Single speciality or inter-professional simulation-based education - does each have a role in anaesthesia training?

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The Case of Elaine Bromiley

Martin Bromiley:

‘So that others may learn, and even more may live’
Airway Management Failures

- Failure to ensure oxygenation by performing a percutaneous or surgical cricothyroidotomy
- Inappropriate multiple attempts at ETT placement
- Incorrect use of I-LMA for blind & fiberoptic intubation
- Inappropriate transfer to PACU without appropriate airway, handover and monitoring
- Inappropriate transfer of an unstable patient to ICU
Crisis Management Failures

In Martin Bromiley’s words..

“We have a breakdown of
..leadership..
..situation awareness..
..prioritization..
..decision making..
..communication..
..assertiveness.”
Outline

- Anaesthesia-specific technical skills training
- Anaesthesia non-technical skills & team training
- A collaborative CAI & RCSI model of inter-professional training: **MASCOT COURSES**
What makes a good anaesthetist?

- Knowledge
- Technical skills
- Non-technical skills
How do anaesthetists acquire their skills?

- Germany 2006; 26-Q survey; 41 hospitals; 607 consultants; 43% RR
- Genuine training - 14% of working hours
- 1-month 1:1 apprenticeship novice to consultant
- Main obstacles to teaching: daily workload (96%), time pressure (96%), lack of personnel (90%)
- Teaching patterns (MCQ)
  - 71% case-oriented teaching
  - 53% ‘see one do one teach one’
  - 49% ‘learning by doing’
How would anaesthetists like to acquire their skills?

- Germany 2014; consensus meeting of residents representatives; 31/39 (79.5%)

- What makes good/helpful: 1) teachers; 2) learning conditions; 3) curricular structure and rotation culture?

- Consensus outcomes
  - Teachers with formal teaching qualifications & protected teaching time
  - Safe working and teaching environment
  - Well structured curriculum and rotation planning
  - Regular simulation training as a team
Mortality and Morbidity in Anaesthesia

- 1990 – 2000; 34 deaths/mill GAs in developed & developing countries

- 2000 – 2010; 10 deaths/mill GAs in ASA I & II patients; 40 % due to airway management problems

- NAP4 – 2011; 5.6 deaths/mill GAs due to poor airway management; true airway-related mortality could be 20 deaths /mill GAs
Fourth National Audit Project UK

- 184 major airway events over 1-year period
- 133 related to GA or 1:22,000 GAs
- 16 deaths related to GA or 1:180,000 GAs
- Airway management was considered good 16%, mixed 43% and poor 35%
- Airway management was poor in 54% of all cases leading to death & brain damage
- Only in 3 deaths the airway management was exclusively good
Primary airway problem in NAP4
Human factors identified in NAP4

- System design and management failure
- Individual and team non-technical skills failure
  - Poor planning and failure to plan for failure
  - Poor judgment
  - Fixation error
  - Poor/dysfunctional communication
  - Casual attitude to risk/overconfidence/failure to follow advice from peers
- Lack of clarity of leadership and team structures
No reason for complacency

- Anaesthesia management has an important impact on perioperative risk

- Perioperative safety is a shared responsibility of multiprofessional teams

- We work together, we train together!
What is to be learned?

- Even the most diligent and carefully practicing anaesthetist can make mistakes.

- Anaesthetists need to acquire and maintain an array of important specialty-specific technical skills.

- Individual and team training in human factors and non-technical skills training is required.
Simulation-based training in anaesthesiology: a systematic review and meta-analysis

G. R. Lorello¹,³, D. A. Cook⁴,⁵, R. L. Johnson⁶ and R. Brydges²,³*

- 52 studies/4483 subjects

Fig 2 Random-effects meta-analysis of comparisons between simulation-based training and no intervention (positive numbers favour simulation): knowledge, time, skill, behaviour, and patient outcomes.
• 11 studies/581 subjects

![Graph showing the comparison between simulation-based and non-simulation instruction](image)

**Fig 4** Random-effects meta-analysis of comparisons between simulation-based and non-simulation instruction (positive numbers favour simulation): satisfaction, knowledge, time, skill, behaviour, and patient outcomes.

• added NTS in 4 studies

![Graph showing the comparison between routine and added non-technical training](image)
Advanced Airway Management Simulation Training in Medical Education: A Systematic Review and Meta-Analysis

Cassie C. Kennedy, MD, FCCP¹; Eric K. Cannon, MD²; David O. Warner, MD²; David A. Cook, MD, MHPE, FACP³

Critical Care Medicine 2014; 42: 169-178
• 76 studies; 5266 subjects

**Figure 2.** Outcomes of studies comparing simulation education with no intervention. The first column lists outcomes (knowledge, time skill, non-time skill, behavior, and patient effect), whereas the second column lists the number of studies and trainees contributing data to each analysis. The forest plot demonstrates point estimate of standardized mean difference (SMD; **black box**) surrounded by 95% CI (**line**). Positive SMDs favor the simulation intervention. *p* values reflect comparison of the estimated effect versus no effect. All SMDs reported represent a meta-analysis of pooled effect.

**Figure 4.** Outcomes of studies comparing simulation education with nonsimulation intervention. See Figure 2 for explanatory notes. Standardized mean differences (SMDs; **black box**) for those outcomes listing more than two included studies are pooled effects by meta-analysis (satisfaction, knowledge, non-time skill, and patient effect). Others represent the point estimate and CI reported in a single study. Positive SMDs favor simulation training, whereas negative values favor the nonsimulation intervention.
Panel E. Behaviors and Patient Effects

<table>
<thead>
<tr>
<th>Feature</th>
<th>No. studies (No. trainees)</th>
<th>Favors absence</th>
<th>Favors presence</th>
<th>Pooled effect size (95% CI), p</th>
<th>I²</th>
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<tbody>
<tr>
<td>Clinical variation</td>
<td>6 (352)</td>
<td></td>
<td></td>
<td>0.16 (-0.30, 0.62), p=.50</td>
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<tr>
<td>Cog. interactivity</td>
<td>4 (170)</td>
<td></td>
<td></td>
<td>0.26 (-0.24, 0.76), p=.32</td>
<td>73</td>
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<tr>
<td>Distrib. practice</td>
<td>1 (61)</td>
<td></td>
<td></td>
<td>0.27 (-0.23, 0.78), p=.29</td>
<td>22</td>
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<tr>
<td>Feedback</td>
<td>2 (47)</td>
<td></td>
<td></td>
<td>0.32 (-0.16, 0.80), p=.19</td>
<td>22</td>
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<tr>
<td>Individualization</td>
<td>4 (193)</td>
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<td></td>
<td>0.19 (-0.22, 0.60), p=.36</td>
<td>54</td>
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<tr>
<td>Mastery learning</td>
<td>3 (168)</td>
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<td>0.26 (-0.07, 0.58), p=.12</td>
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<td>Mult. learning strat.</td>
<td>6 (374)</td>
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<td></td>
<td>0.53 (0.28, 0.77), p&lt;.001</td>
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<tr>
<td>Range of difficulty</td>
<td>5 (227)</td>
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<td></td>
<td>0.25 (-0.19, 0.69), p=.26</td>
<td>73</td>
</tr>
<tr>
<td>Time learning</td>
<td>4 (235)</td>
<td></td>
<td></td>
<td>0.39 (-0.02, 0.80), p=.06</td>
<td>73</td>
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</tbody>
</table>
Characteristics of effective simulation

- Deliberate practice (DP) and mastery learning (ML)
- ‘It involves an array of high- and low-technology educational interventions that aim to shape, refine and maintain the acquisition of cognitive, clinical and professionalism skills to high and uniform achievement standards’
- Improves learners’ skills in relation to many technical skills
- It is associated with translational outcomes
- Allows retention at 6-12 months

Nine Elements of DP

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

Seven Features of ML

- Baseline or diagnostic testing
- Clear learning objectives, sequenced in units in increasing difficulty
- Engagement in educational activity
- A set minimum passing score for each educational unit
- Formative testing to gauge unit completion at a preset minimum passing standard for mastery
- Advancement to the next educational unit given measured achievement at or above the mastery standard
- Continued practice or study until the mastery standard is reached
Applications to Specialist Anaesthesia Training

Currently:

- Apprenticeship to consultants in the workplace; SODOTO
- Various anaesthesia-specific skills courses
- Comprehensive single- and multi-speciality simulation training

Ongoing CAI work on:

- Competency-based curriculum
- Rigorous metrics for each competency
- Entrustable professional activities
Multidisciplinary Anaesthesia-Surgery Crisis Operation Training (MASCOT)

- CAI & RCSI collaborative project
- Pilot funded by the HSE in 2011
- First course in 2012
- MASCOT One for S & A trainees - 2012
- MASCOT Two for S & A trainees - 2013
- EM trainees joined MASCOT Two in 2014
MASCOT Learning Objectives

Acquirement, practice and demonstration of

- specialty-specific knowledge and technical skills
- common non-technical skills
ANTS & NOTSS

- Task management
- Communication and Team working
- Situation awareness
- Decision making
- Leadership
- Coping with pressure
MASCOT Design & Development

- Clear common learning objectives
- Equally relevant to both specialities
- Strong emphasis on cross-speciality crisis
- Opportunities for demonstrating technical skills
- But with focus on ANTS, NOTSS & CRM principles
- Mix of OR-, ED- and ITU-based simulated scenarios
Sudden cardio-respiratory instability during laparoscopic appendectomy

- Management of bradycardia & hypoxia
- Complications of CO2 insufflation & chest drain insertion

- Communication and team work
- Situation awareness
- Decision making
Malignant hyperthermia during laparoscopic cholecystectomy

MH algorithm

Laparoscopic cholecystectomy skills

Mutual understanding

Leadership

Communication and team work

Task management
Aorta penetration and PEA during laparoscopic cholecystectomy

- CPR & Major transfusion
- Complication of laparoscopy

- Situation awareness
- Communication and team work

- Decision making
- Leadership

Complication of laparoscopy
MASCOT Feedback

Liked..

- ‘combined with anaesthetics very useful’
- ‘interesting to hear the point of view of surgical team’
- ‘different specialities enhanced the course’
- ‘the realistic nature of the OR as well as the support staff helped to reinforce realism’
- ‘scenarios are realistic’; ‘hands on’
- ‘best I have experienced compared to ATLS and others’
MASCOT Feedback

Disliked & suggestions for improvement..

- ‘weighted towards anaesthetics and general surgery/general trauma’
- ‘very general surgery orientated; more speciality-specific scenarios’
- ‘technical anaesthetic scenarios were a little less relevant e.g. MH’
- ‘some of the surgical models a little less realistic than the anaesthetist models but by their nature are more difficult to simulate’
MASCOT Challenges and Solutions

- Emphasis on understanding the learning objectives during introduction
- Shift in the simulated crisis trigger from one speciality end to the other
- Enhanced specialty-specific realism: environment, equipment & moulage
- Allocation of scenarios to participants according to sub-specialty interests
MASCOT 2012 - 2015

- 21 courses
- 10 MASCOT One
- 11 MASCOT Two
- MASCOT One 49 A : 49 S
- MASCOT Two 42 A : 45 S : 23 EM
- Multidisciplinary TTT - certified Faculty
- Continuing QA
<table>
<thead>
<tr>
<th>Question</th>
<th>A N = 46</th>
<th>S N = 42</th>
<th>P-value</th>
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<td>Q1: The course met the stated objectives</td>
<td>4.26</td>
<td>4.42</td>
<td>0.26</td>
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<td>Q2: The course matched my own learning needs</td>
<td>4.13</td>
<td>4.21</td>
<td>0.62</td>
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<td>Q3: I found the course relevant to my stage of training</td>
<td>4.26</td>
<td>4.21</td>
<td>0.47</td>
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<tr>
<td>Q4: I found the course relevant to my practice</td>
<td>4.32</td>
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<td>Q7: I am overall satisfied with the course</td>
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<td>Q8: The course will change my future practice</td>
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<td>Question</td>
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<td>Q1: The course met the stated objectives</td>
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<td>Q4: I found the course relevant to my practice</td>
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<td>4.39</td>
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<td>Q8: The course will change my future practice</td>
<td>4.16</td>
<td>4.14</td>
<td>3.95</td>
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</tbody>
</table>
Conclusion

- The acquisition and maintenance of both technical & non-technical anaesthetic skills is essential
- There is scope for using simulation more effectively in anaesthesia training
- Inter-profession team training is satisfactory and relevant to the learning needs, training and practice of anaesthesia, surgery and emergency medicine specialities
- Work is needed to establish a robust and defensible evidence base for simulation-based team training and transferability to clinical practice