

“Design of Crisis Resource Management scenarios for full scale simulators – what is needed to improve the overall clinical safety?”

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## Abstract

The design of Crisis Resource Management scenarios is based on several major steps:

- Define learning objectives
- Use Full Scale simulators with as much of reality as needed to achieve the learning goals
- Provide the environment realistic for the scenario setting
- Design the course of the scenario(s) adapted to the topic and the learning goal
- Use facilitators/instructors capable of teaching towards the learning goals
- Use video to enhance the debriefing; result in a clear take home message

The most important properties will be described in the paper.

## Introduction

Pilots regularly train normal and abnormal flight operations in flight simulators, e.g. engine on fire. That this helps saving life has been proven in summer 2013 in Frankfurt when exactly this (very rare) event happened to an airbus A 320 during start. The flight crew was able to safely land the plane which is remarkable for 2 major reasons:

1. The A 320 had to be operated with just one engine during the start, the short flight and the approach until it landed. This is of course possible, but not done during normal flight operations.
2. The A 320 was heavily loaded with passengers and fuel. That resulted in a so called “heavy landing procedure” which is different from the normal approach. Again – this procedure is not used during routine flight operations.

Nevertheless both situations are common to pilots: they train it in simulators to be ready for the real event.

Crisis Resource Management (CRM) applied to clinical settings does the same to medical teams: train in a simulator setting to be ready for the real event. Thus we can assume that simulator training helps saving patients from complications and major harm, even death.

Several years ago we received a letter from a participant of a training some month before. “Thank you very much for the malignant hyperthermia (MH) scenario that we had during your CRM class. I have to say I recently experienced a MH in a child undergoing minor ENT surgery. With the experience from the simulator scenario I was able to manage the MH without any further complications. The child is doing absolutely well.” Of course – we do not know what would have happened without the scenario, but obviously in the experience of this anesthesiologist it helped saving the child’s life.

The problem is that until now nobody was able to prove that CRM training helps saving life. And this may not be expected in the near future. So the question arises: how shall we design our CRM classes respectively the CRM scenarios that the ultimate goal is as probable as it can be? The experience from now 15 years of active CRM training can be summarized in these design elements:

- Define learning objectives
  - For the CRM class or even for a consecutive series of CRM classes
  - For each scenario

- Medical topic
- Human factor topic
- Use Full Scale simulators with as much of reality as needed to achieve the learning goals
- Provide the environment realistic for the scenario setting
- Design the course of the scenario(s) adapted to the topic and the learning goal
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## Define Learning Objectives

“The participant shall be able to ...”

Learning objectives in CRM focuses on two major groups: a medical learning objective and a human factors learning objective. The medical learning objective can be any typical topic in the professional field. For anesthesiologists it may be recognizing and treating anaphylaxis following antibiotic administration. For emergency personal it may be how to handle a massive bleeding. For endoscopy staff it may be how to conduct sedation with Propofol. Sometimes the medical learning goal is not in the focus of the scenario: this is often the case if real professionals are trained and they may be interested just in human factors. But if it comes to real (physicians, nurses and students) mixed-teams the medical background may not be clear to every participant and it is important to have this in mind and to reach all of the participants. It simply does not make sense to talk about human factors, if the medical background of the scenario remains unclear.

The human factors learning objective may be more interdisciplinary (not special to a certain profession). Typical fields of interest are communication, team work, decision making, leadership, stress management, conflict management or workload management. It is impossible to focus on all these topics during one scenario, even not during a series of scenarios lasting 1 day of training. Our experience is that just one human factor topic should be in the focus during a one day class. If it comes to regular trainings (e.g. 1 day of training per year) the next topic may be added on a yearly basis.

In the following text we will give one example about anaphylaxis (medical topic) and communication (human factors topic) for these design details. It is always given in ***italic letters***

### ***Example:***

*Medical topic: Anaphylaxis*

- *The participant shall be able to recognize early signs of anaphylaxis*
- *The participant shall be able to name the degrees of severity of anaphylaxis*
- *The participant shall be able to conduct the correct therapy for different degrees of severity of anaphylaxis*
- *The participant shall be able to name all drugs and their dosage used in anaphylaxis*

*Human factor topic: Communication*

- *The participant shall speak up, loud and clear*
- *The participant shall understand and practice 3-way communication*
- *The participant shall inform all members from his team from time to time*

## Use Full Scale simulators with as much of reality as needed

Full Scale patient simulators are available from different companies. They differ in several features and have their special advantages and disadvantages. The perfect full scale patient does not exist up to now, but we can get fairly close. Important features are a realistic mannequin showing clinical signs like eyes, pupils, pulses, breath- and heart sounds, ready for various interventions like emergency maneuvers, intubation, ventilation, monitor interface and many more. They all do not have a really complete hemodynamic representation, they do not provide the possibility to connect iv-pumps and they do not have a model for the brain function. Some have a kind of physiology software others do not have this.

Skin function is poor, e.g. cyanosis cannot be demonstrated in the skin (some use blue LED to show cyanotic lips), and swelling or sweating can be simulated in some of the mannequins.

It makes a lot of sense to add more features to the commercial simulators. We use a special open interface software to connect to the simulator interface and are able to add several functions like EEG, brain functions, pumps, complex hemodynamic monitoring and more.

If it comes to lung function, all simulators do not have a real functioning lung. They are indeed extremely limited. That is why we have developed a full physiologic lung simulator, that may added to certain mannequins and by this combination makes full scale simulation with real lung physiology available.

If the medical learning goal is complex, we need one high end simulator, if it is more basic even some resuscitation dolls may do it. In all cases the proper simulated reactions from the mannequins are needed. If a simulated patient is awake, he has to be able to open the eyes and to speak. Speech is normally performed from the instructor using wireless microphones and speakers hidden close to mannequin or integrated into the head of the mannequin.

Let us assume that the anaphylaxis occurs during anesthesia after the routine administration of an antibiotic before start of surgery.

***Example (cont'd):***

*Full scale mannequin needed with the possibility to administer anesthesia (intravenous as well as inhalational); monitor interface to simulate an anesthesia monitor; iv access to administer drugs and volumes and more.*

*"Early recognition" means register bronchospasm (by the lung function and auscultation)*

*"Degrees of severity" means several scenarios with increasing severity and cardiovascular reactions*

*"Conduct therapy, drugs and dosage" finally means that the scenario should react to possible interventions. E.g. in severe anaphylaxis (degree III or IV) epinephrine has to be used. This may be underdosed or overdosed and the possible reactions of these errors have to be shown in the reactions of the mannequin.*

**Provide the environment realistic for the scenario setting**

Emergency scenarios should take place in an emergency room setting, OR scenarios in an OR and so on. We have the experience that the more realistic the whole setting of the scenario the more the participant is willing to accept that the scenario is "real". And in a real scenario the reactions can be judged more real.

Settings in seminar rooms can be done as well, but at least the equipment of the typical working field and some pictures of it should be provided. The optimum is without no doubt the real environment.

**Example (cont'd):**

*A full OR setting would be very helpful. This would also help in realizing the communication learning goals of our example. Sometimes a real OR is loud, there are at least 2 professions working in parallel, they have to communicate to each other, and the orders can be used to verify the correct usage of 3 way communication.*

**Design the course of the scenario(s) adapted to the topic and the learning goal**

This is probably one of the striking tasks when designing CRM scenarios. Actually there is no concrete rule how to do that. Here are some items:

- Use a clear briefing phase before the participants contact the patients
- Provide realistic material about the case like anesthesia records, lab findings, x-ray and more
- Plan the course very precise until the crisis happens
- Have possible reactions of the participants in mind and be able to adapt the course of the scenario to these reactions.
- Add space for the human factor learning goals. Prepare certain reactions. Have people calling and more.
- Conduct the scenarios standardized as much as possible
- Use script files on the simulators to realize this. "Simulation on the fly" with spontaneous interventions by the instructor is not professional.

**Example (cont'd):**

*Patient has minor orthopedic surgery. Either the participants (anesthesiologist) administers routine antibiotic (start of anaphylaxis) or it is detected during preoperative time out and the anesthesia team is asked to administer the routine antibiotic.*

*In dependence of the degree of severity minor or major reactions may occur. If degree IV is to be simulated, cardiac arrest should occur within few minutes after administration of antibiotic.*

*To realize the communication learning goals a phone can be used to "disturb" the team, announce an urgent procedure etc.*

*Drug administration should be performed by anesthesia nurse. This leads to communication between the anesthesiologist and the nurse.*

**Use facilitators/instructors capable of teaching towards the learning goals**

Facilitators or instructors need special knowledge when they are conducting CRM scenarios. This knowledge should cover:

- The medical background of the scenario. Probably it makes a lot of sense, if the instructor is a specialist in the dedicated field.
- The functions of the scenario and the equipment that is used.
- Observe and recognize human factor behavior. Be able to document human factor behavior and to use this during debriefing
- Conduct the debriefing in a way that positive reactions are enforced and negative reactions recognized by the participant

There are some centers offering "Train the Trainer" classes. These classes focus on human factors and provide the ability of conducting scenarios. If the trainer has additional expertise in the medical field that

is covered, he or she must not automatically be a physician of the same faculty (e.g. cardiology) that is trained. Experienced nurses or paramedics can do an excellent job, if they are willing to learn the medical background as well as the human factor business.

***Example (cont'd):***

*Physician with expert knowledge in anaphylaxis and TTT certificate would be the optimal basis.*

**Use video to enhance the debriefing; result in a clear take home message**

The debriefing process itself has to be trained as well and is often also subject of certain “Train the Trainer” classes. Participants remember at the end of the day more from the debriefings than from the scenarios. This results that the debriefing process is the most important one for the success of a scenario.

Video recordings of the scenario are frequently used. Actually they are equivocally important for the success of a scenario as the knowledge of the facilitator. Participants tend to remember the scenario in terms of a model how it should have been. Video analysis can help to understand that the real behavior was sometimes different from the remembered one. The debriefing process also needs an excellent audio system (some facilitators think that this is even more important than the pictures).

***Example (cont'd):***

*Analyze the communication that happened after the administration of the antibiotic.*

*If necessary provide three types of information:*

- *The correct medical behavior*
- *Some items that have been done very well*
- *One or two items that should be done different the next time*

*Sometimes it is worthwhile that the participants name a special learning goal or behavior for the next scenario; e.g. “we will communicate loud and clear”; “I, the nurse, will repeat all orders”*

**Conclusions**

What is needed to improve clinical safety with the means of simulator experience? It is like a chain. And a chain is just as strong as the weakest member. So it takes a lot of effort to design CRM scenarios to improve patient safety.

