

Two Examples of How to Evaluate the Impact of New Approaches to Teaching

DURING the past 15 yr, there has been increasing interest in using newer technologies to enhance the education and training of medical personnel. In this issue of ANESTHESIOLOGY, Morgan *et al.*¹ and Birnbach *et al.*² give two examples of how to evaluate the impact of new approaches to teaching.

Morgan *et al.* conducted a careful study comparing faculty-led sessions using either an “exemplar” video of proper practice or demonstrations with a high-fidelity patient simulator to teach final-year Canadian medical students some key points of the medical responses to specific intraoperative events. Although the students preferred the simulation sessions, there was no difference between the groups in the ability of students to respond to the events when tested in the simulator. Although the authors are circumspect in their claims, others might view this as proof that simulators are not worth their nontrivial price. However, at most, such a view would find justification only for a very restricted set of questions asked in this study.

To assess the value of an educational or training modality we must consider various factors, including the target population, the goal, and the *overall* costs of the intervention. Typical target populations for simulation activities have ranged from outreach programs involving children and lay adults to preclinical and clinical students in medicine, nursing, and allied health professions to highly experienced physicians and nurses. Not all purposes and goals are equally applicable to all target populations. We should distinguish between education and training. The goal of education is typically to teach or improve conceptual understanding or to introduce individuals to skills. For training, the goal is to implement or improve specific skills and behaviors needed to

accomplish a real-world job. Medicine especially has emphasized education, leaving training largely to an apprenticeship model.

Morgan *et al.* chose a target population of final-year medical students. The goal of the intervention must be inferred to be education about intraoperative critical events rather than training because no one would expect these students to be able to perform this task adequately in real patient care. This is reflected in the substantial simplification of the task in the demonstrations and test relative to that encountered in real clinical situations. Given such a restricted goal and task, it may not be surprising that the students who had intensive faculty teaching using either the exemplar videos or the exemplar simulations improved their understanding and abilities *versus* their baseline but did not differ in their performance depending on the modality used to teach them.

Further, was this really a comparison between a \$100 intervention (the video) and a \$150,000 intervention (the simulator)? Making a good training video can itself be expensive, and may require a simulator to create the clinical scenarios. Moreover, in assessing the costs of the simulator intervention, one cannot attribute to any single activity the capital costs of the simulator and the accompanying space and infrastructure. Nearly all simulation centers have a diverse set of users from different departments, for different target populations, and for different purposes. The fixed expenses of the center must be amortized over a number of years and across all the users. Although substantially greater than the cost of a video player, the simulator center usage costs attributable specifically to the intervention studied by Morgan *et al.* might not be that high. This is especially true because the major cost of simulation training is faculty time. Morgan *et al.* acknowledged that for both video- and simulation-based teaching, a roughly equal—and substantial—amount of faculty time was required.

Within the limits that they posed for themselves, Morgan *et al.* demonstrated that it is possible to conduct a careful test of different educational modalities. The conundrum is that measuring the results of the intervention requires the ability to assess performance. Although this proved feasible for the simplified tasks expected of students, it will be more difficult to do so for more complex tasks and behaviors expected of experienced personnel. However, in some cases, studying the details of even a restricted task has important ramifications for safe and efficient patient care. Birnbach *et al.* showed that most aspects of epidural catheter placement can be assessed robustly by reviewing videotapes of clinicians

This Editorial View accompanies the following two articles: Birnbach CJ, Santos AC, Bourlier RA, Meadows WE, Datta S, Stein DJ, Kuroda MM, Thys DM: The effectiveness of video technology as an adjunct to teach and evaluate epidural anesthesia performance skills. ANESTHESIOLOGY 2002; 96:5-9; and Morgan PJ, Cleave-Hogg D, McLroy J, Devitt JM: Simulation technology: A comparison of experiential and visual learning for undergraduate medical students. ANESTHESIOLOGY 2002; 96:10-6.

Accepted for publication September 14, 2001. The author has long been involved in the development and application of patient simulation for a variety of purposes in anesthesiology and other healthcare domains. His laboratory reinvented mannequin-based patient simulation technology and developed the Anesthesia Crisis Resource Management course. The author has also benefited commercially from licensing simulation technology to CAE Link Corporation and, until recently, has received royalties on the sale of patient simulators by MedSim Eagle Simulation (the inheritor of the technology from CAE Link).

performing the task. Although it is a relatively simple act, successful placement of an epidural catheter is a crucial task in clinical domains, such as obstetric analgesia and anesthesia. Therefore, the results of the study by Birnbach *et al.*, though limited in scope, may be more relevant to clinical practice than those of Morgan *et al.*—although whether improvement of catheter placement skill through video analysis has practical outcome benefit for patients remains to be seen.

Another key lesson from both of these studies is that video can be a powerful teaching tool, especially when it is applied (as by Birnbach *et al.*) to specific performances of those under instruction. Nonetheless, in both studies, the use of videotapes was coupled with expert teaching by motivated faculty. This reinforces a common belief that modern technologies provide tools that can enhance, but not substitute for, skilled and dedicated teachers.

By comparison to other industries, such as aviation, in my view, the greatest promise for the use of simulators and other training modalities to impact patient safety lies not in the education of target populations of early learners regarding simplified tasks, but rather with initial and recurrent training of advanced trainees and experienced practitioners regarding much more complex tasks. For these challenging settings, tests that are easy to score unambiguously will rarely replicate or capture the demands of real patient care. Tests that do address the complexity of real care will suffer from higher subjectivity. Therefore, it will be more difficult to make assessments of the impact of novel training for complex real-world job skills. Any such studies are likely to be

expensive to conduct because of the high interindividual variability, the need for multiple experienced raters, and the imprecision of existing or proposed metrics of complex performance. Nonetheless, in a recent assessment of the evidence base for a variety of patient safety interventions sponsored by the Agency for Healthcare Research and Quality, the authors concluded the following regarding patient simulators³:

Definitive experiments to improve our understanding of their effects on training will allow them to be used more intelligently to improve provider performance, reduce errors and ultimately, promote patient safety. Although such experiments will be difficult and costly, they may be justified to determine how this technology can best be applied.

For simulation and for video analysis, the work of Morgan *et al.* and Birnbach *et al.* are only the beginning of a very long road.

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Anesthesiology and Geriatric Medicine

Mutual Needs and Opportunities

DURING the past few decades, much has been learned about the physiology and pharmacology of aging, including the way aging alters the response to drugs used during anesthesia. The literature generally supports the notion that older patients should receive lower doses of

opioids. Several rigorous pharmacokinetic–pharmacodynamic (PK–PD) modeling studies have shown that elderly subjects have increased sensitivity to opioids.^{1,2} This is partly due to changes in opioid disposition with aging (decreased clearance, decreased volumes of distribution), but the primary difference appears to be a true increase in pharmacodynamic sensitivity. This means that lower opioid concentrations are needed to produce the same effect in elderly patients. The article by Aubrun *et al.*³ in this issue of *ANESTHESIOLOGY* seems to be inconsistent with these PK–PD data. The authors conclude that treating postoperative pain by incrementally titrating a fixed morphine dose (2–3 mg every 5 min) is equally effective and safe for adults of all ages. This conclusion is valid, but not because old and young are

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equally opioid sensitive. We must be clear about what this trial has and has not shown.

Aubrun *et al.* have shown us a good way to provide postoperative analgesia. All patients had the same incremental dose of morphine, but it was titrated carefully using visual analog pain scales and frequent observation for side effects. The fact that no patient was hurt probably reflects the frequency of clinical assessments. It does not mean that all patients needed or tolerated the same treatment. In fact, there is good evidence that older patients were being treated differently. The study was unblinded, so all clinical decision makers knew whether they were treating older or younger patients. We do not know whether this affected intraoperative treatment (different premedication, lower doses of anesthetics, analgesics, and so forth), but we do know that postanesthesia care unit nurses waited 45 min longer to give morphine to older patients, and they kept the patients in postanesthesia care unit for observation nearly 2 h longer. If one considers all patients studied (as one should), the absolute morphine dose (in milligrams) was slightly but significantly lower in the elderly. The difference in total morphine dose only disappeared when a *post hoc* adjustment to milligrams per kilogram was made, but this is not how postanesthesia care unit nurses were actually dosing.

Even if the study had been blinded, the results might have been the same. In carefully controlled experimental situations, there can still be 5- to 10-fold individual variability in intraoperative⁴ and postoperative⁵ opioid requirements. In an unselected postoperative population such as that studied by Aubrun *et al.*, morphine dose could have been affected by numerous factors, including sex, duration of anesthesia, intraoperative analgesics, opioid tolerance, organ dysfunction, severity of pain, and so forth. This study did not control for sources of variability other than age and weight, and this makes it highly unlikely that any true age effect could be detected through the clinical "noise." Of course, that is exactly the point the authors are trying to make. Under normal clinical conditions, we can never adjust for all of these factors, so we titrate to effect. Creating an analgesic "recipe" that incorporates only one or two factors, such as age and weight, does not account for sufficient variability to make a meaningful difference in pain relief or side effects.

Despite these limitations, the results suggest that if care is taken, the incremental administration of morphine may not need to be radically modified for age. This novel observation could change our approach to the postoperative treatment of the elderly. Older patients are often treated empirically with less drug and may

therefore be undermedicated in the immediate (postanesthesia care unit) postoperative period. These results indicated that such undermedication is not warranted because of a fear of adverse events.

The importance of knowing how to manage the elderly patient safely cannot be ignored. The 2000 census figures affirm the predictions for growth in the population of older Americans.⁶ By 2050, there are expected to be 31 million citizens aged older than 80 yr. In just the past decade, those over 75 have gone from 5.3 to 6.1% of the US population. Given that the elderly have surgery four times more often than the rest of the population, anesthesiologists can look to the future and see a time when the majority of our patients will be aged older than 65 yr, and many will be older than 80 yr.

The implications of this change in demographics are enormous and require action now. Schneider made a plea in 1999 that scientists and granting agencies around the world commit resources to better understand the implication of aging on our future.⁷ For anesthesiologists, there is a pressing need to learn the differences and similarities between young and old as they relate to the entire continuum of the perioperative period. This is one reason a group of anesthesiologists started the Society for the Advancement of Geriatric Anesthesia last fall.* Research should take a broad, integrative approach *via* systematic clinical trials that test the hypothesis that age alters the physiologic and pharmacologic response of patients. The article by Aubrun *et al.* is an example of a useful, albeit isolated, investigation that needs companion studies looking at pain management throughout the hospital stay. Many postoperative complications, such as cognitive impairment, are directly related to age,⁸ and it is imperative that a carefully planned research program be crafted and presented to funding agencies so that complications and their mechanism are identified and methods to prevent them are tested.

Successful research by anesthesiologists will benefit practitioners of other concerned specialties if there is an effective mechanism to exchange the information. The perioperative care of the elderly has not been extensively examined from a multidisciplinary perspective. Furthermore, available knowledge has not been adequately disseminated. In recognition of these deficiencies, the American Geriatrics Society (AGS) has for several years now been bringing physicians of many specialties together to exchange information and provide ideas on how to correct these problems. The AGS has targeted 10 specialties: emergency medicine, anesthesiology, general surgery, gynecology, ophthalmology, orthopedic surgery, otolaryngology, thoracic surgery, urology, and physical medicine and rehabilitation. With funding from the Hartford Foundation, the AGS has encouraged each specialty to develop its own educational

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programs in geriatrics† and has supported symposia, faculty development for individuals and departments, and production of written materials.⁹ Our specialty has received money to support anesthesiology research through the Foundation for Anesthesia Education and Research, the biannual (1997–2001) Duke Conference on Surgery and the Elderly, and faculty development and resident education at the Universities of California-San Francisco (San Francisco, CA), Duke (Durham, NC), Pennsylvania (Philadelphia, PA), and Washington (Seattle, WA).

The AGS has also held meetings with an Interdisciplinary Leadership Group made up of geriatricians and representatives of the 10 specialties. The initial task was to define what must happen in organized medicine to provide good care for the elderly outside of internal medicine. Their conclusions were summarized in a Statement of Principles.‡¹⁰ The Statement enumerated a number of complications from hospitalization common to the elderly, including delirium, thromboembolism, adverse drug events, dehydration, infection, and inadequate pain management. The Statement set goals for the future, including increased geriatric education of medical students, residents, and practitioners, elimination of historical disinterest in geriatrics, better remuneration for the care of the elderly, and of course, more research.

The next phase of AGS-funded programs will create further opportunities for the various specialties to interact with one another and to expand their geriatric programs. The Interdisciplinary Leadership Group will expand in size and scope into the Executive Committee of the Section on Surgical and Related Medical Specialties of the AGS. Representatives from each specialty are currently reviewing the literature, from which a research agenda will be constructed by determining the most important issues common to the specialties. A significant opportunity to promote individual academic careers will be provided through the Jahnigen Career Development Awards (\$100,000 per year for 2 yr, five per cohort, so applicants from anesthesiology will also compete with those from the other specialties). Institutional grants of \$32,000 over 2 yr are available to enhance faculty development and resident education in the geriatric aspects of

the specialties. In the first round of these grants, 2 of the 15 awards went to anesthesiology programs (Johns Hopkins University [Baltimore, MD] and University of California-San Francisco). Other programs include the Geriatrics Syllabus for Specialists, discretionary grants of \$10,000 per year per specialty, and expansion of a clearinghouse and Web site for information regarding the aging aspects of the specialties. In short, the AGS encourages the involvement of anesthesiology and recognizes our specialty's scientific and clinical contributions to the care of the elderly. The future direction of these AGS initiatives is to devise strategies and test protocols to reduce specific complications common to the elderly. It is important that anesthesiologists seize the opportunities that lie ahead in research and education and join with the other specialties to make the future a safer place for our geriatric patients.

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