



# Evaluating the Effectiveness of Simulation Training in Obstetrics and Gynecology, Pediatrics and Emergency Medicine

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**Received:** 04 May 2019 ♦ **Accepted:** 12 June 2019 ♦ **Published:** 31 Dec 2019

**Citation:** Sandeva MG, Tufkova S, KeteV K, Paskaleva D. Evaluating the effectiveness of simulation training in obstetrics and gynecology, pediatrics and emergency medicine. *Folia Med (Plovdiv)* 2019;61(4):605-11. doi: 10.3897/folmed.61.e47961.

## Abstract

Simulation training in medicine is a powerful tool for acquiring knowledge and practical skills in an environment close to the real world. Decreasing training opportunities directly on the patient tend to introduce simulations close to the real hospital environment without compromising the patient's safety.

The aim of the study was to evaluate the effectiveness of simulation training in the Medical Simulation Training Center (MSTC) at the Medical University of Plovdiv.

A prospective observational descriptive study was performed at the MSTC at Plovdiv Medical University between September 2017 and March 2019. The study included 245 respondents who participated in one or more practical simulation trainings and were surveyed.

The results of the study suggest that the knowledge, skills and attitudes of the trainees improve after training sessions. By increasing the number of visits, the self-esteem and confidence in performing the manipulation also increases, knowledge and technical performance significantly improve and mistakes are reduced. A statistically significant relationship has been demonstrated between the sequence of visits and acquired competencies ( $p=0.0001$ ). There are no performance mistakes in those attending three or more times, but 16.2% of them still experience uncertainty while performing. Here, however, 83.8% performed the manipulation automatically and without mistakes.

Simulation training in medicine is effective and useful. It has its place in the curriculum for students and is a good tool for acquiring knowledge, skills and techniques in postgraduate education.

## Keywords:

debriefing, efficiency, medical education, self-assessment, simulation training,

## INTRODUCTION

Simulation training in medicine is a powerful tool for acquiring knowledge and practical skills in an environment close to the real world. Curricula for laboratory-based simulation training cover a wide range of procedures. They are designed to provide systematic, structured, practical work aimed at preventing mistakes and improving patient safety. There is a clear trend towards the increased use of simulation in medical education. It is effective in improving knowledge in many areas and is associated with improved performance.<sup>1,2</sup>

There is a change in the paradigm of the traditional model of medical training. The training opportunities directly on the patient are increasingly reducing, with increased attention to their safety. This requires the introduction of simulations closer to the real hospital environment, so that learners can gain experience and competence.<sup>3</sup> Simulation is widely used in a number of specialties. A recent study by Doughty et al. discovered that 95% of pediatric emergency medicine programs included simulation training.<sup>4</sup>

The use of simulation in the medical profession requires teachers with a greater degree of control over the educational environment, while at the same time reducing the risks associated with on-the-job training. This is particularly important in areas where there might be mistakes associated with endangering a patient's life or having serious health consequences. Simulations can be designed to copy entire systems, focus on individual skills or generate conditions in which cognitive skills can be practiced.<sup>5</sup> Advances in simulation technology have made it possible to provide a highly realistic immersive learning environments.<sup>5</sup>

Simulation is an interactive educational tool that is increasingly used in medical education.<sup>6</sup> There is evidence to support the role of simulation training to improve knowledge, behavior and skills acquisition.<sup>2,7,8</sup>

It is crucial to emphasize that simulation training acts as a complement to clinical experience and should never be considered as a substitute. Scenarios must be linked to the curriculum and appropriately structured to ensure that specific learning outcomes are achieved. When it comes to reviewing unwanted incidents, simulation training can be used to reproduce the event in question in order to retrieve experience and develop recommendations to prevent future recurrence.<sup>9</sup> There is growing evidence that through simulation training we can identify latent threats in the clinical environment.<sup>10</sup>

## AIM

To evaluate the effectiveness of simulation training in the Medical Simulation Training Center at the Medical University of Plovdiv.

## MATERIALS AND METHODS

A prospective observational descriptive study was performed at the Medical Simulation Training Center (MSTC) at Plovdiv Medical University between September 2017 and March 2019. Two hundred forty-five respondents who participated in one or more practical simulation trainings were surveyed.

The trainees were divided into three groups according to the number of visits to a particular thematic course:

1. One visit
2. Two visits
3. Three and more visits

Fifteen thematic units (courses) were included in training in Obstetrics and Gynecology, Emergencies and Pediatrics. Teaching was done in small groups, on interactive simulators (SimMom, SimJunior and SimMan 3G, Laerdal Medical, Stavanger, Norway) designed to provide the most realistic training. Training sessions can be initiated in both automatic and manual mode. The range of conditions that can be reproduced extends from normal physiology to critical conditions. All simulators have state-of-the-art debriefing system that facilitates the achievement of the educational goals of each trainee once the training is over. Part of the debriefing is done by analyzing a video clip of the training session, after which students can actually recognize their mistakes in their performance.

To achieve the objectives of the study, the following research methods were used:

Survey method - through a direct anonymous survey of the learners (self-assessment form) and a teacher assessment form. A Likert scale of 1 to 5 was used where 1 is poor, 2 - satisfying, 3 - good, 4 - very good, 5 - excellent.

► The questionnaire contains 7 sections and includes questions about the self-assessment of learners' knowledge and skills before and after the thematic course, the quality of the proposed educational content, assessment of the lecturers'/mentors' competence, evaluation of the planning and organization of the training, evaluation after the completion of training, general impressions of the course and a section on suggestions and recommendations.

► The teacher assessment form contains an assessment of the theoretical training of the learner, performance algorithm, psycho-motor and technical skills, acquired competencies and performance mistakes.

• Observational methods - debriefing, filming training sessions.

• Statistical analysis - the data was statistically analysed by correlation analysis (coefficient of Pearson, Spearman), frequency distribution, linear regression analysis, non-parametric dispersion analysis (Mann-Whitney test and Kruskal-Wallis H test), and chi-squared test using SPSS, version 23.0.

## RESULTS

Two hundred and forty-five subjects took part in the study of which 192 were students at MU-Plovdiv (49 midwifery students and 143 medicine students), 29 fellows and 24 practicing physicians. Fifteen thematic units (courses) were included in training in Obstetrics and Gynecology, Emergencies and Pediatrics (**Table 1**).

The duration of the course depends on the size of the group, the specificity and the complexity of the manipulation (2 hours on average).

The mean age of respondents was  $26.43 \pm 5.24$  yrs. At the end of each course, the learner completes an assessment card, self-assessing their own knowledge and skills before and after the practical session, debriefing, and video review. There is a clear distinction in learners' self-esteem about their own knowledge and skills before and after the training (**Fig. 1**). There is a significant increase in the self-assessment after completion of the practical session, a large number of learners share about increased confidence in the performance of the manipulation.

An analysis of the results showed that 11% of learners identified their level of knowledge and skills before the practical course as "poor" and 26.1% as "satisfying". Only 4.5% of respondents assessed their level of knowledge and skills on the issue as "excellent". After completion of training, however, self-evaluation progressively increases. Trainees assessed their level of knowledge and skills in 72.2% of cases as "excellent". There is a statistically significant difference in the self-assessment of respondents attending the

course for the first time or for three and/or more times ( $p=0.0001$ ;  $r=0.57$ ).

In linear regression analysis, we took into account the relationship between the order of the visit in a thematic entity and self-assessment before and after a course (multiple  $R = 0.561$ ; multiple  $R=0.323$ ;  $p=0.0001$ ). The greater the number of visits, the greater the self-assessment as given by the trainees (**Table 2**).

87.8% of the respondents said that the quality of educational content, the presentation and the preliminary briefing were extremely informative to them. The results were similar in assessing learners in development of skills and habits, and conducting a discussion during and after the training (**Fig. 2**).

The analysis of the results showed that 96.3% of respondents determined the thematic course as motivating, 99.2% assessed the course as extremely useful, while for 95.1% of the trainees the courses were well planned, and 98.8% said they were well conducted. We associate this with the fact that simulation training in medicine is yet to be introduced fully in Bulgaria and is extremely attractive given the increasingly diminishing opportunities for training directly on a patient in a real hospital environment.

An analysis of the results of the teacher evaluation form implies that the training and the success of the trainees improve at each subsequent visit. Teachers' assessment covers five categories that assess the theoretical training of learners, algorithm performance, psycho-motor skills, acquired competencies, and mistakes made during execution. Particular differences are observed between the group attending the practical course for the first time and those atten-

**Table 1.** Simulation courses conducted at MSTC, Medical University of Plovdiv (09/2017 – 03/2019)

Training	Theme	N	%
Obstetrics and Gynecology	Childbirth in front occipital presentation	39	15.90%
	Childbirth in rear occipital presentation	24	9.80%
	Breech presentation at birth	38	15.50%
	Shoulder dystocia delivery	19	7.80%
	Collection of vaginal and cervical secretion for microbiological examination	4	1.60%
	Pathology of the placental period	4	1.60%
Emergency medicine	CPR	5	2%
	Endotracheal intubation	5	2%
	Anaphylactic shock	10	4.10%
	Peripheral venous source	18	7.30%
Pediatrics	Ureteral catheterization	14	5.70%
	Endotracheal intubation in children	20	8.20%
	Auscultation of the heart of a child	26	10.60%
	Auscultation of the lungs of a child	7	2.90%
	Lumbar puncture of a child	12	4.90%
Total		245	100.00%

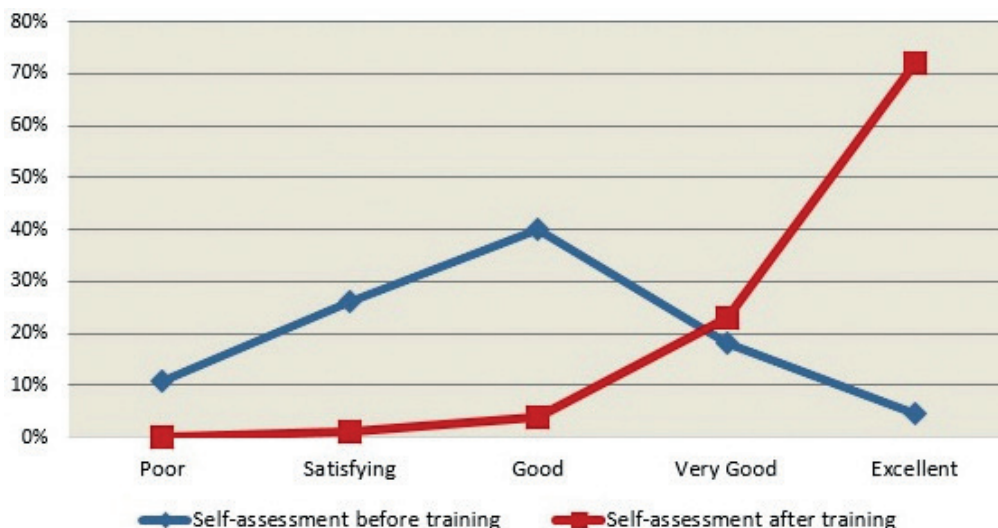


Figure 1. Level of self-assessment of learners before and after the practical course.

Table 2. Sequence of visits and self-assessment before and after training

Sequence of visit	N	%	Self-assessment before training		Self-assessment after training	
			F	p	F	p
For the first time	123	50.20%				
For the second time	85	34.70%				
For third and more	37	15.10%	111.46	0.0001	28.26	0.0001
Total	245	100%				

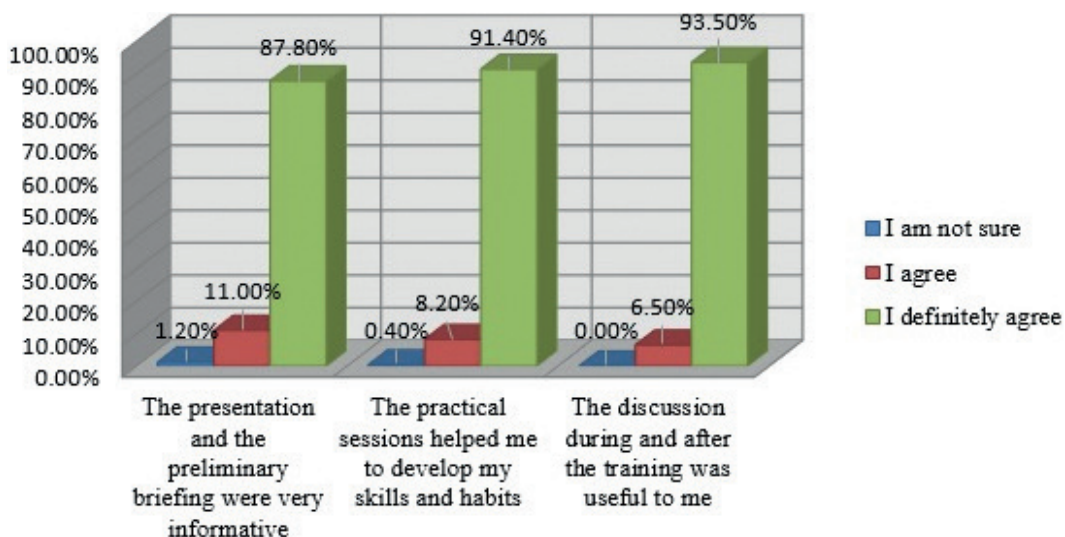


Figure 2. Assessment of learners of the development of skills and habits, and discussion during and after the training.

**Table 3.** Teacher assessment after the practical session

	Average (Mean)			Standard deviation ( $\bar{x} \pm SD$ )			<i>r</i>	<i>p</i>
	After attending session			After attending session				
	the first time	twice	three times and more	the first time	twice	three times and more		
Theoretical training	3.33	4.38	4.59	0.72	0.53	0.5	0.57	0.0001
Algorithm of manipulation	2.69	4.08	4.51	0.62	0.6	0.5	0.66	0.0001
Psycho-motor skills	2.74	3.84	4.51	0.63	0.51	0.51	0.68	0.0001
Acquired competencies	2.68	3.84	4.24	0.56	0.46	0.43	0.66	0.0001
Mistakes	2.42	4.35	4.84	0.83	0.67	0.37	0.67	0.0001

ding the same course for three or more times (**Table 3**). A statistically significant relationship was found between the sequence of visits and acquired competencies ( $p=0.0001$ ).

Worthy of note is the fact that when visiting a particular course three times or more, performance mistakes are kept to a minimum. For the trainees attending the course for the first time, significant mistakes in performance were observed in 13.1% of the cases, mistakes generally occur in 91% of them. In this group there are no trainees performing the manipulation without mistakes. Second-time attendees experienced a significant improvement, with 10.6% making minor mistakes, and 43.5% experiencing insecurity in the manipulation, which in turn leads to slower performance. There are no performance mistakes in those attending three or more times, but 16.2% of them still experience uncertainty while performing. Here, however, 83.8% performed the manipulation automatically and without mistakes.

## DISCUSSION

Simulation-based medical training is a powerful tool for delivering a continuing medical education. There is increasing evidence to support the effectiveness of this training methodology.<sup>2,11,12</sup>

The aim of our study was to evaluate the effectiveness of this kind of training implemented in a safe environment close to the hospital, without any risk to the patient. Both the self-assessment of the trainees and the teachers' assessment are subject to analysis.

According to Poirier et al.<sup>13</sup> self-assessment and video review help learners to understand how well they can perform an activity, to uncover mistakes and what needs to be done to improve their performance. The inclusion of real time teacher evaluation is crucial for increasing the quality of the learning and the usefulness of simulation in the learning process.<sup>13</sup> This statement was also verified in our study. The results show increased efficiency at each subsequent visit. Examining and differentiating the mistakes after each video-based course facilitates more efficient

learning and faster automation performance. A statistically significant relationship was found between the sequence of visits and acquired competencies ( $p=0.0001$ ). Of particular importance is the fact that when visiting a particular course three times or more, performance mistakes are kept to a minimum.

In a number of studies, the skills achieved and the detection of medical errors have been assessed through checklists for the assessment of learners, teachers or standardized patients.<sup>14,15</sup> For a better assessment of the indicators we included a debriefing after the training and filming of the course. They turn out to be a good tool for regulating mistakes and help to effectively acquire knowledge, skills and attitudes among learners.

Teamwork is essential for optimal care and patient safety.<sup>16</sup> The literature review shows that simulation team training can promote teamwork by improving non-technical skills, such as leadership attitude and communication.<sup>17</sup> A limitation in our study is the lack of such simulation training in a team. Developing team training programs is forthcoming, which will increase the efficiency and usefulness of this type of training.

## CONCLUSION

Based on this study, we can conclude that:

- as a result of simulation training, we achieved a significant improvement in the knowledge, skills and attitudes of learners.
- increasing the number of visits increases the self-esteem and confidence in the execution of the manipulation, significantly improves knowledge, technical performance and reduced mistakes.
- integration of structured laboratory simulation training allows the acquisition of skills in an environment that does not compromise patient safety and avoids waste of resources. This approach will improve patient safety and meet the public's medical expectations.

We believe that simulation training in medicine is effective and useful. It has its place in the curriculum for stu-

dents and is a good tool for acquiring knowledge, skills and techniques in postgraduate education.

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# Оценка эффективности симуляционного обучения в акушерстве и гинекологии, педиатрии и неотложной медицине

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**Дата получения:** 04 мая 2019 ♦ **Дата приемки:** 12 июня 2019 ♦ **Дата публикации:** 31 декабря 2019

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**Образец цитирования:** Sandeva MG, Tufkova S, Keteв K, Paskaleva D. Evaluating the effectiveness of simulation training in obstetrics and gynecology, pediatrics and emergency medicine. Folia Med (Plovdiv) 2019;61(4):605-11. doi: 10.3897/folmed.61.e47961.

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## Абстракт

Симуляционное обучение в медицине является мощным инструментом для приобретения знаний и практических навыков в условиях, приближенных к реальной обстановке. Внедрение симуляционного обучения приобщает студентов к реальной больничной среде без ущерба для безопасности пациентов.

Целью данного исследования было оценить эффективность обучения симуляции в Медицинском симуляционном тренировочном центре (МСТЦ) в Медицинском университете в Пловдиве.

Проспективное описательное исследование было проведено в МСТЦ в Медицинском университете в Пловдиве в период с сентября 2017 года по март 2019 года. В исследование были включены 245 респондентов, которые участвовали в одном или нескольких практических занятиях по симуляционному обучению и были проинспектированы. Результаты исследования показывают, что знания, навыки и поведение участников улучшаются после учебных занятий. Увеличивая количество посещений, повышается уверенность в себе и уверенность в выполнении манипуляций, значительно улучшаются знания и технические характеристики, а количество ошибок уменьшается. Статистически значимая связь была продемонстрирована между количеством посещений и приобретёнными компетенциями ( $p = 0,0001$ ). Не было ошибок в исполнении у тех, кто посещал занятия три или более количество раз, но в 16,2% из случаев они всё ещё чувствовали себя неуверенно при выполнении заданий. Тем не менее, 83,8% провели операции автоматически и без ошибок.

Симуляционное обучение в медицине эффективно и полезно. Оно занимает своё место в учебной программе студентов и является хорошим инструментом для приобретения знаний, навыков и приёмов во время последипломого образования.

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## Ключевые слова

симуляционное обучение, эффективность, медицинское образование, исследования, самооценка

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