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The Journal of **THORACIC AND CARDIOVASCULAR SURGERY**

PRESIDENTIAL ADDRESS

THE INNOVATION IMPERATIVE

Delos M. Cosgrove, MD

For thoracic surgeons, this is the best of times and the worst of times. We are in the midst of an unprecedented economic boom that has been powered by the entrepreneurial dreams of millions. It has produced new products, new services, and a revolution in information technology. On the horizon looms a revolution in medicine through human genomics.

For thoracic surgeons, results have never been better. New technologies arrive almost daily to improve results. In the United States, more than \$55 billion is being invested in medical research. Yet, thoracic surgeons are feeling increasingly dejected and under siege. Accelerating health care costs have resulted in a reallocation of money away from surgical specialties. In 1987, Medicare allocated \$4000 for a three-vessel

bypass graft. This year, it is half that. Corrected for inflation, the purchasing power is \$900. Similar changes have affected general thoracic and congenital heart surgery.

The increasing number of practicing thoracic surgeons and techniques developed by colleagues in other specialties have increased competition. For example, in 4 years, the number of coronary artery stents increased from zero to one-half million last year. Could competition get more intense? You bet it could. Not long ago, an aorta-coronary bypass graft in a pig was performed with catheter technology—without incision. Should this technology prove effective, primary coronary artery bypass surgery could go the way of surgery for tuberculosis.

Adding to our mounting concerns is the realization that the esteem in which we are held is eroding. Evidence of this is the escalating number of malpractice cases forcing us into more defensive practices. Another is that the “best and the brightest” are no longer attracted to our specialty. In 1999, of the 16,000 US medical school graduates, fewer than 100 sought thoracic surgical residencies. That was not enough to fill the available positions.

How could this happen to a specialty that pioneered heart and lung transplantation, aorta-coronary bypass surgery, and repair of tetralogy of Fallot in newborn infants? All of these achievements are now more than

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15 years old. Somehow our pioneering spirit has been squelched. There are a number of possible explanations. Perhaps this was as natural and unavoidable as the "technology S curve." This concept emanates from the world of management. In the early stages of a given technology, such as myocardial revascularization, the rate of progress is slow as the advance goes through the process of winning adherents. This is the bottom of the S curve. As technology becomes well understood and widely used, the adoption rate accelerates. This is the middle of the S curve. As technology matures, improvements are less dramatic. The technology begins to bump against a growing number of limitations. This is the top of the S curve. In some enterprises, the pathfinders manage to overcome these natural forces of obsolescence. They do it by being alert to new technologies. They embrace these latest advances, try new concepts, and launch their enterprise on a new S curve. Where is coronary surgery on the first technology S curve? If it is at the top, should we consider what is necessary to move it to another breakthrough, another S curve? The next step could be beating heart or robotic assisted surgery.

It is my observation that our excitement with new technology has been replaced with suspicion. We have become slow adopters. We were quick to embrace coronary artery surgery in the early years. We were slow to adopt the use of the internal thoracic artery in later years. In 1975, an enormous amount of data demonstrated the superiority of this graft. We were slow to change. Thirteen years elapsed. Dr Floyd Loop's article in the *New England Journal of Medicine* (1986;314:1-6) was the impetus that spurred cardiologists to demand internal thoracic artery grafting for their patients. Surgeons were pressured into adopting it.

Why have thoracic surgeons become slow to adopt new technology and hesitant to innovate? One possibility is that we have become victims of our own success. Procedures have become low risk. Why would we change? Another possibility is that creative thinking is not one of our cultivated strengths. Medical schools require accumulation of a large amount of facts and the ability to accurately regurgitate this information. Residents are not encouraged to be creative but rather to be a younger copy of the best technical and intellectual surgeons. I remember being told and subsequently repeating to others, "No improvement, please. Today, we'll do it my way."

In addition, the pressure to reduce the costs of health care in the United States is tremendous. This situation has produced a paradigm shift. We have gone from

doing everything possible to weighing treatment cost versus potential benefit. In short, our success, education, society's expectations, and financial pressures have biased us against innovation. If we are to survive and prosper, we must cast off these shackles and free our innovative spirit. In 1862, with the Civil War fully engaged, Abraham Lincoln challenged Congress. "The dogmas of the quiet past," he said, "are inadequate for the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. . . . We must think anew and act anew." [December 1, 1862, message to Congress.]

We must think anew and act anew in clinical practice

Will thoracic surgery survive when the very operations we perform are being replaced by less invasive techniques practiced by other specialties? The answer is "yes" if we are *willing* to innovate and change. Charles Darwin wrote, "It is not the strongest of the species that survives, nor the most intelligent; it is the one that is most adaptable to change."

Our specialty has been and should be one of constant innovation. The first issue of *The Journal of Thoracic Surgery* in 1931 had not one reference to the heart. My, how things have changed. Not only has journal content changed, but so have the very diseases we treat. In my professional lifetime, rheumatic disease has become infrequent, only to be replaced by degenerative disease. Tuberculosis has become rare, replaced by carcinoma of the lung. Surgical procedures have changed. Mitral valves are now repaired instead of replaced. Palliative shunts for congenital heart disease have been replaced by complete repair in infancy. Yet, there are still huge clinical challenges and opportunities that require imagination and innovation. Albert Einstein said, "Imagination is more important than knowledge." It will take imagination and innovative surgical solutions to treat the 400,000 new cases of heart failure each year and the uncounted cases of respiratory insufficiency.

To accomplish this, we need to talk about the thing we fear the most—change. Historically, surgical therapy had been reserved for the most advanced diseases for which no other therapies were available. Gradually, these surgical therapies were replaced by medical and preventive solutions, as they should be. Change has never been more rapid. If the 1980s were about quality and the 1990s about reengineering, the 2000s will be about velocity. Most technology becomes obsolete in 5 to 7 years. Changes in clinical practice must be viewed as opportunity. We must accelerate our rate of change.

We must think anew and act anew in education

In the past quarter century, training of thoracic surgeons has changed little in length or format despite an explosion of knowledge. Standard textbooks have doubled in size and more surgical techniques need to be learned. Twenty-five years ago, the Norwood procedure, arterial grafting, and volume reduction surgery did not exist. Yet, we are expected to teach these new approaches and much more in a 2-year residency program. It is impossible to do this well with the best residents and the best teachers. Extending our training programs to 3 years would fulfill our obligation to our residents and society. It is time!

Practice patterns have evolved into the subspecialties of general thoracic, congenital, and acquired heart disease. It is increasingly rare to find thoracic surgeons practicing more than one subspecialty. Residents would benefit from exposure to all three subspecialties to obtain basic skills and then select one for intensive training. This approach would provide greater knowledge, experience, and technical expertise. It would shorten the apprenticeship that most trainees serve after completion of their residency. Most important, it would improve patient outcomes.

Postgraduate education has been, at best, haphazard. This poses a major problem for practitioners because of the quantity of new information. The total amount of information available doubles every 2½ years. More information has been created in the past 40 years than in the previous 5000. With this proliferation of new knowledge, how is the practitioner to keep up? Fortunately, the age of global telecommunication is now. Time and distance have been swept away. New knowledge can be disseminated directly to the practitioner. This very meeting marks a milestone in postgraduate education. It is the *first* major medical meeting to be *entirely* available over the Internet and archived for future reference. We have been joined by 1300 surgeons from 79 countries via the Internet. Today, we have become a global community of thoracic surgeons capable of sharing new knowledge instantaneously.

The Internet brings the potential to deliver didactic material and surgical techniques to surgeons by the experts. This would elevate the quality of teaching. Can you imagine one week having *Alain Carpentier* explain the techniques of mitral valve repair and *Joel Cooper* discussing volume reduction surgery and the next week hearing *Bruce Lytle* discuss arterial revascularization and *Mark Orringer* the topic of esophageal resection? Technologies are available to have these presentations interactive and archived. The possibilities are stunning and limited only by our imaginations.

We must think anew and act anew in research

At no time in human history has the potential been greater for translating biologic knowledge and technical capability into powerful tools for preventing and treating disease.

Clinical research is the scientific bottleneck through which all developments flow to patients. Landmark developments in basic science mean little if clinical researchers are unable to implement them. The viability of clinical research enterprise is in jeopardy. Funding for clinical research is becoming more difficult. Today's cost-conscious health care market has had a major impact on funding for clinical research. This impact has been negative.

At the same time, another change has occurred. Large animal physiologic studies, the traditional model for thoracic surgical research, have been highly productive. This model is perfectly suited to the surgeons' skills and for their training. Research, however, has been moving toward the province of molecular biologists, in which surgical skills are less applicable. There is certainly no shortage of scientists to perform basic research. Ninety percent of all scientists who ever lived are currently alive.

This convergence of change and need provides an enormous opportunity for surgical scientists. Increased emphasis on clinical and translational research will meet an unmet need. Learning the skills of clinical research and becoming facile with the use of the new information technology is a huge new opportunity. Would it not be more practical and productive to provide residents with these skills rather than basic research training?

Where is the funding for clinical research in thoracic surgery? In the United States, the government's contribution to the total research budget has diminished to less than 25%. Industry and venture capitalists have increased their contributions to 75% of the total research dollars. They have become the de Medicis of the information age. It is imperative that we forge mutually beneficial alliances between health care providers, industries, and venture capitalists.

We must think anew and act anew in health care delivery

The health care delivery debate is currently taking center stage. Pivotal is the realization that our ability to do good for individuals exceeds society's *current* willingness to pay. This simple reality lies behind every issue in health care today. It is not a comfortable situation. It is responsible for the dramatic change in attitude toward health care delivery. The time has come to

face this reality not as a menace, but as an opportunity. We, as leaders in the medical community, can influence this process.

Central to the debate about health care delivery is the question of quality *and* cost—the two determinants of value. The cost versus quality contest has always been lopsided in favor of cost because costs are easily measured in dollars. Quality is more subjective and much more difficult to measure.

Today, most proposals concentrate on cost-saving measures. Some see technology as the enemy because it raises cost. Adoption of new technology is delayed to avoid raising cost. Quality is ignored rather than measured. These are misguided approaches. Our goal should be to optimize value by simultaneously maximizing quality and reducing cost.

Eighty years ago, when this organization was founded, the average life expectancy was 54 years. Thoracic surgeons have contributed to extending life expectancy to 76 years. The *quality* of life has surged ahead. This is a result of the increasing use of services that drive up the total bill for health care. No one would turn back, and yet we have failed to emphasize these benefits in our discussions. We must help turn society's emphasis from cost to value.

In industry after industry, it is competition that drives continuous quality improvement and cost reduction through innovation. The Food and Drug Administration, Health Care Financing Administration, and multiple other agencies have regulated and stifled competition. Health care reform must reduce these regulations and build stronger incentives for medical and managerial innovation. Failure to promote innovation will lower quality and ration health care. Economist Elizabeth Teisberg wrote, "Innovation is the only long-term solution to high-quality, affordable health care."

Who will drive the innovations necessary to improve health care delivery? Who better than thoracic surgeons? You are natural leaders. You have risen to the top of the surgical pyramid. You head complex surgical teams. You are the chairs of depart-

ments and heads of hospitals and major health care systems. Your leadership extends into the halls of Congress. A number of you have sharpened your understanding of the health care delivery system by attending courses at the Kennedy School of Government. Through your work and interaction with multiple teams, you have learned the importance of collaboration. As Luciano DeCrescanzo describes so poignantly, "We are all angels with one wing; we can only fly while embracing one another." This type of collaboration will be necessary across a wide spectrum of health care and society.

You understand the techniques and importance of quantitative measurement of quality. Without this, we have no ability to measure, evaluate, or improve. Your creativity and innovativeness have been an inspiration to the medical world. Finally, you understand most acutely the pains and lessons taught by failure. You understand that failure is the handmaiden of risk and the father of innovation. Innovation requires people who are willing to take risks and face failure.

We are those people. So, let's resolve to renew the pioneering spirit that was our tradition. Let's look at changes in clinical practice as opportunities. Let's accelerate our rate of change. Let's extend our residency program to 3 years; let's emphasize and teach clinical and translational research; let's return to an appreciation of value, not just cost.

And so, let it be said of the first year of a new millennium, this was the time when thoracic surgeons recognized the imperative for innovation in clinical practice, in research, in education, and in health care delivery. This was the time we had the vision to *think anew* and the courage to *act anew*.

The world must know, from this hour, from this day, and from this hall, that thoracic surgeons step forth with a new sense of purpose, a new sense of possibility, and a new sense of dedication to the future of our specialty. I congratulate you on your accomplishments and wish you Godspeed in the challenges ahead.

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