



# Simulation in obstetric anesthesia: an update

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## Purpose of review

Simulation training (crew resource management training and scenario training) has become an important tool in the education of anesthesiologists. This review summarizes recent research performed in this area, focusing more specifically on obstetric anesthesia.

## Recent findings

Simulation training is becoming more integrated in the modern education of anesthesiologists. Research regarding the most effective way to perform simulation training in terms of learning outcomes and long-term skill retention has started to appear. Scenarios which are played independently and that allow for simulated mortality, as well as relaxation techniques before debriefing might have positive effects in this regard. Furthermore, simulation has been investigated as a tool to improve patient safety in low-resource settings. In addition, simulation training in the domain of obstetrics has been rapidly expanding and has an important role in this field of medicine as well.

## Summary

Simulation training has acquired a central role in modern education of anesthesiologists. Further research regarding elements to optimize simulation training in terms of learning outcomes and long-term skill retention is desirable. In addition, little data exist concerning the effect of simulation training on possible improvement of patient outcomes in anesthesia.

## Keywords

crew resource management, obstetric anesthesia, scenario training, simulation

## INTRODUCTION

Prevention of maternal morbidity and mortality should be the number one concern for anesthesiologists, especially when interested in obstetric anesthesia. By optimizing patient management and introducing safety rules we try to provide optimal care. Simulation, meaning crew resource management (CRM) as well as scenario training, has become a very important tool in the education of anesthesiologists who experience this as an added value in their training.

To review the current research in the development of simulation, scenario training and CRM in obstetric anesthesia, we performed a literature search in this area and continued onto the previous reviews published in 2017 in *Current Opinion in Anesthesiology* on this topic [1,2].

## SIMULATION IN ANESTHESIA

Fortunately, life-threatening situations are rare during anesthetic practice. However, anesthesiologists are always at risk to face a life-threatening medical situation in which urgent intervention is needed. Considering increased patient safety, as well as in

surgical as in anesthetic techniques, and because of the rarity of these urgent life-threatening situations we risk to be confronted with anesthesiologists that are unexperienced facing potentially life-threatening situations.

As illustrated in Fig. 1 [3], medical situations with low opportunity to experience and high urgency for medical intervention are the ones where simulation and scenario training can play a very important role. Anesthesia is a specialty in which anesthesiologists might face high urgency/low opportunity situations relatively frequently indicating they might benefit most from simulation and CRM training.

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## KEY POINTS

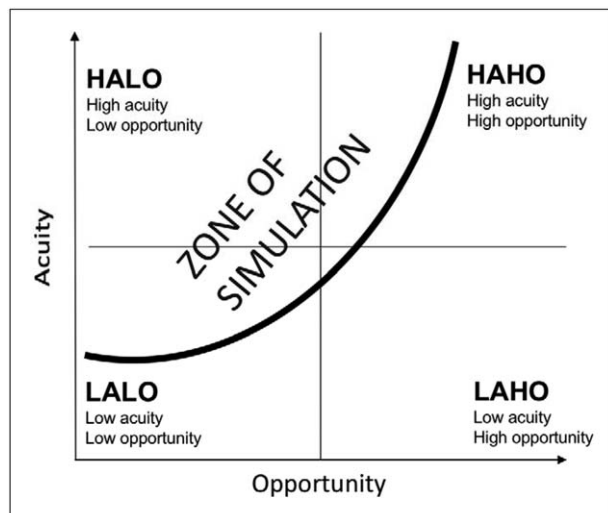
- Simulation training is an important tool in the modern education of anesthesia practitioners.
- Simulation training is of specific interest in infrequently occurring emergencies.
- Scenarios which are played independently and that allow for simulated mortality might improve knowledge and skill retention.
- Application of relaxation techniques before debriefing might enhance learning experiences and improve knowledge retention.
- Simulation training is an effective tool to identify gaps in patient care, whether they are clinical or organizational.

When anesthesiologists are exposed to simulation and CRM training, much emphasis is placed on retention of knowledge. Recent research has focused on elements that are crucial for knowledge and skill retention following simulation training. Burnett *et al.* [4<sup>■</sup>] performed a randomized controlled trial investigating the effect of specific scenario modalities on participants' performance in follow-up simulations 6 months after the initial scenario training. Interventions that were compared, were whether or

not participants played the scenario independently (or they received support from an attending physician), and whether or not the scenario allowed for simulated mortality (when the scenario was not managed appropriately). The group who played independently and where the simulation could turn out wrong (possible mortality) performed significantly better in a follow-up simulation 6 months later, compared with all other groups. Moreover, the combination of independence and potential simulated mortality had a greater impact on performance in the follow-up simulation when combined together than either factor alone. This study has several limitations, such as the small sample size and the fact that all participants were trainees in anesthesiology. An interesting item is the potential for simulated mortality in a scenario. Proponents believe in using potential simulated death as a teaching tool for several reasons: it increases stress during simulation training and thereby increases memorability and fidelity in simulation and allows participants to learn the real-life consequences of actions (including failure) within medicine. Opponents of simulated mortality state that it might place undue stress on the learner [4<sup>■</sup>].

Another element that may improve knowledge retention after simulation training was investigated by Lilot *et al.* [5]. They hypothesized that a relaxation break after playing the scenario and before the debriefing would enhance the memory retention of critical key messages mentioned in the debriefing. They found that significantly more active participants in the relaxation group recalled the critical messages (at least three out of five critical messages) at 3 months compared with a control group. We believe that further benefits of relaxation techniques to enhance learning in medical education should be investigated [5].

Because of the growing success of high-fidelity simulation as a teaching tool, an imbalance between the growing number of candidate-participants and the resources to let them actually participate in a simulation training might develop. Because of this concern and in an attempt to find a concept where more students can benefit from a simulation session, Blanié *et al.* [6<sup>■</sup>] investigated the impact of the learners' role (active participant-observer or observer only) on learning outcomes during simulation training in anesthesia. They found an immediate improvement of learning outcomes (participant satisfaction, medical knowledge and nontechnical skills) for both roles (active participant – observer or observer only) after simulation although some learning outcomes (increase in medical knowledge and participant satisfaction) were better for candidates who actively participated in the scenario. Investigation that



**FIGURE 1.** The zone of simulation matrix [3]. The 'zone of simulation' is that area in which simulation might play an important role in teaching and training necessary skills and may be preferable over other instructional media. *Acuity* (y-axis) is defined as the potential severity of an event (or a series of events) and its subsequent impact on the patient. *Opportunity* (x-axis) is defined as the frequency in which a certain department or individual is actually involved in the management of the event [3].

focuses on strategies to reinforce observers' active learning are needed [6<sup>■</sup>].

## SIMULATION IN OBSTETRICS

In the domain of obstetrics, simulation training has been rapidly expanding and the amount of published research in this area has exponentially increased in recent years. However, only a small percentage of reports links simulation training to improved clinical outcomes and patient safety. Clinical topics of obstetric medicine in which simulation training is associated with improved clinical outcomes are [7<sup>■</sup>]:

- (1) Shoulder dystocia management
- (2) Forceps delivery
- (3) Emergency unplanned Cesarean delivery
- (4) Postpartum hemorrhage
- (5) Neonatal resuscitation

Besides these topics, a lot of other procedures, obstetric emergencies and team-based drills are common in obstetric simulation curricula. Obstetric simulation has become a required component in accredited obstetrics and gynecology residency training programs [7<sup>■</sup>].

Obstetric simulation doesn't have to be expensive. Ramseyer and Lutgendorf [8<sup>■</sup>] evaluated the perceived competency in the management of obstetric and pelvic hemorrhage after simulation training with low fidelity task trainers using common and inexpensive medical supplies. For example, they used a basic mannequin and a hollowed-out cantaloupe melon (to simulate an atonic postpartum uterus) for a postpartum hemorrhage simulation. They found that perceived competency increased significantly for all participants (18 of 23 participants completed the survey) after low fidelity simulation training [8<sup>■</sup>]. Low fidelity simulation might be very useful in for example remote areas with limited resources or in situations where a large group of people need to be trained over a short period of time.

Simulation training might also influence clinical practice in specific obstetric cases. For example, in twin vaginal delivery, where specific obstetric maneuvers are required. Although most obstetric societies support vaginal delivery of twins, which involves fewer maternal and fetal risks, there has been a consistent rise in the rate of twin cesarean sections (from 53.9% in 1995 to 75% in 2008 in the United States [9]). This discrepancy between guidelines and real-life clinical practice might be due to a lack of obstetricians trained in these specific obstetric maneuvers and who

choose the supposed ease of a cesarean section in such cases.

To fill in this clinical gap, Lepage *et al.* [10<sup>■</sup>] designed a simulation model of second twin vaginal delivery to practice specific obstetric maneuvers required for such cases, and tested it on obstetric trainees. Trainees performed two sessions on the simulator and results were analyzed to look for improvement between these two sessions. Whether specific feedback on the trainee performance was given between these two sessions has not been documented. The investigators found a significant improvement in the time required for breech extraction and internal podalic version. They also noticed a significant improvement in the confidence score of the trainees between the two trials [10<sup>■</sup>].

According to Fig. 1, simulation training is of specific interest in infrequently occurring emergencies. In the domain of obstetrics, a deeply impacted fetal head at Cesarean section at full dilation is an urgent medical problem that fits this description. Additional time taken by obstetricians unsuccessfully attempting to dis-impact the fetal head may potentially worsen outcomes. Because of the limited exposure to this obstetric emergency by trainees, and because of the necessity to manage this problem appropriately and accurately to minimize maternal and neonatal morbidity, Yu *et al.* [11<sup>■</sup>] set up a hospital-based training program which included simulation-based training for trainees performing Cesarean section at full dilation. They demonstrated improvements in knowledge, skills and self-confidence [11<sup>■</sup>].

Simulation training should be constantly optimized and critically reviewed for potential corrections and critical gaps. Gurewitsch Allen [12] reviewed simulations in shoulder dystocia management and identified several critical gaps, including obstetrical technical issues.

## SIMULATION IN OBSTETRIC ANESTHESIA

Obstetric anesthesia is a dynamic field of medicine where life-threatening emergencies might occur at any time. Emergencies in obstetric anesthesia are a perfect subject for simulation training: high urgency and a low rate of opportunity to build experience (Fig. 1). In addition, since obstetric emergencies are a multidisciplinary matter, multidisciplinary simulation training and CRM is of great importance for an optimal cooperation during emergencies.

As concluded by Schornack *et al.* [2] after reviewing the literature regarding simulation in obstetric anesthesia, simulation has been shown to improve individual and team performance and to increase self-evaluated provider comfort with difficult patient

scenarios. Whether patient outcomes improve through simulation in obstetric anesthesia is not clear [2].

In addition to medical knowledge, nontechnical skills are a very important topic in simulation training. Human behavior is responsible for 50–80% of adverse events or errors in medicine [1]. Moreover, in obstetric anesthesia nontechnical skills are of major importance: interdisciplinary communication, the unexpected nature of emergencies and the chaotic scenes associated with obstetric emergencies underline the crucial role of team management and other nontechnical skills. Partly because of these reasons, human factors are the most relevant issues contributing to adverse events in obstetrics.

These nontechnical skills (CRM) must be practiced and developed during scenario training, although it may not be easy to evaluate these nontechnical skills during simulation. Bracco *et al.* [13] developed a set of observable behaviors connected to the key elements of crisis resource management (CRM) in the delivery room. This tool was used in a 2-day seminar on obstetric hemorrhage where simulation training was held, and was rated for its usefulness for the peer-to-peer feedback, its ease of use and its usefulness in facilitating the reflection upon one's own nontechnical skills. The ratings were positive and the authors believe this CRM observational tool might be valuable in facilitating debriefing [13].

Another issue regarding improving nontechnical skills in simulation-based training is established by Man *et al.* [14<sup>a</sup>]. Their study was carried out in a Chinese hospital and involved operating room personnel and general hospital personnel. They found that a locally adopted simulation-based CRM training is associated with improvement in attitude and knowledge toward patient safety. However, they also noticed that these improvements decreased 1-year post course. Man *et al.* [14<sup>a</sup>] mentioned that the effect of the CRM-course may be short-lived and that regular refresher courses should be carried out to sustain momentum of ongoing change toward more patient safety.

Simulation in obstetric anesthesia can be used as a tool to assess the impact of an intervention which is designed to improve patient safety. In a reaction to the unacceptably high maternal mortality rates in low-income and middle-income countries, Alexander *et al.* [15<sup>a</sup>] created a context-relevant obstetric anesthesia checklist for Cesarean delivery and tested its effect in high-fidelity simulated obstetrical emergency scenarios in East-Africa. Clinical observation in real-world (no simulation) setting (in East Africa) revealed significant deficiencies in the management of obstetric emergencies. They report that the use of

this developed checklist as a cognitive aid managed to establish a significant improvement in adherence to best practice guidelines in simulated obstetrical emergency scenarios, hereby confirming its potential efficacy to improve patient safety [15<sup>a</sup>].

Another application of medical simulation is to identify organizational or clinical life-threatening gaps. Chima *et al.* [16] used low-cost, in-situ simulation systems to perform simulation-based obstetric anesthesia scenarios in Sierra Leone, carried out by (local) nurse anesthetists. Through these simulations some substantial risks to patient care were identified: several actions taken by participants (regarding the case preparation, management of anesthesia and rapid sequence intubation) substantially deviated from safe anesthesia standard of care practices. According to these results, this study provides evidence to support the use of in-situ simulation-based performance assessment for identifying critical gaps in anesthesia care in low-resource settings [16].

We think that this is not only applicable to the low-resource environments, but in every healthcare system. Simulation training is a very good tool to identify weaknesses in the system, whether they are clinical or organizational. Further investigation may evaluate the sustainability and impact of simulation based training regarding skills transfer and retention among anesthesia providers in low resource environments [16].

## CONCLUSION

Simulation training (CRM training and scenario training) has become a very important tool in the education of medical practitioners and is specifically important in the education of anesthesiologists. Especially in obstetric anesthesia and obstetrics simulation training and CRM may be of an important added value. Research regarding the most effective way to perform simulation training in terms of learning outcomes and long-term skill retention has started to appear. Moreover, simulation has been investigated as a tool to improve patient safety in low-resource settings. Cost efficiency studies are lacking.

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## Conflicts of interest

There are no conflicts of interest.

## REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

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Excellent review that provides an overview of the status of simulation training in obstetrics.

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Study highlighting the potential benefits of using common and inexpensive medical supplies in obstetric simulation training.

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Excellent example of how simulation training might influence clinical practice in specific obstetric cases.

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Study emphasizing that the effect of a crew resource management-training may be short-lived and that regular refresher courses should be carried out to sustain momentum of ongoing change toward more patient safety.

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Study highlighting the possible usage of simulation as a tool to assess the impact of an intervention which is designed to improve patient safety.

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