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Ambulance Safety Efforts Gaining Ground

By Jenifer Goodwin, NAEMT Program Manager

In February, an ambulance responding to an emergency call lost control on an icy road outside San Angelo, Texas. The ambulance rolled over and caught fire, killing a paramedic, the patient and another passenger.

Each year, ambulances are involved in about 4,500 crashes, of which one-third result in injuries, according to statistics compiled by the National Highway Traffic Safety Administration (NHTSA). About 1 percent of crashes are fatal, killing an average of 29 people annually.

Those kinds of tragedies have propelled national EMS and fire organizations, ambulance manufacturers, safety engineers, physicians, state officials and federal agencies to come together to develop new standards for ambulance design intended to make ambulances safer for EMS practitioners and their patients.

Earlier this year, the Commission on Accreditation of Ambulance Services (CAAS), a nonprofit organization that accredits ambulance services, established a Vehicle Standards Committee, made up of a multi-disciplinary group of experts and stakeholders to create new ground ambulance standards. A draft for public comment was expected to be released in mid-September.

At the same time, the National Fire Protection Association (NFPA), which has developed some 300 codes related to fire and fire apparatus safety, has also brought together a broad array of experts and stakeholders to revise *its* ground ambulance standard, NFPA 1917.

When the first edition of NFPA 1917 was released in 2012, several EMS organizations voiced concerns that the standard didn't adequately address the needs of all types of EMS agencies, said Kenneth Willette, division manager of the NFPA's public fire protection division. In response to that feedback, NFPA 1917 was quickly placed into a process of revision. A draft is expected to be released for public comment in the next few months; the final version should be ready in the latter half of 2015.

New Data Fueling Better Design

Despite the parallel efforts, EMS leaders who are participating in the discussions believe the time is coming that EMS will see a new generation of far safer vehicles. A key reason is that both the CAAS and NFPA committees can now refer to a wealth of new data about how to engineer a crashworthy ambulance.

The data includes research conducted by the National Institute of Standards and Technology on the design and layout of safer patient compartment; and research and crash testing by engineers at the National Institute for Occupational Safety and Health (NIOSH) on restraint systems, cot mounts, equipment mounts, seating and other

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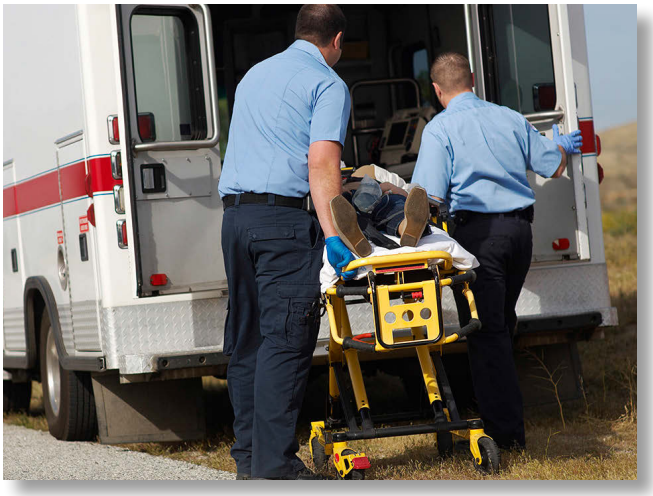
features of the patient compartment.

Six new guidelines based on the NIOSH research were recently published by SAE (the Society of Automotive Engineers) International, an organization that automotive manufacturers look to for peer-reviewed, validated testing guidelines. Another five guidelines for ambulance components are under SAE review.

"We now have tested, validated science and published guidelines," said Mark Van Arnam, co-chair of the CAAS Vehicle Standards Committee and president/CEO of American Emergency Vehicles, the nation's largest ambulance manufacturer. "That is not something EMS has had before."



NAEMT has representatives participating on both the NFPA and the CAAS committees. Given the new information that both NFPA and CAAS are working with, EMS practitioners should expect significant changes to ambulance design in the next few years, said NAEMT President Don Lundy.

"I think within 10 years you will look at the back of an ambulance and not recognize it," Lundy said. "You're going to see a stretcher-holding device that is much sturdier. You're going to see black box technology. You're going to see all the medical equipment mounted on the same side as practitioners so they can reach it without getting up. I believe even the squad bench is going to go away one day."

A Long Road to Safer Ambulances

Since 1968, car manufacturers have had to comply with Federal Motor Vehicle Safety Standards, which sets minimum requirements for crash worthiness for passenger cars. But many vehicles above 10,000 pounds, including ambulances, were exempted from those crash test requirements, said Jim Green, a NIOSH mechanical engineer who has led the ambulance research.

In the absence of an ambulance design standard, over time, state regulators who license ambulances in most states, came to rely on ambulance procurement specifications put out by the U.S. General Services Administration. Officially known as the KKK-A-1822F Ambulance Purchasing Guide, it's usually referred to as "Triple K" or simply, "K".

The problem is that the KKK standard, first published in 1974 and updated periodically since then, was never intended to be a guideline for designing safe ambulances, explained Van Arnam. It's a federal *purchasing* specification, informing manufacturers of what the federal government expects when it buys ambulances.

According to 2012 research from the National Association of State EMS Officials (NASEMSO), 42 states have rules regarding the design of ambulances, while eight don't. Of those that do, 30 states use the KKK specifications, either with modifications or in its entirety. "If you get in your Nissan or Mercedes or whatever you're driving, you have every confidence it's certified to a certain standard," Van Arnam said. "You get in an ambulance, you don't know what you're getting."

Even in states that don't require KKK, most manufacturers will still build to that specification, he said, "but that standard is lacking," Van Arnam added.

As it evolved over the years, the KKK standard did contain some performance requirements, such as requiring the patient compartment to be strong enough to withstand a load 2.5 times the weight of the vehicle when placed on the top or side of the patient compartment, said Skip Kirkwood, chief of Durham County (N.C.) EMS and NAEMT's representative to the CAAS Committee. The load test is typically done by placing a water-filled tank on the ambulance to see if any components buckle. The issue with such as test is that it's a static test, not a dynamic test that would reflect the real world forces placed on an ambulance in a collision. "No one ever puts a swimming pool on the roof of an ambulance," Kirkwood said.

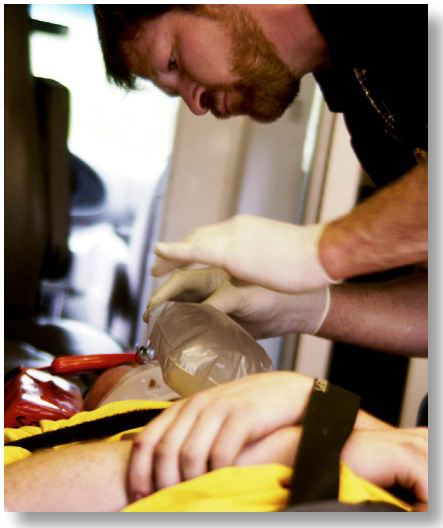
Replacing "K" Takes On More Urgency

If the grim news reports weren't enough, the need to replace the KKK standard took on more urgency when the federal government, indicating other organizations should step in to develop true ambulance design standards, announced it

would no longer maintain or update the KKK Standard as of September 2015.

With the need for a better standard becoming increasingly obvious, the International Association of Fire Chiefs and NFPA's Technical Committee on Fire Department Apparatus broached the idea of the NFPA developing an ambulance standard, Willette said. "The Technical Committee on Fire Apparatus includes folks who are very experienced in managing fleets of fire and EMS vehicles. They felt the work that had been done on another NFPA standard, 1901, which is a specification and safety standard for fire apparatus, had led to safer fire vehicles," he said. "They knew there was a lack of a comparable standard for ambulances and the thought was NFPA could provide the same benefit to the responder community."

But as soon as it was released in 2012, NFPA 1917 drew criticism from NASEMSO, the American Ambulance Association, NAEMT and others for certain requirements that the organizations said would raise the cost of an ambulance significantly without necessarily enhancing safety. Since NFPA 1917's release, only the District of Columbia has adopted the standard; no states have. Heeding the feedback, NFPA went back to the drawing board.



"The number one goal is safety," Willette said. "We want to give the opportunity for everybody who wants to be heard to be heard in our process. We became aware there were folks who didn't think they were being heard; our job is to give them access to our process and allow them to participate."

But even as NFPA was working to revise its standard, CAAS, urged by NASEMSO and other EMS organizations, was getting ready to enter the fray.

"CAAS has established a reputation of having what we view as the gold standard of operating an EMS agency, and has a couple of decades experience doing that," said Mark Meijer, CEO of Life EMS Ambulance in Grand Rapids, Mich. and chair of the CAAS Board of Directors. "We had some requests from EMS organizations, and we recognized that there was an opportunity for CAAS to establish a vehicle standard that goes hand in hand with their overall EMS agency standards."

Enter The Engineers

About a decade ago, Green, the NIOSH engineer, and his colleagues got some funding to test a harness used in military helicopters that would enable EMS personnel to stand up, and move about the ambulance to reach patients, while still being restrained. Though crash tests showed the harness improved safety, EMS practitioners brought in to try it out perceived it as cumbersome, Green says, and it was never widely adopted.

But the success of those initial tests made Green want to continue investigating. In the crash tests, they noticed the crash dummies hitting their head against cabinets and wall surfaces during impact, cabinet latches swinging open, stretchers dislodging from the floor, oxygen tanks becoming projectiles and seats coming loose. "This made us aware of some additional areas for improvement," Green said.

With additional grant funding largely from the Department of Homeland Security and the support of ambulance, seat and cot manufacturers, Green crash tested 15 ambulances, about 150 seats, 40 cots and 75 pieces of equipment at independent crash testing facilities used by the automotive and aviation industries. From that came a series of guidelines for various components of ambulance seats, cots, equipment mounts and restraints.

"Nobody had ever done much more to see what it took to make a cot or a seat in the back of an ambulance crashworthy, or what force a cot or a seat had to withstand to bring it to the same level of safety as a car," Green said.

SAE published the first guideline based on that research in 2010. Since then, SAE has published a total of six guidelines for ambulance components; five more are in the pipeline. Throughout the process, Green has worked closely with manufacturers, who have been re-designing their products in accordance with the new information, he said.

"The government paid for the cost of testing, but manufacturers have paid for the cost of the engineering to design and manufacture new parts that meet the SAE guidelines," he said. "They are partners in this. It's been one of the greatest experiences of my 30 year working career."

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Green is also working closely with both the NFPA and the CAAS committees with the goal of his work being incorporated into each set of standards.

Hurdles Remain

While there is broad agreement on the need for a safer ambulance, hurdles remain. The NIST and the NIOSH data is available, but it's ultimately up to the committees to determine how much makes it into the standards.

One factor both committees are considering is how much the safety improvements will add to the cost of manufacturing and purchasing a new ambulance. If the price of an ambulance goes up too much, too quickly, the standards could be rejected, and end up collecting dust on a shelf instead of being used to make real changes, Kirkwood said.

Another hurdle is that each state EMS office will need to choose what, if any, standard to adopt for it to go into effect in that state. If states don't take action, individual states could continue to be without a ground ambulance design standard. With two competing standards under development, manufacturers also worry the result could be a continued lack of consistency in ambulance design standards from state to state, Van Arnam says.

And not to be discounted is one other major influence on safety – human behavior.

A major ambulance safety issue that has emerged from the research and crash reports is cots coming loose from their "antler" hold in a crash. Both the CAAS and the NFPA standard will likely have requirements for stronger stretcher mounts. But for that to be successful in reducing injuries, EMS personnel also need to use the shoulder harness to secure patients to the cot. Crash investigations have shown that patients not secured by the shoulder harness have been thrown off the cot, Green said.

Other SAE guidelines recommend strengthening oxygen canister mounts and seatbelts. But those changes will only reduce injury if EMS personnel actually secure the oxygen canister instead of tossing it in the back of the ambulance, and remember to wear a seatbelt in the first place. Those safety measures require cultural change, Green said. "We're creating better components and safer ambulances for EMS personnel, but just like in your car, if you don't have your seatbelt on, you're choosing to be in a risky position," Green said.