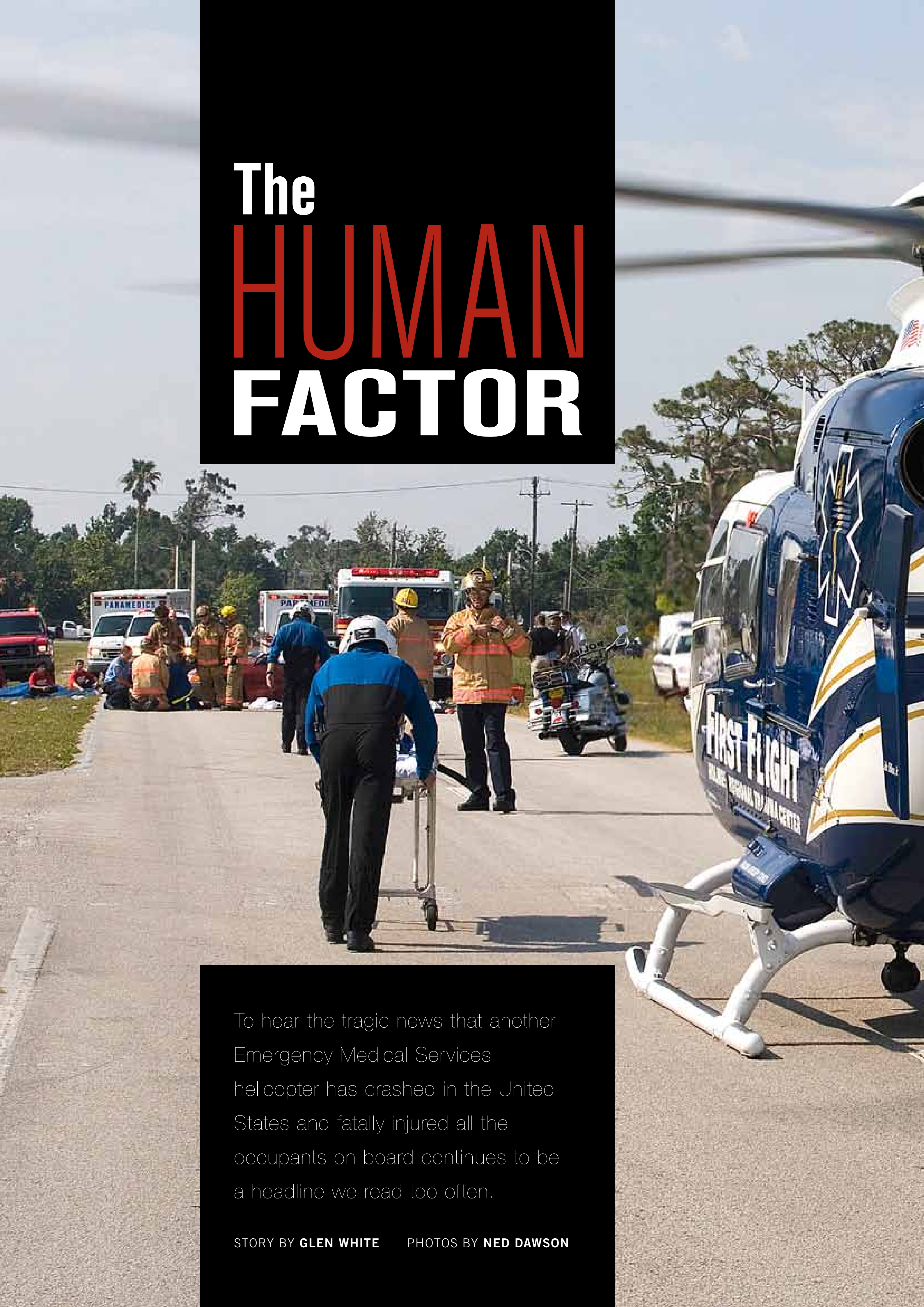
# The HUMAN FACTOR




To hear the tragic news that another Emergency Medical Services helicopter has crashed in the United States and fatally injured all the occupants on board continues to be a headline we read too often.

STORY BY **GLEN WHITE** PHOTOS BY **NED DAWSON**


A First Flight EC135 lands on a suburban street in Melbourne, Florida during a training mission.

Air-Med's Bell 430 picks up a patient early in the morning after a flight from Salt Lake City, Utah.

Despite study after study, endless task force recommendations, rules and technology implementation, we continue to lose people in an industry whose purpose it is to save rather than cost lives.

Between the mid-1990s and 2004, EMS helicopter accidents have doubled, with the main cause being controlled flight into terrain after entering instrument meteorological conditions. Since 1998 there have been more then an average 12 EMS helicopter crashes per year. In 2006, the Congressional Research Service determined that 80 percent of all helicopter ambulance accidents were caused by the pilot losing visual references at night or in poor weather.

When looking at accident statistics they show a more reliable trend over a larger period of time. For example, 2008 was one of the most deadly years for HEMS with 13 accidents and 29 fatalities. Then there wasn't a fatal HEMS accident for 49 weeks when on September 25 2009, an AS350B2 crashed in Georgetown, SC, killing all three crewmembers. Without looking at the long-term trend, it would be easy for the uninformed to conclude the problem had been remedied prior to this accident.

There are currently more than 850 EMS helicopters operating in the United States, performing more than 400,000 transports per year. This is an increase from a little more than 200 helicopters in the late 1980s. When viewing the accident-rate per 100,000 hours today as compared to the early 1980s, there has been a staggering improvement.

In 1980 HEMS experienced almost 10 fatal accidents per 100,000 hours.

Today the HEMS fatal accident rate is 1.18 per 100,000 hours. When compared to other air taxi operations the rate is 1.13 per 100,00 hours.

So there have been vast improvements in safety and culture in the HEMS community. Still, that doesn't help the crew that is part of that 1.18. As a community we need to strive to continue to reduce the potential of increasing this trend.

Within the last quarter of 2009, we continued to see how prone the EMS industry is to these occurrences. On 22 September 2009, an EMS A109 was being ferried from maintenance to its base in Idaho when it experienced a dual engine failure after fuel starvation. September 24 saw an AS350B3 experience a loss of tail rotor authority and land hard on the hospital pad at St Mary's in Tucson, AZ. On September 25, an AS350B2 crashed in Georgetown, SC, at night in marginal weather after dropping off a patient at Medical University of South Carolina in Charleston, SC, fatally injuring all three crewmembers on board.

A month later on October 22, an A119 in Blythe, CA, landed hard after a partial loss of power. Then on November 5, an AS350 hit a set of powerlines with its tail rotor in Council Bluffs, Iowa, after departing from a scene landing at night, and just over a week later, an AS350B crashed at night in Doyle, CA, after dropping off a patient at Reno hospital. All three crewmembers were killed.

To have an honest discussion of these accidents can be difficult. To point fingers at our friends and colleagues who have been involved in a fatal crash can often be disrespectful and at times hypocritical. We all want to believe that, "It couldn't happen to me." But all it takes is one chain in a situation to take us from, "Wow, that was close!" – to a devastating news story. Often in an attempt not only to honor the deceased but to psychologically protect us from the fact that it could have easily been us, we search for every reason for the accident except the decisions made before or during the flight, or reactions made in a difficult situation.


First Flight delivers its patient to the hospital.

A fireman acts as a patient during a training mission.

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Miami Dade Fire Department's Bell 412 is one of the busiest EMS operations in Florida.


Operating a fleet of A109s, Dallas based Careflite provides a much needed service to the residents of Texas.

PHOTO COURTESY OF AGUSTA WESTLAND

In addition to the personal reasons why such discussions are uncomfortable, litigation in the United States almost always plays a role after an accident. This forces all even remotely involved to protect themselves from blame. So instead of companies, managers, pilots and crewmembers looking at the problem rationally and attempting to ensure that it doesn't happen again, everyone is encouraged to shield themselves from blame.

Since 2004 the FAA has been very active in attempting to create solutions that will reduce the number of EMS helicopter accidents. In August of that year, the FAA established a task force to review and guide government and industry efforts to reduce EMS accidents. In January 2005 they hosted a meeting with EMS industry representatives and published a notice for guidance on providing decision-making skills. Later, in August of that year the FAA issued guidance to inspectors on promoting risk assessment. This list of committees and recommendations continues much in the same manner through to today.

These actions look very good on paper and give the appearance of action. In reality, they are political "feel good" measures that have proven to have very little net worth in the reality of flying HEMS.

The NTSB, in most cases, does a very good job in investigating and publishing all the facts of an accident. The purpose of publishing these reports is an attempt to ensure that the same mistakes are not repeated. In most accidents it is very clear why the aircraft crashed. So why is it then that we continue to have so many fatal accidents?

Many in the EMS industry have promoted various solutions as the "magic bullet" to reducing the accident rate. The majority of these ideas involve the implementation of some form of technology, including NVGs, collision avoidance, two pilot operations or IFR-equipped aircraft. All of these tools can be extremely helpful in the right situation, but we are all looking everywhere but where we should.

The fact is that most EMS accidents have a common root cause – how the pilot reacted to a difficult situation and how he got there in the first place. I am not saying he messed up, let's move on. Rather, how do we as an industry honestly address conditioning pilots to react properly to unusual circumstances and make sound decisions before and during a flight? The bottom line is that the human factor is at the root cause of all accidents.

No meeting, committee or publication is going to infuse a pilot with the ability to react in the most beneficial manner to a less then ideal situation. This behavior is practiced and learned over time. There is a reason why operators prefer to hire experienced pilots. It is not because


Tri-State Careflight are more than pleased with the attributes of the single-engine A119 Koala.

PHOTO BY GLEN WHITE

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PHOTO COURTESY OF AGUSTA WESTLAND

PHOTO BY GLEN WHITE

they have wiggled the cyclic for thousands of hours. It is because during many thousands of hours they have seen many scenarios and made a great many mistakes from which they have learned. If these lessons have been learned properly, the pilot is less likely to make the same mistakes again. The Danish physicist, Niels Bohr, put it well when he said, “An expert is a person who has made all the mistakes that can be made in a very narrow field.”

Depending on a person’s background, training and personal experiences various individuals react very differently to stressful situations. When these situations are compounded with additional stresses the proper reaction becomes more difficult. Flying EMS is the epitome of this reality.

While teaching at FlightSafety in Hurst, TX, an epiphany occurred to me during a Bell 412 simulator session. The two pilots that I had in the simulator were from the same company, Roberto Bouchard an Italian and Nicolas Van Heurck from Belgium. Both were and are currently US citizens, and have spoken English as their primary language for over 20 years, but both spoke French from childhood.

During the session, I gave them various emergencies and could see how they preformed them easily and without any great effort. I decided to see how far I could take them before their performance was degraded. As one emergency appeared after another, without any logical reason for the mixture of the items, the pilots continued to perform each one without fail. But something strange occurred during the events. Word by word the English language started to disappear from their sentences as they performed and read the checklist. Not all at once, but the verbal commands in the aircraft slowly changed into French. A deeper level of the thought process was being used. When I commented to the pilots after they landed the helicopter about the change to the French language they were unaware that they had done so.

This complex problem-solving level of thought utilizes deep regions of our brains. Studies have found that the region of the brain that has been found to govern our problem-solving skills is the anterior cingulate cortex, a brain region connected to emotion, decision-making and the art of anticipating what will happen next. These abilities can be conditioned and improved through a learned process.

To improve these problem-solving abilities takes practice and time. To take a stressful situation and make it ordinary, so that stresses do not impede a pilot’s problem-solving abilities, takes exposure to the occurrences. To simply tell a pilot, “If you enter IMC conditions, climb, and declare an emergency,” will not work if the pilot has not been conditioned to react properly. The natural reaction for most pilots would be to either try to descend to escape the situation


Lee County EMS was one of the first operators to put the EC145 into service as an EMS helo in the United States.

or to slow down in paralyzing fear.

The results of both of these solutions are self-evident. Descent can cause the aircraft to make impact with surface objects, and slowing down in IMC conditions will result in the loss of attitude, resulting in spatial disorientation followed by an uncontrolled descent to the ground.

Keeping these simple truths in mind, our industry has two choices in regard to solving the problem of losing aircraft due to the loss of visual references for VFR programs. Either the weather minimums need to be increased to such a level that there is almost no chance of a pilot entering IMC conditions, or pilots need conditioning on, and enhancement of, the skill sets needed when entering IMC.

The vast majority of EMS pilots in the United States hold an instrument rating to their certificate. This rating is good for the life of the pilot. To utilize the rating though, the pilot must have performed six approaches, holding procedures and intercepted and tracked courses through the use of navigation systems in the previous six months.

Most EMS pilots holding an instrument rating will fly one or two approaches per year during their 135 check-ride. Very rarely is any IMC training given prior to the check-ride. So the pilot is only expected to be able to fly the approach in a very broad proficiency level.

One or two approaches per year by no means prepare a pilot for entering IMC conditions. This entry usually occurs at low attitude due to the fact that the pilot has been descending in order to stay out of the IMC conditions. The pilot is not prepared to climb, find the proper frequency for ATC and navigate to an appropriate landing facility.

The majority of HEMS accidents due to marginal weather happen almost immediately after entering IMC conditions. Since this narrow time-frame is where the majority of the inadvertent IMC accidents occur, this is the area in which training and conditioning needs to be focused.

The conditioning of a pilot to make proper decisions on whether to take a flight, to react properly to a systems failure, to prioritize decisions, to work as a crewmember or fly in a manner which will not cause damage to the aircraft or crew, requires vigilance to training and exposure. To tell a pilot, “We do not want you to fly if you think the weather is not acceptable,” but then require that same pilot to prove that the weather was not sufficient enough to take the mission is a contradiction in attitudes. It gives the appearance to the pilot that the organization is protecting itself while still saying, “Get out there and make us money.”

When you add that the reason for the flight is to potentially save someone’s life, unnecessary risks are encouraged. The HEMS community needs to adopt a “zero pressure to fly philosophy.” Of course, in meetings and on paper this attitude is widespread. In reality there is still a mindset in the HEMS community, whether valid or not, that every possible mission should be accepted.

On June 8 2008, a Bell 407 crashed in Huntsville, TX, in marginal weather. This helicopter had been dispatched after another operator had aborted the same requested mission flight. The operator who had aborted the flight reported low clouds in the vicinity of where the accident would occur. Weather reporting stations in the area recorded visual flight rules when the 407 accident occurred. The station with the lowest reported weather was Huntsville, with greater then a 2,000-foot ceiling and more than 10 miles visibility.

This weather scenario is very common in the United States. The reason for this is that weather reporting stations are typically located at airports. An airport generally needs


Houston, TX is home to Hermann Life Flight, who operate a number of brand new EC145s.

PHOTO COURTESY OF EUROCOPTER

to be located on a more elevated area of land, and most vegetation is cleared around the runways for a very large distance. This produces somewhat of a localized area of better weather.

It is very common for lower cloud levels and/or ground fog to exist between weather reporting points. The pilot of the 407 was a very high- time aviator with more than 20,000 hours, so he had to be more then aware of this. What would have prompted him to disregard this potential weather phenomenon?

The pilot of the accident helicopter was informed of the aborted flight and after looking at the weather decided to take the mission. What would have prompted the pilot of the 407 to take this flight after receiving a poor en-route weather brief from another pilot? Was there pressure for him to take the flight? Did he not believe the en-route weather report?

A risk assessment matrix is a recommendation that the FAA and CAMTS have promoted heavily for the last few years. It is a form where points are added up to determine whether a flight should be conducted or whether the flight poses too much of a risk to conduct. The operator of the 407's risk matrix produced a score from 0 to 16 points with 0 being clear to fly and 16 being a no-fly situation. The accident flight risk matrix had a score of 1. This example highlights the fact that pilot decision-making cannot be quantified on a piece of paper with any great accuracy. Because of this risk matrix score, did the pilot believe that the flight was safe to take?

The helicopter departed Huntsville Memorial Hospital at 2:46am, enroute to Herman Hospital in Houston, TX. The last recorded altitude and speed by the Outerlink GPS tracking system at 2:47am was 600 AGL and 106 kts. The accident scene was 2.5 miles from this last reported GPS position.

The time between departure and the accident was short. It is evident that the 407 had to start encountering weather almost immediately. What would have prompted him to continue? It is a natural human behavior to want to continue with a set choice. This pilot had decided to fly from point A to point B, not take off from point A and return to point A. This change in thought is a difficult mindset to alter.

Humans also do not like to be "wrong." This pilot had made a choice to take this mission even though another pilot had to abort it because of bad weather. To return this patient to the same hospital that he/she had come out of would have reflected poorly on the pilot.

The 407 was equipped with night-vision goggles. Night-vision goggles provide a 40-degree field of vision and can be extremely beneficial when operating in mountainous terrain or terrain with little ground illumination. Not only do the goggles provide for safe navigation, but if a failure occurs en route they provide for better visual ground reference for landing.

But with every tool there are limitations. One of the most prominent is that the onset of IMC weather conditions can be very abrupt under night-vision goggles. The wispy clouds that can be seen by the naked eye are not visible to the under night-vision goggles. These wispy clouds are generally a first indication that the pilot is about to enter IMC conditions.

With night-vision goggles, the pilot views everything outside the cockpit through the goggles themselves. But to see the gauges, he has to look under

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The EC135 has proven to be one of the most popular helicopter types in use with EMS providers worldwide.

the goggles. If the gauges are viewed through the goggles they simple show up as very blurry images. Why? Night-vision goggles are focused to a distance and this distance is for the terrain outside the helicopter.

It was determined that the pilot did not have his under night-vision goggles down at the time of the accident. This would be congruent with the operations of under night-vision goggles. The most likely scenario is that the pilot entered IMC and flipped the goggles up to their upper locked position in order to better see the cockpit gauges for instrument flight.

Even though under night-vision goggles are an extremely valuable tool, they do not solve all of the problems. In this particular instance, they may have even enhanced the likelihood of entering inadvertent IMC conditions.

The initial impact was identified as contact with several trees, 80 to 100 feet in height. Much of the wreckage was spread over a wide area indicating a high rate of speed at impact. The transmission of the helicopter was located 511 ft south of the initial impact area while the fuselage came to rest within 578 ft of the initial impact area.

This accident highlights that even a well-equipped helicopter, with an operator complying with FAA/CAMTS recommendations of a risk matrix and a high-time pilot at the controls will not eliminate the possibility of an accident unless the pilot is well prepared for the situation.

Dealing with a systems failure during a normal everyday Part 135 flight can be extremely challenging. Include the additional stresses of the EMS environment, night operations, lack of rest and weather conditions, and the situation can become overwhelming. An EMS pilot, more then a pilot flying any other mission profile needs to be well versed in the execution of system failures. The simple fact is that, sooner or later something will break on almost every helicopter. In fact, 17 percent of HEMS accidents involve a mechanical failure.

In June of 2009, I encountered a low side governor failure in an Agusta 119 in a mountainous area between Durango and Cortez Colorado. This flight occurred on the first night of a seven-night hitch. When arriving for my shift I was briefed by the off-going pilot that there had been some vibrations in the helicopter. The suspected problem was a pitch change link. Maintenance had inspected and measured the pitch change link and found it to be within tolerances. Immediately after this statement, a call came in for a flight to pick up a patient in Cortez. I quickly did a weather check, preflight and launched for the mission.

Depending on a persons background, training and personal experiences various individuals react very differently to stressful situations.

Approximately 10 minutes into the flight the aircraft slowly started to vibrate violently. My obvious initial thought, having just been told that there may be a problem with a pitch change link was of course – there is a problem with one of my pitch change links. All of the gauges indicated correctly with the exception of the NR gauge. It was slightly low. Like the scenarios played out in the 412 simulator, different failures started to appear that seemed to have nothing in common with one another.

I immediately decided that we were going to land the helicopter. I lowered the collective and started to make a left-hand turn to an open field. As I lowered the collective the NR

PHOTO BY GLEN WHITE

Winters in Colorado are a challenging environment for the TriState Careflight crews.

Either the weather minimums need to be increased to such a level that there is almost no chance of a pilot entering IMC conditions, or pilots need conditioning on, and enhancement of, the skill sets needed when entering IMC.

PHOTO COURTESY OF SIKORSKY

A handful of programs across the United States operate the S76. Palm Beach Health Care District is one of these, with two S76s at its service.

dropped as if the helicopter's throttle had been retarded. I continued to lower the collective to enter an autorotative state, which returned the NR to the green range. But my engine was still operating. Reintroducing the collective again produced a decrease in rotor rpm.

The analysis of the malfunction was that I was having a low side governor failure. But what do vibrations, a possible problem with a pitch change link, low rotor rpm followed by a low side governor failure have in common? As mentioned earlier, the ability to successfully problem- solve through a situation is the result of conditioning. This conditioning has been instilled into my subconscious through years of training at FlightSafety, Bell, Eurocopter and EuroSafety, and teaching at FlightSafety, Eurocopter and EuroSafety. The reactions that occurred were not so much a conscious address of the problem, but rather a subconscious muscle memory of the proper reaction.

To address a governor failure in an A119, a large slider on the throttle needs to be moved down and forward. At that point the pilot has control of the fuel flow into the engine with the throttle. All collective movements at that point need to be compensated with the throttle.

As I controlled the NR with the throttle I made a slight run on landing to the open field. Two day later a new fuel-control unit was installed on the helicopter and it was flown back to the base in Durango where is still operates today.

But the question is, what do vibrations, a possible problem with a pitch change link, low rotor rpm and a governor failure have in common? The answer is if the NR of the A119 becomes slightly low in cruise flight, the rotor system produces a strong vibration. The NR was low because the governor was starting to fail, when the collective was lowered, the governor failed. And the suspected vibration due to a possible bad pitch change link? The pitch change link was fine, the aircraft just needed tracking.

Getting the aircraft safely to the ground was not the result of my piloting skills, it was not luck, and it wasn't a regulation – it was conditioning.

As we continue to look for a rule to make, a publication to write or a piece of technology to implement, the HEMS community will continue to lose aircraft and crew. Though many of these items may be beneficial to a certain extent, the area that needs focus is the driver in the pilot seat. The perception that a pilot has on the necessity to take a flight and the training to deal with a deteriorating situation should be our number one job. In the mean time, I really hope that another crew has not found the flaw in the human factor prior to this article being published. ■