Simulation in Radiology Education

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“Simulation is a technique, not a technology, to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner.”

Key Components of Simulation Education

- Clearly stated objectives presented to student prior to simulated experience
- Student prepared with basic knowledge of clinical material
- Hands-on deliberate practice
- Debriefing with feedback on performance
Evolution or “Revolution” in Medical Education
Apprenticeship Model

Objectives/Competency Based Model
Apprenticeship Model

• **Strength** –
  - Trainees learn skills with oversight on real patients

• **Weakness** –
  - “July Effect”
  - Learning is dependent on exposure to clinical material
Objectives/Competency Based Model

The Pediatric Radiology Milestone Project

*Published by The Accreditation Council for Graduate Medical Education and The American Board of Radiology*

July 2015

ACGME Milestone Project

- Designed to help all residencies and fellowships produce highly competent physicians
- Provide more explicit and transparent expectations of performance
- Support self-directed learning and assessment
- Facilitate better feedback for professional development
## Pediatric Radiology Milestones

**Version 2/2014**

**THE PEDIATRIC RADIOLOGY MILESTONES: ACGME REPORT WORKSHEET**

### Competence in Procedures — Patient Care 3

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competently performs basic* pediatric procedures under direct supervision</td>
<td>Competently performs basic and intermediate* pediatric procedures with indirect supervision</td>
<td>Competently performs advanced* pediatric procedures under direct supervision</td>
<td>Competently, efficiently, and independently performs basic and intermediate* pediatric procedures</td>
<td>Competently and independently performs advanced pediatric-specific procedures</td>
</tr>
<tr>
<td>Recognizes complications of basic procedures</td>
<td>Recognizes complications of intermediate procedures</td>
<td>Efficiently performs basic* pediatric procedures with indirect supervision</td>
<td>Examples include: <strong>Fluoroscopy</strong>  - Intussusception reduction  - Contrast enema  - VCUG  - Bladder catheterization  - Upper GI series  - Airway fluoroscopy  - Modified barium swallow</td>
<td><strong>Ultrasound/Doppler</strong>  - Head and neck  - Spine  - Hips  - Abdomen – pyloric stenosis, appendicitis, intussusception  - Pelvic/testicular</td>
</tr>
</tbody>
</table>

**Comments:**

*as defined by the fellowship program

Not yet achieved Level 1 □
Keys to Developing Competence

- Identify training goals
- Motivation to improve
- Opportunity to repeat and refine performance
- Critique/Feedback to Trainees

Key Components of Simulation Education

• Clearly stated objectives presented to student prior to simulated experience

• Student prepared with basic knowledge of clinical material

• Hands-on deliberate practice

• Debriefing with feedback on performance
Achieving Competence with Simulation

Identify training goals → Clearly stated objectives prior to simulated experience

Motivation to improve → Student prepared with basic knowledge of clinical material

Opportunity to repeat and refine performance → Hands-on deliberate practice

Critique to Trainees → Debriefing with feedback on performance
Type of Simulators

- Low fidelity
  - Standardized patients
- High fidelity
  - Part-task trainers
  - Virtual reality
  - Mannequins
• **Anesthesiology**
  - 60-70 high-fidelity anesthesia simulation centers in the US for med students and trainees
  - Mandatory simulation for MOC

• **Surgery**
  - 40 centers with advanced simulation training worldwide run by the ACS

SIMULATION IN RADIOLOGY

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OXFORD UNIVERSITY PRESS
Simulation in Radiology

- Contrast Reactions
  - high fidelity mannequins
  - low fidelity computer based model
Simulation in Radiology

- Procedural Simulations
  - US guided foreign body removal pioneered by WE Shiels, DO.
  - Turkey breast simulation model developed in 1989 with annual hands on RSNA workshops beginning in 1991

Simulation in Radiology

- Procedural Simulations
  - Fluoroscopy guided
    - Intussusception
    - Lumbar puncture
  - CT guided
    - Lumbar puncture

Fig. 1 Plastic tubing with the instructor’s external release valve (arrow) connects the aneroid gauge and bulb insufflator to the cylinder within the doll. Additional tubing extends from the doll to a pressure sensor and is transmitted via USB cable to a computer.

Simulation in Radiology

- Interpretive Simulations
  - Fluoroscopy
    - UGI and Enemas in Neonates
  - PACS on call
    - iPad model

Potential Barriers

- Cost of buying or making simulation device
- Time to train residents and fellows
- Lack of experience using this educational technique
So where do we go from here?
Translational Research Assessing Effect of Simulation Experience

- Develop simulation models/devices/scenarios for Radiology

- T1 – Evaluate educational outcomes looking for improved knowledge, skills, behaviors

- T2 – Assess for skill transfer from simulation laboratory to observed clinical practice

- T3 – Identify improvement in clinical outcomes due to simulation experience

Severe contrast reaction emergencies high-fidelity simulation training for radiology residents and technologists in a children’s hospital.

Figure 1. Radiology residents and radiology technologists’ (RT) knowledge improvement during simulated contrast emergencies.

*T P < .01.

Prospective randomized study of contrast reaction management curricula: computer-based interactive simulation versus high fidelity hands-on simulation.

Fig. 3. Mean scores from the three written tests using all available participants per test (N = 44). The error bars indicate the range of scores. No significant differences in scores between groups were detected for any of the three tests (p = 0.83, 0.65, and 0.98, from left to right).

Simulation-based educational curriculum for fluoroscopically guided lumbar puncture improves operator confidence and reduces patient dose.

**TABLE 2. Average Fluoroscopy Time (Minutes) for Prospective versus Retrospective Study Cohorts**

<table>
<thead>
<tr>
<th></th>
<th>Avg. Fluoro Time (Prospective), Minutes</th>
<th>Avg. Fluoro Time (Retrospective), Minutes</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic LP</td>
<td>0.81</td>
<td>0.94</td>
<td>.002*</td>
</tr>
<tr>
<td>LP for myelogram</td>
<td>0.98</td>
<td>1.4</td>
<td>.001*</td>
</tr>
<tr>
<td>All FGLP (total)</td>
<td>0.87</td>
<td>1.09</td>
<td>.002*</td>
</tr>
</tbody>
</table>

Avg., average; FGLP, fluoroscopically guided lumbar puncture; LP, lumbar puncture.

*Indicates a statistically significant difference between prospective and retrospective groups.
Future Directions

• Encourage collaboration to foster growth

• Start a subcommittee within our society to raise awareness

• Invite experts from other subspecialities to speak at SPR/IPR


References for Simulation in Radiology Education


