
</tr>
<tr>
<td>2. Use all available resources</td>
</tr>
<tr>
<td>3. Use all available information</td>
</tr>
<tr>
<td>4. Anticipate and plan</td>
</tr>
<tr>
<td>5. Assume the leadership role</td>
</tr>
<tr>
<td>6. Allocate attention wisely</td>
</tr>
<tr>
<td>7. Maintain professional behavior</td>
</tr>
<tr>
<td>8. Communicate effectively</td>
</tr>
<tr>
<td>9. Call for help</td>
</tr>
<tr>
<td>10. Delegate workload optimally</td>
</tr>
</tbody>
</table>
PRACTICE Teamwork

• Each simulation has at least one teamwork focused objective
  – Build teamwork challenges into simulation

• Teamwork discussion incorporated into all debriefings
DIFFERENT WAYS TO INTEGRATE SIMULATION INTO TEACHING AND PRACTICE

Procedural learning
NRP
Teamwork training
Maintenance
Patient safety
Promoting Skill Retention/Responding to Decay

Theoretical graph of time vs. competency and type of training based on skill decay amount

Comparison of “Maintenance”, “Booster” and “Refresher” training

X = maintenance
X = booster
X = refresher
Just in Time Just in Place
“Rolling” Refresher
High Frequency-Low Dose

Figure 2. Box plot diagram demonstrating time to achieve chest compression skill success per group.
DIFFERENT WAYS TO INTEGRATE SIMULATION INTO TEACHING AND PRACTICE

Procedural learning
NRP
Teamwork training
Maintenance
Patient safety
Simulation and Patient Safety

• Testing new equipment, new procedures, new pathways
• Testing new spaces
• Learning new equipment, new procedures, new pathways
• In situ sims
• Sims based on frequent reported safety issues or high-risk situations
THE POWER OF SIMULATION

Why I am a believer: Reason #2
IMPROVING TEACHING

• Facilitating
  – Debriefing
THE POWER OF SIMULATION

Why I am a believer: Reason #3
“I was called in for a 24wk premie last night (abruption! chest compressions! epi! emergency UVC! fluids!). I think I'm going to have to kiss Anne’s feet for all the simulations she put me through -- it went so smoothly.”

-- Previous fellow--
“We are what we repeatedly do. Excellence, then, is not an act, but a habit.”

Aristotle
A SNAPSHOT OF SIMULATION

• Yearly Programs
  – Fellow boot camps
  – ECMO course
  – Fellow orientation
  – ECMO senior week
  – FLOC skills days
  – Special delivery unit team
  – Combined sims with obstetricians
A SNAPSHOT OF SIMULATION

• Monthly
  – Fellow Sims
    • Standardized patients
  – FLOC Sims
  – NRP
A SNAPSHOT OF SIMULATION

• Weekly
  – Resident simulations
  – Team simulations
NEW PROGRAMS PLANNED

• Communication skills day for new fellows
• Inter-professional communication
• ECMO sims for ECMO attendings
• Advanced airway course
• PALS for NICU providers