

Feature analysis of high-fidelity obstetric simulators

Analiza cech symulatorów wysokiej wierności w dziedzinie położnictwa

Agnieszka Katarzyna Żeromska-Michniewicz^{B-D}

Monoprofile Medical Simulation Centre, Collegium Medicum, University of Zielona Góra, Zielona Góra, Poland

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;

D – writing the article; E – critical revision of the article; F – final approval of the article

Pielęgniarstwo i Zdrowie Publiczne, ISSN 2082-9876 (print), ISSN 2451-1870 (online)

Piel Zdr Publ. 2020;10(3):165–170

Address for correspondence

Agnieszka Katarzyna Żeromska-Michniewicz
E-mail: a.zeromska@wlnz.uz.zgora.pl

Funding sources

None declared

Conflict of interest

None declared

Acknowledgements

I would like to thank my supervisor and mentor, Professor Leszek Bieniaszewski, for his support, motivation and faith.

Received on August 19, 2019

Reviewed on January 19, 2020

Accepted on March 16, 2020

Abstract

The article presents the history of development of phantoms and obstetric simulators since the 18th century and the history of improvements in the curriculum of midwives' education in several European countries. The main purpose of the work is a feature analysis of characteristics of high-fidelity obstetric simulators and of their utilization for acquiring skills in the scope of preventive, diagnostic, treatment, and rehabilitation services provided by a nurse or a midwife independently, without a medical order. The comparison shows similarities between available simulators and indicates a wide range of their use for teaching at every stage of education (under- and postgraduate). Several high-fidelity simulators available on the market were taken into consideration, namely, SimMom (Laerdal), Victoria (Gaumard) and Lucina (CAE Healthcare). The comparison indicates the possibility of learning of some individual obstetric procedures using low- and medium-fidelity phantoms, or using hybrid simulation (standardized patient combined with simulators). High-fidelity obstetric simulators offer a possibility of training advanced simulation scenarios, which together with properly prepared simulation environment give an approximation of the clinical setting.

Key words: education, midwife, legal aspects of midwifery

This is a translated article.

Please cite the original

Polish-language version as

Żeromska-Michniewicz AK. Analiza cech symulatorów
wysokiej wierności w dziedzinie położnictwa
Piel Zdr Publ. 2020;10(3):165–170. doi:10.17219/pzp/119059

DOI

10.17219/pzp/119059

Copyright

© 2020 by Wrocław Medical University

This is an article distributed under the terms of the
Creative Commons Attribution 3.0 Unported License
(<https://creativecommons.org/licenses/by/3.0/>)

Streszczenie

W artykule przedstawiono historię rozwoju fantomów i symulatorów położniczych od XVIII w. oraz programu nauczania położnych w niektórych krajach w Europie. Głównym celem pracy była analiza cech porodowych symulatorów wysokiej wierności z wykorzystaniem ich do ćwiczenia umiejętności z zakresu świadczeń za-pobiegawczych, diagnostycznych, leczniczych i rehabilitacyjnych udzielanych przez pielęgniarkę albo położną samodzielnie, bez zlecenia lekarskiego. Zestawienie ukazuje podobieństwa pomiędzy dostępnymi symulatorami i prezentuje szeroki zakres możliwości wykorzystania ich na każdym etapie kształcenia (przed- i po-dyplomowym). Wzięto pod uwagę położnicze symulatory wysokiej wierności dostępne na rynku: SimMom (Laerdal), Victoria (Gaumard), Lucina (CAE Healthcare). Porównanie ukazuje możliwość nauki części pojedynczych procedur położniczych za pomocą fantomów niskiej oraz pośredniej wierności lub za pomocą symulacji hybrydowej, czyli łączenia pacjenta standaryzowanego z trenażerami. Położnicze symulatory wysokiej wierności stwarzają możliwość ćwiczenia zaawansowanych scenariuszy symulacyjnych, które przy odpowiednio przygotowanym środowisku symulacyjnym przybliżają środowisko kliniczne.

Słowa kluczowe: edukacja, położna, położne – prawo

History of obstetric simulations

The history of development of simulations in the field of obstetrics dates back to the 18th century. The first phantoms dedicated to education of midwives were created around 1762 in Bologna, Italy. Giovanni Antonio Galli, a surgeon, observing midwives of that time during a delivery, noticed that they were poorly educated. He designed the first simulator of female reproductive organs consisting of a glass uterus with a pelvis and a flexible fetus made of wax. The first maternity hospital founded in 1739 by Sir Richard Manningham in London was another facility which educated midwives using birth phantoms made partly of glass. The childbirth simulator made it possible to mimic labor complications, such as an umbilical cord wrapped around the fetus or a prolapse of small parts (hands, legs, umbilical cord). Madame Marie-Catherine Bihéron was a French anatomist famous for medical illustrations and the design of anatomical models made of wax. In 1771, she presented a new model of a pregnant woman at the Académie royale des sciences in Paris. It simulated all 3 stages and mechanisms of labor, and was equipped with an anatomically modelled tailbone and a cervix which mimicked dilation as labor progressed.

In 1759, during the reign of Louis XV, a decrease of the population in rural areas of France was noted. In order to prevent high mortality of newborns at birth, a new system of teaching midwives was introduced. Angélique Marguerite Le Boursier du Coudray was responsible for the change in education of midwives. She introduced a two-month course with 40 sessions/lessons. A textbook was prepared with detailed pictures to facilitate the learning of girls from rural areas, most of whom could not read. It was the first time that a curriculum was developed as part of a preparatory course for the midwife's profession. Another part of the training concerned the acquisition of practical skills. Madame du Coudray created a life-size phantom of the lower female torso with thighs and a removable uterus. The basic set included life-size models of a newborn, seven-month-old fetus and twins, as well as artificial amniotic fluid.¹

A development of simulations in the field of obstetrics – creation of phantoms and simulators

The above examples show a rich history of medical simulation in obstetrics. The first models were anatomically modelled pelves, often with the possibility of removing individual elements. The point of reference for the design of phantoms and delivery simulators was the need to create a safe teaching aid for learning how to deliver births with various complications. In the 19th and 20th century, whole-body birth phantoms were already in use. In Spain, maternity schools were established, majoring in specialized education. The first school of this kind was founded in Madrid around 1868. A theoretical and practical training there was conducted by Francisca Iracheta. In 1870, she published a basic textbook for midwives, which included, among other things, instructions on how to pronounce technical terms to improve communication with obstetricians.¹

Simulation in obstetrics was initially based on low and medium fidelity. Whole-body obstetric phantoms were created in line with technological development and an increasing demand. Advanced whole-body phantoms made it possible to simulate deliveries in various birthing positions; some of them also gave the opportunity to learn resuscitation of a woman in labor. The process of creating more and more advanced delivery simulators gave an opportunity to create simulation scenarios with various clinical situations. An American manufacturer Gaumard Scientific is the first company in the world which started designing and producing on a large scale whole-body simulators of a woman giving birth. The prototype birth mannequin of this company was produced in 1949. The main product of this company was a delivery simulator called Noelle, known on the medical simulation market in various configurations, from basic to advanced. Each subsequent number of Noelle represents the level of advancement of the model – medium-fidelity models gave

way to high-fidelity delivery simulators, fully wireless. The end result is currently the most advanced pregnant woman simulator called Victoria, which enables to run high-fidelity scenarios in a modelled hospital environment with the possibility of using real clinical equipment.²

Similar high-fidelity obstetric simulators were also developed by other manufacturers, such as Laerdal and CAE Healthcare. The initial focus of Laerdal company was on producing a whole-body, medium-fidelity, semi-computerized delivery simulator without a delivery mechanism. Over time, the SimMom simulator was designed with high-fidelity software and with the ability to perform advanced birth scenarios.

A description of selected high-fidelity simulators

The history of development of obstetric phantoms is extensive and includes many examples of the importance of simulation training also in this field of medicine. Nowadays, in obstetrics, as in the case of nursing, the range of teaching aids is based on 3 levels: low, medium and high fidelity. Currently, there are 3 high-fidelity delivery simulators available on the market:

- Victoria – a high-fidelity delivery simulator by Gaumard Scientific⁴;
- Lucina – a high-fidelity delivery simulator by CAE Healthcare⁶;
- SimMom – a high-fidelity delivery simulator by Laerdal.⁵

The above simulators are characterized by similar properties, enabling training at the highest level of advancement and practicing simulation scenarios including perinatal care (possibility of performing a palpation test of a pregnant woman to assess the position of the fetus in the uterus; simulation of pathologies related to birth, including falling out of small parts and umbilical cord wrapping; simulation of procedures performed during a childbirth: operative delivery using vacuum, forceps, perineal incision, etc., a birth of placenta; and a simulation of postpartum bleeding, massage of the shrinking uterus after a delivery and of perineal stitching). An additional advantage of high-fidelity simulators is a possibility of applying non-obstetric clinical scenarios to birth pathologies, as well as practicing soft skills.

Table 1 shows a comparison of high-fidelity obstetric simulators in terms of the list of services provided by a midwife independently, without a medical order. It shows capabilities of high-fidelity simulators with respect to activities performed by a midwife. Parameters of the equipment are much broader, especially those which allow to perform resuscitation procedures or simulate postpartum hemorrhage. High-fidelity obstetric simulators can be used to learn skills in obstetrics and medical rescue

(practicing difficult birth scenarios, e.g., when the life of a mother and child is at risk at the pre-hospital stage), and in gynecology and obstetrics specialization during post-graduate medical education.

Summary

High-fidelity mother and child simulators are a perfect tool for learning holistic care for a parturient woman before, during and after a delivery. However, learning some of the procedures is only possible on phantoms and trainers of low and medium fidelity. They make it possible to arrange rooms with less effort than in the case of high-fidelity simulators. So far, no single definition of the division into low, medium and high fidelity has been developed. It is partly because the boundary between low and medium fidelity is often fairly vague. The division into individual levels applies to both the teaching itself and the equipment used for simulation.

ORCID iDs

Agnieszka Katarzyna Żeromska-Michniewicz  <https://orcid.org/0000-0003-3768-8294>

References

1. Owen H. Early use of simulation in medical education. *Simul Healthc.* 2012;7(2):102–116. doi:10.1097/SIH.0b013e3182415a91
2. Dahlberg N. Miami-based Gaumard's medical simulators provide human (like) touch. *Miami Herald.* <https://www.miamiherald.com/news/business/biz-monday/article2105528.html>. Published on September 14, 2014. Accessed on August 21, 2019.
3. Rozporządzenie Ministra Zdrowia z dnia 28 lutego 2017 r. w sprawie rodzaju i zakresu świadczeń zapobiegawczych, diagnostycznych, leczniczych i rehabilitacyjnych udzielanych przez pielęgniarkę albo położną samodzielnie bez zlecenia lekarskiego. *DzU z 2017 r., poz. 497.*
4. Gaumard – Simulators for Health Care Education. Products. Obstetrics. <https://www.gaumard.com/products/obstetrics>. Accessed on August 21, 2019.
5. Laerdal. Products. Simulation training. Obstetrics. <https://www.laerdal.com/pl/products/simulation-training/obstetrics-paediatrics/>. Accessed on August 21, 2019.
6. CAE Healthcare. Patient simulation. Lucina. <https://caehealthcare.com/patient-simulation/lucina/>. Accessed on August 21, 2019.

Table 1. Parameters and functions of high-fidelity delivery simulators**Tabela 1.** Parametry i funkcje symulatorów porodowych wysokiej wierności

Skill/medical service	Simulators and their functions with regard to the list of medical services in the regulation ³				
	Noelle, Gaumard ⁴	Victoria, Gaumard ⁴	SimMom, Laerdal ⁵	Lucina, CAE Healthcare ⁶	remarks/comments
Providing pre-conception care for a woman in order to prepare her for conscious family planning and caring for a newborn and infant	yes	yes	yes	yes	standardized patient, the use of low-fidelity phantoms, such as: pelvis for learning to insert an intrauterine device, educational charts, etc.
Conducting counseling in the field of family preparation for the procreative function	yes	yes	yes	yes	the use of simulation with a standardized patient
Conducting active counseling for pregnant women and referring to specialist doctors	yes	yes	yes	yes	a standardized patient, a hybrid simulation, a trainer applied on a standardized patient for role-play
Preparing women to conduct self-observation at all stages of life in order to early detect and eliminate risk factors for neoplastic diseases	no	no	no	no	a standardized patient, the use of low-fidelity phantoms, such as: a trainer for learning a breast self-examination, educational charts, a hybrid simulation (a standardized/simulated breast model applied to the patient to learn self-examination)
Conducting active counseling for women with gynecological diseases	yes	yes	yes	yes	the use of simulation with a standardized patient
Establishing a diet for particular periods of a woman's life, during physiological pregnancy and high-risk pregnancy	yes	yes	yes	yes	the use of simulation with a standardized patient
Carrying out patronage visits to a puerpera and a newborn (infant)	yes	yes	yes	yes	the use of simulation with a standardized patient
Providing advice on nutrition of newborns and healthy infants	yes	yes	yes	yes	the use of simulation with a standardized patient
Care of skin and mucous membranes with the use of pharmaceuticals and medical supplies	yes	yes	yes	yes	–
Performing preventive vaccinations in newborns as part of the vaccination schedule	yes	yes	yes	yes	a possibility to learn the procedure on a low-fidelity phantom
Collecting samples for tests and performing diagnostic tests: a pregnancy test, a test for the presence of protein in urine, a blood glucose level test	yes	yes	yes	yes	–
Referring for diagnostic tests or collecting samples for diagnostic tests	yes	yes	yes	yes	–
Collecting samples for bacteriological tests (urine, feces, sputum, genital discharge, other secretions)	yes	yes	yes	yes	–
Performing a physical examination enabling an early detection of breast diseases	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Performing and interpreting tests to assess the health of the fetus and a pregnant woman, consisting of: – an external obstetric examination – an internal obstetric examination – a cardiotocography	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Conducting measurements of concentration of gases involved in the respiration process: gasometry, capnometry	no	no	no	no	a reading in the simulator software
Performing pulse oximetry	no	no	no	no	–

Table 1 cont. Parameters and functions of high-fidelity delivery simulators**Tabela 1 cd.** Parametry i funkcje symulatorów porodowych wysokiej wierności

Skill/medical service	Simulators and their functions with regard to the list of medical services in the regulation ³				
	Noelle, Gaumard ⁴	Victoria, Gaumard ⁴	SimMom, Laerdal ⁵	Lucina, CAE Healthcare ⁶	remarks/comments
Assessment of the patient's state of consciousness using appropriate assessment methods (diagrams, classification)	yes	yes	yes	yes	–
Performing an ECG	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Providing the water balance	no	no	no	no	a reading in the simulator software
Conducting a physiological birth	no	no	no	no	
Conducting a water birth	yes	yes	yes	yes	lack of possibility to carry out a water birth due to the design of the simulators, built-in sensors
Performing an incision, local anesthesia and suturing of the perineum and a ruptured perineum	no	no	no	no	a simulation of anesthesia
Performing the Credé maneuver on a newborn	yes	yes	yes	yes	a possibility to learn the procedure on a low-fidelity phantom
Removal of perineal stitches	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Vaginal lavage	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Performing rectal procedures (a cleansing enema, a retention enema, a drip enema)	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Performing treatments with heat and cold	yes	yes	yes	yes	–
Application of medical cupping	yes	yes	yes	yes	–
Performing an inhalation	no	no	no	no	–
Emergency oxygen administration	no	no	no	no	–
Oxygen therapy	no	no	no	no	–
Insertion of a catheter into the bladder and a removal of the inserted catheter	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Bladder rinsing	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
A selection of methods and a dressing of wounds, bedsores (up to stage 3)	no	no	no	no	a possibility of learning the procedure on a low-fidelity phantom or using wound replica sets in the scenario which are applied on the simulator
Removal of stitches from postoperative wounds	no	no	no	no	a possibility to learn the procedure on a low-fidelity phantom
Performing a cannulation of peripheral veins	no	no	no	no	a possibility of learning the procedure on a low-fidelity phantom depending on the goal set in the scenario, e.g., taking into account the physiology of a pregnant woman
Intravenous drug administration and an intravenous fluid drip injection as a part of cardiopulmonary resuscitation procedure in accordance with applicable standards of emergency management	no	no	no	no	–

Table 1 cont. Parameters and functions of high-fidelity delivery simulators**Tabela 1 cd.** Parametry i funkcje symulatorów porodowych wysokiej wierności

Skill/medical service	Simulators and their functions with regard to the list of medical services in the regulation ³				
	Noelle, Gaumard ⁴	Victoria, Gaumard ⁴	SimMom, Laerdal ⁵	Lucina, CAE Healthcare ⁶	remarks/comments
Performing an emergency endotracheal intubation	no	no	no	no	–
Performing defibrillation	no	no	no	no	–
Emergency maternity care before the doctor's arrival: – providing manual assistance in pelvic births – a manual extraction of the placenta in case of hemorrhage (a uterine massage, a Credé maneuver) – a vaginal tamponing in the event of a cervical rupture – an internal rotation in the case of a twin birth, when after the birth of the 1 st fetus, the 2 nd one is in the transverse position and the attempt to perform an external rotation has failed	no	no	no	no	–
Ordering the transport of a patient	no	no	no	no	–
Rehabilitation exercises for improvement in pregnancy, puerperium and gynecological diseases	no	no	no	no	these functions may be performed to a limited extent on a simulator; they may be performed with a standardized patient
Conducting bedside rehabilitation in order to prevent complications resulting from immobilization	no	no	no	no	these functions may be performed to a limited extent on a simulator (without learning to walk); they may be performed with a standardized patient
Conducting motor improvement (sitting down, verticalization, learning to walk, learning self-care skills)	no	no	no	no	these functions may be performed to a limited extent on a simulator (without learning to walk); they may be performed with a standardized patient
An activation of charges by using elements of occupational therapy	yes	yes	yes	yes	the use of simulation with a standardized patient