

TRAIN WHERE YOU WORK – MOBILE “IN-SITU” SIMULATION**17RC1****WITH VIDEO-ASSISTED DEBRIEFING IN DIFFERENT ACUTE CARE SETTINGS****MARCUS RALL, ERIC STRICKER, SILKE REDDERSEN, PETER DIECKMANN**

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WHAT IS MOBILE “IN SITU SIMULATION TRAINING (INSI-ST)”?

Realistic simulation training is becoming increasingly popular and widespread in anaesthesia and other critical care fields [1]. For example, in Denmark simulation training is compulsory for all anaesthesiologists and nurse anaesthetists, in Germany the Anaesthesia Society DGAI has promoted the establishment of simulators in all medical schools, and the German Air Rescue (DRF) is offering simulation training to all of their rescue team members. Simulators are being used for an ever widening number of purposes including basic education, advanced training, research and even performance assessment [2]. Even though there is still no data from large studies to prove that simulation training enhances patient safety, there is increasing acceptance by decision makers that a realistically trained crew performs better. There are many different usages of modern patient simulators [3]. Courses for anaesthesia and related fields courses are based upon on the format of the Anaesthesia Crisis Resource Management courses (ACRM) developed by Gaba, Howard et al. These courses are currently amongst the best available and are in use around the world. The key elements of ACRM simulator courses are shown in Table 1 (details of ACRM courses are described elsewhere^{4,5}).

TABLE 1: KEY ELEMENTS OF PROTOTYPICAL REALISTIC ACRM SIMULATION COURSES^{1 4 5}

1)	Small groups (4-10)
2)	High instructor-trainee ratio (1:2 to 1:4)
3)	Duration approx. one full day
4)	Realistic clinical environment in simulation area
5)	All tasks have to be performed practically (e.g. opening ampoules, diluting drugs, preparing infusion devices etc)
6)	The simulator is controlled from outside the simulation room (control room simulation)
7)	Sessions are videotaped for debriefing Whenever possible sessions are transmitted live to the remaining not active participants of the training group in the debriefing area (stimulating self reflection)
8)	After each session a video-assisted debriefing takes place (time ratio scenario-debriefing 1:1 to 1:2)
9)	The ACRM scenarios are carefully designed to address certain critical elements and learning objectives
10)	The atmosphere is blame free and error friendly – analysis of “why” is leading
11)	The focus is on ACRM, not on medical/technical issues
12)	The format focuses on facilitation and self reflection, not instruction by the instructors (mentors)

ACRM courses, typically take place in fully equipped especially designed simulation centres. More recently simulators have been taken out of their centres and been used in hospitals and other sites of clinical practice (“mobile” simulation). The idea is to train in the location where people normally work, using most of their normal equipment used in routine work (“in situ” training). As these mobile courses take place in a productive health care institution, course participants are usually working together as teams in their daily practice. In order to maintain the benefits of the CRM-type courses with live transmission of the scenarios, video-assisted debriefing and the ability to control the simulator from outside the simulation room, a complete set of mobile audio-video equipment is necessary. We call this training “mobile in situ simulation training” (insi-st). The term “in situ” was suggested by David Gaba (personal communication) and we think that it very nicely describes the way in which the training is embedded into peoples’ routine practice. The simulator set up and course format in these mobile in situ simulations is similar to that of the CRM courses described in Table 1 [6,7].

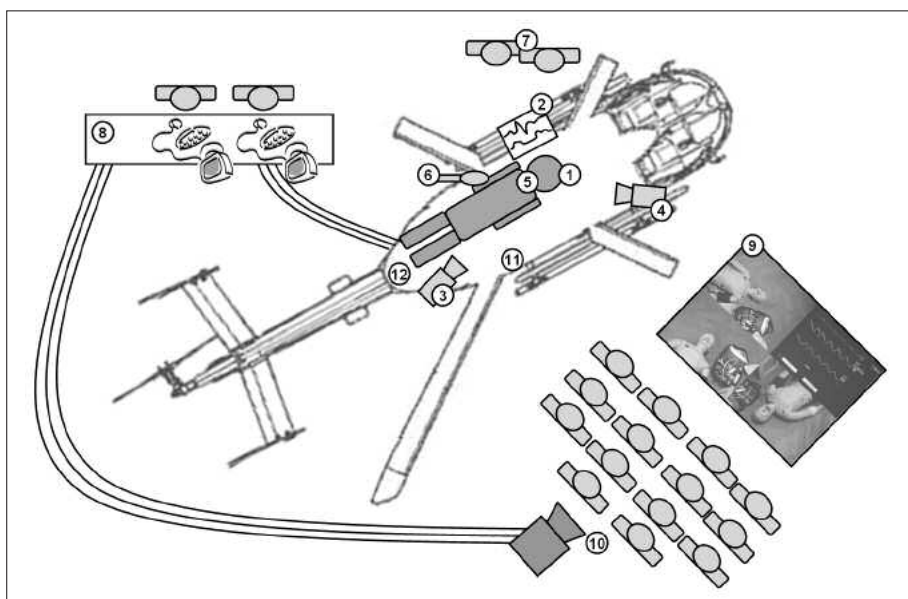
In-situ mobile simulation can be done in most areas where medical treatment is provided. Of course it seems especially beneficial if the environment is very special and imposes difficult working conditions on health care professionals in terms of space, noise etc (e.g. an ambulance, a cath lab, a dentist's chair or even an ICU ambulance jet). The key issue is to do a thorough needs analysis and to explicitly agree on the goals and circumstances of the mobile simulation course. It is necessary to define the special requirement of the environment in which the course is to be run, in order to design and run relevant simulations [8]. Our group has run courses in many environments and our aim is to share this experience in this article (see examples). For all training the SimMan (Laerdal Medical) simulator was used.

EXAMPLES

- In co-operation with the German Air Rescue (DRF) we provided a simulator-based course within helicopters and fixed-wing ambulance planes (Learjets). In both environments the constricted space is one of the challenges – both as a working and a training environment. The other major challenge to providing medical care in this environment is the high ambient noise level. With the background noise, both medical treatment (e.g. auscultation) and resource management (e.g. communication) are hampered [9,10].
- Dentists do not experience emergencies very often. Simulating the management of emergency situations in the dental chair allows the participants to gain valuable experience in a safe situation; thus showing one of the very real benefits of simulation.
- Training of Italian White Cross teams inside ambulances and in the prehospital setting (in an apartment).
- Training of the emergency response team inside a cardiac catheterisation lab
- Training of anaesthesia teams inside their operating room (e.g. focus on airway management).

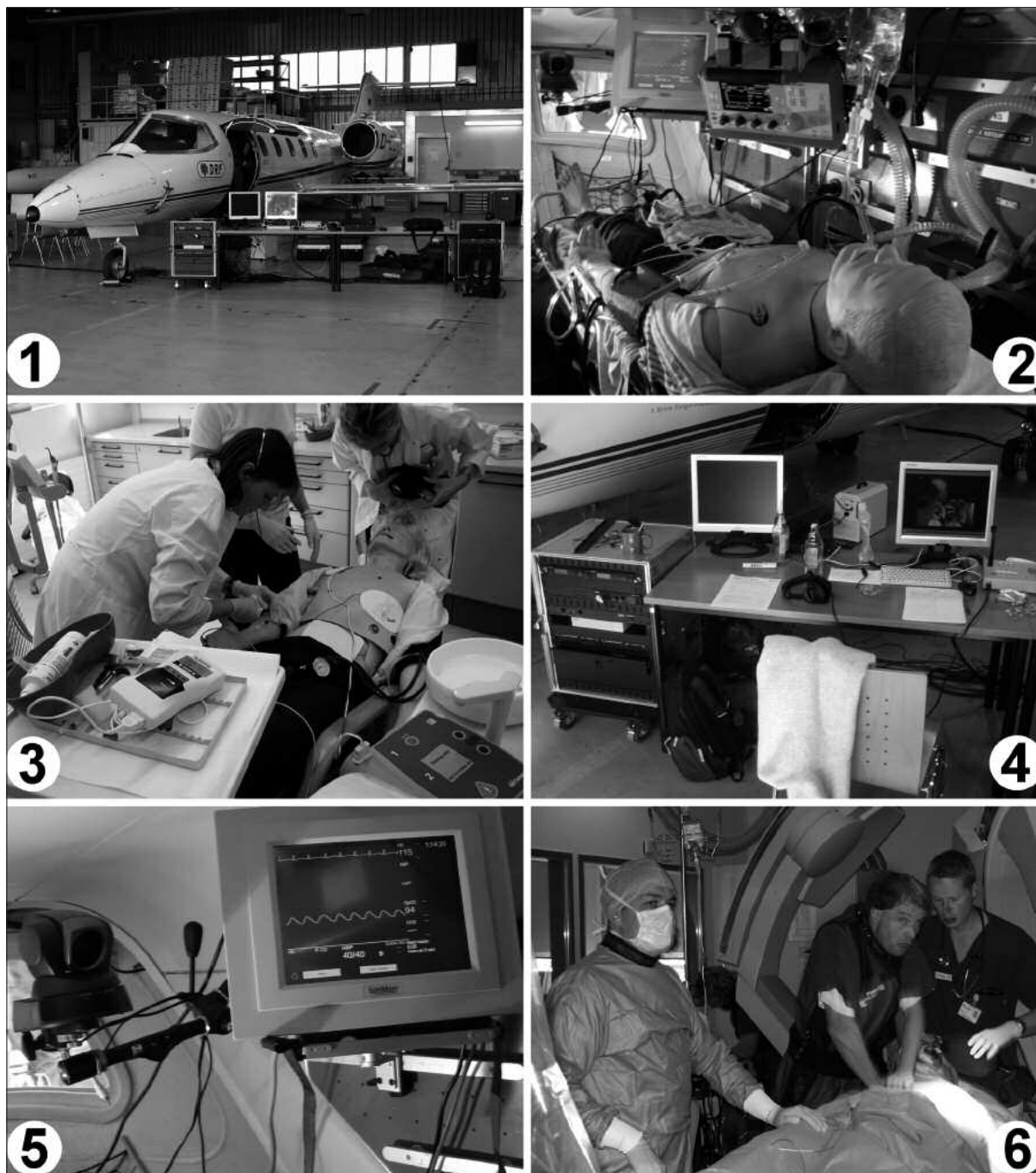
WHAT IS NEEDED?

PICTURE 1: DIAGRAM OF A TYPICAL SET-UP OF A MOBILE IN SITU SIMULATION TRAINING WITH VIDEO-ASSISTED DEBRIEFING AND LIVE TRANSMISSION TO A DEBRIEFING AREA.



(1) Simulator mannequin in the place of the patient. (2) Simulated vital sign monitor located where the real monitor would be. (3) Back camera with total view. (4) Front camera with head and chest view. (5) Ceiling ("gods view") dome camera with wide angle. (6) Wired microphone for ambient pickup and (7) Wireless clip microphones for all active participants connected to an audio mixer. (8) Control room with full control of simulator and A/V-equipment. (9) Screen with live projection of the quad-split videostream and debriefing use. (10) Debriefing room with video projector and loudspeakers. (11) Loudspeaker for instructor input to the simulation ("voice of god"). (12) Loudspeaker for special FX (e.g. engine noises in helicopters or Learjets).

PICTURE 2: EXAMPLES OF MOBILE IN SITU SIMULATION TRAINING.



(1) An ambulance jet of the German Air Rescue (DRF) in a hangar with the mobile control room in front of it. The beginning of the debriefing area with chairs can be seen on the left. (2) The simulator inside an EC rescue helicopter (courtesy of DRF). A remote controlled pan tilt zoom camera is shown in the left upper corner, followed by the simulated vital sign monitor and the breathing machine. (3) Scene from an in situ training of dentists teams in their original work environment (they always have suction ready to go...). (4) Mobile control room with two video monitors, a multi channel communication box and one of the three heavy duty 19" transport cases (left). (5) Inside a helicopter: Fixation of one of the three pan tilt cameras on a multi purpose holding device. Simulated vital sign monitor with only those signals activated as usually available in reality. (6) In situ emergency training in a cardiac catheter lab. The handling of the x-ray machine, the delegation of roles and tasks between the cath lab team and the resuscitation team poses great challenges.

THE TECHNICAL SIDE

Before you can place the simulator for example in an ambulance car or a helicopter it is important to know, where all parts of the simulator may be placed. As an example you can see in the picture below the set up for a fully equipped helicopter (the bracketed numbers in the text below refer to the numbers on the diagram).

SIMULATOR SET-UP IN A HELICOPTER (PICTURE 1)

The basic set up consists of the manikin (1) and its patient monitor (2). Most simulators need an interface to the control computer that is best placed outside the simulation area. Furthermore the simulators need compressed air. The compressors should be placed so that the noise does not disturb the training.

To enable a good audio-/video transmission some things must be considered. Placing the video cameras and the microphones is always a challenge. The first time that training is carried out in a new environment it is usually necessary to experiment until the most suitable camera positions are found. Having several different camera positions gives the participants sitting in the debriefing room a better view of the simulator room. Usually, three cameras are used and their images displayed simultaneously on the screen, with a fourth area of the screen used for the vital signs (a quad split). This ensures that their colleagues outside the simulation have a good view of the scenario. In our experience the best camera positions are; at the back (3), the front (4) and the so called “gods view” camera above the simulator mannequin (5).

In order to include the vital signs monitor on the video it is necessary to convert the patient monitor into a video signal.

The position and quality of the microphones is very important. The highest possible audio quality is of the utmost importance for good debriefings, and it is a false economy to use cheap (and usually poor quality) microphones/transmitters. We prefer wireless microphones (7) to transmit the spoken words of the participants and a wired microphone (6) to have a good background sound quality.

The audio and video signals are transmitted live to the control room (8) and the debriefing room. In the control room the incoming audio/video data is mixed and recorded. The three video streams from the different cameras and the stream coming from the vital sign VGA converter are compressed into a quad split video stream. This video stream can be seen during the session in the debriefing room as a live video. The recorded video can be shown afterwards in the debriefing. We use a digital video system which allows the time-shifted insertion of markers. The advantage of a good audio and video transmission in the control room is that you have an idea of what they can see and hear in the debriefing room.

To execute the training without a hitch, there should be two computers in the control room, one to control the simulator and the other one to record the video and to have a live view into the simulator room.

THE LOGISTICAL SIDE

In order to set up a simulator and all the audio-/video equipment quickly it is useful to place all the technical equipment in 19 inch cases. With a selection of fixed cable setups, it is very simple and quick to connect all the components rapidly. These cases allow for easy transportation of all equipment and are sufficiently robust to protect the expensive gear. (See Picture 2 on the left)

ADVANTAGES OF IN-SITU TRAINING

FOR THE TRAINEES

- In-situ simulation can be much more relevant for the participants and their organisation as it is possible to tailor the training specifically to their needs.
 - o Problems already experienced during daily routine or critical incidents can be re-enacted, then analysed and even solved.
 - o Problems not previously encountered may be discovered during the analysis of scenarios and plans devised to deal with their possible occurrence in the future. [11].
- Participants are more familiar with the simulated environment as compared to centre-based courses. They know where to find their gear and know how to use it. They know the ventilator, how to get help, whom to call for help etc.
- During debriefing the real team is able to reflect on their actual medical practice. From strengths and weaknesses that are discovered during this process the people who are involved in these processes can learn directly. They could even decide to change their practice.
- In-situ training can help to form very influential hot spots that might actually succeed to trigger changes in organisational practice to enhance patient safety. If your colleagues have experienced the same training it is much more likely that you will be able to apply what you learned in the simulator course.
- When you consider travel expenses it might be cheaper to bring a simulator team (three persons) and the simulator to the organisation than it is to bring in a complete team or even many members of a bigger department to a simulator centre.
- Extending the use of in-situ simulation might spare many organisations from buying their own simulator, additional equipment, building facilities, and the considerable expense of building up a simulator team that is able to run high quality courses.

FOR THE SIMULATOR INSTRUCTOR TEAM

- It is very interesting, and challenging, to see how others work and how their performance regarding patient safety can be improved.
- It is a very creative work always adjusting to new locations and domains.
- Lessons learned at one institution can be transferred to the next training facility and so on.

DISADVANTAGES/ PROBLEMS OF IN-SITU TRAINING

FOR THE TRAINEES

- Many problems within the team, both current and historical, can hinder effective training. For example, conflicts within the team might make it impossible to openly discuss aspects that can be improved in the organisations clinical practice – especially when they are hidden in the group dynamics.
- Working with participants in their own environment might mean that it is harder for them to concentrate on the course and for the organisation to really free them up. Often they will have to carry their pager (just in case...). It might take some negotiation ahead of the course to insure that the participants can actually participate in the course and are not called to normal clinical duties during the course or its breaks. Participants who have to leave for these reasons may spoil the atmosphere for those who are staying.
- The rooms for the in situ trainings need to be available which often means they are unavailable for other clinical productive use. An operating room in which the simulator course takes place cannot be used to earn money.
- If the training group is larger (8-12), then the institution needs to free up those personnel, which may result in conflict with the required staffing levels for patient care.

FOR THE INSTRUCTOR TEAM

- In mobile simulation it is the simulator team who needs to be familiarised with an unknown environment.
- Most teams develop a specific language quickly that is not easily understood by other persons. The instructors need to be sensitive for this “slang” especially during debriefing. While a sentence like “Hey, we should call the second floor” might be perfectly clear for the local team (“this means calling the resuscitation team”) the simulator instructor team might not have a clue about this “hidden” message. During mobile debriefing it is even more important than in centre-based training to ask participants what kind of reality they constructed out of the scenario and not to rely solely on observations. Facilitating the reflection about what can be learned from the scenario gains even more weight during mobile simulations.
- Mobile working means less control of the training infrastructure for the simulator team in terms of availability of training areas (helicopter, airplane, ambulance), medical equipment, environmental conditions (cold hangars), or catering
- During a mobile simulation the simulator team cannot insert an instructor into the scenario, for example in the role of a nurse, as this changes the normal team dynamics. Thus, the instruction team has less direct control over the scenario (checking actions, helping participants).
- It is essential that everybody in the mobile team knows the technical equipment to avoid cancellation of the training if a key member is unwell.
- Sometimes people who normally supervise the participants (e.g. the head of the department) might show up during the course, influencing the group dynamics. They should be gently but firmly asked to leave as they might unwittingly change the training from a blame free-culture to a more personally critical format.
- As the challenges for instructors are bigger for mobile simulations, we strongly recommend that new instructors attend an instructor course (e.g. InFacT at TuPASS) prior to instructing on courses.

MOBILE IN SITU SIMULATION TRAINING PEARLS

ORGANISATIONAL

- Have a single contact person at the training site who is responsible and able to reliably organise the necessary things. (“Your” training will be rated bad, if there is nothing to eat or no coffee in the morning).
- Get detailed information about the logistics (rooms, light, heating, power, noise) at the training site.
- Thoroughly research special conditions in the field of training (your instructors must know the “secrets” of flight medicine if they train air rescue teams). Also know what equipment will be available (e.g. what kind of difficult airway equipment is stored at the training site). Gaps in this knowledge always lead to big problems during debriefings.
- Perform a thorough needs analysis, including as many of the professions in local team as possible in order to understand the salient characteristics and safety requirements of the environment.
- Have good insurance for all your equipment (simulation and especially audio-video) including theft and damage by trainees and instructors. Liability insurance is recommended as your team might damage equipment or other structures unintentionally in the remote site.

TECHNICAL

- Another good idea is an additional loudspeaker with some special effects. For example for simulator-based training in a helicopter or a jet, the noise is a salient characteristic and needs to be included in the training for this reason. During training its influence on communication patterns and diagnostic steps (auscultation) can be addressed. We replay the previously recorded original engine noises with heavy speakers placed on the bottom of the aircraft [12].
- We would recommend the use of a specialised covers to protect the connectors from water. This will prevent any mishaps if the simulator gets wet.
- The best way to convert the patient monitor into a video stream is to use VGA to Video Converter (the most expensive is not necessarily the best for vital signs).
- Often the installation of the simulated patient monitor is rather difficult, since it should be in the usual position. It's often better to use a 15 inch Monitor with a copy of the patient monitor.
- As the instructors are not in the simulation room, it is necessary to have an additional loudspeaker inside [11] with connection to the control room (e.g. to report on findings like skin colour or pupil state). Always have enough cables (longer than you think), connectors, gender changers etc with you. A soldering iron is vital.
- The monitor of the simulator inside the training room can partially be covered with tape in order to have all vital signs available for the debriefing and the live transmission.
- A very good sound system for recording and replay is more important than a good video system.

PERSONNEL

- Your team must be ready to travel and flexible to adapt to changing and unexpected conditions.
- Instructors for mobile training must even be more aware about group dynamics (e.g. Group structure, norms, the culture in the group, hidden rules, coalitions, status etc.) as they are dealing with existing teams (the instructors are the “aliens”).
- Especially in mobile in situ trainings all members of the actual team should be included (nurses, doctors, paramedics, technicians etc), if the maximum benefit from the training effect is to be extracted. If some members are not included then this may lead to ill-feeling within the team.

POTENTIAL OF IN SITU SIMULATION TRAINING

From an ergonomic point of view the mobile simulation equipment can be used to set up a mobile test bed for layouts and processes in newly built or reconstructed facilities.

A further variant of mobile simulation is to conduct mobile instructor courses. This concept has the advantage that the instructor can work within their own environment, where they can practice the use of both their technical equipment and setting up the simulation environment. A mobile instructor course in the Netherlands has been conducted successfully.

CONCLUSION

Mobile “in-situ” simulator-based training is a very promising concept that is feasible in many different acute care settings. Bringing simulation to the users can help to spread simulation more quickly and make it possible in locations not easily reproduced in simulation centres. There are good reasons to assume positive effects on patient safety. And these are very well worth the efforts of these interesting endeavours.

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