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THE PIONEERS OF PREHOSPITAL CARE

PIONEERS, TRAILBLAZERS AND ICONS

The short history of EMS has been driven by the wisdom, foresight, and innovation of countless individuals. As the field ages into its second half-century and its origins fade to the past, it's worth commemorating the greatest pioneers of prehospital emergency medical services.

This supplement, a compilation of EMS World columns authored by Senior Editor John Erich, honors these trailblazers.

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PIONEERS OF RESUSCITATION

Paul Zoll

Pacing, defibrillation leader

Paul Maurice Zoll, born in 1911, was an American cardiologist and pioneer in the development of the artificial cardiac pacemaker and cardiac defibrillator. In 1980 he cofounded ZOLL Medical Corp., which remains a major provider of resuscitation and critical care solutions today.

After medical school Zoll served as an army physician during World War II, rising to chief of medicine at the 160th general hospital, which was designated for combat casualties with chest injuries. While successful heart surgery had been rare until that point, he and chest surgeon Dwight Harken removed bullets and shrapnel from in and around the hearts and great vessels of 138 soldiers without a fatality.

A presentation at a 1950 American College of Surgeons meeting prompted Zoll to develop a technique for pacing the heart through the intact chest during asystole. In a 1952 article he described cardiac resuscitation via electrodes on the bare chest, helping prompt resuscitation leaders to more widely embrace the concept of pacing. Subsequently Zoll described a mechanical technique for stimulating the asystolic heart and an approach to terminating v-fib with a large chest surface shock. With colleagues he also developed a way to display the heart's electrical activity on an oscilloscopic screen, paving the way for cardiac monitors.

In 1960 Zoll discovered external counter-shock could terminate supraventricular tachycardia and ventricular tachycardia. By 1964 he'd developed a method for long-term direct heart stimulation through an implanted pacemaker. The NTP 1000 temporary pacemaker that emerged from this research helped establish ZOLL Medical in the early '80s.

Zoll retired from practice in 1993 and died of pneumonia in 1999.



Paul Zoll's early experiments paved the way for cardiac monitors and implanted pacemakers.

William Kouwenhoven, Guy Knickerbocker, and James Jude

Developers of defibrillation, closed-chest massage

In the history of emergency resuscitation, EMS students well know the names of early pioneers like Pantridge and Safar. But their efforts were preceded by the even more foundational work of those who made the initial forays into electrical therapy and the chest manipulation techniques that helped lead to CPR. Coming together at Johns Hopkins in the mid-20th century, William Kouwenhoven, Guy Knickerbocker, and James Jude were among those key contributors.

Kouwenhoven started as a professor in the university's school of engineering in 1914 with an interest in the effects of electricity on the human body and cardiac arrest. As electricity spread across the U.S., line workers had begun dying of ventricular fibrillation, and Kouwenhoven wanted to develop an instrument that could restore dysrhythmic hearts without invasive surgery. A ConEd grant in 1925 led to research showing that low-voltage shocks to the heart could induce v-fib and high-voltage shocks could stop the heart and lungs completely. In canine research in 1933, Kouwenhoven found delivering a second surge of electricity could restore sinus rhythm.

By the 1950s he was working toward a closed-chest defibrillator and by 1957 produced a 200-pound prototype for humans that saved the life of a patient at Johns Hopkins. By 1961 it was down

to 45 pounds and fit in a small suitcase.

A student of Kouwenhoven's, Knickerbocker was working in 1958 to better operationalize the professor's cumbersome early device when a laboratory dog went into cardiac arrest. The defibrillator they needed was seven floors below, and Knickerbocker knew they couldn't retrieve it in time. A few weeks earlier, though, he'd discovered that applying the copper electrodes even without current caused a rise in blood pressure when they were pressed down onto a dog's chest. "We started to pump the dog's chest because it seemed to be the right thing to do," he told the BBC in 2015.¹

His colleagues compressed while Knickerbocker ran for the defibrillator. It took him 20 minutes to get back with it, at which time he shocked the dog twice—and resuscitated it. "We had found a way to slow down the dying process and give people time to receive defibrillation," he told the BBC.

Jude was a cardiac surgeon who worked in the lab next door. When he learned of Knickerbocker's discovery, he began investigating where to push, how often, and how hard. Ultimately research showed compressions could simulate up to 40% of normal cardiac activity and extend a dog's life by more than an hour, but skepticism persisted about the approach's efficacy on humans.

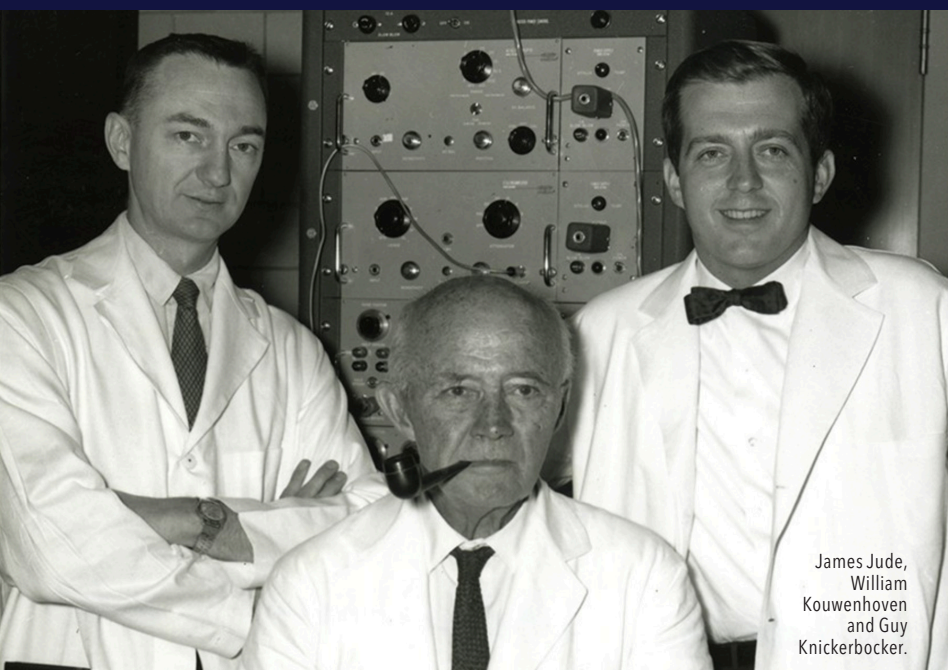
Then a year later, a 35-year-old woman at Johns Hopkins for gallbladder surgery had an unexpected cardiac arrest after anesthesia. Jude began chest compressions, and within two minutes her heart restarted. She then went on to a successful operation and full recovery.

With that save, Kouwenhoven, Jude, and Knickerbocker published their discovery in a landmark 1960 JAMA paper, "Closed-Chest Cardiac Massage."²

"Anyone, anywhere, can now initiate cardiac resuscitative procedures," they concluded. "All that is needed are two hands."

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James Jude,
William
Kouwenhoven
and Guy
Knickerbocker.

PIONEERS OF OPERATIONS & TRANSPORT

Dominique Jean Larrey *“Ambulances volantes”*



Larrey adapted horse-drawn artillery carriages to move combat casualties in the 1790s.

trained crews of drivers, corporals, and litter-bearers and tried it at the 1793 Battle of Metz, and the idea's success led to its adoption throughout the French army. Larrey also improved access to French field hospitals, bringing surgical capacity closer to the front, and established the idea of triage by severity rather than rank.

He became surgeon-in-chief of the Napoleonic armies in Italy in 1797 and gained acclaim as an expert on wound management and limb amputation. He served Napoleon through 25 campaigns, 60 battles, and 400 engagements. His continuing medical exploits included the first successful pericardiocentesis for trauma, ligation of the femoral artery below Poupart's ligament, identifying the diaphragmatic defect known as Larrey's cleft, using positive-pressure breathing to treat chest wounds, and using snow and ice for anesthesia before and after amputation.

At Waterloo in 1815 Larrey's courage under fire led the Duke of Wellington to order his men not to fire in Larrey's direction, but rather to “give the brave man time to gather up the wounded.” Captured by the Prussians, he escaped execution when he was recognized by a German surgeon who convinced field marshal Gebhard von Blücher—whose son Larrey had earlier saved upon his wounding and capture by the French—to spare Larrey's life. von Blücher instead hosted Larrey as an honored guest and sent him home with money and new clothes.

Larrey lived until 1842, writing, teaching, and serving as chief surgeon of the French army.

Dominique Jean Larrey (1766–1842) has been described as the “father of military surgery” and is credited with conceiving the first ambulances to evacuate wounded soldiers from fields of battle, the pioneering ambulances volantes of revolutionary France.

Raised by a surgeon uncle after the early death of his parents, Larrey saw his own medical studies interrupted by war. His landmark contribution came in the 1790s, when he realized the carriages of France's horsedrawn “flying artillery” could be adapted to move casualties from combat. He staffed them with

Walter Schaefer

Air-medical pioneer

Walter Schaefer, a German immigrant who'd worked as an undertaker, founded the California ambulance service that later bore his name as Hollywood Ambulance in 1932 and went on to achieve a number of firsts in American EMS. Schaefer Ambulance, as it was ultimately known, was the first U.S. service to provide critical care transportation and fielded the first FAA-certified air ambulance service in the United States.



Schaefer Ambulance served citizens in six Southern California counties (Los Angeles, Orange, Ventura, San Bernardino, San Diego, and Imperial) and lasted more than eight decades before ceasing operations in 2019. Schaefer

himself "took pride in being an industry leader... [and] believed in sharing his vision and knowledge with others," the company notes on its website. He was the founding president of both the California Ambulance Association in 1948 and the American Ambulance Association in 1979.

Hollywood Ambulance started with a single six-year-old vehicle but by its peak it grew to 100 ambulances and was run by Schaefer's children after his death in 1986.

The first documented use of an air ambulance was during the Prussian siege of Paris in 1870, and planes took over by 1917, but medevac capabilities didn't come to American civilians until after World War II. The provincial government of Saskatchewan, Canada, launched a service in Regina the year before Schaefer started in the U.S. Paramedicine hadn't been developed yet, however, meaning that unless a patient were accompanied by a physician or nurse, such early flights were transportation only.

Today in the U.S., helicopters and air-planes perform an estimated half-million transports per year.



Schaefer Ambulance fielded the first FAA-certified air ambulance service in the United States. Photos: Schaefer Ambulance



James Warren *Columbus Heartmobile*

James V. Warren was a prominent cardiologist and chair of medicine for almost two decades at Ohio State University. During his tenure in the 1960s he led creation of an early “Heartmobile” that delivered mobile coronary care in Columbus.

Warren began talking about the issue with his local fire department as early as 1966. A coalition to drive the idea forward ultimately involved the Central Ohio Chapter of the American Heart Association, the Ohio Regional Medical Program, the Advanced Coronary Treatment Foundation, and local industrialist Dave Ellies. It came to fruition in 1969 when the Heartmobile program began as a joint effort between Columbus Fire and the OSU Medical Center. It was the first vehicle of

its kind in the United States.

The 25-foot Heartmobile was outfitted with ER equipment and resided in the “heart shack,” a small temporary building adjacent to the OSU Medical Center ED. When cardiac calls came in, physicians were paged and responded from the hospital’s coronary care unit. A doctor would accompany three off-duty firefighters into the field.

Studies of mortality validated the truck’s benefit, and by 1971 Warren came to believe physicians were no longer needed. That year Columbus Fire took things over, leading to the development of paramedics in the state.

The Heartmobile was retired in 1973 in favor of more traditional vans, and Warren died in 1990.



The vehicle was outfitted with ER equipment and kept in the “heart shack.”

Jan Schwettman, Stanley Zydlo

Northwest Community EMS System

In October 1971 Ohio physician James Warren appeared on NBC's Today to promote his Heartmobile concept and the paramedics operating it. Among the viewers that morning was Illinois housewife Janet Schwettman. Schwettman had lost a neighbor to a heart attack just two months earlier and was galvanized to improve care for others like him.

Schwettman began researching the subject and meeting with experts. A hospital executive suggested a regional approach, and by January 1972 Chicago newspaper editorials were promoting the mobile coronary care concept across area communities. Support and donations began to roll in.

Schwettman allied with Stanley Zydlo,

an emergency doc at Chicago's Northwest Community Hospital who was similarly galvanized about the issue. She contacted half a dozen area fire departments and presented to boards representing a quarter million residents. The idea was favorably received everywhere, with some providing quick authorization and funding.

Schwettman went to Northwest in January '72 and won the support of its president for what would ultimately be a full mobile intensive care unit. Zydlo persuaded skeptical physicians, and the program was formally announced in March, with Zydlo as director of training. Within days more than 200 people from 17 communities committed. Training began in April, and other

hospitals were recruited to join Northwest.

Schwettman's persistence then helped push through authorizing legislation for paramedics in Illinois. The Northwest Community EMS system ultimately went live by the end of 1972, the first in Illinois and the nation's first multicommunity program.



Zydlo persuaded skeptical physicians.



Janet Schwettman allied with Stanley Zydlo, both of whom were galvanized about the issue of saving lives from cardiac arrest.

Edward B. Dalton

Military, civilian ambulance innovator

Born to a family of doctors in 1834, Edward Dalton was an American physician who served in the Civil War before going on to create the first ambulance service in New York City.

After graduating from New York's College of Physicians and Surgeons and interning at Bellevue Hospital, Dalton enlisted with the Union Army at the war's outset and ended up in charge of the Army of the Potomac's field hospitals, overseeing the treatment of thousands of casualties. Largely victims of gunshot wounds and fractures, these patients were moved roughly from the front via stretchers, carts, and wagons, often being hurt further in transit. In response Dalton developed a military ambulance with a roof and suspension system to better absorb shocks. It became standard throughout the Army.

After the war, at the recommendation of general and future president Ulysses S. Grant, Dalton was named head of New York City's new Metropolitan Sanitary District and, amid a cholera epidemic, asked to create a civilian version of his ambulance operation. This launched in 1869, delivering patients to Bellevue.

The initial vehicles were a pair of horse-drawn coaches equipped, per a History Magazine profile of Bellevue (www.history-magazine.com/bellevue.html), with "a quart flask of brandy, two tourniquets, a half-dozen bandages, a half-dozen small sponges, some splint material, pieces of old blankets for padding, strips of various lengths with buckles, and a two-ounce vial of persulphate of iron." These accommodated two patients lying or eight sitting. Inside they had rolling beds that slid in and out on iron tracks, as well as auxiliary stretchers on rollers. A bell connected to a foot pedal served as a siren.

Dalton used a pair of Bellevue doctors as full-time ambulance surgeons. He wanted to fill out crews with rotating classes of new graduates of Bellevue's surgical pro-

gram, but according to Ryan Bell's *The Ambulance: A History*, they resisted both the schedule (12-hour shifts with one day off every four weeks) and salary (\$50 a month). Instead the service used residents in training, who were simply assigned (and by 1935 were still making \$50 a month).

Dalton's ambulances were used extensively during the Orange Riots of 1870–71, and in 1870 his service answered 1,401 emergency calls. Based on the Bellevue program's success, Brooklyn, then its own city, launched municipal ambulance services at its Long Island College Hospital and Eastern District Hospital in 1873, and others quickly followed.

Dispatch in New York's burgeoning system was built on telegraphic communications between the police and hospitals and fire department signal boxes located throughout the city. Street cops initiated calls through their headquarters that were forwarded to the nearest ambulance hospital. Alarms via the signal boxes went simultaneously to all participating hospitals' surgeons, drivers, and gatekeepers. The horses that drew the ambulances were initially kept in harnesses while waiting for calls, but that gave way to a system that lowered the tack from a pulley on the ceiling. The horses could be ready in 30 seconds.



Dalton's ambulances were used extensively during the Orange Riots of 1870–71, and in 1870 his service answered 1,401 emergency calls.

Edward Dalton was asked to create a civilian version of his military ambulance operation.



New York City's system did not represent the first civilian ambulance service in America—that began in Cincinnati in 1865. The Commercial Hospital of Cincinnati (now the University of Cincinnati Medical Center) developed it under the auspices of another war surgeon, Dr. Roberts Bartholow. Its driver was James Jackson.

PIONEERS OF ADVOCACY AND EDUCATION

Drew Dawson

State, national EMS leader

Born in Boulder, Mont., Drew Dawson rose from a volunteer EMT to director of the Boulder Volunteer Ambulance Service and ultimately Montana state EMS training coordinator and then director, a position he held for more than 20 years.

In 2003 he moved into a national role at the National Highway Traffic Safety Administration (NHTSA), leading its Office of EMS and overseeing the development and implementation of its programs and activities. There he helped establish both the National EMS Advisory Council (NEMSAC), a stakeholder group to advise federal

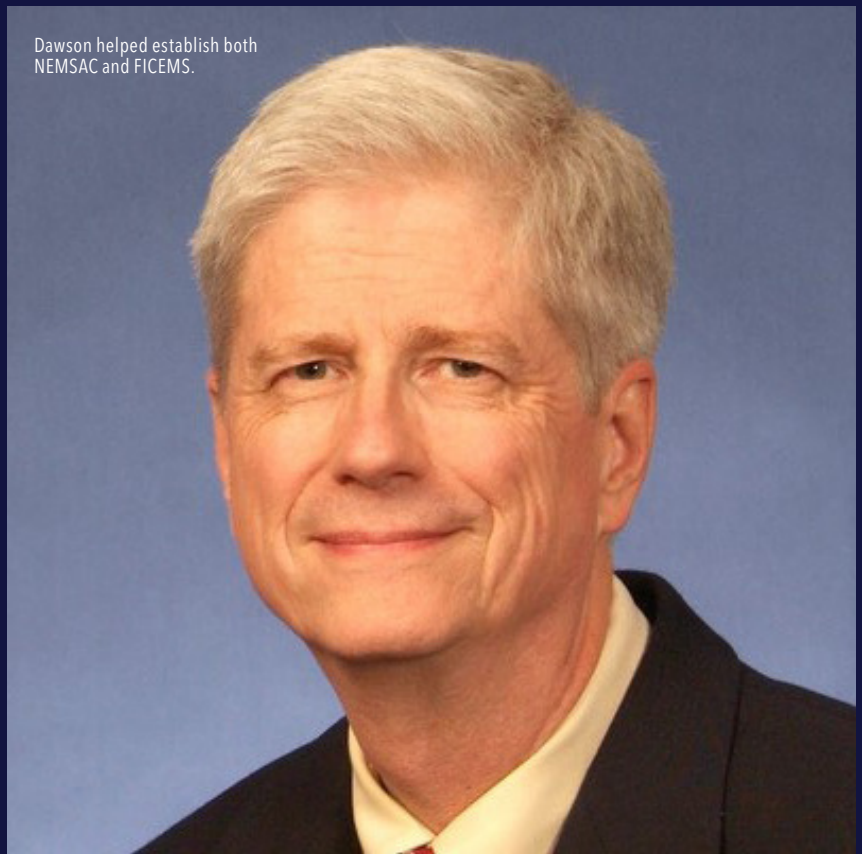
policy, and the Federal Interagency Committee on Emergency Services (FICEMS), the coordinating body among federal agencies involved in EMS.

Dawson served in this role for 12 years before returning to Montana. Back in Boulder he has remained involved both locally, as chair of the Boulder Transition Advisory Council and a member of the city council, and on the national EMS scene, where he's served as interim executive director of the NREMT.

He has served as president of the National Association of State EMS Directors (Officials) and chair of the NREMT's

board. His awards include the NAEMT's/NREMT's Rocco V. Morando Award for Lifetime Achievement in EMS; an Outstanding Contribution in Emergency Medical Services award from ACEP; an Eagles Award from the International Association of EMS Chiefs; the American Academy of Pediatrics' Meritorious Contributions to the Health and Well Being of Children, Youth and Families; an NREMT Special Recognition; the NAEMSP's Ronald D. Stewart Award for Outstanding Contributions to Prehospital Emergency Care; and the National Association of EMS Educators' Lifetime Achievement Award.

Dawson helped establish both NEMSAC and FICEMS.



After returning to Montana, he remained active locally and nationally.

Walt Stoy, PhD, EMT-P, CCEMT-P

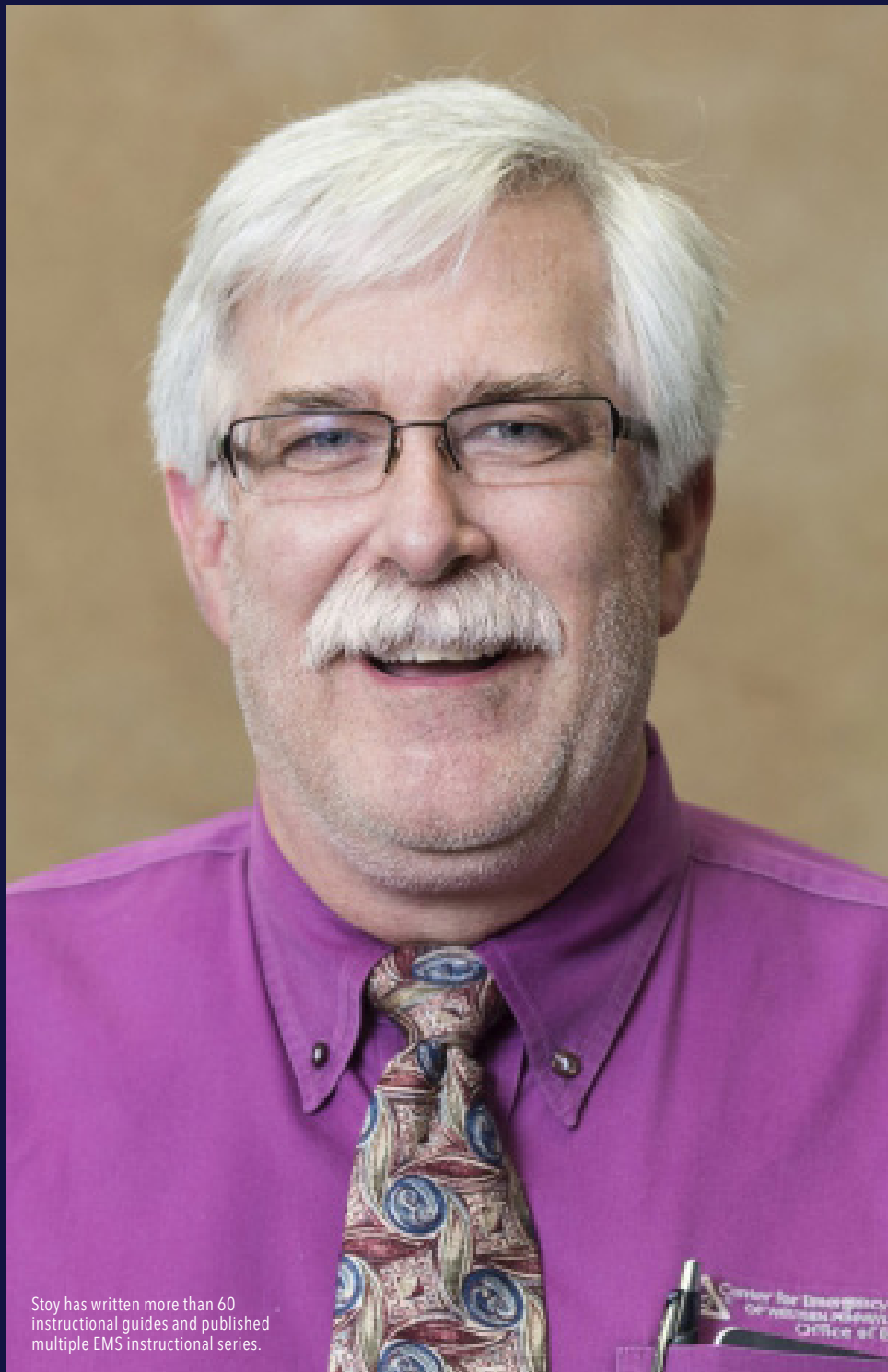
EMS education leader

Walt Stoy, PhD, EMT-P, CCEMT-P, is a professor and director of emergency medicine at the University of Pittsburgh's School of Health and Rehabilitation Sciences and the director of educational and international emergency medicine at the Center for Emergency Medicine. He is globally recognized for his work in the field of EMS education, which has included key roles in developing the EMS National Standard Curricula and serving as the founding president of the National Association of EMS Educators.

Stoy came to the CEM and started teaching EMS and emergency medicine at Pitt in 1981. Around that time he attended his first meeting of what would ultimately grow into the Committee on Accreditation of Educational Programs for the Emergency Medical Services Professions (CoAEMSP). Stoy ultimately became a reader and site visitor for CoAEMSP.

He served as project director for the 1998 EMT-Intermediate and EMT-Paramedic NSC revisions and was principal investigator for both the national guidelines for first aid training curriculum and 1994 EMT-B update. He was also project director for the 1995 First Responder revision. In the 2000s he oversaw the four levels of EMS patient assessment sections in the National EMS Education Standards.

Stoy has written more than 60 instructional guides and published work that includes instructional guides for multiple EMS instructional series. He has authored Mosby's EMT-Basic and first responder textbooks and is an instructor or affiliate faculty in ACLS, BTLS, and PALS. He has received lifetime achievement awards from both NAEMSE and NAEMT, as well as the James O. Page EMS Leadership Award.



Stoy has written more than 60 instructional guides and published multiple EMS instructional series.

PIONEERS OF DISEASE PREVENTION

Onesimus, Edward Jenner *Smallpox vaccine*

Considered eradicated since 1980, smallpox was once one of the most frightening, deadly, and disfiguring diseases out there. A vaccine can prevent it, but it has no cure, and advances in synthetic biology mean it's a continuing bioterrorism threat.

The roots of the smallpox vaccine trace to the early 1700s, when an African named Onesimus had the pus of a smallpox victim rubbed into an open wound to help stave off the disease. At the time this was a common practice in various places around the globe. But Onesimus was later enslaved and brought to Boston, where he shared the practice with his owner, Puritan minister Cotton Mather. Mather became a staunch supporter and advocate of the practice, called variolation, during a smallpox outbreak in 1721. It is believed to have saved many Bostonians.

Variolation became common in Europe during the 1700s. There English physician Edward Jenner observed that dairy workers who'd had cowpox—an animal virus not fatal to humans—also seemed resistant to smallpox infection. In 1796 he swabbed material from a milkmaid's cowpox sore onto an 8-year-old boy, James Phipps. Phipps became ill for several days but then recovered. Two months later Jenner exposed him to pus from a smallpox sore, and Phipps did not become infected. Jenner coined the term vaccination from the Latin *vacca*, for cow.

The most successful vaccine in history, the smallpox vaccine was given routinely to U.S. children until 1972, when the disease was eradicated in the U.S.



Edward Jenner observed that dairy workers exposed to cowpox seemed resistant to smallpox, helping develop the concept of a vaccine.

Jonas Salk, Albert Sabin

Polio vaccine

Unlike smallpox, which requires direct and generally prolonged face-to-face contact to spread, polio is highly contagious. The CDC recommends a series of four vaccinations for children, who face its greatest threat. The U.S. eradicated polio four decades ago, but it persists in other parts of the world.

By the 1950s polio outbreaks were causing more than 15,000 cases of paralysis a year. U.S. virologist Jonas Salk had studied the disease since the '40s, and he came to believe a vaccine made from dead virus material, rather than live, as was the previous practice, could be just as effective

and possibly safer. He developed a way to deactivate the virus with formaldehyde that still triggered the immune system to produce antibodies against it. Salk tested his invention on his family before its approval in 1955. Subsequently he chose not to patent or profit from it in order to maximize its global distribution.

A competitor to Salk, Polish-American physician Albert Sabin developed an oral polio vaccine by 1961. This was a live-virus vaccine that used weakened poliovirus. It was easier to produce and administer, as well as cheaper, and quickly came into broad use.

Following introduction of the vaccines, polio cases in the U.S. declined to less than 100 in the 1960s and fewer than 10 in the 1970s. Less than 25 years after Salk's vaccine, its domestic transmission in the U.S. was eliminated. Globally cases have fallen from around 350,000 in 1988, when the Global Polio Eradication Initiative began, to the elimination of serotypes 2 and 3 in the last six years. The last evidence of wild poliovirus type 1 transmission was in Africa in 2018, and five of six World Health Organization regions are now certified polio-free.



Jonas Salk chose not to patent or profit from his polio vaccine in order to maximize its global distribution.



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