

Research in the simulated OR: working within constraints to create the illusion of control

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Background

In addition to being used for education and training¹, patient simulators are being used increasingly in research^{2,3}. Under the right conditions, the simulated OR can be used to test human factors issues that depend on a clinical context³.

Methods

We chose a high fidelity simulated operating theatre to assess the utility of a head-mounted monitoring display (HMD) for anesthesiologists⁴. We created operative scenarios within specific constraints, while maintaining a high level of physical, semantic and phenomenal realism⁵. Our three experimental scenarios confirmed to the following constraints:

- Each scenario contained 8 independent events, each associated with a clinically relevant⁶ visual distractor task.
- Distractor tasks did not cue participants to events.
- Participants had to be exposed to all events under the same circumstances and events should have similar resolutions.
- All events and distractors had to occur within a “believable” 35- to 40-minute operation.
- Each event had to be detectable in one of 4 sites: anesthetic machine (AM), HMD, patient or OR).
- Each distractor had to be either near (within 3 meters of the participant) or far.
- Events had to be repeatable and highly controlled.

In consultation with local anesthesiologists, we designed four typical operative scenarios. Intra-operative events were overlaid on the basic scenarios, having been chosen on the basis of conceptual fidelity, predictability of the anesthesiologists’ response and ease of returning the simulation to a standard state once resolved. We incorporated typical OR distractions into each scenario, with significantly more distractions than events.

Scenarios were then translated into a format applicable to the METI ECS™ patient simulator and comprehensive acting scripts were developed.

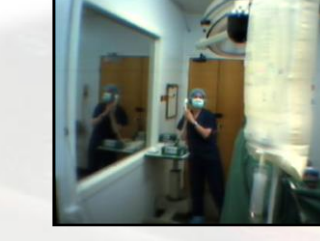
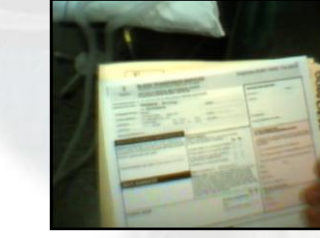
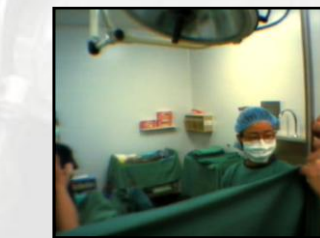
Transitions in scenario and script were cued by participant actions or directly from the control room. Thus, although the participants were given the “illusion of control” by allowing them to choose how and when to manage issues as they arose, the scenarios were largely deterministic.



Results

The table below shows a basic flowchart of one scenario. 12 anesthesiologists were tested over a seven-day period. Participants demonstrated a range of activity in our scenarios that would not have been evident in a laboratory or clinical study⁷. Although the scenarios were tightly scripted, no anesthesiologist commented that they felt any scenario was deterministic.

Time	Script	Event	Distraction
00:00	Preparation of anesthetic drugs		
01:00	Argument between surgeon and scrub nurse (SN)	Incorrect knee joint implant	Drawing up drugs
02:30	Induction of anaesthesia		
05:30	Intubation		
11:00	Anesthetic nurse (AN) “tidies up” and leaves laryngoscope on patient	Laryngoscope left on patient	Surgeon asks for antibiotics
12:00	Prep and drape, AN claims to have touched gloved hand of SN		Distraction from AN and SN
14:00	Routine check of patient, operation site etc.		
14:30	Start operation		
15:30	Request for patient’s ASA status		Distraction from scout nurse
17:00	AN hands chart to anesthesiologist, ST segment depression on monitor	ST depression	Charting
19:00	Once detected, ST depression spontaneously resolves		
20:30	Low BP, high HR	Hypovolaemia	Phone message
22:00	After participant notices hypovolaemia, removes cover from suction, revealing 1500ml blood.		
25:30	After decision to get blood, AN asks for signature on request form. IV stops (clamped).	IV stops	Signing transfusion form
28:00	IV restarted when flushed.		
29:00	Operation continues.		Distraction from surgeon
30:30	Discussion re previous patient	Volatile empty	Discussion with nurse at door
32:30	Volatile refilled.		
33:30	AN disconnects circuit when participant moves to drug trolley.	Circuit disconnection	Surgeon asks for gentamicin
36:00	Circuit reconnected.		
37:30	Blood arrives in OR. Transfusion commenced.	Failure to check blood	Surgeon discusses transfer
38:00	Stop to check blood against patient.		
39:00	Phone message from HDU re bed status.		Distraction from AN
40:00	End of scenario		



Conclusions

Meticulous planning and attention to detail, along with extensive consultation with local subject matter experts, is mandatory to design a scenario within such constraints. The “illusion of control” for the anesthesiologist must similarly be maintained to ensure emotional fidelity, while the scenario must also be highly deterministic to achieve meaningful results within the constraints required.

References

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