Use of Simulation-based Mastery Learning to Improve Patient Outcomes for Central Venous Catheter Insertion

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Objectives

• Identify problems with traditional procedure training

• Review principles of deliberate practice and mastery learning

• Describe how simulation-based mastery learning affects patient outcomes for central venous catheter insertion
Traditional Education: Unethical and Ineffective

Apprenticeship Model

• See one
• Do one
• Teach one
Ethical Considerations

• Patient safety and cost of errors

• Patients don't want to be used for practice

• Cannot ensure competency

VIDEO
Limitations of Clinical Training: Lumbar Puncture
Traditional Training $\neq$ Competence
Lumbar Puncture Skills

Most Simulation Interventions

1. Pretest
2. Simulation-based Training
3. Posttest
Not everyone is competent even after training

Simulation-based Mastery Learning: A Better Approach

Pretest

Lecture, video, demonstration and deliberate practice

Posttest

FAIL

PASS
"individualized training activities especially designed by a coach or teacher to improve specific aspects of an individual's performance through repetition and successive refinement. To receive maximal benefit from feedback, individuals have to monitor their training with full concentration, which is effortful and limits the duration of daily training”.

(Ericsson & Lehmann, 1996, pp. 278-279)
Mastery learning

• Deliberate practice can be used with rigorous assessment procedures to develop mastery learning programs

• Education outcomes are uniform while training time varies

Wayne DB et al, Academic Medicine 2005
McGaghie WC et al, World Health Organization 1978
Mastery Learning Educational Outcomes

Central Venous Catheter Insertion (CVC)
Simulation-based Mastery Learning
Educational and Clinical Outcomes

Pretest

Video, lecture, Demonstration

Deliberate Practice

Posttest (Minimum Passing Score)

Educational and Clinical Outcomes
# CVC Insertion Checklist

## Central Line Insertion (IJ)

<table>
<thead>
<tr>
<th>Skill Key: A = Done Correctly</th>
<th>B = Done Incorrectly/Not Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informed consent obtained</td>
<td>A</td>
</tr>
<tr>
<td>Benefits (medicines, fluids; (1))</td>
<td>B</td>
</tr>
<tr>
<td>Risks (infection, bleeding; (2))</td>
<td></td>
</tr>
<tr>
<td>Consent given (1)</td>
<td>A</td>
</tr>
<tr>
<td>Call “time out” and site mark if appropriate</td>
<td>A</td>
</tr>
<tr>
<td>Wash hands</td>
<td>A</td>
</tr>
<tr>
<td>Place the patient in slight Trendelenburg position</td>
<td>A</td>
</tr>
<tr>
<td>Test each port and flush the lines with sterile saline</td>
<td>A</td>
</tr>
<tr>
<td>Clamp each port (ok to keep distal port open)</td>
<td>A</td>
</tr>
<tr>
<td>Keep distal port open to accommodate guidewire</td>
<td>A</td>
</tr>
<tr>
<td>Area is cleaned with chlorhexidine (30 seconds if use one, ok to use 3)</td>
<td>A</td>
</tr>
<tr>
<td>Don sterile gown, gloves, hat and mask</td>
<td>A</td>
</tr>
<tr>
<td>Area is draped in usual sterile fashion (must be full body drape, must remove bottom sticky sheet)</td>
<td>A</td>
</tr>
<tr>
<td>The US probe is properly set up, draped</td>
<td>A</td>
</tr>
</tbody>
</table>
CVC Insertion Skills Improve after Simulation

Barsuk et al. *Crit Care Med* 2009

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Jugular</td>
<td>50.6 (23.4)</td>
<td>95.9 (5.1)</td>
</tr>
<tr>
<td>Subclavian</td>
<td>48.3 (26.8)</td>
<td>97.4 (3.5)</td>
</tr>
</tbody>
</table>

$p < .005$
Long-term Retention after Mastery Learning

Barsuk et al. Acad Med 2010
Clinical Outcomes Improve

% of Inserted Lines

<table>
<thead>
<tr>
<th>Complications</th>
<th>Traditionally-Trained</th>
<th>Simulator-Trained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Arterial Puncture</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>CVC Adjustment</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>Insertion Failure Rate</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

Barsuk et al. *Crit Care Med* 2009
Catheter-related bloodstream infections

85% REDUCTION

(p = .001)

Barsuk et al. *Arch Intern Med.* 2009
Simulation-based Mastery Learning is Cost Effective

Cost Savings From Reduced Catheter-Related Bloodstream Infection After Simulation-Based Education for Residents in a Medical Intensive Care Unit

Elaine R. Cohen, BA; Joe Feinglass, PhD; Jeffrey H. Barsuk, MD; Cynthia Barnard, MBA, MSJS; Anna O’Donnell, RN, BSN; William C. McGaghie, PhD; Diane B. Wayne, MD

• The total annual estimated savings were approximately $820,000, 139 patient hospital days, and 120 MICU days
• When compared with the cost of our intervention ($112,000), the net savings was approximately $708,000
SBML Outcomes: Cost Effectiveness

Cost Savings From Reduced Catheter-Related Bloodstream Infection After Simulation-Based Education for Residents in a Medical Intensive Care Unit

7:1 rate of return

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Cohen et al. Simulation in Healthcare 2010
Thank you on behalf of our Northwestern team
Discussant
Scaling and Spreading this Innovation to other Academic Medical Centers

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