

The use of a hybrid mannequin for the modern high-fidelity simulation in the labor ward: the Italian experience of the Ecografia Gestione Emergenze Ostetriche (EGEO) group



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Clinical and Historical Background

Intrapartum care is provided mostly by active surveillance of women delivering a healthy baby uneventfully with no need for medical intervention. However, labor ward professionals acknowledge that even with low-risk deliveries, there is a risk of infrequent but catastrophic events that may jeopardize within a few minutes the life of both the woman and the newborn. Obstetric emergencies consist of tremendous and unexpected complications that require a prompt diagnosis combined with efficacious and aggressive management to mitigate or hopefully prevent an adverse outcome. Because the occurrence of obstetric emergencies is rare, most practitioners do not face them on a regular basis, and the vast majority may not have encoun-

Regular training in the management of intrapartum emergencies has been demonstrated to yield measurable benefits in terms of maternal and perinatal outcomes. Thanks to technologic advances, computerized, full-body mannequins have been created and made available for high-fidelity simulation in obstetrics. The technical skills subjected to training are conventionally represented by classical manual maneuvers, which are recommended in the case of instrumental vaginal delivery, shoulder dystocia, or postpartum hemorrhage. During the past few years, manual skills in the labor ward have been increasingly supported by the use of ultrasound, and this has substantially altered the practical management of intrapartum emergencies in real life. Based on this, a new generation of mannequins suitable for both clinical maneuvers and ultrasound examination seems to be the most appropriate tool for the modern high-fidelity simulation in the management of intrapartum complications. The use of these new hybrid clinical ultrasound mannequins may usher in a new era in high-fidelity obstetric simulation and can hopefully optimize the competencies and technical skills of labor ward professionals in the management of obstetric emergencies. It is from this background that at the beginning of 2018, the Ecografia Gestione Emergenze Ostetriche group was founded in Italy. This group has aggregated a multiprofessional labor ward team including obstetricians, midwives, and anesthesiologists under the common philosophy that ultrasound provides an essential added value in the management of obstetric emergencies. Thanks to the use of these mannequins, the multiprofessional Italian Ecografia Gestione Emergenze Ostetriche group has started to run practical workshops to promote the culture of extraordinary synergy of ultrasound and clinical skills as the best approach to handle intrapartum complications.

Key words: birth mannequin, obstetrical emergencies, operative delivery, postpartum hemorrhage, simulation, ultrasound

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tered any emergencies within several consecutive years of routine practice in the labor ward. However, when such intrapartum emergencies do occur, physicians and midwives must treat them efficiently, irrespective of their actual level of competence or experience. The optimal management of a rarely managed complication is mandatory to minimize the risk of adverse outcomes in the labor ward.^{1,2}

To be potentially able to fulfill this requirement, the professional obstetric team on the labor ward is expected to undergo formal sessions of simulations on the management of major intrapartum

emergencies.^{3–5} This approach commonly is adopted by all branches of medicine dealing with life-threatening emergencies^{6–8} and has been derived from the experience of the aviation industry,⁹ where it was introduced in 1970s with the aim of reducing adverse events due to human factors or errors.

In fact, the use of obstetric simulators dates back to as early as the 18th century. It is said that Madame du Coudray (1712–1790) used to run practical courses of childbirth assistance, using a portable leather mannequin that reproduced the features of the uterus with a cavity in which to insert the dummy of

FIGURE 1

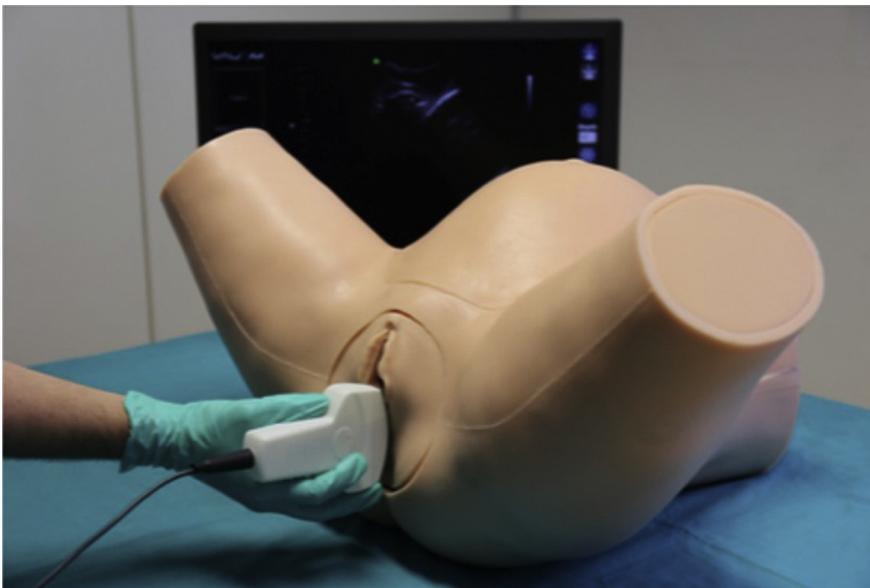
The “Birth Machine” (18th century), hosted at the University Museum of Bologna



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FIGURE 2

IUSim (Intrapartum Ultrasound Simulator)



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the fetus (Figure 1). Thanks to this “birth machine,” she found it easier to teach the population of the countryside which maneuvers were to be used during easy or complicated vaginal delivery.¹⁰

In recent decades, increased social and medicolegal pressure, especially in developed countries, has increased the need to minimize intrapartum complications to ensure safe childbearing. For this reason, the use of simulation training for the management of obstetric emergencies has become popular. Obstetric training consists of different modalities among the various health systems, and it is often prescribed as a compulsory update task to the maternity team by the hospital’s risk management unit. Multiprofessional simulation training is now recommended in national guidelines¹¹ and is also incentivized through the National Health Service Resolution Clinical Negligence Scheme for Trusts in England.¹²

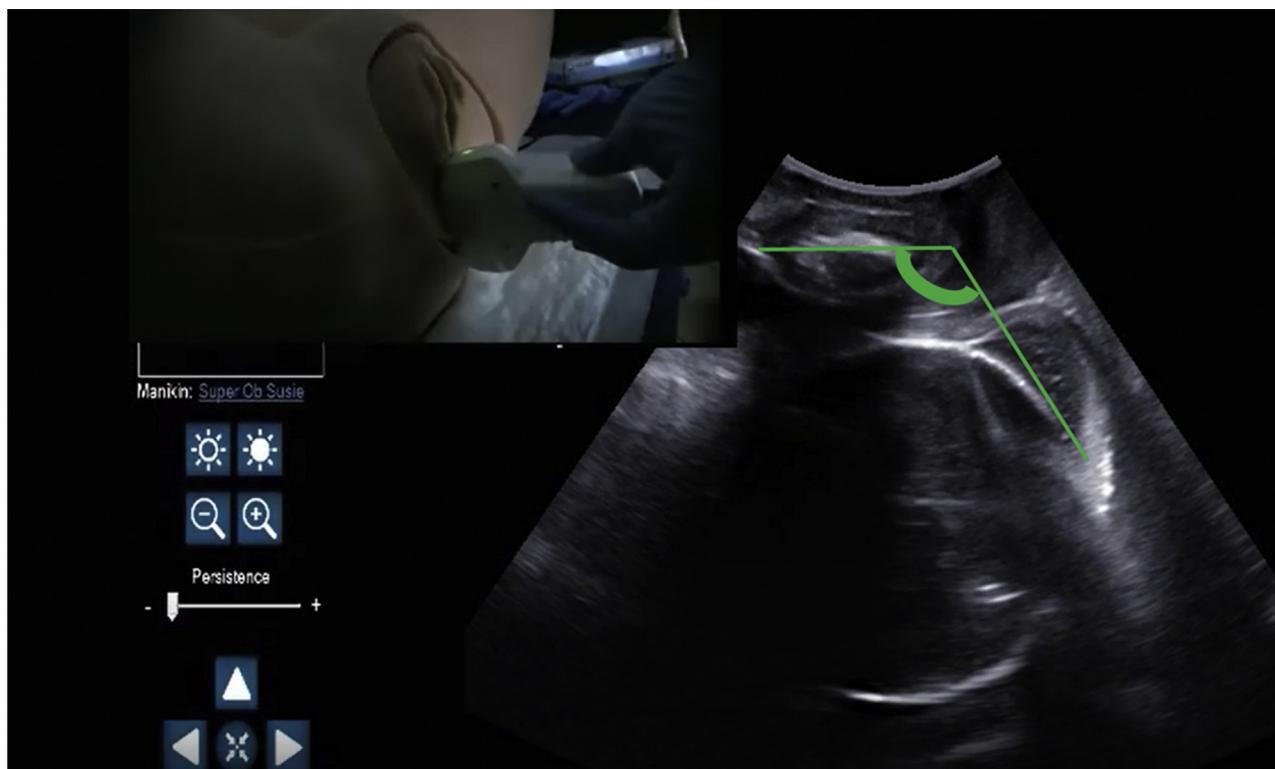
Conventional Simulation for the Management of Intrapartum Complications

During the simulation courses, the labor ward team is administered a series of potentially catastrophic events and is required to manage the simulated complications according to best clinical practice and the most recent guidelines. Thanks to technologic advances, computerized, full-body mannequins have been created and made available for high-fidelity simulation in obstetrics. These dedicated phantoms can be programmed to reproduce the main intrapartum complications and to provide realistic responses to trainees’ actions.

The ideal emergency drill is suggested to be carried out in a real-life setting by a small team of professionals who are expected to handle synergistically the major types of intrapartum complications, including difficult vacuum or forceps extraction, breech delivery, shoulder dystocia, postpartum hemorrhage, cord prolapse, and eclamptic fits. The high-fidelity simulation is usually supervised under recording by a group of experts, with each training session followed by debriefing with external assessment of the quality of the performance.^{13,14}

FIGURE 3

Measurement of the angle of progression on the sagittal plane



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Benefits and Aims of Simulation in Management of Intrapartum Complications

Regular training in the management of intrapartum emergencies has been demonstrated to yield measurable benefits in terms of clinical outcome. A significant decrease in some adverse perinatal outcomes has been reported by some institutions in which high-fidelity simulation has been implemented.^{15–20} In addition, international literature has shown that the implementation of a simulation facilitates learning, increases skills and competencies, improves the communication of the team, and reduces the possibility of error.⁸

Crofts et al¹⁶ showed that multidisciplinary training on shoulder dystocia over a 12-year period led to more effective management of this obstetric emergency, with improved neonatal outcomes (reduction of brachial plexus injury, humerus and clavicle fractures,

and Apgar score less than 7 at 5 minutes). A decade after the introduction of the training, no case of brachial plexus injury was reported in 562 cases of shoulder dystocia.

A retrospective cohort study exploring the effect of formal teaching (lectures and simulation training) was able to demonstrate a significant reduction in third- and fourth-degree tear rates following forceps births (odds ratio [OR], 0.78, $P < .005$).¹⁹ Another study demonstrated a significant reduction in neonatal morbidity, including scalp injury and cephalohematoma (OR, 0.14; 95% confidence interval [CI], 0.02–0.98, $P < .05$), special care birth unit admission (OR, 0.72; 95% CI, 0.02–0.6, $P < .05$), and facial injury (OR, 0.02; 95% CI, 0.01–0.04, $P < .05$) following formal training for operative vaginal birth.²⁰ There is currently a Cochrane review underway that seeks to precisely define the impact of emergency

training on maternal and neonatal outcomes.²¹

Some groups of experts in the field of management of intrapartum complications have been created to deliver local courses for labor ward professionals at the national or international level²² or to teach the senior figures on how to run their own courses (“train the trainers”). This has further contributed to promote the culture of simulation as the best technique for teaching and training professionals in obstetrics. The Royal College of Obstetricians and Gynaecologists Operative Birth Simulation Training course (ROBuST)²³ is designed to improve outcomes associated with operative vaginal delivery. The aim of these courses is to develop, reinforce, or maintain both technical and nontechnical skills, including teamwork, clinical leadership, interpersonal communication, and clinical decision making.²⁴

FIGURE 4

Measurement of the head–perineum distance on the axial plane



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The technical skills subjected to training are represented conventionally by the classical manual maneuvers that are recommended by guidelines and textbooks in each obstetric emergency context. In particular, the course attendant may practice with the digital palpation of the fetal head dummy to determine the station and the position and to simulate thereafter a trial of instrumental vaginal delivery by vacuum or forceps. Similarly, the trainees are asked to resolve manually on the mannequin a case of shoulder dystocia, to use their hands in assisting a breech delivery, or to manage a postpartum hemorrhage by means of uterine massage, tamponade, or suturing. This simulated activity turns out to be of great value in managing the intrapartum complications when such events do occur in the real life.

The Potential Usefulness of Adding Ultrasound to Conventional Simulation for Management of Intrapartum Complications

However, one critical aspect is that during the past few years, the manual skills in the

labor ward increasingly have been supported by the use of ultrasound, and this has substantially altered the practical management of intrapartum emergencies in real life. Ultrasound has been shown to be far more accurate than digital examination in the assessment of fetal head position and station in the second stage of labor.²⁵⁻³⁷ On this basis, the use of ultrasound before vacuum or forceps is purported to provide a more precise placement of the instrument on the fetal head and subsequently to reduce the risk of failure of operative vaginal delivery and of related adverse events, including perinatal or maternal complications.^{34,35,37,38} Although the studies conducted thus far were underpowered to demonstrate a significant difference in terms of clinical outcome, routine sonographic evaluation of fetal position and station before considering or performing a vaginal extraction is strongly endorsed by the recently published international guidelines on labor ultrasound.³⁹

In the management of other intrapartum complications or emergencies, such as postpartum hemorrhage or

shoulder dystocia, despite the lack of specific recommendations and guidelines, the ancillary use of ultrasound, in addition to manual skills, is widely popular when refining and speeding up the diagnosis and treatment of the condition are not required. For instance, in women with massive bleeding after delivery, the usefulness of ultrasound to rule out retained tissue in the uterine cavity or to guide visually its evacuation by means of curettage is indisputable.⁴⁰ Similarly, in cases of shoulder dystocia, some of the most common maneuvers such as Rubin I or II, Wood, or Jacquemier are appropriately performed and are more likely to succeed only if the side of the fetal back (right or left) has been ascertained sonographically before starting the procedure. However, evidence from obstetric emergencies demonstrates that how procedures are commonly performed is not a fully reliable simulation of what is done (or should be done) in real life when an intrapartum complication occurs.

If we accept that to be profitable, an obstetric simulation training should

FIGURE 5
Sonographic assessment of the uterine cavity



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replicate (as the word *simulation* derives from the Latin “similis,” which means “similar”) the setting, steps, and procedures that take place in the labor ward, we must admit that current simulation practice based exclusively on manual maneuvers does not meet this requirement. From this awareness has come the idea to produce and test a new generation of mannequins for use during the intrapartum complications drill. This mannequin should be suitable for practice of both clinical maneuvers and ultrasound examination, since this combined approach is now used in real life to deal with emergencies and to reduce the risk of adverse outcomes.

The Use of a Hybrid Mannequin for Modern, High-Fidelity Simulation in the Labor Ward

In the past few months, a hybrid phantom for manual and sonographic assessment has been developed and released in the clinical market for obstetric simulation. IUSim (Intrapartum Ultrasound Simulator; Accurate —

Health and Learning, Cesena, Italy) (Figure 2) is an advanced simulator that allows the practitioner to become accustomed to intrapartum ultrasound images and to practice traditional obstetric maneuvers under ultrasound guidance. Such a device may be installed on each mannequin for birth assistance for an integrated clinical and sonographic training in the management of intrapartum complications. The use of sonographic images permits the attendant to reassess the clinical findings obtained at digital examination and to measure some quantitative parameters that have been proven to be useful in the practice of intrapartum ultrasound for the exact definition of fetal station, such as the angle of progression (Figure 3) or the head—perineum distance (Figure 4).³⁹

The simulator is composed of a PC system that reproduces a realistic sonographic interface, a mock convex probe, and a skill-trainer mannequin for birth assistance. It is able to display ultrasound images and clips whenever the probe is placed by the examiner on radiofrequency identification sensors,

which are located in specific anatomic landmarks of the mannequin. The software includes a digital library of different clinical cases that have been created with real sonographic images and can be alternatively loaded and displayed by the trainer by means of a remote-control device.

On a hybrid clinical-sonographic mannequin such as IUSim, in addition to digital examination, it is possible to perform transabdominal and transperineal scans to visualize a sonographic videoclip from the library, from which the fetal head station, position, or attitude can be assessed. A correct evaluation of these parameters is crucial before the decision is made to perform an instrumental vaginal delivery as well as the correct technique to use (Video 1).

Following the development of the mannequin for intrapartum ultrasound, other types of hybrid mannequins currently are being developed that use the same technical principles of IUSim, in that they allow the ancillary use of ultrasound in the management of obstetric emergencies such as postpartum hemorrhage or shoulder dystocia. On these

smart phantoms, thanks to the activation of radiofrequency identification tags, it is possible to load and visualize the sonographic findings that are compatible with each different clinical scenario administered to the trainee during the simulation. For instance, in a case of postpartum hemorrhage, sonographic images of an empty uterine cavity (Figure 5), retained tissue, or uterine rupture may be alternatively displayed to the attendant. The use of these new hybrid clinical ultrasound mannequins may usher in a new era in high-fidelity obstetric simulation and can possibly optimize the competencies and technical skills of the labor ward professionals in the management of obstetric emergencies.

It is from this background that at the beginning of 2018, the Ecografia Gestione Emergenze Ostetriche (EGEO) group was founded in Italy. This group has aggregated a multiprofessional labor ward team, including obstetricians, midwives, and anesthesiologists under the common philosophy that ultrasound has an essential added value in the management of obstetric emergencies. Following its creation, the EGEO group has started to run practical workshops within the main national and international congresses on labor and delivery with the goal to promote the culture of the extraordinary synergy of ultrasound and clinical skills as the best approach to handle intrapartum complications and prevent the occurrence of adverse events. ■

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