The intensive care unit at Dartmouth-Hitchcock Medical Center celebrates its 50th anniversary this year. It was a pioneering concept back in 1955. And DHMC has remained a leader in critical-care medicine ever since.

By Laura Stephenson Carter

Total chaos. That’s how John Sibley, M.D., describes what taking care of critically ill hospital patients was like until the mid-1950s. Acutely ill patients would be scattered on different floors throughout the hospital. “One person waaaay over there, and another one waaaay over there, and another one waaaay over there,” he says. Sibley, who was a resident at Dartmouth in the 1950s and is now an assistant professor of community and family medicine emeritus, spreads his arms wide for emphasis.

“And you need an oxygen over there . . . and we need another one over here,” he continues. But
Laura Carter is the co-associate editor of Dartmouth Medicine magazine. Sadly, William Mosenthal, M.D., who established the MHMH intensive care unit in 1955, died in 2003—well before Carter began work on this feature. However, she was able to draw upon not only recollections from many colleagues who worked with Mosenthal, but also materials in Dartmouth’s Rauner Special Collections Library, including a taped interview with Mosenthal that was conducted in 1988 by the late Louis Matthews, M.D.

when a floor’s supply of oxygen canisters was exhausted, the staff had to scramble to get more. He acts out what such a scene would be like: "'Get it from the basement.' 'Yeah, but it will take half an hour, you know, because we have to [take] the elevator, and it's very, very slow.' It was crazy," Sibley says.

Not only did chaos prevail, but less seriously ill patients suffered if they had the misfortune of sharing a room or ward with someone who was really sick. They were understandably anxious, might have trouble sleeping, and could even be ignored by medical staff.

"The other bed in that room might be somebody whose blood pressure is around 60 over nothing and barely conscious, or semiconscious, or going out," recalls Sibley. "The nurses are running around and trying to get his blood pressure up and get oxygen and so forth. And then the [non-acute] patient says, 'Can I have an aspirin?' The doctor or nurse says, 'I haven't got time.'"

To make matters worse, the best-trained and most experienced nurses weren’t always the ones who tended to the sickest patients. Some nurses hadn’t been taught how to keep accurate intake and output records, do urine sampling, measure specific gravity and pH, cope with endotracheal tubes or respirators, or do a myriad of other things.

On the facing page: A painting (by Joseph Dwaihy, DMS ’06, and Sara Dykstra) based on a photograph of DHMC’s first intensive care unit, circa 1955. Top: Drs. Howard Corwin, Stephen Surgenor, David Glass, and Andrew Gettinger in today’s ICU. Above: Nurses and other staff who manage the unit.

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Everyone, that is, except for the late William Mosenthal, M.D., a surgeon at Mary Hitchcock Memorial Hospital. In the late 1940s, Mosenthal began thinking that there had to be a better way to manage the needs of acutely ill patients. By 1955, MHMH had one of the first intensive care units in the country.

Until recently, it was thought that Dartmouth's was the very first ICU in the nation, but it's become clear that there were varying definitions of what constituted an ICU in the early part of the 20th century. Johns Hopkins claims that it developed the first ICU in the world—a postoperative neurosurgical unit—in 1928. Massachusetts General Hospital in Boston established a burn ICU in 1942 to treat victims of the Coconut Grove nightclub fire. And many hospitals had polio wards in the '40s and '50s that some considered ICUs. However, Mosenthal's ICU may have been the first to concentrate nursing care and medical equipment in one place for critically ill surgical and medical patients.

The idea of concentrating nursing care for the seriously ill was even a century older. In 1854, Florence Nightingale wrote about the benefits of establishing a separate area of the hospital for patients recovering from surgery. From 1899 to the 1940s, American nurses treated people with yellow fever in isolated quarantine camps. And during World War II, shock wards were established to resuscitate and care for soldiers who had been injured or had undergone surgery.

Mosenthal's Dartmouth colleague, Arthur Naitove, M.D., now a professor of surgery emeritus, suspects the military may have been "what gave Bill the idea of the effectiveness of having a unit that concentrated on giving care to the acutely ill people who desperately needed good care and couldn't be left alone." Indeed, Mosenthal served in the U.S. Army from 1944 to 1946. But he himself said that it was during the latter part of his residency in general surgery at Roosevelt Hospital in New York, from 1946 to 1948, that he first gave serious consideration to the idea of intensive care.

"The concept of a special-care unit really germinated as far as I was concerned in my residency in New York, after the war," he said in a 1988 interview with the late Louis Matthews, M.D. "The war was a tremendous stimulus to advances in medical care. Antibiotics were coming in, and things like fluid, electrolyte, [and] acid-base balances were becoming more and more and more important. We were doing more and more pretty large-scale surgery." Soon, Roosevelt's surgeons began sequestering their sickest patients in a small four-bed room that each ward had. "We drifted into the habit of putting our very sick patients in there," Mosenthal said. When "we made our own rounds, we'd go in there first and spend the most time, instead of going from here over to there, down to the end, back over here."

In 1948, Mosenthal joined the faculty of DMS. Shortly after his arrival, he proposed the idea of a hospital-wide special care unit at a fourth-Monday clinical staff meeting. "The proposal was well received by many of the staff and provoked considerable discussion," Mosenthal wrote in a 1992 letter to neurosurgeon Ernest Sachs, M.D. "I remember that Dr. Bowler [a founder of the Hitchcock Clinic] encouraged me to proceed with the idea, but put action on the back burner. The need was not as acute then as it was soon to become. . . ."

"During the next several years, sophisticated and complicated advances in medicine and surgery, stimulated by the war experiences and by the increasing import of the MHMH as a referral center, resulted in a significant increase in clinical, administrative, and financial problems in the care of acutely ill patients," Mosenthal's 1992 letter con-
otential in acute-care techniques, potent new medications and machinery, lack of special interest in this difficult subspecialty by some nurses and physicians, etc. Of course the main concern was the increasing inability to provide the expert special care that these acutely ill patients required.

So Mosenthal again brought up the idea of an organized special care unit (SCU), as it was first known—this time in a meeting of the newly formed hospital patient-care committee, made up of medical staff, nurses, and administrators. The committee not only welcomed the idea but also helped Mosenthal develop a plan. “We worked out a program of special training for nurses; special forms; a standard operating procedure for anybody who was going to get into this unit; rules and regulations about who could admit, who couldn’t admit, who could discharge; other restrictions about not admitting moribund people; and minding the psyche of the nurses who were taking care of these people—not to have everybody in there die on them,” Mosenthal explained in the 1988 interview.

“The administration okayed” the establishment of the special care unit, said Mosenthal. “The absolute delight of working in a hospital like this was that when the doctors or clinical staff came up with something significant or important or obviously needed . . . they’d say, ‘Well, certainly, that sounds fine. If that’s what you want we’ll see if we can’t get it for you.’ And they always did.”

So in 1955, one ward was renovated into an 18-bed SCU—for both medical and surgical patients who were critically ill. In addition to its own nursing staff, the unit had its own supply of medications and equipment; piped-in oxygen and suction; wall-mounted blood pressure manometers; wall brackets for IV bottles; and sterile instrument sets to perform emergency tracheotomies (to relieve airway obstructions), vein cut-downs (to administer fluids or draw blood), thoracenteses (to remove fluid from the chest cavity), catheterizations, irrigations, or lumbar punctures. Equipment on the unit included laryngoscopes, intratracheal tubes (now called endotracheal tubes), an electrocardiograph, a resuscitator, and even a set of bed scales.

In 1957, Mosenthal published two journal articles—in Modern Hospital and the Journal of the Maine Medical Association—describing the special care unit. That year he also took an exhibit to the American College of Surgeons’ Clinical Congress in Atlantic City, N.J. “I thought if it’s good, people will benefit by seeing what we’d done [and] improve on it, adapt it to their own needs,” he said.

The exhibit included several sketches drawn by surgical resident Sibley, who was working in the special care unit at the time, as well as a three-dimensional model depicting two hospital-floor layouts at 3:00 a.m.: one with lights blazing and nurse figures running around everywhere, and another with an illuminated special care unit surrounded by darkened rooms where the other patients were sleeping undisturbed. “The interest was amazing,” said Mosenthal, who spent most of the conference sitting beside the exhibit and answering questions while Sibley attended the lectures. “They wanted to know everything about how it worked, nursing problems, how many nurses would you need in a place like this, what was the occupancy. It just came along at the right time. . . . It was right after that the whole thing kind of ballooned up—everybody had an ICU.”

Mosenthal gave presentations around the country, and by the late 1950s, according to the Society of Critical Care Medicine, about 25 percent of community hospitals with more than 300 beds had an ICU. A decade later, most hospitals in the United States had at least one. But the ICUs of the 1950s were not the high-tech units they are today. “It wasn’t intensive care the way we think of it now, with oodles of people circulating constantly and monitors going jing-jang,” says Naitove. He spent part of his residency working in the Hitchcock SCU, and his wife was a patient in the unit in 1961, after she was in a serious automobile accident. “It was really a place where people were aware they had somebody seriously ill and followed them as closely as they could,” says Naitove.

Anesthesiologist Andrew Gettinger, M.D., agrees. He was medical director of the ICU from 1987 to 1996 and says the 1955 unit was “not an intensive-care technology space” but was “about the nursing.”

To achieve round-the-clock staffing, Mosenthal’s unit had one head nurse, six staff nurses, five senior nursing students, two practical nurses, three aides, two orderlies, and one clerk. In fact, the emergence of ICUs stimulated the evolution of critical-care nursing. The American Association of Critical-Care Nurses was founded in 1969,
Early on, Glass arranged for DHMC to get a prototype of an Emerson high-frequency ventilator, which delivered air at many times the rate of other ventilators. Emerson also designed a timing device that allowed two ventilators to deliver air separately to the lungs of the same patient.
serting a tube through which the person could breathe. The tube could then be attached to a ventilator.

But tracheostomy tubes would fill with mucus and had to be suctioned out on a regular basis—sometimes as often as every 15 minutes. In pre-SCU days, nurses might be running from bedside to bedside, to patients in different rooms and on different floors of the hospital, to keep up with the suctioning. One of Sibley’s sketches used in the SCU exhibit depicted this challenge.

The precursors of today’s ventilators were the iron lungs used to sustain polio patents whose respiratory muscles were paralyzed. Iron lungs worked by negative pressure generated with a big bellows. “There was this horrible racket. It was like a vacuum cleaner running all the time,” recalls David Glass, M.D., chair of anesthesiology at Dartmouth and director of the ICU from 1977 to 1987. As a patient lay inside an iron lung, its negative pressure caused the chest to expand so air could enter the lungs. Then the chest collapsed, forcing air out of the lungs.

But there weren’t always enough iron lungs to go around. Physicians found that they could manually deliver air to a patient by squeezing an inflatable bag attached to a tracheostomy tube. “Actually, medical students were the primary ventilators through the big polio epidemics of Europe in the early part of the ‘50s,” says Glass. “They would take shifts, studying and so forth, . . . just ventilating patients” around the clock—sometimes 70 patients at a time. The concept of volume-controlled ventilation evolved from this practice. The first such device, developed in 1963, was driven by a piston and delivered a fixed amount of air with each breath.

The next advance was portable ventilators that didn’t require electricity. These were a great boon during the Vietnam War. “It was all done on pressurized gas and magnets,” explains Glass. While ever-better respirators and ventilators were great at helping patients breathe, they could create problems, too. First “it became apparent that if you started to ventilate people, . . . and didn’t provide humidity, that mucus would get really thick and they’d plug up and have complications,” Glass says. A further complication arose in the late ‘50s and early ‘60s as sicker people—with stiffer lungs—were ventilated. Pressurized air alone couldn’t force its way into stiff lungs, so ventilators had to be developed that would push the air in.

Boston-based entrepreneur John Emerson, who had improved on the iron lung design, invented an early volume-controlled ventilator. It looked like a green washing machine and used a system of valves and an old airplane piston to deliver precise volumes of air. “He added a humidifier, a little pressure cooker that put humidity in,” says Glass, who knew Emerson personally. “The whole thing was built out of a hardware store, literally.”

Early on, Glass arranged for DHMC to get a prototype of an Emerson high-frequency ventilator, which delivered air at many times the rate of other ventilators and was particularly beneficial for babies in the intensive-care nursery. Emerson also designed a timing device that allowed two ventilators to deliver air separately to the lungs of the same patient. Though some people considered Emerson “a little bubble off plumb,” recalls Glass, “he was a great innovator . . . a very bright and interesting guy.”

But even these improved ventilators could cause trouble. True, they saved lives, but sometimes survivors’ lungs would become permanently injured. “We’d have people survive their illness and then be pulmonary cripples basically—because their lung had healed, but it had healed in such scar tissue that they were debilitated for the rest of their life,” says Glass. “So that led to more research and different kinds of ventilators. Now they’re all electronic flow generators. . . . [We] keep the pressures down and humidify much more fancily. So we’re still able to keep people alive much longer, but we don’t have nearly the ventilator-induced trauma that was the product of the ‘70s and ‘80s when we were sort of learning.”

Mosenthal even introduced a few innovations back in the 1950s that seemed high-tech for the times. One was a mattress that would gently turn a patient. “It was a plastic mattress with two long, sausage-shaped compartments in it,” Mosenthal said in the 1988 interview. “There was a motor that was an old vacuum cleaner motor. There was an outlet for each of these tubes, and they’d blow up. . . . There was a timer on the motor and an automatic reversal. And you get some old patient who was a sitting duck for . . . postoperative pneumonia and death. In the old days, you used to get them up and make them turn over, bang ’em.” He clapped his hands for effect. But with the special mattress, as the “sausages” alternately inflated and deflated, the patient would be gently tilted back and forth. “I thought this was the greatest device known to man,” recalled Mosenthal.
A long with better equipment came improved techniques. The method for inserting catheters into the superior vena cava—one of the vessels that returns blood to the heart—was standardized in the 1970s. By the late 1980s, central venous lines—tubes put into a blood vessel in the neck and snaked down into the heart or vena cava—had become commonplace. Tubes were also used for feeding people who couldn’t eat. And transfusion therapy and dialysis became possible, too. “All those things improved and got better and better,” says Naitove.

In 1970, the Swan-Ganz catheter was developed. It had a small balloon at its tip which, when inflated, caused the blood flow to pull the catheter into the heart and then into the pulmonary artery. The catheter was connected to a monitor that provided a constant, direct readout of pulmonary blood flow, pressure, and cardiac output.

By the 1970s, the ICU environment had gotten so specialized that even Mosenthal realized the specialty was getting beyond him. “As it got bigger and bigger, and into the hands of the anesthesiologists and the intensivists, they began to know so much more about this stuff than I or anybody generally did, who hadn’t had special training, that you kinda get pushed out,” he said in the 1988 interview. He resigned from the ICU committee in 1970 after having chaired it since 1955.

When Glass arrived at DHMC as medical director of the ICU in 1977, he was the first faculty member trained in critical-care medicine. Until then “DHMC’s ICU was primarily a specialized nursing unit, as Mosenthal had developed it,” Glass explains. “In 1977, we introduced the concept” of staffing the ICU with physicians who had trained in critical-care medicine. This concept was so new, he adds, that it existed in “only a very few medical centers in this country.”

Glass had been inspired by one of the pioneers in critical-care medicine, Peter Safar, M.D., who in 1958 had begun a medical-surgical ICU at Johns Hopkins’s Baltimore City Hospital. In the 1960s, Safar moved on to the University of Pittsburgh, where he started the largest training program for critical-care specialists. Glass did his surgical internship there, met Safar, got hooked on critical-care medicine, and went on to Harvard’s Mass General Hospital for a residency in anesthesiology. There, he trained with a group that had started a respiratory-care unit and a surgical ICU in the mid-1960s. Then in 1972, he went to the University of Mississippi, where he helped to start a medical-surgical ICU in Jackson; he directed that unit from 1975 to 1977.

Soon after Glass arrived at DHMC, he started one of the first intensive-care fellowship programs in the country. It has since become one of the most sought-after fellowships in critical care.

Being led and staffed by critical-care specialists since 1977 puts DHMC’s ICU in the forefront nationally. In 2000, the Leapfrog Group determined that the best ICUs were those staffed by physicians with credentials in critical-care medicine. DHMC was Leapfrog compliant decades before Leapfrog existed.

He also recognized early on the importance of bed scales. “I remember when this ICU was being formed, there was no way to weigh a patient who was in bed,” Mosenthal said. He knew that maintaining fluid balance depends on many factors, including a patient’s weight, so he wanted to order an expensive forklift-like bed scale. “You put [the patient] in there,” he explained, “lifted him up, weighed him, and dropped him back.”

So Mosenthal went to Dr. Bowler, then president of the Clinic. “I said, ‘Bowler, we’ve got this special care unit set up here, which will not be effective until we can weigh patients who are in bed. Weigh them any time we want.’ I told him about these bed scales, costing about $1,500 . . . maybe more than that—the price of a car maybe—to be able to do this. He reflected a minute,” Mosenthal recalled, “and he said, ‘Well, I think we can handle that.’ We used it for years.”
A consortium of major businesses that is initiating improvements in the safety, quality, and affordability of health care for Americans—determined that the best ICUs were those staffed by physicians with credentials in critical-care medicine. DHMC’s ICU has been Leapfrog compliant since 1977, decades before the Leapfrog Group existed.

DHMC’s ICU was also unusual—perhaps even unique—in that it has always been multidisciplinary. “There were trauma ICUs and there were certainly burn ICUs and so forth,” Glass says. At many institutions, “this was a time of a fair amount of money, and unfortunately also was a time when fiefdoms were growing up in various medical disciplines.” So there was a tendency at other institutions for different departments to each have their own ICU. But gradually some institutions began to appreciate what DHMC had recognized all along—that multidisciplinary ICUs made the most sense, because “medicine patients when they were critically ill were really no different from surgical patients when they were critically ill,” as Glass puts it. Now everyone realizes “that concentrating physician and nurse resources for critically ill people is a much more efficient, cost effective, and ultimately better outcome-based environment.”

Although DHMC has since then created some specialty ICUs—including an intensive-care nursery, cardiothoracic units, and a pediatric intensive-care unit—its main ICU is still multidisciplinary.

It also became clear over the years that critically ill patients do better when they are cared for by collaborative teams of health-care providers, including not only physicians and nurses but also respiratory therapists, clinical pharmacologists, nutritionists, social workers, occupational therapists, and physical therapists. The team develops “a camaraderie and an ability to work together without turf battles and without pecking orders getting in the road—where a nurse can approach a physician and say, ‘This isn’t right,’” explains Glass. The collaborative team concept has “been the hallmark of effective ICUs for 25 or 30 years,” he adds.

“I would say that if Mosenthal founded the multidisciplinary ICU, Dave Glass . . . brought this ICU to national prominence,” says his colleague Andy Gettinger. To be sure, Glass has long been involved in national efforts to improve critical-care medicine. He participated in efforts to get critical-care medicine certified as a specialty. He was also one of two people who developed the original exam for certification in critical care for anesthesiologists. And, in the 1980s, he served on a national committee that considered combining training programs for anesthesiology and surgery.

Gettinger, too, has left a mark on history. When DHMC was preparing for the 1991 move from Hanover to the new Lebanon facility, Gettinger, then medical director of the ICU, seized the opportunity to improve the design of the ICU. He wanted to make it more efficient for staff and more comfortable for patients.

So now all patient rooms in the ICU have windows. Instrument panels in each room are built away from the walls so caregivers can approach patients from behind rather than having to reach over them. Each room has a dual-function glass door, which can both swing open and slide horizontally. The nursing stations are built on two-foot-high platforms, providing nurses with a downward view toward—and thus greater visibility of—patient rooms. And supplies are located right outside each nursing unit.

Patients in an ICU today are a lot sicker than ICU patients of the 1950s. Many patients are now cared for in step-down units that have advanced monitoring equipment but are elsewhere in the hospital. “We’re trying to very carefully manage what are increasingly limited resources and, at the same time, maintain a really high quality of care and keep our staff satisfied,” says Stephen Surgenor, M.D., the current medical director of the ICU.

Keeping staff satisfied was something Mosenthal paid attention to as well, back in the ’50s. He was careful to staff the unit with people who had certain characteristics. “Qualities required are vigorous aggressiveness, love of hard work, optimism, and accuracy in detail,” Mosenthal wrote in his 1957 journal articles. He was also concerned about staff morale and thought it a bad idea to put patients in the unit who had no chance of survival. “We did not want it to be a pre-cemetery roosting place,” he said in the 1988 interview. And Mosenthal knew it was important for staff to be aware of their successes. “In order to prevent discouragement and to promote job satisfaction, successful end results should be communicated to the Special Care Unit staff,” he wrote. Staff elsewhere in the hospital “often send a ‘graduate’ down to pay a visit to his ‘alma mater.’”

Surgenor says the same qualities are essential today. “I would add to that that it is not a banker’s-hours job. This is a job that requires continued on page 67
PARTNERS FOR LIFE

Gladyce

Throughout their 59-year marriage, Gladyce and Ward Amidon were a team. Together, they ran Amidon Jewelers in Hanover, N.H. Together, they enjoyed their free time. And together, they gave generously to DHMC.

When Ward was diagnosed with leukemia, the Amidons battled the disease together by supporting cancer research at DHMC. Now a widow, Gladyce has established a Charitable Gift Annuity to continue DHMC’s important work. In addition, she receives a guaranteed fixed income for life and a charitable tax deduction. They may no longer be together, but Gladyce and Ward are still very much a team.

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The Power of Partnership

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continuous care to provide patients what they need, when they need it.” And just as the 1950s staff enjoyed seeing their “graduates,” so do today’s staff. “There’s nothing better than having some of our patients who have . . . done well come back and visit us,” says Surgenor.

But the ICU’s ability to save lives in ways that were impossible 50 years ago has raised tough ethical questions. “The keys right now in my view are we can do a lot in terms of life-sustaining therapy—artificial kidneys, artificial ventilators, nutrition, cardiac support—you can go on and on about all the technology that’s available,” says Glass. “The big issue is . . . and will continue to be . . . just because we can do it, should we do it? And how do you decide who should get this very high-cost, very invasive intervention and identify those where comfort should be a more predominant feature? When I started in intensive care,” he adds, “there were no such things as living wills.”

Today’s ICU has “a very important relationship with the palliative-care program,” says Surgenor. The best thing in some situations, he explains—“if it’s what the patient wanted”—is to focus on comfort, on what’s important to that patient, on “a quality end-of-life experience.” The key goal, he says, is “compassionate and good pain control at the end of life. It feels good to know that we can do that right . . . and help families manage what is an untenable, unfixable problem.”

Ethical questions aside, what might the ICU of the future look like? “Well, I always thought Buck Rogers [had] the answer to that,” says Naitove, recalling the 20th-century science-fiction hero. “Buck would always be killed or broken or whatever. Dr. Huer would put him on a machine that would make a diagnosis of all the things that were wrong with him. Then he’d move him to another machine and push all the buttons that would make him correct. . . . [Buck] would come out the other end, all fixed up.”

Several centuries from now, Naitove says, maybe there will be “a special unit for reconstitution”: in goes the critically ill patient, on go an assortment of genetic repairs, out comes the patient, “all fixed up.”