For decades, Pitt has been an "intellectual engine" for prehospital care, starting with CPR and the first highly trained paramedics.
Paul Paris (MD ’76), a University of Pittsburgh professor of emergency medicine and the ERMI Professor of Healthcare Quality, has spent much of his career studying prehospital emergency care. But he remembers the pre-EMS (emergency medical service) era all too well. In 1972, when he was a medical student at Pitt, a police paddy wagon was called to transport his gravely ill mother to the hospital. At the time, no citywide EMS existed in Pittsburgh. American ambulances then often carried little more than first aid supplies anyway.

Things soon changed. Prehospital care began to take shape. Ambulances began to deliver care as well as deliver patients. Cities founded ambulance services. Many of these advances were sparked here, under the guidance and scrutiny of Pitt researchers.

Just the idea that rescuers should follow a protocol, for example, was preached early by Pitt luminary, the late Peter Safar, MD Distinguished Professor of Resuscitation Medicine. In addition to co-inventing and then advocating for CPR, Safar developed the resuscitation ABCs (airway, breathing, circulation) in the late 1950s. The mnemonic has, in various forms, been the foundation of emergency care ever since.

National standards were born here, too. After a 1966 white paper decried the dismal survival rates for auto and other accidents in this country—trauma victims had a better chance on the battlefield—the nation began to standardize prehospital care. It was Safar and critical care fellow-turned-faculty member the late Nancy Caroline, an MD, who developed a curriculum for paramedics here in the 1970s. She also authored the nation’s first textbook for paramedics, which was published in 1979. Her Emergency Care in the Streets is now in its seventh edition.

After many an ambulance ride-along, Caroline knew what she was talking about. Between 1967 and 1975, Pittsburgh hosted one of the country’s first professional...
ambulance services offering advanced care. Cofounded by Safar with the Falk Foundation’s Phil Hallen, Freedom House Ambulance Service was staffed by African American emergency medicine technicians; they were among the nation’s first to be trained to a high standard. Caroline served for a year as its director and frequently joined the paramedics, who served African American neighborhoods (that had been barely served previously) and other parts of the city, as well. When the City of Pittsburgh set up its own EMS program in the 1970s, Pitt’s future founding chief of the Division of Emergency Medicine, Ronald Stewart, an MD, signed on as the city’s medical director. (Stewart, who is from Nova Scotia, experienced baptism by fire in EMS with LA County’s progressive program, of which he was the founding medical director.) Many EMS program leaders throughout the nation cut their teeth here, notes Paris.

The U.S. Department of Transportation adopted Caroline’s curriculum for Freedom House in 1977, and recently called it “the foundation for all prehospital advanced life support education today.” National curricula, guidelines, and textbooks for first responders continue to come from the efforts of Pitt people, notably the University’s Walt Stoy, a paramedic and PhD professor and director of emergency medicine in the School of Health and Rehabilitation Sciences.

*Prehospital Emergency Care*, edited since its 1997 founding by Pitt’s James Menegazzi, a PhD, was the first peer-reviewed EMS journal. By 2010, EMS had gained enough scientific backing to become an official subspecialty of the American Board of Medical Specialties. Much of that backing came from Pitt faculty. Pitt has been an “intellectual engine” for many EMS advancements, notes Donald Yealy, an MD and chair of the School of Medicine’s Department of Emergency Medicine. In some cases, Pitt people invented an idea that caught on; in others, they studied and spearheaded ideas born elsewhere. But every American EMS crew today does what it does in large part because of Pitt.

### A ROUTE BROUGHT TO YOU

**AMBULANCES THAT WORKED**

When Pittsburgh antipoverty activists teamed up with Pitt’s Peter Safar to create the Freedom House Ambulance Service, they didn’t skimp on training. Its African American paramedics may have been the country’s most skilled, using ECGs and airway equipment at a time when many ambulances carried only first aid supplies or less. Word of their competence got around. (Eventually, police officers would call Freedom House for their own family members in need, instead of calling the police.) The U.S. Department of Transportation has noted that Freedom House technicians were “pioneers in the field of EMS.” (The service’s director Nancy Caroline would later be nicknamed the “Mother Teresa of Israel,” after leaving Pitt in the ‘70s to build a prehospital program in that country.) A recently placed historical marker on Centre Avenue honors the Freedom House team.

To read more of Freedom House’s extraordinary story, see tinyurl.com/freedomh2004.

**OXYGEN NATION**

The gentle press of a pulse oximeter on a patient’s earlobe or fingertip tells paramedics whether a patient’s hemoglobin is saturated with oxygen or whether it’s time to, say, secure a path to the lungs or give oxygen. Pitt researchers studied and adopted the measurement of this “fifth vital sign” in prehospital care ahead of many other centers, pointing out in a 1989 study of its use in air medical transport that the oximeter was often the only sign the patient was desaturating to life-threateningly low levels of oxygen. Around the same time, pulse ox monitors were becoming commonplace in hospitals. More prehospital studies followed, and the devices are now ubiquitous in medevac helicopters and ambulances.

**EARLY AIRWAY ACCESS**

Sometimes the best way to make air enter the lungs is to place a breathing tube. Teaching paramedics how
was a far-out idea when Pitt researchers began doing so in the '70s, a time when anesthesiologists weren't sure they liked the idea of even emergency medicine physicians encroaching on what was traditionally their territory. But Ronald Stewart's 1984 study in *Chest* showed a more than 94 percent success rate in cardiac arrest or comatose patients in the field. These days, most cardiopulmonary arrest patients in the United States receive a prehospital breathing tube. Yet Pitt has continued to revisit the wisdom of the practice. In the 2000s, Henry Wang, an MD, then an emergency medicine faculty member at Pitt, pointed out that some medics go years between intubations. Studying field intubations, he found they can interrupt CPR, replace less risky options like noninvasive positive airway pressure masks, and fail all too often. Wang's colleagues, including Pitt's Clifton Callaway, an MD (Res '96), and Jestin Carlson, an MD (Res '10, Fel '12), have been monitoring field intubations with video to help determine what works and what doesn't. “This and other research,” says Paul Paris, “has helped define the best tools and indications for airway management.”

**D LIGHTING THE WAY**

Intubation is tricky: You're apt to push the tube down the esophagus instead of the trachea. Ronald Stewart, Paul Paris, and others did the first study of the use of a lighted stylet—that is, a light pushed into the tube itself—for prehospital intubations. They used a surgical light that Stewart shrink-wrapped to keep the bulb from falling into the patient's lungs. In the late '80s, an updated version of the stylet, then found in many paramedic toolkits, captured interest and spurred other airway innovations.

**E ABCs & CPR**

After publishing a 1958 landmark paper on mouth-to-mouth ventilation, Peter Safar combined that expertise with Johns Hopkins colleagues' findings on chest compressions to develop the ABCs (airway, breathing, and circulation) of resuscitation, the now-iconic system for CPR training. With Norwegian anesthesiologist Bjorn Lind and toymaker Asmund Laerdal, Safar helped create the CPR mannequin Resusci Anne in 1960. (For more of the story behind Anne, see p. 40.) As founding chair of Pitt's Department of Anesthesiology in the 1960s and '70s, Safar advocated so strongly for CPR that he earned the nickname the “father of CPR.” In 1979, he founded what is now called the Safar Center for Resuscitation Research at Pitt.

To read more about Peter Safar’s monumental contributions: tinyurl.com/Safar-Oct99

**F CPR QUALITY**

The right compression depth, full chest recoil, proper speed, and no interruptions: It's not enough just to give CPR; you've got to do it right. Sloppy CPR can doom a patient. Following two studies that warned of poor-quality CPR in American hospitals and Norwegian EMS units, Pitt researchers like Clifton Callaway and James Menegazzi began to study the issue. CPR is much less effective, they found, if defibrillation is involved, if rescuers pause after shocking the heart, or if they're doing it on a moving stretcher instead of the floor. Thanks to insights like these, as well as improved hospital care, survival rates to discharge for prehospital cardiac arrest care have more than doubled in Pittsburgh since the late '90s, from about 6 percent to 15 percent. The nationwide Resuscitation Outcomes Consortium reports similar trends in the past 10 years. That translates to tens of thousands of lives saved a year, notes Paul Paris.
SKIPPED A BEAT
Paroxysmal supraventricular tachycardia (PSVT) is a speedy heart rhythm that can sometimes keep the heart from having enough time to fill. To treat dangerous bouts, providers can use a drug called adenosine, which “pauses” the heart briefly. The provider pushes it in fast, eyeing the monitor. The heart flatlines, and the patient experiences what is commonly described as a kick in the chest or a feeling of doom. When the drug wears off a few seconds later, a normal beat often resumes. Brows are wiped. Pitt was the first center to study adenosine for PSVT in the prehospital setting. Now it’s part of standard Advanced Cardiac Life Support protocol and the Pitt-authored paramedic National Standard Curriculum.

STICKER SHOCK
A pacemaker can save a life in cardiac arrest brought on by a slow heart rate, but it doesn’t have to be the implanted kind. Shocks to the surface of the chest can pace the heart, too, if the electrodes are stuck on soon after the deadly rhythm begins. In a series of studies in the late ’80s, Pitt’s Paul Paris and Ronald Stewart did early investigations of transcutaneous pacing (which uses external pads) in the field. The researchers also subjected brave resident volunteers to the procedure, including Vincent Mosesso Jr. (MD ’88, Res ’91), who is now a professor of emergency medicine and medical director for prehospital care at UPMC. The City of Pittsburgh’s EMS system adopted transcutaneous pacing in 1993.

FUZZ BUZZ
In an era when automatic defibrillators are in every mall, it’s worth remembering that there was a time when only health care workers were trusted with them. But police often arrive before paramedics at the scene of an emergency. So in the early ’90s, Vincent Mosesso Jr. organized a pilot program for police—one of the first two groups to do so nationwide. The studies found that when police did arrive before EMS and shock patients, the patients were 10 times more likely to survive to hospital discharge than those shocked when EMS arrived. Today, about three-quarters of the country’s state police agencies train officers to operate defibrillators.

DEFIB FOR LAYPEOPLE
On his birthday in 2001, a Washington, D.C., lawyer named Richard Brown was jumping rope at the gym when he collapsed in cardiac arrest. Trainers leapt to perform CPR, then defibrillated him and restored a normal rhythm. The very automated external defibrillator (AED) that saved Brown’s life was one he himself had urged the gym to get just weeks earlier after a friend had collapsed and died there. Brown is now executive director of the Sudden Cardiac Arrest Association, a patient-led advocacy group originating from Pitt.

COMFORT ZONE
While pain management in ambulances still isn’t adequate—recent studies found astonishingly high rates of untreated pain from broken limbs—EMS crews do have good options. For decades, Pitt people have been evaluat-
Of 11,920 calls throughout nearly three years, there were 30 in-flight deaths and three early landings for childbirth. The program is also a world leader in aeromedicine research. For example, its crew was among the first to test the feasibility of video laryngoscopy for inserting breathing tubes during air transport. And STAT MedEvac can test trauma patients for a spike in lactic acid, which can happen when you’re bleeding internally and means you’re more likely to require emergency surgery or blood products. (They can give you the blood right there on board and are studying the best way to do this, too.) Their research findings on point-of-care lactate have since been replicated by the Resuscitation Outcomes Consortium. “It’s really dramatic what they are doing in the small, hectic environment of a flying helicopter now,” notes Paul Paris.

If you’re struck by sudden chest pain at 35,000 feet, there’s a good chance Pitt docs will get involved. UPMC’s STAT-MD Commercial Airline Consultation Services is one of only two such centers in the nation, handling hundreds of calls from commercial flights every month. In a 2013 New England Journal of Medicine article, Pitt emergency medicine physicians Donald Yealy (Res ’88, Fel ’89), who chairs Pitt’s department, and Christian Martin-Gill (Res ’08, Fel ’10) reported that most commercial-flight emergencies involve syncope (fainting), breathing problems, or vomiting, and that a doctor was available to help in about half of all cases. Of 11,920 calls throughout nearly three years, there were 30 in-flight deaths and three early landings for childbirth.

Twenty years ago, Pitt’s Peter Winter, an MD who was then chair of anesthesiology, created a simulation facility for Pitt med students and hospital providers to practice procedures on responsive mannequins rather than real patients. Since then, Pitt faculty members have advocated for paramedics to administer other analgesics, notably fentanyl. Perhaps most importantly, as textbook authors and national leaders on prehospital pain management, Pitt docs encourage EMS personnel to take people’s need for relief seriously.
A PEEK AT HOW PREHOSPITAL CARE MAY BE CHANGING

CUFF 'EM
For heart attacks, limiting the size of the damage to cardiac muscle is a key goal of care. Remote ischemic conditioning is a simple way to trick the body into a smaller heart attack by inflating and deflating a blood pressure cuff. Invented in Europe, the procedure was recently tested for the first time in medevac helicopters by Christian Martin-Gill and colleagues, who found it useful and effective enough to study further at Pitt's Applied Physiology Lab. It might not be long before paramedics put the squeeze on prehospital heart-attack care.

FEEDBACK LOOP
Did we mention that CPR quality matters? It really, really does. Yet the rescuer often doesn't know moment by moment whether her efforts are actually helping. With a recent $1.8 million grant from the National Heart, Lung, and Blood Institute, James Menegazzi and colleagues are building a powerful database of electrocardiograms (ECGs) that researchers can digitally analyze in order to track how ECG changes during CPR correlate to patient survival. The aim is to give better real-time feedback during CPR and, of course, save more lives.

BACK TO BASICS
Compressions with or without interruptions for breaths? In 2008 the American Heart Association advised untrained bystanders attempting CPR to stick with compressions alone, because it's simpler. "But it hasn't been tested (to see) whether it's better for patients," notes Clifton Callaway. The Resuscitation Outcomes Consortium, which includes Pitt, is pursuing a study comparing both techniques head-to-head (or chest-to-chest, as it were).

ROUGH RIDERS
Oddly enough, emergency physicians seldom spend much time in ambulances. But at Pitt, emergency medicine residents go on EMS runs in their very own vehicle. The tradition started after Ronald Stewart and Paul Paris jumped in their own cars to respond to emergencies. Paris recalls the "silly magnetic light that I would throw on the top of my normal Buick." In 1982, the second year of the residency's existence, he and his colleagues fixed up a vehicle for residents to use in order to respond to certain emergencies, like cardiac arrests. Pitt remains probably the only residency in the country with its own emergency vehicle. (Residents now do these runs in a hospital Jeep instead of Paris's purple Skylark.) As they attempt to save lives in homes, streets, and alleys, Pitt emergency medicine docs get schooled by paramedics on the realities of prehospital care. "Paramedics are so used to the crazy environment and how to get things done," Paris says. Pitt's Allan Wolfson, an MD professor of emergency medicine and vice chair of graduate education, adds, "It's definitely a favorite rotation."