Simulation in physiology

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Content

• Teaching physiology – can we make it better?
• Hi-fidelity simulators - expensive toys?
• Physiology Live
• Does it really matter?
Teaching physiology
Can we make it better?
Challenges

• Applying principles to clinical practice
• Demonstrating dynamic changes
• Modeling multiple body systems
• Visualizing rare clinical scenarios e.g. shock, respiratory failure
• Anchoring concepts with a clinical case
Hi-fidelity simulators – expensive toys?
Simulation Technology

Spectrum

- Computer software programs
  - E.g. www.cyber-anatomy.com
- Virtual reality interfaces
- Mannequins (Task/Computerized)
- Standardized/Simulated patient
- Hybrid
Simulation Technology
Advantages

• “Physiology Live”
  • Application of principles to differential diagnosis and therapy
  • Instant feedback
  • Clinical correlation

• Scenarios can be halted to allow for discussion
• Build experience with simulators
Simulation Technology

Disadvantages

- Cost
- Class size
- Faculty time
Physiology Live
### Scenario 5: Acute Myocardial Infarction

**Patient Story:**
Emergency Department: Elderly male presents to the A&E dept complaining of sudden chest pain and breathlessness at rest.

**Patient Data:**
Name: Mr F  
Stats: 78 year old 1.6 meter tall, 66kg  
Prior Medical History: Hypension, diabetes mellitus, hyperlipidaemia, smoker.  
Recent Medical History: External chest pain relieved by rest.

On examination, he has the following parameters

<table>
<thead>
<tr>
<th>PRESET BASELINE PARAMETERS</th>
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<td>A) He is diaphoretic (perspiration), but is alert and rational. He is able to speak short sentences.</td>
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<td><strong>HR 100, RR24, O2 sats 94% temp Celsius, b.p. 110/60 mmHg, CVP14</strong></td>
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Examination reveals decreased bilateral basal crepitations

**Acute Pulmonary Oedema**

| B) When indicated by instructor (this is to demonstrate development of pump failure), He develops cyanosis and frothing from the mouth |
| **HR 110, RR30, O2 sats 88%, mildly cyanosed, temp 36.7 deg Celsius, b.p 110/70 mmHg, CVP16** |

Examination reveals decreased A/E in the left chest, CxR pulmonary oedema.

**Changes in Simulator**
SPO2 falls, display CxR

**Moderate**

| C) When indicated by instructor (this is to demonstrate continual deterioration), ХR 140, RR32, O2 sats 86%, b.p. 90/50mm Hg, CVP18 |

**Changes in Simulator**
HR RR Rise BP SPO2 falls
Case 1

You are the medical officer in the high-dependency ward. You are asked to see a 75 year old man who has just returned from the operating room following a total knee replacement 6 hours ago. The nurses report that his oxygen saturation is low (90%).

You review his medical history and note that he has no previous medical problems and had the operation done under a general anesthetic. He is on a morphine infusion for analgesia. The intraoperative course was uneventful.
Does it really matter?
Random-effects meta-analysis of traditional clinical education compared with simulation-based medical education (SBME) with deliberate practice (DP). Effect size correlations with 95% confidence intervals (95% CIs) represent the 14 studies included in the meta-analysis. The diamond represents the pooled overall effect size. McGaghie et al. Acad Med 2011.
Outcomes in basic science education
Improved test scores


Outcomes in basic science education
Higher preference


Where do we go from here?
Future directions
Nine elements of deliberate practice (DP)

1. Highly motivated learners with good concentration who address
2. Well defined learning objectives or tasks at an
3. Appropriate level of difficulty with
4. Focused, repetitive practice that yields
5. Rigorous, reliable measurements that provide
6. Informative feedback from educational sources (e.g., simulators, teachers) that promote
7. Monitoring, error correction, and more DP that enable
8. Evaluation and performance that may reach a mastery standard where learning time may vary but expected minimal outcomes are identical† and allows
9. Advancement to the next task or unit

Teaching physiology
Can we make it better?
Teaching physiology
We can make it better
Thank you