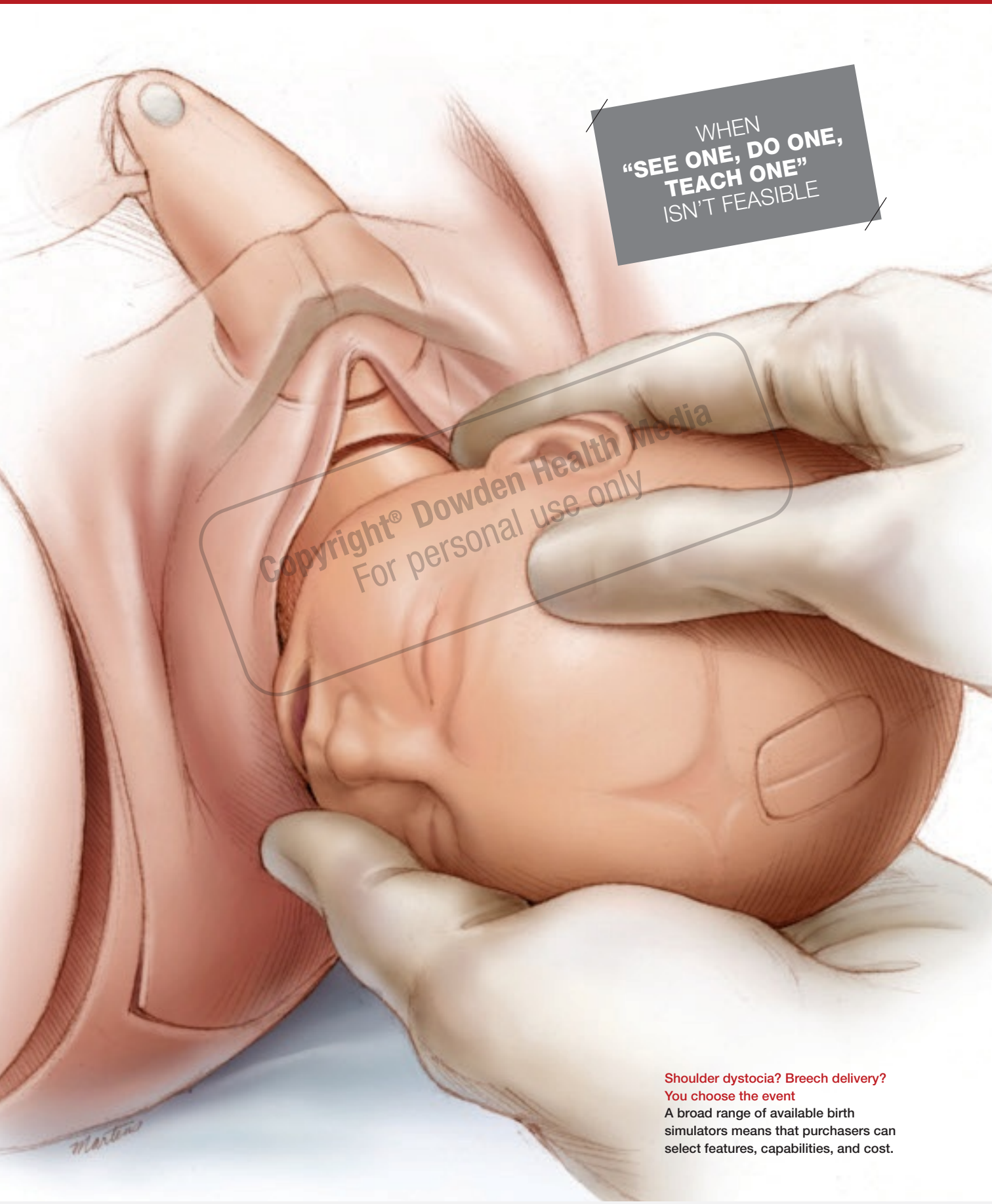

WHEN
"SEE ONE, DO ONE, TEACH ONE"
ISN'T FEASIBLE

Shoulder dystocia? Breech delivery? You choose the event
A broad range of available birth simulators means that purchasers can select features, capabilities, and cost.

How simulation can train, and refresh, physicians for critical OB events

Perinatal teams can practice handling emergencies without endangering patients or risking litigation. Hospitals and insurers are taking notice.

Robert Gherman, MD
Andrew Satin, MD
Roxane Gardner, MD, MPH

Dr. Gherman is Adjunct Assistant Professor of Obstetrics and Gynecology, Uniformed Services University of the Health Sciences, Bethesda, Md., and Director of the Division of Maternal-Fetal Medicine, Prince George's Hospital Center, Cheverly, Md.

Dr. Satin is Professor and Vice Chair, Department of Gynecology and Obstetrics, Johns Hopkins University School of Medicine, and Chair, Department of Obstetrics and Gynecology, Johns Hopkins Bayview Medical Center, Baltimore, Md.

Dr. Gardner is Assistant Professor of Obstetrics, Gynecology, and Reproductive Biology, Harvard Medical School, and a faculty member in the Department of Obstetrics and Gynecology, Brigham and Women's Hospital, Boston, Mass., and the Center for Medical Simulation, Cambridge, Mass.

The authors report no financial relationships relevant to this article.

>> SHARE YOUR COMMENTS
Have you been part of an OB simulation? How did it go?
E-MAIL obg@dowdenhealth.com
FAX 201-391-2778

Many senior obstetricians—you may be among them—have vivid recall of performing their first vaginal delivery as an intern or junior resident, guided by a seasoned obstetric nurse or senior resident. "See one, do one, teach one," an unwritten motto at large teaching hospitals, aptly characterized the learning environment for many older physicians.

Regrettably, obstetric residents and fellows today face a very different situation. Restrictions on residents' working hours, financial pressures that make attending faculty less available for supervision, and wariness prompted by malpractice litigation—all these have made such teaching cases less available. So, how can physicians-in-training acquire the skills they will need in practice? And how can experienced clinicians breathe life back into skills that they use infrequently but are nonetheless critical?

We believe the answer can be found in the educational technique of simulation, which we describe in this article.

Simulation provides opportunities for physicians to practice, gain experience, and refresh. The technique offers a credible way to augment the educational curriculum and, even in the absence of unequivocal proof, to improve patient safety and reduce the likelihood of adverse outcomes.[1] For that reason, some malpractice insurers are making simulation training part of their safety and risk reduction initiatives.

To begin our discussion, a brief history of simulation appears on page 44.

IN THIS ARTICLE

Watch a C-section simulation in the Video Library
obgmanagement.com

Where simulation detected gaps in management of critical OB events
page 44

A sampling of childbirth simulators
page 50

CONTINUED ON PAGE 44

KIMBERLY MARTENS FOR OBG MANAGEMENT

A brief history of simulation, in and outside medicine

Simulation has roots in prehistoric times, when it facilitated acquisition of hunting skills and prepared people for tribal games or warfare.[1] The ancient Greeks used simulation to illustrate philosophical concepts and help students understand them.[2] Today, simulation techniques are used in various industries and disciplines, especially when real-world training is too dangerous or expensive, or impossible.[3]

Safety in the air. The airline industry is known for incorporating simulation techniques into training programs for pilots and flight crews. The first airplane simulator was built in 1910, after the first fatal airplane crash in 1908.[4] The need to train pilots during World War I and World War II greatly increased the use of flight simulators.

Beginning in the early 1980s, the airline industry began to use a range of risk-reduction activities designed to make commercial flying safer. Airlines established standard operating protocols and checklists, required pilots to participate in simulation-based training, and scheduled periodic skills and behavioral assessments. These changes in procedures, along with technological advances, led to a substantial decline in aircraft flight errors over the two decades that followed.

In labor and delivery. Obstetric simulators designed to illustrate the process of childbirth and teach midwives how to manage complications have been dated to the 1600s.[1] Early childbirth simulators were typically made of basket and leather fragments in the shape of a female pelvis, accompanied by a dead fetus or doll. Later, such devices were made of wood, glass, fabric, or plastic. Their use and evolution continued through the 19th and 20th centuries.[5]

Computerized simulator technology was introduced during the 1960s, and widespread adoption across medical specialties began in the 1980s.[6,7] Gaba and DeAnda were among the first to adapt simulation training for healthcare providers during the late 1980s.[7]

Since then, simulation training has become increasingly common in the fields of anesthesia, general surgery, and emergency medicine. Residents use simulation to train for difficult airway intubation, central venous access, adult and pediatric trauma resuscitation, and such complex surgical procedures as laparoscopic cholecystectomy. Reports of human patient simulation to reenact some or all aspects of routine and critical obstetrical events began to appear in the specialty's journals in the late 1990s.[8,9]

References

1. Wilson A. The Bomb and the Computer: Wargaming from Ancient Chinese Mapboard to Atomic Computer. New York: Delacorte Press; 1968.
2. Buck GH. Development of simulators in medical education. Gesnerus. 1991;48 Pt 1:7–28.
3. McGuire CH. Simulation: its essential nature and characteristics. In: Tekian A, McGuire CH, McGaghie WC, et al, eds. Innovative Simulations for Assessing Professional Competence: From Paper and Pencil to Virtual Reality. Chicago: University of Illinois at Chicago, Department of Medical Education; 1999.
4. Haward DM. The Sanders teacher. Flight. 1910;52(50):1006–1007.
5. Gardner R. Simulation and simulator technology in obstetrics: past, present and future. Expert Rev Obstet Gynecol. 2007;2:775–790.
6. Denson JS, Abrahamson S. A computer controlled patient simulator. JAMA. 1969;208:504–508.
7. Gaba DM, DeAnda A. A comprehensive anesthesia simulator environment: re-creating the operating room for research and training. Anesthesiology. 1988;69:387–394.
8. Macedonia CR, Gherman RB, Satin AJ. Simulation laboratories for training in obstetrics and gynecology. Obstet Gynecol. 2003;102:388–392.
9. Knox GE, Simpson KR, Garite TJ. High reliability perinatal units: an approach to the prevention of patient injury and medical malpractice claims. J Healthc Risk Manag. 1999;19(2):24–32.

What simulations reveal about OBs' skills

Maslovitz and colleagues, in a study that used simulated events, investigated errors among residents and nurse-midwives that occurred while teams managed four critical obstetric events[1]:

- eclamptic seizure
- postpartum hemorrhage
- shoulder dystocia
- breech extraction.

The most common management errors found were:

- delays in transporting a bleeding patient to the operating room (82% of the time)
- unfamiliarity with administering prostaglandin to reverse uterine atony (82%)
- poor cardiopulmonary resuscitation technique (80%)
- inadequate documentation of shoulder dystocia (80%)
- delayed administration of blood products to reverse consumptive coagulopathy (66%)
- inappropriate avoidance of episiotomy in shoulder dystocia and breech extraction (32%).

CONTINUED ON PAGE 47

Managing eclampsia

Thompson's study of eclampsia simulation drills[2] identified three major problems in handling this emergency:

- difficulty summoning senior staff
- multiple protocols for managing eclampsia, without a clear first-line anticonvulsant
- significant time lost gathering items required to manage seizures.

Based on what was observed in simulations, Thompson recommended **1)** creating so-called eclampsia boxes that contain all necessary equipment and **2)** establishing a liaison with the pharmacy to ensure consistency in supplies of magnesium sulfate.

Shoulder dystocia

The 5th Report on Confidential Enquiries into Maternal Deaths in the United Kingdom found that, in 66% of neonatal deaths following shoulder dystocia, "different management could have reasonably been expected to have altered the outcome."[3]

Using a standardized shoulder dystocia simulation, Deering and colleagues reported significantly higher scores for residents who were trained in the scenario, including in the timeliness of their intervention, performance of maneuvers, and overall performance.[4]

Crofts, Draycott, and various colleagues developed a training mannequin for hospital staff that included a force-monitoring system comprised of a strain gauge mounted on both clavicles. After training, they found a reduction in **1)** head-to-body delivery duration and **2)** maximum applied delivery force after training, although these reductions did not reach statistical significance.[5,6]

Where do you begin?

Starting a simulation program can be challenging: Significant financial hurdles may exist, and teamwork and communication issues can be major barriers to yielding improvements in practice. What's the first step?

Find backing. Garner support for your project (**TABLE 1**, page 48). It's imperative to involve administrative leadership early.[7] One champion cannot sustain a program of this

TABLE 1 Opening questions about a simulation training program

How do you get started?

- Garner support
- Build consensus
- Define outcomes
- Create a budget

What are the key components?

- Skills inventory
- Necessary competencies
- Stated objectives
- Adult learning principles
- Performance measures
- Debriefing
- Feedback

magnitude.

Assemble a multidisciplinary team. Include obstetricians, gynecologists, anesthesiologists, neonatologists, and other members of the perinatal or surgical team. All will be needed to create complex interdisciplinary drills or simulations.

Build consensus. Determine the scope, goals, and objectives of the project. Define measurable outcomes.

Outline a budget. Make a realistic assessment of the resources available to fund the curriculum you design.

Know how adults learn

A simulation designed to raise the skill level of professionals—be they residents, nurses, or attending physicians—must recognize the special characteristics of adult learners. Unlike school children, adult learners are self-directed; they bring real-life experience to the table, are motivated primarily by a need to know, have individual learning styles, and deserve to be treated with respect.

A simulation curriculum should incorporate so-called crew resource management skills—a style of open cockpit communication of proven worth in improving airline safety.[8] Those crew skills should promote best practices in closed-loop communication (such as the readback/hearback system[9]), information sharing, assertiveness, adaptability, and leadership skills—all elements of successful simulation. Means of coordinating, allocating, and monitoring team resources should be built into the curriculum (**TABLE 1**).

Find the time

A practical rule to follow when designing a simulation goes by the acronym ARRON—As Reasonably Realistic as Objectively Needed.[10] The team leader should match the task to:

- time allotted
- baseline level of medical knowledge of the trainee (resident, nurse-midwife, experienced attending)
- budget.

A major hurdle, especially in a community hospital, is to schedule sessions at a time when as many providers as possible can attend. Taking time off for training is particularly difficult for office-based providers; a workable schedule must take their needs into consideration—possibly with evening or weekend sessions.

Multiple nursing shifts may necessitate repeating a simulation several times. Consider having a so-called stand-down declared, in which all nonemergency cases are delayed (if hospital administration is amenable). Alternatively, the hospital may allot time for a simulation exercise during a slot for a weekly educational lecture or monthly department meeting.

What equipment is needed?

A community hospital can develop a simulation program that is focused on its educational and safety needs. For example, a broad range of birth simulators is available (**TABLE 2**, page 50). The features and capabilities of each model vary with cost (we do not recommend any particular simulator). The ideal childbirth simulator has yet to be defined, but existing modalities can be adapted to meet specific needs of a target audience. A standard obstetric birthing pelvis equipped with an inflatable uterus for simulating uterine atony, for example, can be modified and made to bleed from the model's cervical os to simulate postpartum hemorrhage.[11] Com-

FAST TRACK

Childbirth simulators cover the range of costs, features, and capabilities. That flexibility means a program can be tailored to the needs of any audience.

mercial models (mannequins) are not always necessary for OB simulation; task trainers (devices that allow repeated practice of individual skills) and standardized patients (persons trained to portray patient scenarios) can also be used.

Most hospitals do not have an extensive simulation center. Several state-of-the-art facilities exist in the United States, including:

- The Uniformed Services University of the Health Sciences, Bethesda, Md.
- the Center for Medical Simulation, Cambridge, Mass.
- the International Academy for Clinical Simulation and Research, Miami, Fla.

The Society for Simulation in Healthcare maintains a list (at www.ssih.org/public) of institutions that host a simulation center.

What topics should be covered by simulation?

A simulation curriculum may begin with low-frequency, high-acuity events, such as shoulder dystocia, postpartum hemorrhage, breech delivery,[12] and maternal cardiorespiratory arrest (**TABLE 3**, page 52).

Some birth simulators included prepackaged clinical scenarios (**TABLE 2**, page 50). We recommend that you conduct prescenario and postscenario didactic teaching seminars on the specific topic of the simulation. These seminars should touch on the major aspects of care and specifically address risk components.

Debriefing is key

Real learning occurs during postscenario debriefing, during which participants explain, analyze, and synthesize information on their actions and emotional state during the simulation (or a real event). The objective? To improve performance in similar situations.[13]

In a debriefing, teammates gather to discuss:

- their assumptions, actions, and feelings
- matters of teamwork and communication
- availability of needed equipment or other resources.

After-action reviews. Debriefing has its ori-

TABLE 2 What are the commercially available childbirth simulators?

Models are listed in ascending order by price

Manufacturer	Model	Price	Features
Childbirth Graphics	• Vinyl Pelvic Model set	$ 188.50	Accommodates cloth fetal model's head
	• Abdominal Palpation Model	486.70	Fetal head with palpable anterior and posterior fontanels; fetal body flexes for demonstration of all presentations; movable gel packs to simulate amniotic fluid
Gaumard Scientific	• Advanced Childbirth Simulator	500.00	Removable diaphragm end plate for manual positioning of fetus
Simulaids	• Obstetrical mannequin	547.00	Includes disposable umbilical cords and powder to make simulated blood
	• Forceps/vacuum delivery OB mannequin	651.00	Used in Advanced Life Support in Obstetrics training programs; soft vinyl pelvis replicates the resistance encountered in an operative vaginal delivery
Nasco	• Life/form birthing station simulator	720.00	Shows relationship between fetal head and ischial spines
Gaumard Scientific	• Obstetric Susie	995.00	Adaptive birth canal to demonstrate shoulder dystocia; ability to practice manipulation of breech
3B Scientific	• Standard Childbirth Simulator	1,336.00	Covered belly cavity; removable vulva and fetus at 40 weeks gestation
Gaumard Scientific	• NOELLE S552 Birthing Torso	1,750.00	Automatic birthing system that rotates baby as it moves through birth canal
Gaumard Scientific	• NOELLE S551 Birthing Simulator	2,795.00	Inflatable airway with chest rise, IV arm for meds/fluids, vulval inserts for suturing practice
Limbs & Things	• PROMPT Birthing Simulator: Standard	3,600.00	Movable legs (semirecumbent, lithotomy position, McRoberts maneuver, all fours)
	• PROMPT Birthing Simulator: Force Monitoring	6,100.00	Electronic strain gauge allows for measurement of force applied to baby as it is delivered
Gaumard Scientific	• NOELLE S555 Birthing Simulator	11,995.00	PEDI Blue full-term newborn included; nine prepackaged scenarios
	• NOELLE S560 Birthing Simulator	15,995.00	Testing stations include ALS, NRP, and obstetrics; virtual instruments used to monitor the mother include heart rate, blood pressure, pulse oxygenation, and electrocardiogram
	• NOELLE S565 Birthing Simulator	19,995.00	Computer interactive; instructor controls delivery as well as fetal monitor
Koken	• Full-body pregnancy simulator	28,518.00	Model made of lifelike materials for realistic practice
Gaumard Scientific	• NOELLE S575 Birthing Simulator	34,995.00	Wireless, tetherless, and fully responsive; built-in scenarios for crash C-section, postpartum hemorrhage, shoulder dystocia, placenta previa, and operative vaginal delivery

CONTACT INFORMATION

3B Scientific
www.3bscientific.com

Childbirth Graphics
1-800-299-3366
www.childbirthgraphics.com

Gaumard Scientific
1-800-882-6655
www.gaumard.com

Koken
www.kokenmpc.co.jp/english

Limbs & Things
1-866-GOLIMBS
www.golimbs.com

Nasco
1-800-558-9595
www.enasco.com

Simulaids
1-800-431-4310
www.simulaids.com

Watch a C-section simulation
in the OBG MANAGEMENT Video Library
at www.obgmanagement.com

ARTICLE CONTINUES ON PAGE 52

TABLE 3 What are possible scenarios in an OB simulation curriculum?

- Amniotic fluid embolism
- Breech delivery
- Eclampsia
- Episiotomy/procto-episiotomy repair
- Maternal cardiac arrest
- Operative vaginal delivery
- Postpartum hemorrhage
- Shoulder dystocia
- Trauma in pregnancy
- Umbilical cord prolapse
- Vaginal birth after C-section/uterine rupture

gins in **1)** so-called after-action reviews that are part of military protocol—that is, preflight and postflight discussions aimed at diminishing airplane crashes—and **2)** studies of organizational behavior and psychology. Gaba is credited for leading the first "critical medical event management" debriefing in the late 1980s.[14] Debriefing can be self- or team-directed or led by a skilled facilitator; the team can address routine or critical events.

Good judgment. Ideally, a trained instructor or facilitator leads a debriefing session, encouraging group feedback and reflection on clinical practice and team behavior. Debriefing with good judgment is an approach that values the expert opinion of the instructor and the unique perspective of each participant. It allows the instructor to match teaching objectives with trainee concerns by understanding the assumptions and beliefs that drive participants' actions.[13]

Debriefing can identify deficiencies in practice and documentation, and can promote best practices for teamwork among physicians, nurses, and support staff.[15] Objective and subjective performance can be assessed by reviewing videotaped simulations [*Editor's note*: Watch a video of a C-section simulation in the OBG MANAGEMENT Video Library (www.obgmanagement.com)], participant or third-party performance evaluations, and pre- and postsession testing.

Vulnerabilities. Simulation can expose interpersonal and intrapersonal vulnerabilities. To hear criticism from colleagues about behavior and technical performance can be difficult, whether participants are inexperienced students or professional colleagues who work together in a high-stress perinatal environment.

In a debriefing with good judgment, the leader ensures an atmosphere of safety, in which teammates can speak up freely and must be mutually respectful and accountable to each other. Suggestions that arise from a debriefing session should be viewed as an opportunity for improvement, not a time to assign blame or impose penalties.

After the session is over

The steps you take after debriefing are the most important of all (**TABLE 4**, page 54). To have a real impact, a simulation program must include mechanisms for assessing and documenting measurable outcomes, staff satisfaction, and improvements in patient safety. Ongoing feedback to, and from, the staff—by way of newsletters, announcements, grand rounds, and social gatherings—is crucial. Last, assessment and feedback must be used to inform regular updates of the simulation program.

FAST TRACK

Simulation is very good at illuminating systems problems and inadequate staff responses to critical OB events

What simulation does best

According to a "root cause" analysis by the Joint Commission on Accreditation of Healthcare Organizations, most (72%) cases of perinatal death and permanent disability can be traced to problems with organizational culture and communication among caregivers.[16] These are precisely the kind of issues that simulation training is best suited to confront: Simulation allows participants to identify system-based issues and staff responses that are inadequate for managing critical clinical events.

The impact of simulation training programs can be assessed by monitoring trends in key maternal and neonatal outcomes.[17] A downward trend in adverse events (e.g., low Apgar score for term newborns, maternal or neonatal birth-related injury), for example,

A 10-minute video presents highlights of a simulated C-section, in the Video Library at www.obgmanagement.com

TABLE 4 What ongoing program elements are needed?

- Documented assessment
- Ongoing feedback
- Periodic program updates

would underscore the value of simulation in improving patient safety and quality of care.

Liability insurance. Professional liability carriers are beginning to incorporate simulation training into patient safety and risk-reduction initiatives. Harvard University's medical malpractice insurer, Controlled Risk Insurance Company/Risk Management Foundation, established a voluntary incentive program in 2003 that provides a 10% premium credit to providers of OB services who complete risk-reduction activities that include simulation-based and didactic team training. A downward trend in obstetrical claims in association with this incentive program was recently noted.[18]

Resident and continuing medical education. The Council on Resident Education in Obstetrics and Gynecology featured simulation at its annual meeting in 2007 as a credible way to augment the curriculum for resident education.[19] Simulation is also being used to train OBs who need to learn new skills and procedures, refresh infrequently needed skills (cesarean-hysterectomy, laparoscopy), or reenter the workplace after an extended absence.[20]

What does the future hold?

Simulation provides a safe environment, in which mistakes are tolerated without harming patients and appropriate responses can be learned and practiced.[21] Benefits of the technique are acknowledged in England, where annual skill drills, using simulation, are recommended by the Royal College of Midwives and the Royal College of Obstetricians and Gynaecologists.

In the United States, the use of OB simulation in residency and postresidency training programs is growing. This change is likely to trigger the introduction of simulation into board certification and credentialing procedures.

Work is needed to validate and standardize simulation-based scenarios. Studies will need to show that simulation improves clinicians' and teams' performance not only on simulators but in practice. Despite these hurdles, it is reasonable to conclude that respect for patients and a desire to learn without doing harm will expand and diversify the role of simulation in OB training and practice.

References

1. Maslovitz S, Barkai G, Lessing JB, Ziv A, Many A. Recurrent obstetric management mistakes identified by simulation. Obstet Gynecol. 2007;109:1295–1300.
2. Thompson S, Neal S, Clark V. Clinical risk management in obstetrics: eclampsia drills. Qual Saf Health Care. 2004;13(2):127–129.
3. Hope P, Breslin S, Lamont L, et al. Fatal shoulder dystocia: a review of 56 cases reported to the Confidential Enquiry into Stillbirths and Deaths in Infancy. Br J Obstet Gynaecol. 1998;105:1256–1261.
4. Deering S, Poggi S, Macedonia C, Gherman R, Satin AJ. Improving resident competency in the management of shoulder dystocia with simulation training. Obstet Gynecol. 2004;103:1224–1228.
5. Crofts JF, Attilakos G, Read M, Sibanda T, Draycott TJ. Shoulder dystocia training using a new birth training mannequin. BJOG. 2005;112:997–999.
6. Crofts JF, Bartlett C, Ellis D, Hunt LP, Fox R, Draycott TJ. Training for shoulder dystocia: a trial of simulation using low-fidelity and high-fidelity mannequins. Obstet Gynecol. 2006;108:1477–1485.
7. Friedrich M. Practice makes perfect: risk free training with patient simulators. JAMA. 2002;288:2808–2812.
8. Pizzi L, Goldfarb N, Nash DB. Crew Resource Management and Its Application in Medicine. In Making Healthcare Safer: A Critical Analysis of Patient Safety Policies. Evidence Report/Technology Assessment # 43. AHRQ Publication No. 01-E058, July 2001. AHRQ. Rockville, MD. www.ahrq.gov/clinic/ptsafety/
9. Brown JP. Closing the communication loop: using readback/hearback to support patient safety. Jt Comm J Qual Saf. 2004;30:460–464.
10. Macedonia CR, Gherman RB, Satin AJ. Simulation laboratories for training in obstetrics and gynecology. Obstet Gynecol. 2003;102:388–392.
11. Gardner R. Simulation and simulator technology in obstetrics: past, present and future. Expert Rev Obstet Gynecol. 2007;2:775–790.
12. Deering S, Brown J, Hodor J, Satin AJ. Simulation training and resident performance of singleton vaginal breech delivery. Obstet Gynecol. 2006;107:86–89.
13. Rudolph JW, Simon R, Rivard P, Dufresne RL, Raemer DB. There's no such thing as "non-judgmental debriefing: a theory and method for debriefing with good judgment. Simul Healthc. 2006;1(1):49–55.
14. Gaba DM, DeAnda A. A comprehensive anesthesia simulator environment: re-creating the operating room for research and training. Anesthesiology. 1988;69:387–394.
15. Deering S, Poggi S, Hodor J, Macedonia C, Satin AJ. Evaluation of residents' delivery notes after a simulated shoulder dystocia. Obstet Gynecol. 2004;104:667–670.
16. Joint Commission on Accreditation of Healthcare Organizations. Sentinel event alert. 31 July 2004.
17. Draycott T, Sibanda T, Owen L, et al. Does training in obstetric emergencies improve neonatal outcome? BJOG. 2006;113:177–182.
18. McCarthy J, Cooper JB. Malpractice insurance carrier provides premium incentive for simulation based training and believes it's made a difference. Anesth Patient Saf Found Newsl. 2007;22(1):17.
19. CREOG and APGO Annual Meeting 2007. Innovations in medical education: achieving your potential. March 7–10, 2007. Salt Lake City, Utah.
20. Allen R. Update of AMA's initiative to transform medical education (ITME). Section on medical schools interim meeting. November 10, 2007. Available at: http://www.ama-assn.org/amal/pub/upload/mm/44/i07highlights.pdf.
21. Vozenilek J, Huff JS, Reznek M, Gordon JA. See one, do one, teach one: advanced technology in medical education. Acad Emerg Med. 2004;11:1149–1154.