Does Simulation-based Medical Education with Deliberate Practice Yield Better Results than Traditional Clinical Education? A Meta-Analytic Comparative Review of the Evidence

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- 633 learners participated, including 389 residents, 226 medical students, and 18 internal medicine fellows
- The SBME studies address a number of competencies and skills
- Of the 14 selected studies:
  - 6 demonstrated *improvement in laparoscopic surgical skills including* cholecystectomy, instrument and camera navigation and handling, and suturing live tissues
  - 2 showed *improved performance and adherence to American Heart Association advanced cardiac life support guidelines* including responses during actual patient codes
  - 2 showed *improved cardiac auscultation skills* including identification and interpretation of heart sounds and murmurs among medical students and residents
  - 4 demonstrated *improved ability to perform three invasive procedures* (hemodialysis catheter insertion, thoracentesis, central venous catheter insertion) among residents and fellows
Does Simulation-based Medical Education with Deliberate Practice Yield Better Results than Traditional Clinical Education? A Meta-Analytic Comparative Review of the Evidence

<table>
<thead>
<tr>
<th>Research design and study</th>
<th>Correlation</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Randomized trials</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1. Wayne et al, 2005</td>
<td>0.81</td>
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<td>0.88</td>
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<td>2. Ahlberg et al, 2007</td>
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<td>3. Andreatta et al, 2006</td>
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<td>4. Korndorffer et al, 2005</td>
<td>0.62</td>
<td>0.29</td>
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<tr>
<td>5. Korndorffer et al, 2005</td>
<td>0.52</td>
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<td>6. Van Sickle et al, 2008</td>
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<td>0.17</td>
<td>0.74</td>
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<tr>
<td><strong>Cohort studies</strong></td>
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<tr>
<td>7. Issenberg et al, 2002</td>
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<td>0.73</td>
<td>0.82</td>
<td>.000</td>
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<tr>
<td>8. Barsuk et al, 2009</td>
<td>0.61</td>
<td>0.29</td>
<td>0.81</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>
</tr>
<tr>
<td>10. Wayne et al, 2008</td>
<td>0.51</td>
<td>0.29</td>
<td>0.68</td>
<td>.000</td>
</tr>
<tr>
<td><strong>Pre-post baseline studies</strong></td>
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<tr>
<td>11. Wayne et al, 2008</td>
<td>0.80</td>
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<tr>
<td>12. Barsuk et al, 2009</td>
<td>0.79</td>
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<td>0.86</td>
<td>.000</td>
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<tr>
<td>13. Barsuk et al, 2009</td>
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<td>0.71</td>
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<tr>
<td>14. Stefanidis et al, 2006</td>
<td>0.71</td>
<td>0.55</td>
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<td><strong>Overall effect size</strong></td>
<td>0.71</td>
<td>0.65</td>
<td>0.76</td>
<td>.000</td>
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</tbody>
</table>

Learning Curves and Reliability Measures for Virtual Reality Simulation in the Performance Assessment of Carotid Angiography

Amar D. Patel, MD, Anthony G. Gallagher, PhD, William J. Nicholson, MD, Christopher U. Cates, MD, FACC, FSCAI

Atlanta, Georgia

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Graphs showing changes in procedure time, contrast volume, and fluoroscopy time over different trials.

Graphs showing changes in catheter movement errors, catheter vessel errors, and composite catheter handling errors over different trials.
Superiority of Simulator-Based Training Compared With Conventional Training Methodologies in the Performance of Transseptal Catheterization

Roberto De Ponti, MD,* Raffaella Marazzi, MD,* Sergio Ghiringhelli, MD,* Jorge A. Salerno-Uriarte, MD,* Hugh Calkins, MD,† Alan Cheng, MD†
Varese, Italy; and Baltimore, Maryland

TSP-C Transseptal Simulator (Mentice)

Electrophysiology fellows inexperienced in TSP-C

Complete the enrolling questionnaire

Randomization

n=7

Conventional training

End of training evaluation

End of training evaluation

Performance evaluation in 3 consecutive patient-based TSP-C procedures

n=7

Simulator training

De Ponti et al. JACC 2011;58:359-363
# Table 1: Score Table for Performance Evaluation

<table>
<thead>
<tr>
<th>Actions and Metrics</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1: workflow</td>
<td></td>
</tr>
<tr>
<td>Correct positioning of the guidewire in the superior vena cava</td>
<td>5</td>
</tr>
<tr>
<td>Correct advancement of the TSP assembly over-the-wire</td>
<td>7</td>
</tr>
<tr>
<td>Flush by saline of dilator lumen before needle insertion</td>
<td>6</td>
</tr>
<tr>
<td>Correct positioning of the needle inside the dilator</td>
<td>10</td>
</tr>
<tr>
<td>Correct rotation of the needle during assembly withdrawal</td>
<td>10</td>
</tr>
<tr>
<td>Correct rotation of the sheath and dilator during assembly withdrawal</td>
<td>5</td>
</tr>
<tr>
<td>Correct localization of the fossa ovalis</td>
<td>12</td>
</tr>
<tr>
<td>Use of oblique projections to verify correct engagement of the fossa ovalis</td>
<td>10</td>
</tr>
<tr>
<td>Check of pressure curve and/or contrast injection from the needle lumen</td>
<td>10</td>
</tr>
<tr>
<td>Correct needle advancement into the left atrium</td>
<td>6</td>
</tr>
<tr>
<td>Correct dilator/sheath advancement into the left atrium</td>
<td>4</td>
</tr>
<tr>
<td>Subtotal section 1</td>
<td>85</td>
</tr>
<tr>
<td>Section 2: ability</td>
<td></td>
</tr>
<tr>
<td>Fluoroscopy time &lt;5 min</td>
<td>4</td>
</tr>
<tr>
<td>Procedure time &lt;10 min</td>
<td>4</td>
</tr>
<tr>
<td>Volume of radio-opaque contrast injected &lt;20 cc</td>
<td>2</td>
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<tr>
<td>Number of attempts &lt;2</td>
<td>5</td>
</tr>
<tr>
<td>Subtotal section 2</td>
<td>15</td>
</tr>
<tr>
<td>Composite score</td>
<td>100</td>
</tr>
</tbody>
</table>

De Ponti et al. JACC 2011;58:359-363
Simulateur transseptal: Résultats

A. TRAINING TIME

- p = 0.0175

B. PERFORMANCE: COMPOSITE

- p = 0.0001

C. PERFORMANCE: WORKFLOW

- p = 0.0001

D. PERFORMANCE: ABILITY

- p = 0.0296

De Ponti et al. JACC 2011;58:359-363
Simulateur transseptal: Résultats

A

B

Simulateur Conventionnel

De Ponti et al. JACC 2011;58:359-363
A Technical and Cognitive Skills Evaluation of Performance in Interventional Cardiology Procedures Using Medical Simulation

This study suggests that an evaluation method using high-fidelity medical simulation to assess technical and cognitive skills of physicians performing interventional cardiology procedures can be used to identify physician outliers who are extremely poor performers and likely not to be providing appropriate patient care.

Lipner et al. Sim Healthcare 2010;5:65-74
Simulation en cardiologie interventionnelle

- Les besoins
- L’existant
- Les techniques
- La validation
- Le futur
Vision traditionnelle de l’apprentissage « sur le patient »

Cates and Gallagher. Eur Heart J 2012;33:2127-2134
Apport de la simulation basée sur des indicateurs de performance

7. Wisdom acquisition
6. Real patients with good mentoring and feedback
5. VR procedural simulation
   a. Full procedural VR simulation with summative metrics
   b. Full physics VR simulation with proximate formative & summative metrics
4. Emulation models
   a. Silicon, animal tissue (no formative feedback)
   b. Silicon, animal tissue (with formative feedback)
3. Formative assessed explanation (e.g. online)
2. Lecture
1. Simple explanation

from Gallagher & O'Sullivan, 2011 (4)

Cates and Gallagher. Eur Heart J 2012;33:2127-2134
Place de la simulation dans la formation : changement de paradigme

I. Stade débutant
(« Novice »)
Evaluation des connaissances
(« knowledge assessment »)

II. Stade débutant avancé
« Advanced beginner »
Points faibles (« areas of improvement »)

III. Stade de compétence
(« competence »)
Aide à atteindre le stade de maîtrise

IV. Stade de maîtrise
(« proficiency »)
Aide à atteindre le stade d'expertise

V. Stade d’expertise
(« Expert »)

VI. Nouvelles techniques
(« continuous learning »)

Le principal challenge

Core Curriculum

The Current State of Medical Simulation in Interventional Cardiology: A Clinical Document from the Society for Cardiovascular Angiography and Intervention’s (SCAI) Simulation Committee

Sandy M. Green, MD, Andrew J. Klein, MD, FSCAI, Samir Pancholy, MD, FSCAI, Sunil V. Rao, MD, FSCAI, Daniel Steinberg, MD, FSCAI, Rebecca Lipner, PhD, Jeffery Marshall, MD, FSCAI, and John C. Messenger, MD, FSCAI
Medical simulation training is well-suited to interventional cardiology. These procedures are often complex, the learning curves can be steep, and complications can be life-threatening. Simulation provides a safe arena to develop and refine skills that improve overall patient care. It’s especially helpful in interventional cardiology because of the field’s ever-changing technological and procedural environment. We need to increase use of medical simulation and accessibility to this training for highly complex procedures, such as structural heart interventions. Simulation can also improve training in areas where procedural volumes are low. The key is for clinicians and simulation vendors to collaborate and find ways to alleviate the financial burden associated with simulation. Using simulation at annual meetings and establishing regional or central simulation centers could ease this burden.

John C Messenger, MD, FSCAI
Chair of the SCAI Simulation Committee

http://www.physiciansweekly.com/medical-simulation-interventional-cardiology/
The Society for Cardiovascular Angiography and Interventions Structural Heart Disease Early Career Task Force Survey Results: Endorsed by the Society for Cardiovascular Angiography and Interventions

Konstantinos Marmagkiolis,1* MD, Abdul Hakeem,1 MD, Mehmet Cilingiroglu,2 MD, FESC, FACC, FSCAI, Steven R. Bailey,3 MD, FACC, FSCAI, Carlos Ruiz,4 MD, FACC, FSCAI, Ziyad M. Hijazi,5 MD, MPH, FACC, FSCAI, Howard C. Herrmann,6 MD, FACC, FSCAI, Alan Zajarias,7 MD, FACC, FSCAI, Steven L. Goldberg,8 MD, FACC, FSCAI, and Ted Feldman,9 MD, FESC, FACC, FSCAI

Over the last decade, structural heart disease interventions have emerged as a new field in interventional cardiology. Currently, the Accreditation Council for Graduate Medical Education accredited interventional cardiology fellowship programs in the United States provide high-quality and well-established training curriculum in coronary and peripheral interventions, but training in structural interventions remains in its infancy. The current survey seeks to collect relevant information and assess the opinion of interventional cardiology program directors in ACGME-accredited institutions that are actively involved in structural interventional training. Our study describes the actual number of structural procedures performed by interventional cardiology fellows in ACGME-accredited programs, the form of the structural training today and the suggestions from program directors who are actively trying to integrate structural training in the interventional cardiology fellowship programs.

Key words: congenital heart disease in adults; patent foramen ovale/atrial septal defect; paravalvular leaks
Place de la simulation en cardiologie interventionnelle structurelle

“No single interventional cardiology fellowship program can offer sufficient training in all 15 types of structural interventions in a single year,” says Dr. Cilingiroglu. “To overcome this problem, it may be possible to combine rotations in different institutions. **Computer-based hands-on training simulators might be an approach to achieve training in all the required types of advanced structural interventions.** Since it will be difficult to define a uniform training curriculum, we need to think outside the box to find ways to enhance education and training for interventional cardiologists.”

Mehmet Cilingiroglu, MD, DSCAI, FACC, FESC
Member of SCAI Structural Heart Disease Early Career Task Force

http://www.physiciansweekly.com/enhanced-structural-heart-disease-training/
Les défis de la simulation en cardiologie interventionnelle: (1) Défis techniques

- **Cadre didactique** (« core curriculum »)
- **Référentiels d’indicateurs de performance** (« benchmarking, metrics ») comportant des points positifs et surtout négatifs (erreurs)
- **Rendu quantitatif immédiat** (« proximate feedback »)
- **Standardisation du niveau de maîtrise** (« proficiency ») prenant en compte connaissances ET compétence cognitives et techniques
- **Adaptation continue à la complexité** des procédures structurelles
Les défis de la simulation en cardiologie interventionnelle: (2) Défis structurels

- **Réorganisation** du cursus de cardiologie interventionnelle: Place de la simulation dans la certification, la formation continue et le renouvellement d’exercice des cardiologues interventionnels?

- **Nouveau gold standard de compétence minimale** = maîtrise assistée par la simulation (« proficiency-based simulation training »)?

- **Centres de simulation régionaux** (expériences d’Angers, Nancy et Rouen)

- **Financement**: université/ESC/SFC/GACI/industrie/régions?

- **Etudes de validation** (performance du médecin et pronostic du patient)
Conclusions sur la simulation en cardiologie interventionnelle

- La cardiologie interventionnelle est **leader**
- Des techniques performantes sont **disponibles**
- Impact fort sur la **formation** des cardiologues interventionnels (bénéfice patient?)
- Ces techniques sont encore **insuffisamment partagées**
- Leur **coût** explique qu’elles sont largement contrôlées par l’industrie
- La simulation a été largement **adoptée en Amérique du nord**
- **Au niveau européen et français**, présence de centres de simulation de grande qualité, l’intégration dans la formation reste à faire