

Houston Setting the Standard for Emergency Care

By La’Nora Jefferson, James Thornock, and Paulina De Paz

A year before the City of Houston implemented its ambulance program, a nonprofit volunteer ambulance service went to the Houston home of a five-year-old girl only to find her dead on arrival. Earlier in the day after giving the child cursory care for asthma, the staff at a local hospital sent her home, advising the family to take her to Ben Taub Hospital since they did not have insurance or money to pay for her care. The family asked friends for help but could not find transportation, private or public, to get to Ben Taub, and they did not know who else to call. Once the child’s grandmother finally located help, it was too late to save the little girl.¹

When Houston began its ambulance program on April 10, 1971, it became a trailblazer in emergency medical services, responding to the 1966 recommendations of the Committee of Trauma and Committee on Shock in the Division of Medical Sciences of the National Academy of Sciences National Research Council (NAS). However, not all of the NAS suggestions could be implemented immediately in Houston or other cities, such as the nationwide 9-1-1 system. In addition, the Harris County Medical Society (HCMS) remained unhappy with the “negligible survival rate” for out-of-hospital cardiac arrest cases, which exceeded 1,000 annually in Houston in the early 1980s.² More had to be done; and today, Houston Fire Department Emergency Medical Services (HFD EMS) Assistant Chief David Almaguer points out, bringing cardiac arrest patients back to life is the hallmark of the department.³

In 1973 the federal government passed the Emergency Medical Service Systems Act that outlined fifteen essential components for EMS programs, but medical direction was not among them. Thus by the 1980s HCMS contended that Houston EMS lacked a key element that would enable the department to save more lives: “intensive accountable physician supervision.” Prior to this revelation, different specialists who served on an emergency care policy committee provided medical guidance. Emergency department physicians who rotated shifts at a local county hospital directed patient management following written medical protocols that they transmitted via radio. Few of those physicians had experience in prehospital care or emergency medicine.⁴

In 1983 members of the Harris County Medical Society, the Texas Medical Association, and numerous academic medical institutions helped enact a new state law that required all Texas paramedic programs to designate an “accountable physician director, who [is] not only familiar with the prehospital management of critical emergencies, but also responsible for the actual capabilities of each and every individual prehospital care provider.” Hence every certified EMT and paramedic in Texas operates directly under the physician director’s license for that city or county entity. This gives the physician director a degree of autonomy but also holds him or her “responsible for all medical aspects of prehospital patient care,” including the actions of the men and women in the field. Different states require different levels of accountability for physician directors, with Texas



Dr. Paul Pepe, right, was Houston’s first Physician Director for EMS. His protocols revolutionized emergency treatment in Houston. Paramedic Tom McDonald, now a retired Senior Captain, is standing at left. Photo courtesy of Tom McDonald.



This patient is receiving Continuous Positive Airway Pressure (CPAP) for severe difficulty breathing due to congestive heart failure (CHF), which causes fluid to back up in the lungs. The patient is also on a heart monitor that can transmit rhythms electronically to the receiving hospital before the patient arrives, which can expedite treatment. Photo courtesy of Diana Rodriguez.

being the only state that holds them personally responsible for the actions of all EMTs and paramedics, necessitating physician directors have greater disciplinary and instructive powers. They approve the level of prehospital care on patients as well as monitor and establish compliance with field performance guidelines and training performance.⁵

Fortunately, Houston has always had well-qualified, experienced directors. The city's first physician director, Dr. Paul Pepe, came from Seattle, Washington, where he studied under Dr. Michael Copass, a pioneer in modern emergency medicine. Pepe served the City of Houston as physician director from 1983 until 1996. Former EMS Assistant Chief Michael Ivy said that Pepe was a "key individual to bringing the [Houston] EMS system into the advanced stages" and that he literally wrote the manual on care.⁶

Pepe stressed that medical care must begin in the field and led research that revolutionized cardiac care resuscitation, making the paramedic program significantly more effective. Pepe developed resuscitation protocols and constantly updated the Houston EMS procedures based on his research and by monitoring the effectiveness of the methods. Pepe emphasized proper training as well. Retired Captain Frank Mettlach explains that Pepe called paramedics out of service and worked with them until "two, three, four in the morning" to test on cardiac arrest resuscitation and certify the number of paramedics needed in a city the size of Houston.⁷

The key to taking care of cardiac arrest patients, according to Pepe's research, was early defibrillation, in which an electric shock is administered to restore the heart's natural rhythm. Mettlach recalls that early in his paramedic career, EMS used heavy defibrillators in a big orange box, like those created by Telecare for NASA.⁸ Standard procedures re-

quired that paramedics ask for a radio channel to transmit vital signs and get permission from a physician to shock a patient, then go back to the vehicle to get the device, set the repeater, and, lastly, administer the shock. When Mettlach dealt with his first cardiac arrest patient, he set up the channel without permission in his haste to revive the patient, a doctor's wife. The doctor yelled at Mettlach to get away from his wife, but after shocking her twice, Mettlach and his fellow paramedics were able to restore her heart rhythm, stabilize her, and get her to the hospital. As the EMS team was leaving the hospital, the doctor apologized, admitting that Mettlach had saved his wife's life but, at the time, he believed Mettlach lacked the medical knowledge to properly treat her.⁹

When making presentations Pepe often said the department had no cardiac arrest resuscitations before his arrival, at which time Mettlach playfully cleared his throat, reminding him that Mettlach had saved two people, including the doctor's wife, before Houston had a physician director. Despite his early successes, Mettlach admits that he was just lucky and confirms that following Pepe's protocols enabled him to resuscitate about 200 more people during his twenty-nine-year tenure.¹⁰

Thanks to the efforts of Pepe and the department, Houston EMS moved to the forefront of emergency care research and development because it had the resources and a high volume of calls, giving the department a large data set from which to measure trends. "Your statistics are what you are," former Assistant Chief Ivy notes, in explaining why he monitored the department's data every week. In addition, he communicated what he learned from Pepe about the protocols in laymen's terms, saying, if he could "firemenize" them, "then they would work."¹¹

This 80-vehicle wreck on Beltway 8 at Main Street occurred on December 28, 2002, as a result of foggy conditions.

Photo courtesy of Tom McDonald.



Houston's current physician director, Dr. David Perse, first served as a paramedic and paramedic instructor in Buffalo, New York, before attending medical school. On the day in 1993 that Perse interviewed with Pepe to become a fellow with Houston EMS, a mentally ill man walked into a police station and shot a police officer in the face. In less than an hour, EMS transported him to Ben Taub Hospital and he underwent surgery. The speedy response of EMS and its communication network with the trauma center and neurosurgeons impressed Perse. Although he had considered jobs in other cities, he saw "something unique about the way that they [were] doing things in Houston," and he wanted to be a part of that. Perse received a Physio-Control Fellowship from the National Association of EMS Physicians and became an assistant physician director of Houston EMS under Pepe in 1993. After completing the fellowship, he served as physician director of the Los Angeles County Paramedic Training Institute and Los Angeles County EMS. In the fall of 1996 after a national search in response to Pepe's resignation, Perse was selected to succeed him as EMS Physician Director. Grateful for the opportunity to return to Houston, Perse now has 3,800 EMTs and paramedics practicing under his license, and he continues to approach this position with passion and vigor.¹²

Another important focus of emergency medicine is public health. In May of 2004, then Mayor Bill White asked Perse to assume the role of Public Health Authority, making him the first person to serve in that position and EMS Physician Director simultaneously. In the public health role Perse is responsible for "medical aspects of clinical care quality management, disease control, and public health prepared-

ness." The law mandates that diseases be reported to the public health office, which includes the offices of surveillance and public health preparedness. Epidemiologists work with the Public Health Department, handling information on disease outbreaks, such as Ebola, flu, and Zika. Perse must be watchful of diseases and trends, such as the recent popularity of synthetic recreational drugs, in addition to educating HFD members, who are sometimes the first line of care for patients, and the community to help them understand the health risks.¹³

The Public Health Authority also handles disaster preparedness, which includes responding to flooding, natural disasters, chemical emergencies, terrorist attacks, and coordinating with neighboring communities. In 2001 Tropical Storm Allison produced the largest urban flood in U.S. history before that time. Allison displaced a quarter-million residents from 100,000 homes and shut down several hospitals in the Texas Medical Center for months. Houston EMS played a critical role in evacuating hospitals to facilities unaffected by the flood, including one set up in the Astro Arena by Brooke Army Medical Center of San Antonio, which was the first time a U.S. military hospital was deployed for civilian casualties in the continental United States. Perse served as Houston's incident commander, conducting meetings with representatives from all the hospitals. The lessons learned from this experience enabled city leaders like Mayor White and Dr. Perse to mount an organized response when 250,000 people displaced by Hurricane Katrina in New Orleans evacuated to Houston in 2005 (See *Houston History*, Summer 2010).¹⁴

After Hurricane Katrina hit, HFD EMS served as a medical safety net for any emergency medical situations, attending first to elderly patients evacuated by plane to Ellington Air Force Base and then to people who arrived at the Astrodome by bus. The city and county opened the



Astrodome, Reliant Center and Hall, and the George R. Brown Convention Center to house people. The Public Health Department built a foundation to control disease there, while Harris Health, Baylor College of Medicine, and the University of Texas Medical Branch created facilities akin to mobile army surgical hospitals (MASH) at various sites accommodating evacuees. Of course EMS still had to respond to the needs of Houstonians, who continued to have their own medical emergencies. With the population of Houston increased by ten percent upon the survivors' arrival in Houston, the system and staff were stretched, but EMS placed extra units in service to successfully answer the call.¹⁵



Sr. Capt. Isabel Sky-Eagle and Capt. Tony Harrison take part in one of the many HFD EMS tabletop exercises to plan how networks will work in an emergency. Photo courtesy of Diana Rodriguez.

To address unplanned events, HFD, EMS, and Houston Emergency Management prepare and conduct emergency training exercises, performed at three levels: planning, tabletop, and functional. In the planning phase city leaders address worst case scenarios to stress the system in order to determine its strengths and weaknesses, understand what resources are available, and how they can respond. During the EMS tabletop exercises planners imagine what will and will not work in a hypothetical emergency situation. By helping EMS know its resources, the exercises show how people act and react, who takes on what roles, and if procedures are done correctly or at all. Lastly, HFD EMS conducts functional exercises to demonstrate how well it uses a certain set of resources. The department completes multiple functional drills until it reaches a full scale evaluation during which everything is put to the test, stressing the system to the maximum. As Perse points out, referring to U.S. General Dwight Eisenhower's strategic philosophy, "The plan is nothing, the planning is everything." Things may not go as planned in an emergency but without the planning the efforts will fail.¹⁶

Houston EMS can handle more than one might think. The region has approximately forty hospitals inside the city limits and forty-five outside. In the case of a mass emergency, Perse reports HFD can distribute about 250 patients without

asking hospitals if they can accommodate them; EMS only needs to communicate that ambulances are on their way. In the case of a natural disaster, each hospital will get a certain number of red tag patients in the most critical condition, less critical yellow tag patients, and green tag patients with minor ailments. The large number of area hospitals enables EMS to distribute patients in small numbers to each. Hospitals cannot reject patients during an emergency, but to avoid overwhelming them, EMS distributes patients in waves to give hospitals time to initiate their emergency plans.¹⁷

Although having a physician director has enabled Houston EMS to improve its patient care greatly over the last four decades, other variables also played a role in Houston setting the standard for emergency care, such as the department's recruitment, training, and technology.

As one of the first U.S. cities to implement emergency medical services, Houston also led the way in diversity among its EMTs and paramedics. When the city initially asked firefighters to volunteer, a large number of African American firefighters stepped forward, including Glen Morris and Otis Owens, who answered the first EMS call. African Americans faced adversity when first admitted to HFD in 1955 after the city annexed the predominately black community of Clinton Park and accepted its volunteer firefighters working out of what then became Station 46. Their inclusion in EMS offered a more positive atmosphere than in other careers. As retired paramedic Junior Captain Richard Sadler observed, "We all had the same blood," so color did not matter.¹⁸

While true within the department, Morris was warned that some patients may have a problem with him treating them. Nevertheless, he never experienced any major problems as a result of race; instead he recalled most of the negativity came from firefighters who wanted to be separate from EMTs. The department has seen a number of firsts in hiring. Linda Honeycutt became the first woman to join the Houston Fire Department, receiving her EMT training in 1975 and five months later joining the members at Station 9. In 1982 Arands L. Madison became the first African American female firefighter/EMT. Today HFD prides



Captain Howard Shaw (left), Paramedic EMS Supervisor, started with HFD in 1971 and has forty-five years of service to date. His son, Delance Shaw (right), an EMS Supervisor, followed in his father's footsteps joining HFD in 1994. Photo courtesy of Diana Rodriguez.



Cardiac arrests take up to twelve HFD personnel to do CPR and advanced life support. Photo courtesy of Diana Rodriguez.

itself on its efforts to increase diversity. The department is approximately 21 percent Hispanic, 17 percent African American, just over one percent Asian American, and three percent women.¹⁹

It remains a common myth that firefighters only fight fires and HFD is working to encourage Houston's diverse student population to consider careers in the department. In 2013 the Human Resources Department Client Relations Classified Recruiters and HFD created C.A.S.E.Y. Fire Ops, which stands for "cultivate, advise, support, empower youth," to encourage high school students to enter HFD careers. Currently twenty-four schools within the city limits take part. Participants in the one-day camp engage in simulations of the basic skills required of a Houston firefighter with "Intro to Firefighting and Emergency Medical Services (EMS)." They wear firefighter's turnout gear, receive hands-on experience in patient assessment, mechanical aids to breathing, obtaining vital signs, bandaging/splinting, spinal immobilization, adult CPR, use of automated external defibrillator (AED), and mass casualty/triage.²⁰ HFD also has summer programs that encourage young girls to become firefighters. For students who choose to enter the department, seven regional schools offer Basic Firefighter Certification and the Texas Health Services EMT Basic Certification, as all new firefighters are EMTs.

Today when people have an emergency they call 9-1-1. It's a number even preschoolers can recite, but that has not always been the case. Chief Almaguer remembers firefighters visiting his school and telling the children to dial the words "Cap a dad" if they needed assistance. This gave the students an easy way to remember the local number, 227-2323. Nevertheless, following the recommendation of the NAS, a simpler nationwide number for all emergencies, 9-1-1, was adopted, with Harris County implementing it in January of 1986. It incorporated every computerized feature available at the time. In 1988 the HFD yearbook reported, "9-1-1 is the first system of this nature in the state of Texas serving 2.8 million people." Operators answered residents' calls in their own jurisdiction. The citizen's telephone number and address appeared on a computer screen, enabling the

operator to respond quickly and route the call to the HFD dispatch center, which had staff members trained to use the "computer-assisted-dispatch (CAD) capability."²¹

The 9-1-1 system significantly reduced emergency response time. Early on dispatchers found locations manually on a Rolodex card file and then used a map to locate the station closest to the incident to determine who to send. With the computerized system, the dispatcher typed in the incident address and the computer indicated which station should answer the call. The system could be pre-programmed to determine who responded to what type of call. For example, a paramedic squad, medic unit, or a basic EMT ambulance could be deployed. The system also allowed for pre-arrival instructions.²²

Under current protocol when a 9-1-1 call is received at the Houston Emergency Center (HEC), the operator begins with, "9-1-1. What is your emergency?" and connects the caller to the appropriate emergency department. Another operator asks additional questions to determine the measure of the emergency and send the appropriate help. For the callers it may be the worst day of their lives and the questions may seem unnecessary, but the answers to those questions enable the calltaker and the computer to locate the closest HFD unit to assist the patient. For example, a patient reporting a stomach ache will receive an ambulance. If no ambulance is available nearby, then the closest fire truck, fully staffed with EMTs, will respond. According to protocol, if the patient is unconscious a paramedic will be called immediately. Further, before EMS arrives on the scene, dispatchers can give callers instructions, such as how to administer CPR or assist in childbirth, to maximize positive outcomes. When the dispatcher lacks enough information to determine what kind of help or apparatus is needed, two of the closest EMTs are sent to the scene for extra evaluation before calling for more help. Following this tiered response helps HEC send the most specific personnel and equipment needed to conserve the department's resources in the event of simultaneous emergencies. This is critical given



HFD Dispatch was located at Preston and Bagby before moving to the Houston Emergency Center (HEC) in 2003.

Photo courtesy of the Houston Fire Department.



The ETHAN project has reduced non-emergency transports, saving ambulances for serious emergencies and saving money for the city.
Photo courtesy of the Houston Fire Department.

that less than half of the people who call for an ambulance actually need to be transported.²³

In 2015 HFD received approximately 290,000 calls with 270,000 of those requiring a medical response rather than fire, Chief Almaguer reports. The increasing volume of calls creates a financial and operational burden for the fire department. This sharply contrasts with the 1970s, when they received 15,000 to 20,000 calls and were required to assist non-emergency patients.²⁴

The department receives many calls that may not require transport by ambulance. In response the City of Houston has implemented a first-of-its-kind program, ETHAN, or Emergency Tele-Health + Navigation. The program uses video technology to allow patients to speak with a physician, reassuring patients that they are receiving the proper care. ETHAN physicians help EMTs evaluate the needs of people who dial 9-1-1 but do not necessarily have a medical emergency requiring a trip to the emergency room, now referred to as emergency department (ED). If a primary care physician or clinic can treat the patient, the ETHAN doctor makes the appointment on the spot and arranges city-paid transportation by cab, thereby conserving HFD and city resources. If the patient still wants to go to the ED, the ETHAN doctor has the authority to insist they go by cab or find another ride because they will not be transported via ambulance. During the first year, out of the 55,000-56,000 ETHAN contacts, 82 percent of them did not use the ambulance service.²⁵ By reducing the number of non-emergency transports, EMS ambulances get back in service faster. ETHAN also provides a follow-up home visit to ensure the patient is keeping up with doctor appointments, helping to maintain chronic illnesses and prevent future unnecessary 9-1-1 calls.²⁶

Training the community about calling for help and critical bystander actions such as CPR, Chief Almaguer explains, also improves survival rates. The “Chain of Survival” for cardiac arrest includes the community on the first level, followed by EMS and hospitals. Even after a patient leaves the hospital, people need to be aware that prevention and follow-up care are also important to avoid a repeat incident and how to respond should that occur.²⁷

HFD EMS is a leader in technology and innovation, in part because it continuously reviews its methods to provide the most effective treatment. Emergency medicine is difficult to research, and Persse points out that physicians conduct few studies on emergency medicine because emergencies cannot be observed in a controlled environment. As a result, mistakes have been made in the field, but two critical changes to protocol were made based on research done in Houston in the late 1980s and early 1990s. One lesson related to EMTs’ treatment of patients suffering from blood loss due to injury. Initially paramedics inserted two large IVs into the patient and pumped as much fluid into them as possible to raise their blood pressure. Dr. Kenneth Mattox and Dr. Bill Bickell began to ask, “If we are raising the pressure and they are bleeding internally, isn’t that causing them to bleed more?” The patient’s blood became diluted and actually began to flow too much, losing its ability to clot. EMTs/paramedics’ protocols directed a similar mistake with military anti-shock trousers (MAST), which were also used to get blood flowing through the body. The pants inflated, causing pressure that pushed the blood back to the brain and heart, but this was later linked to bleeding acceleration, dislodging of clots, and dilution of the blood’s clotting factors. According to Mettlach, the MAST study, led by Pepe, had “world implications” because it was the universal standard for care at the time.²⁸

Continued research has enabled HFD EMS to be proficient in its technology, especially in the case of the End-tidal CO₂, a device that measures the amount of carbon dioxide in the blood after exhaling. This device can be helpful in the study and treatment of COPD and asthma patients. It is also



Military anti-shock trousers (MAST) were the standard for care to get blood flowing through the body until research done in Houston proved them to be detrimental to patients.

Photo courtesy of David Almaguer.



The South East Texas Regional Advisory Council's (SETRAC) mass casualty response bus or AMBUS will hold up to thirty patients. It is staged from a Houston Fire Department station and responds to twenty-four other counties as needed. It and several others throughout Texas were funded by grants. Photo courtesy of Diana Rodriguez.

useful when performing CPR. If EMTs and paramedics are doing CPR incorrectly, the measured numbers will decrease, indicating that the person administering CPR is tired and should switch with someone else. End-tidal CO₂s were on ambulances in Houston before they were in intensive care units at hospitals. Houston EMS was the first to implement the technology, now commonly used by other ambulance programs and hospitals.²⁹

Another area in which HFD EMS worked to improve its procedures is treatment of heart attack patients. Originally EMS rushed patients suffering from heart attacks to an ED, where a doctor called the cardiologist to prepare the catheterization lab to work on the patients. Now communication via radio is so fast that a person suffering from a heart attack gets sent directly to the cath lab to see a cardiologist upon arrival at the ED. Although lines of communication to help expedite treatment of heart attack patients began with only a few hospitals, it is now routine for heart attack patients to go straight to the cath lab in most Houston hospitals.³⁰ EMS uses the door to balloon time (D2B), which measures the time it takes to inflate the balloon used to re-establish blood flow after a patient arrives at the hospital, to help gauge its effectiveness with cardiac care. HFD EMS continually strives to lower its D2B time, which averages eighty-nine minutes, or one minute better than the national requirement.

Houston EMS became the nation's first emergency service equipped with a mobile stroke unit (MSU). The vision of Dr. Jim Grotta, a neurologist at Memorial Hermann Hospital at the Texas Medical Center and director of the Mobile Stroke Unit Consortium, the MSU was developed in conjunction with the University of Texas Medical School, Memorial Hermann, and regional stroke centers to reduce the time from onset to hospital treatment. Equipped with a portable CT scanner and operating out of the Medical Center, the specially equipped ambulance enables medical staff to determine, for example, if a patient has a bleed or a

blockage in the brain, so they know whether or not to administer clot-busting drugs, which would yield devastating consequences if the person had bleeding. Early evaluation can be critical to getting the most appropriate treatment in a timely manner to maximize the chances of recovery and quality of life after a stroke.³¹

The majority of Houstonians are well aware they live near one of the world's greatest medical centers, but perhaps fewer realize the critical component in an emergency will be the care they receive in the capable hands of HFD EMS before they ever reach the doors of the hospital emergency department. In the short forty-five years since HFD Emergency Medical Services came into being, the services, the technology, and the medical research it performs have revolutionized the quality of care Houstonians receive and offered a template for other cities to follow. What made Houston different from other EMS services? EMS Assistant Chief David Almaguer explains that throughout its history, the leadership in Houston set their sights higher than just being "a good ambulance service . . . they took on the role to be a leader." They took the time and effort to do research because they knew it would make a difference in thousands of people's lives, in Houston and in communities around the world who benefitted from the groundbreaking research and protocols developed in the Bayou City.³²

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