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Helicopter EMS (HEMS) Safety: A Disturbing 40-Year Trend

At approximately 11:30pm on Friday, October 3rd, 2014, 26-year-old Buddy Rhodes was with a group of friends in Waurika, OK passing around a shotgun when it accidentally discharged and the blast struck Rhodes in the chest. Local PD and EMS arrived and made the decision to contact Air Evac Lifeteam 25 based out of Duncan, OK about 26 miles north of the scene of the shooting to transport the patient to United Regional Health Care System in Wichita Falls, TX, which was located about 38 miles to the southwest of the scene. The Air Evac Lifeteam arrived, landed on scene, picked up the patient, and took off towards Wichita Falls, TX. By air, this would be an approximately 17-minute flight versus at least 30-minutes by ground transport. Upon arrival to the hospital around 2am on October 4th, the pilot began his descent and prepared for landing on the ground-level helipad, but according to reports, believed his approach was too fast, and in trying to abort the landing, he sent the Bell 206 LongRanger III aircraft into a violent spin which resulted in the aircraft slamming into an intersection approximately 400-feet to the north of the helipad. The aircraft burst into flames. Wichita Falls-based fire and EMS, including the crew of the Air Evac Lifeteam based at United Regional Health Care immediately responded. Rhodes was pronounced dead at the scene. The pilot, Zechariah Smith, was rescued and admitted to United Regional in serious condition. The nurse, Leslie Stewart, and the paramedic, Johan van der Colff IV, were rescued and flown immediately to Parkland Hospital in Dallas, TX where they both had severe, life-threatening injuries and burns. Stewart died from her injuries on October 8th and van der Colff died from his injuries on October 23rd. Little additional information is available at this time, and additional information will not be available until the Federal Aviation Administration and the National Transportation Safety Board conclude their investigations sometime in the distant future.

Unfortunately, this gut-wrenching story has become all too painfully familiar for those healthcare professionals who are involved in the prehospital care of patients. The use of air medical transport dates back to World War I, and its role became much more pronounced during the Korean and Vietnam War.[2]

Today's "air ambulance" is a specially outfitted aircraft (helicopter or airplane) that transports a sick or injured patient in a medical emergency or over distances or terrain impractical for a conventional ground ambulance.[2] They are typically equipped with medications, ventilators, cardiac monitors, CPR equipment, surgical devices, and blood/fluid resuscitation products which may be vital to sustaining life in the first few minutes of that patient's care prior to arriving to the hospital. At minimum, these units are typically expected, but not required to be staffed by a crew that consists of a pilot, a paramedic, and a nurse. Some air EMS units will also carry a physician or a respiratory therapist depending on the size of the unit. These pilots and healthcare providers are also expected, but not required to carry extra credentialing and certifications specifically designed to prepare them for the quality of care and challenges expected in the treatment and transport of their patients. The word "expected" is used intentionally to indicate that the industry does not often conform to these "expected" standards.

Initially, the vast majority of helicopter EMS (HEMS) providers were "hospital-based". The helicopter EMS (HEMS) industry has now grown to ~1,515 helicopters in 2014, transporting over 400,000 patients annually. It is a $2.5-billion dollar per year industry and is responsible for only 3% of patient transports in the U.S.[3,13] The rapid growth of this industry would lead one to assume that the industry is well-designed and well-regulated, but that assumption is flawed. To truly understand where the industry is now and the challenges being faced, we must look at a timeline of where the industry has come from. Buckle up.

The Past 40 Years

1972 - The first hospital-based air medical transport began in the U.S. in Denver.[2,4]

1978 – The Airline Deregulation Act restricted states from regulating medical helicopters.[4] The purpose of this act was to remove the government's control of fares, routes, and market entry for commercial aviation, but a rather controversial interpretation removed their ability to regulate medical helicopters. However, it did not remove the FAA's regulatory powers over airline safety.

1980 – Approximately 40 medical helicopters operating in the U.S.[4]

1986 – Concerns are raised about safety after 14 accidents.[4]

1987 – FAA conducts a 60-day review of medical helicopter safety nationwide.[4]

1988 – NTSB releases study of medical helicopter safety, investigating 59 HEMS accidents between May 1978 and December 1986, making 19 recommendations to the FAA to improve safety, which addressed equipment, training, crew resource management, decision-making, flight-following procedures, weather minimums, and the development of safety programs for HEMS flights.[4,5]

1994 – An FAA study showed that night vision goggles can improve safety.[4]

2000 – Nearly 800 medical helicopters operate in the U.S. The FAA and the HEMS industry hold an emergency safety summit after a rise in fatal accidents.[4] Between 1990-1999, there were a reported 42 medical helicopter crashes with 42 fatalities and 32 serious injuries.[6]

2002 – Medicare introduces a new fee schedule, increasing payments for medical helicopters by 434%.[8] This upgrade in revenue did not lead to an upgrade in medical and aviation capabilities as expected. Actually it did almost the opposite. It inadvertently triggered an uncontrolled growth in the number of medical helicopters (377 in 2000 to over 1500 in 2014). As a result of requiring hospitals to unbundle their charges for patients who were received via hospital-owned air transportation, many hospitals decided to abandon their helicopter operations and for-profit companies saw an opportunity. Subsequently, most of this growth has been in the corporate, profit driven sector of the

industry, essentially dominated by three large corporations (Air Medical Group Holdings, PHI Air Medical, Air Methods Corporation). These three publicly traded corporations own, operate and control well over 1/3 of all U.S. HEMS programs.[8] They have invested hundreds of millions in the industry, opening scores of free-standing bases.[4] These bases are no longer primarily operated by hospitals. The medical crews are no longer trained or regulated by medical industry. The aircraft, pilots, and mechanics are no longer primarily employed or operated by aviation vendors.

2002 – After an extensive 2-year safety review and risk assessment of HEMS accidents, the Air Medical Physician Association (AMPA) reported in November 2002 that the time of day that flights occur could contribute to accidents. The report indicated that even though 38% of all helicopter EMS flights occur at night, 49% of accidents during a 20-year period occurred during nighttime hours. The report also cited controlled flight into terrain (CFIT), in particular during the takeoff or landing sequence, as a common problem, as well as collision with objects (wires were the most common obstacles for EMS helicopters); inaccurate weather forecasts (about 26% of helicopter EMS accidents were weather-related, with most occurring because of reduced visibility and IMC while the helicopter was en route); and communications problems with air traffic control (ATC) or a lack of communications due to remote locations and high terrain. AMPA's report also cited time pressures related to the patient's condition, rapid mission preparation, flight to the patient pick-up location, and low fuel as frequent issues in EMS aircraft accidents. According to a query of the National Aeronautics and Space Administration's Aviation Safety Reporting System, patient condition was cited in 44% of the EMS accidents or incidents reports as a contributor to time pressure leading to inaccurate or hurried preflight planning. In addition, the AMPA report stated that accidents occurred more often when flight crews were en route to pick up a patient than at any other time during flight.[6,7]

2004 – FAA and HEMS industry create task force to examine medical helicopter safety in light of the alarming rate of recent medical helicopter crashes.[4]

2005 – A total of 100 HEMS accidents occurred between 1998-2005, with 29 of those accidents being fatal, resulting in a total of 75 fatalities and 74 serious injuries. The NTSB specifically investigated 55 accidents that occurred between January 2002 and January 2005 and gave the following seven as the best examples of the safety issues involved. These seven accidents were specifically cited in the NTSB's discussion of each safety issue.[6]

- **Salt Lake City, Utah (FTW03FA082).** On January 10, 2003, an EMS helicopter crashed into terrain while maneuvering in dense fog on an aborted mission to pick up a patient. The pilot and flight paramedic were killed, and the flight nurse was seriously injured.

- **Redwood Valley, California (LAX04FA076).** On December 23, 2003, an EMS helicopter was en route to pick up a patient when it collided with mountainous

terrain while operating in high winds and heavy rain. The pilot, flight nurse, and paramedic were killed.

- **Dodge City, Kansas (CHI04FA066).** On February 17, 2004, an EMS airplane crashed about 5 miles beyond Dodge City Regional Airport while on a repositioning flight. The pilot, flight paramedic, and flight nurse, who were at the end of a 14-hour duty day, were killed.

- **Pyote, Texas (FTW04FA097).** On March 21, 2004, an EMS helicopter crashed into terrain while maneuvering in reduced visibility conditions while transporting a patient. The pilot, flight paramedic, patient, and patient's mother were killed, and the flight nurse was seriously injured.

- **Newberry, South Carolina (CHI04MA182).** On July 13, 2004, an EMS helicopter collided with trees shortly after picking up a patient from an accident site on an interstate. The pilot, flight nurse, flight paramedic, and patient were killed.

- **Battle Mountain, Nevada (SEA04MA167).** On August 21, 2004, an EMS helicopter crashed into mountainous terrain at night and in deteriorating weather conditions while transporting a patient along a direct route through mountainous terrain rather than taking an indirect route around the high terrain. The pilot, two medical crewmembers, patient, and patient's mother were killed.

- **Rawlins, Wyoming (DEN05FA051).** On January 11, 2005, an EMS airplane that was operating in icing conditions crashed when it impacted terrain while en route to pick up a patient. The pilot and two medical crewmembers were killed, and a third medical crewmember sustained serious injuries.

While investigating the 55 crashes, the NTSB noted the following recurring safety issues:

- Less stringent requirements for EMS operations conducted without patients on board
- Lack of aviation flight risk evaluation programs for EMS operations
- Lack of consistent, comprehensive flight dispatch procedures for EMS operations
- No requirements to use technologies such as terrain awareness and warning systems (TAWS) to enhance EMS flight safety.

On January 14, 2005, the FAA hosted a meeting with industry representatives to discuss safety issues and gain feedback. Representatives from the Association of Air Medical Services, Helicopter Association International, the National EMS Pilots Association and several operators attended.[13]

In response to the NTSB investigation and the recent surge in HEMS crashes, the FAA released a series of voluntary safety recommendations known as "Best Practices" following internal report showing dramatic increase in fatal crashes. The report, similar

to that of the NTSB's, showed that a total of 100 HEMS accidents occurred between 1998-2005. Of note, these were only "recommendations" and not orders or mandates.[4,6]

Specifically, on January 28, 2005, the FAA released Notice N8000.293, "Helicopter Emergency Medical Services Operations," which contained information that FAA inspectors could provide to helicopter EMS operators "for a review of pilot and mechanic decision-making skills, procedural adherence, and crew resource management".[6]

On August 1, 2005, the FAA released Notice N8000.301, "Operational Risk Assessment Programs for Helicopter Emergency Medical Services," which identified possible risks and dangers to flight crews and patients and encouraged aircraft EMS operators to promote the use of risk assessment models. The FAA issued similar (although less detailed) guidance in AC 135-14A; however, the recommended practice of risk assessment and decision-making had not been incorporated in a formalized manner into the EMS operations that were investigated by the NTSB.[6]

On September 22, 2005, the FAA issued guidance to operators establishing minimum guidelines for Air Medical Resource Management (AMRM) training. The training focuses on pilots, maintenance technicians, flight nurses, flight paramedics, flight physicians, medical directors, specialty team members (such as neonatal teams), communications specialists (dispatchers), program managers, maintenance staff, operational managers, support staff, and any other air medical team members identified by specific needs (AC No. 00-64 Air Medical Resource Management).[13]

Finally, on September 27, 2005, the FAA released Notice N8000.307, "Special Emphasis Inspection Program for Helicopter Emergency Medical Services," which provided guidance to aviation safety inspectors for the examination of operational factors that were identified as causal to EMS accidents from 1999 to 2004, such as operational control, safety culture development, and access to and use of weather information by flight crews, management, and in-flight communications specialists.[6]

In December 2005, the FAA's Flight Standards Service's Air Transportation Division established the new Commuter, On Demand, and Training Center Branch (AFS-250) to work Part 135 and Part 142 policy issues. The FAA has begun hiring aviation safety inspectors with specific "helicopter only" experience in order to keep pace with industry growth.[13]

Despite these positive steps to improve EMS operation safety, the FAA has not yet imposed any requirements for all aircraft EMS operators regarding flights without patients on board, risk management, flight dispatch, or the use of technologies. The FAA's published notices are simply information for principal operations inspectors (POI) to convey to their operators and encourage them to incorporate into their operations. Because the guidance provided in ACs 135-14A and 135-15 were not widely adopted by EMS operators, the NTSB did not anticipate that the guidance provided in the FAA's notices would be widely implemented. The NTSB was concerned that, without requirements, some EMS operators will continue to operate in an unsafe manner, which

could lead to further accidents. Although the NTSB recognizes that the nature of EMS operations involves some risks, operators should be required to provide the best available tools to minimize those risks and help medical personnel, flight crews, and patients arrive at their destinations safely.[6]

2006 – NTSB issues second study of medical helicopter safety. The report includes four major recommendations for improving safety, including night vision goggles and collision avoidance technology. The FAA does not adopt any of these regulations.

On January 24, 2006 the FAA issued "revised guidance" to inspectors regarding HEMS OpSpecs, amending the Visual Flight Rule (VFR) weather requirements for HEMS operations, including consideration of the adverse affects of reduced ambient lighting at night and mountainous terrain (HBAT 06-01 Helicopter Emergency Medical Services; OpSpec A021/A002 Revisions).[13]

On March 2, 2006, the FAA issued guidance to inspectors on the surveillance and oversight of public aircraft operators for air ambulance operations (Notice 8000.318 Public Helicopter Emergency Medical Services (HEMS) Operations).[13]

Also, in March 2006, the FAA and the University Corporation for Atmospheric Research hosted a weather summit in Boulder, Colorado to identify the air ambulance-specific issues related to weather products and services. Attendees explored possible regulatory improvements, weather product enhancements, and operational fixes specific to helicopter air ambulance operations. Attendees included the National Weather Service, National Center for Atmospheric Research (NCAR), Helicopter Association International, American Helicopter Society International, Association of Air Medical Services, National EMS Pilots Association, National Association of Air Medical Communications Specialists, manufacturers, and many operators. As a result, the FAA funded the development and implementation of a graphical flight planning tool for ceiling and visibility assessment along direct flights in areas with limited available surface observations capability. It improves the quality of go/no-go decisions for air ambulance operators. The tool was fielded in November 2006. The FAA and industry [would later meet] in 2013 to fine-tune the tool.[13]

On June 27, 2006, at the FAA's request, RTCA, Inc. established a Special Committee to develop Helicopter Terrain Awareness and Warning System (H-TAWS) standards. These standards will be used to develop FAA requirements for H-TAWS systems, installation and operations.[13]

In August 2006, the FAA revised the Aeronautical Information manual (AIM) to provide guidance to pilots on assessing ambient lighting for night VFR operations and for off-airport/heliport landing zone operations.[13]

2008 – 850 medical helicopters are operating in the U.S. A record number of fatal crashes that year kill 29 crew members, prompting calls for reform. NTSB officially

places HEMS safety and the FAA on its "Most Wanted List" in the fall of 2008 for failing to adopt earlier safety recommendations.[4]

On May 5, 2008, the FAA's Flight Standards Service issued an advisory circular (AC 120-96) highlighting the "best practices" for use by air ambulance operators in establishing their operational control centers and training their specialists.[13]

On July 11, 2008, 80 representatives from the FAA and the Association of Air Medical Service met in response to recent accidents. Discussions focused on night operations in poor or deteriorating weather, risk management, complacency, the agency's policies on the use of NVGs, as well as helicopter shopping.[13]

On November 14, 2008, the FAA published a Notice in the *Federal Register* that advised operators of important mandatory changes to air ambulance flights. The agency also included a provision to encourage the use of NVGs and Terrain Awareness Warning Systems. Consistent with NTSB recommendations, all air ambulance operators will comply with Part 135 weather minimums, including repositioning flights with medical crew onboard. The FAA also provided greater access to weather reporting facilities, and required the flight crew to determine a minimum safe altitude and obstacle clearance prior to each flight. The compliance date was no later than February 22, 2009.[13]

2009 – On January 12, 2009, the FAA issued a notice (Notice 8900.63) to agency inspectors with oversight of air ambulance operators to find out how many operators have adopted FAA-recommended best practices. With reports in from all of the 74 operators surveyed, the percentages that have adopted various programs were:[13]

- Decision-making skills and risk assessment programs – 94%
- Response to FAA guidance on Loss of Control (LOC) and Controlled Flight Into Terrain (CFIT) avoidance – 89%
- Integration of operation control center – 89%
- Installation of Flight Data Recorders and devices that can re-create a flight. – 11%
- AWS equipage – 41%
- Use of radar altimeters – 89%

On January 26, 2009, the FAA's Flight Standards Service established a task group to focus on the certification and surveillance requirements for large air ambulance operators that support diverse medical programs throughout the United States. The group's findings resulted in an increase in the cadre of inspectors assigned to air ambulance operations and the organization of those inspectors into operator-specific oversight teams.[13]

In February 2009, after the record number of crashes in 2008, including a high-profile HEMS crash near Washington in September 2008 which involved a Maryland State Police Medevac helicopter crashing and killing 4 occupants due to the "casual and sloppy" guidance from air traffic controllers and the use of "outdated weather information", the NTSB held a 4-day hearing on medical helicopter safety in Washington. Experts testified it was time for the air ambulance industry "to change the way it does business" by focusing more on safety and less on profits.[9] The previously

voluntary recommendations from the FAA were not working. The NTSB made three main points during the hearing:[10]

- The current HEMS accident record is unacceptable
- Not all air ambulance operators are created equally from a safety perspective
    - Multiple levels of performance exist among operators
        - World Class (Top 3-5%)
        - Best practices (adopts and implements quality, standards, procedures, equipment, and training above and beyond regulatory requirements)
        - Basic regulatory compliance (meets regulations, but no higher)
        - Sub-standard performance (non-adherence to regulations, cutting corners are the norm)
    - Multiple levels of performance exist among HEMS aircraft
        - Single engine vs twin engine
        - Single pilot vs 2-pilot
        - Weather capability, instrumentation, distance
    - Regardless of performance, all CMS reimbursement is the same
- As consumers of air ambulance transport, you can "up the ante" on how they operate

As a result, they released 21 additional safety recommendations immediately following the hearing, including recommendations on pilot training, aircraft equipment, airspace infrastructure, CMS reimbursement, and HEMS utilization criteria. After years of balking at safety regulation, the FAA announces it will adopt new safety rules, including several of the earlier NTSB recommendations.

2009-2010 – For a period of 49 weeks surrounding the NTSB hearing in Washington, there was not a single HEMS crash. It was thought by some that simply bringing the issues to the public forefront would inspire new safety advances and a higher degree of diligence from the HEMS industry. However, following that interval was a 12-month period between September 2009 and August 2010 where the U.S. saw an astounding 14 HEMS crashes with 22 fatalities.[10]

2010 – There are over 850 medical helicopters in the U.S. operated by 74 air ambulance companies. In February 2010, the FAA publicly responded to the NTSB's "Most Wanted List", stating "The FAA and NTSB share a common goal: promoting safety in aviation and preventing aircraft accidents. The record shows the NTSB and FAA agree on a course of action 88% of the time. Of literally *thousands* of safety recommendations made to the FAA, the [NTSB] has classified about 82% 'Closed – Acceptable Response', and approximately 6% remain open in 'Acceptable' status."[12] The FAA did not classify the remaining 12% of the NTSB recommendations, which if there truly were "thousands", then this could be on the order of well over 200 recommendations that remain in a status other than those listed above, which assumedly can not be a favorable status.

In a busy year for the FAA, in October 7, 2010, the FAA "proposed" new warning systems and increased training for emergency medical flights to deal with the spate of recent crashes. Some of the specific details of the FAA's plan would require terrain warning systems, operation control centers for larger companies, pre-flight risk analysis, particularly for weather, and stricter flight rules whenever medical crew members - not just patients - are onboard. Interestingly, the FAA plan did not require the use of night-vision goggles or an autopilot to help relieve pilots' workloads during difficult flights. Both were among the long-standing safety additions advocated by the NTSB. Les Dorr, an FAA spokesman, said that the agency had considered requiring night vision goggles but that it did not "because those are not a one-size-fits-all solution." The FAA acknowledged that the proposal would be open for public comment for 90 days, followed by a process of "at least a year" to write the proposal. The full implementation of the regulations, if passed, could take "years". It was expected that some of the industry might give "push-back" and approach these long-awaited regulations from a cost perspective rather than outcomes perspective.[11] These proposed rules would not cover public companies, which occupy the profit-driven sector of the industry, essentially dominated by three large corporations (Air Medical Group Holdings, PHI Air Medical, Air Methods Corporation). These three publicly traded corporations own, operate and control well over 1/3 of all U.S. HEMS programs.[8]

2011-2013 – During a relatively quiet period for the FAA and NTSB as far as policies, procedures, recommendations, rulings, meetings, proposals, and notices are concerned, the HEMS industry continued to grow at lightning speed. The number of air ambulances in service nearly doubled between 2010 and the end of 2013, and now there are over 1500 air ambulances owned by 75 companies. Interestingly, the number of companies is similar to the 2010 numbers, leading one to believe that the 75 companies are ending their fiscal years with a rather lucrative bottom line and able to purchase additional air ambulance units to support the growing demand for their services. It is expected and would come as no surprise that such a rapid rate of growth would limit the ability of the inspectors to keep up with the demands placed upon them to maintain the certifications and credentialing as needed to ensure that citizens are receiving the highest-quality HEMS operator when they are called upon. This period saw a total of 11 HEMS crashes claiming 19 lives and causing 6 serious injuries. Meanwhile, the FAA was still working on the "proposals" offered in October 2010.

2014 – On February 20, the FAA issued a sweeping final rule that requires helicopter operators, including air ambulances, to have stricter flight rules and procedures, improved communications and training, and additional on-board safety equipment. The rule follows the proposal made in October 7, 2010. The rule represents the most significant improvements to helicopter safety in decades and responds to government's and industry's concern over continued risk in helicopter operations.[13,14]

Within 60 days, all operators will be required to use enhanced procedures for flying in challenging weather, at night, and when landing in remote locations. Within three years, helicopter air ambulances must use the latest on-board technology and equipment to

avoid terrain and obstacles, and within four years, they must be equipped with flight data monitoring systems.[14]

The FAA examined helicopter air ambulance accidents from 1991 through 2010 and determined 62 accidents that claimed 125 lives could have been mitigated by today's rule. While developing the rule, the FAA considered 20 commercial helicopter accidents from 1991 through 2010 (excluding air ambulances) that resulted in 39 fatalities.[14]

The estimated cost of the final rule in present value for the air ambulance industry is $224 million with a total benefit of $347 million over 10 years. The cost for other commercial operators is $19 million with a total benefit of $83 million over 10 years. There is no cost for any operators to use new Class G airspace weather minimums for visual flying but the benefit is $147 million over 10 years.
The rule responds to the FAA Modernization and Reform Act of 2012 and National Transportation Safety Board recommendations.[14]

Bringing It All Together

HEMS is a unique and complex medical process with its own inherent risks and benefits to both the patient and the provider.[3] It's a medical decision made to specifically manipulate time in an attempt to "conserve life."[15] There is no doubt that the industry is experiencing a rapid growth in the number of helicopter EMS units in operation, the number of flight hours, and the number of both fatal and non-fatal crashes.

This is not a discussion on the utility of the HEMS industry. There are studies present that both support and argue against the value of using a helicopter to transport a critical patient versus using ground EMS transportation. It is the personal opinion of this author that the HEMS industry does in fact save lives by saving time to definitive medical treatment for the critically ill and injured.

This is also not a discussion of whether the actual accident *rate* is increasing or not. Some argue that the only reason more medical helicopters are crashing is because there are more of them actually flying and the number of accidents is not growing as fast as the number of helicopters and flight hours are growing. Tell that to the families of the accident victims. According to executives of medical helicopter companies, they could not be sure an accident trend existed because the industry had been operating without a system to track its total flight hours, a standard measure for assessing air deaths.[16] The fact is that if the commercial airline industry had a similar accident *rate*, we would lose 90 commercial airliners per year.[17] Is that significant? Is that worth our focus and efforts? Would that grab the attention of all our regulatory agencies, news media, and government officials?

The purpose of this article is to shed light on the fact that when we *do* choose to utilize the HEMS industry, we are ultimately choosing between the benefits of possibly increasing the chances of life for one patient with the risks of simultaneously jeopardizing the lives of that same patient and the rest of the crew on board who are operating under lax rules and regulations.

The HEMS industry has made long awaited advances in its rules and regulations courtesy of the FAA and NTSB this year. After decades of hundreds of lives being lost unnecessarily, rules and regulations are finally in place that creates a safer environment for all involved. There are still, however, several additional recommendations that can be made which would make the industry even safer for our prehospital healthcare colleagues and their patients. Below are just a few of those potential recommendations.

- Not every patient needs a HEMS transport. This is a fact. First responders play a crucial role under today's regulations in deciding whether or not to "launch". The other players are the rural hospital physicians that choose to fly a patient to larger tertiary care center. In February 2005 in Arkansas, a 71-year old male car accident victim had a cut on his forehead but was otherwise stable and alert. An Air Evac Lifeteam helicopter crashed within seconds of taking off, still in view of the ground EMS crews, and killed the patient and seriously injured the three crew members. This patient would have been on a 7-minute flight versus a 45-minute ground transport. However, it took over one hour from the time the helicopter was summoned until the helicopter was taking off with the patient on board. How was this supposed to help the patient? How was this supposed to save time? Did he really need to be flown in the first place?

1. *Critically evaluate the time advantage of air transport versus ground transport*. Without thinking of the patient condition, consider air miles versus ground miles and total transport time, including the additional time needed for the helicopter to launch and for local EMS to set up a landing zone. If no landing zone is available on scene, then additional time must be considered for transporting the patient by ground to a remote location where the helicopter can safely land. After all of this, if the benefit of flying *still* exists, then we can consider flying our patient.

2. *Consider the patient's condition and utilize objective, evidence-based guidelines to consider whether the patient would benefit from air medical transport*. After calculating the time advantage with air versus ground transport, is the total number of minutes that will be saved likely going to make a difference in this patient's outcome? Does the patient truly have a life or limb-threatening injury? What can that helicopter provide the patient that the ground transport crew cannot? What can one helicopter offer a patient that another helicopter cannot? Will the patient likely be discharged from the emergency department rather than be admitted or taken directly to the operating room? Or, will the patient likely die during transport or soon after arrival to the ED regardless of transport mechanism? An excellent set of guidelines was published in January 2014 in Prehospital Emergency Care.[19] These guidelines represent the work of a multidisciplinary panel consisting of experts in prehospital medicine, trauma, EMS research and evidence-based medicine. The objective of this guideline is to recommend a practical strategy for deciding which prehospital trauma patients will benefit most from air medical transport. Utilizing a well-accepted, systematic methodology, this guideline makes several recommendations for the

transport of prehospital trauma patients. Recommendations are then incorporated into a suggested algorithm for real-time use by EMS providers. The first and most important recommendation is that the "2011 CDC Guidelines for the Field Triage of Injured Patients" be used as the basis for risk-stratifying injury severity, and thus guide decisions as to transport destination and modality.[3,19] The CDC Guidelines use the best available evidence to derive the safest possible triage guidelines focused on the anatomic, physiologic and situational criteria associated with risk of major injury and poor patient outcomes.[3,20] The guideline goes on to recommend that consulting online medical direction prior to HEMS activation shouldn't be required for patients meeting the CDC criteria for serious injury. Recommendations suggest HEMS be used to transport patients meeting criteria for serious injury only if there will be significant time savings over ground EMS. All other trauma patients are to be transported by ground EMS unless system variables or road conditions prohibit safe and timely transport.[3,19] The guidelines don't define "time savings," but previous publications suggest HEMS may become the faster mode of travel when ground transport to a trauma center exceeds 30 minutes. Of note, if a patient was entrapped, HEMS may be faster at transporting much shorter distances.[3,19] When examining this new guideline, it's important to acknowledge all recommendations were made based on the best available evidence, which is typically of low scientific quality. This reflects the difficult nature of performing HEMS research and of making ground versus air ambulance comparisons.[3,19] These guidelines have inherent challenges, such as weighing regional differences in the consideration to fly a patient or not, but they have the potential to have a meaningful impact on patient care.[3,19] In its review of documents associated with 26 deadly helicopter EMS crashes in the United States between in the mid-2000's, the Baltimore Sun claimed that the helicopters were sometimes used in situations that were not immediate or life-threatening. "At least eight [fatal crashes] involved patients who waited longer for a helicopter than a ground ambulance might have needed to drive them to a hospital. And at least six were for patients discharged soon after a helicopter dropped them off at a hospital, or who survived a lengthy ambulance ride after the helicopter sent to get them went down," according to the Sun.[18] If there is *any* question about the utility of air transport in improving the patient's chances of survival and whether a mortality benefit exists, do not hesitate to contact your online medical control physician or the receiving physician and present the scenario.

- Pilots and crews are sometimes pressured to fly. This is understandable given the nature of the industry. They are called upon to save the most critically ill or injured patient and get them to the definitive care that they require. They provide a unique service that is unparalleled in the healthcare industry. Often, these patients grip our emotions. They are often innocent victims, the critically ill neonate, the teenage accident victim, or the elderly woman who suffered a massive stroke. When our colleagues call us to provide assistance, we don't want to say no. We can't. Some argue that it may be the pressure received from the operations managers who are thinking about the bottom line. Air ambulance companies receive an average of ~$7500 reimbursement per flight from Medicare

or other insurances, and often receive even more. They charge a liftoff fee of $12,000 to $30,000 depending on the amount of care offered in the current fee-for-service healthcare model, with an additional per loaded mile fee of $110 to $190. While some argue that the motive to fly is financially driven, others, especially those who have been in the field and in the trenches, argue that it is the inherent nature of an EMS professional to want to be there to provide life-saving skills to the patient. Pilots sometimes find themselves in particularly trying situations. Despite darkness or bad weather, they may be summoned to accident scenes. They aren't supposed to take off in poor conditions, but their decision whether to fly could mean life or death, and their emotions often dictate the decisions that are made.[17]

3. *The decision to launch should be up to the pilot, and the pilot alone. And the pilot should not have ANY knowledge of the patient or the patient condition.* Take the emotion out of it. This should be an objective decision made by the trained pilot who has knowledge of the most accurate weather conditions for the *entire* length of the flight and knowledge of the local topography along the route and at the destination. Even after the patient is loaded, the pilot should not have any knowledge of their deteriorating condition for fear that this may tap into the pilot's emotions and cause the pilot to make flight decisions that they would not otherwise do, and potentially place the entire helicopter and crew at risk.

- Human error. This element will always exist, regardless of the field in discussion. Human error, however, can have much more deadly consequences in the HEMS industry. Across the industry, mistakes by pilots remain the cause of the overwhelming majority of crashes. An analysis of almost 30 years worth of accidents shows that 82% of fatal crashes were caused by human error – almost all by pilots.[17] The other instances involved error by ground crews in establishing landing zones or in air traffic controllers providing inaccurate information. Why does the commercial airline industry not have the same elements of human error? Simple. Training and regulations. Their pilots are not simply "more experienced" in terms of flight hours. They receive more safety training and have higher degrees of regulation. The rapid growth of the HEMS industry may have depleted the pool of skilled or experienced helicopter pilots, but there have been plenty of documented accidents with highly skilled and experienced helicopter pilots. It is unfair to compare the HEMS industry to the commercial airline industry though. The unique mission of the air ambulance industry has contributed to the difficulty of preventing crashes. Unlike charter or airline flights that go into well-lit airports, air ambulances land on hospital roofs, or worse, by the sides of rural roads at night. And instead of delivering anonymous airline passengers, air ambulance pilots are charged with helping save lives. That mission can prompt pilots to press on in conditions when others might turn back (see recommendation #3).[17]

4. *Pilot training, pilot training, pilot training.* The air ambulance industry would drastically benefit from applying the same training principles to their pilots that

are applied in the commercial aviation industry. Improve pilot training, oversight, and technology. Teach them to monitor themselves for factors such as fatigue and tension. Teach them to listen to concerns from other crewmembers. All of this is performed in the commercial aviation industry and is known as "Crew Resource Management".[17] If the pilots need better equipment, including navigational tools and weather tracking tools, then find the funds to provide them. Force the industry operators to purchase these tools for their crews. It is a small price to pay to improve the safety of the patient and crew, and will ultimately result in many more dollars saved than spent in the near future.

- FAA inspectors are having a hard time keeping up with the growing demand for their services given the dramatic growth in the air ambulance industry. Air ambulance companies have expanded rapidly into the rural areas where rural hospitals had shut down. Given that the number of air ambulance bases have both grown in number and in geography, inspections are likely not happening on regular intervals. One example, in Miami in 2002, an Air Methods Inc helicopter clipped a parking garage as it tried to take off at Miami Children's Hospital. Luckily, no one was hurt. The NTSB discovered in its investigation that the FAA had never inspected the helicopter operation because it was new. Construction at the hospital had rendered the heliport dangerous, but the hospital had never told state and federal officials of the changes. And even though flying into the hospital was tricky, Air Methods had not provided the pilots any special training, the copilot told NTSB investigators. The copilot, who wasn't named in the NTSB's accident report, said company managers told him they knew it was "tight in there, but to deal with it since they needed the work."[17] The FAA requested to add inspectors back in 2005, but the request was turned down by the Bush administration as they instead faced a $25-million dollar cut. So, instead, they focused their limited resources on their biggest mission – inspecting large airlines. They have recently added new inspectors over the past few years to try and keep up with the demand, but the rate of growth of the HEMS industry is outpacing the rate of growth of the FAA inspectors. Considering that many of those inspectors work in Washington and do no inspections, that further limits the number of field inspectors.

5. *Funding is needed for more FAA inspectors. Initiate severe and stiff penalties for bases and operators who continue to operate while not in compliance with inspections.* This will likely contribute to base operators, the HEMS industry, and likely even the healthcare industry in general to begin lobbying for funding for more FAA inspectors when they feel the pinch of limited HEMS access due to failure of completed inspections.

- Not all helicopters are created equal. As referenced earlier, the majority of medical helicopters in operation in the U.S. are singe-engine, single-pilot Bell 206 models. Many of these helicopters that are responsible for picking up critically ill patients are refurbished models that have been in operation for over 20 years in other fields, such as the oil industry or tourist industry, as was the case with the

helicopter which crashed in that Arkansas accident referenced earlier. Each HEMS program is free to choose the helicopter that it utilizes. Some programs choose the small 30-year-old single engine aircraft worth $700,000, while another local program invests in new $10 to 12 million state of the art, twin-engine helicopters. Each program also largely determines its own fee structure, and is not required to report their fee structure under federal guidelines. Liftoff charges range widely from $12,000 to $30,000 with an additional per loaded mile fee of $110 to $190. Under the current CMS guidelines, all HEMS programs receive the same reimbursement per loaded patient mile regardless of aircraft size, level of care or capabilities. There is absolutely zero financial incentive for quality.[8]

- Similarly, the medical training of the crew is not created equal. Some HEMS crews consist of 2 paramedics with token training/experience while others in the same region may use highly trained EM physician-nurse teams. There is obviously a difference in the level of care received from these two different treatment teams.[8] However, there are still many HEMS programs who have a dedication to safety and quality patient care. They continue to operate in the early hospital-based programs and utilize highly trained, experienced pilots flying state of the art aircraft. The medical crews have continual intensive training and experience. They maintain close communication with medical direction.[8] Reimbursement remains the same regardless of the cognitive and technical abilities of the crew.

- CMS does not have any precertification or meaningful utilization requirements for HEMS as they do for almost every other area of medical care. HEMS is somehow inexplicably exempt. Payment by CMS is seldom denied or downgraded. Current published guidelines on HEMS utilization are so vague that almost any transport can be justified from a medical standpoint. If CMS pays, private insurers typically follow. As a result, the HEMS industry is one of the most potentially lucrative and unregulated entities in U.S. medicine.[8]

6. *Regulate the fee structure and reimburse based on quality of care received, quality measures, and appropriate utilization.* This is not a novel concept. It is actually one of the driving ideas in healthcare today. Today's healthcare is getting away from the traditional fee-for-service model and going more towards outcome-based reimbursement. When quality is incentivized, much of the redundant, profit-driven subsection of the HEMS industry will fade away and so will many of its inherent problems.[8]

Final Thoughts

There are many more recommendations that can be made, especially if you ask those who have been on the frontlines of the industry and have not only seen the challenges first-hand, but have fallen victim to them. The HEMS industry has faced many challenges from its infancy through the present day. While this was not a discussion regarding the utility or efficiency of using air medical transport, it is this author's belief that there is great value in flying a patient who appropriately meets the established guidelines,

although the true financial, mortality, and morbidity benefit may never be known. The HEMS industry currently offers a wide variety in the delivery of its services that, until now, has been dictated by the individual operators. This variability includes everything from the quality of medical services through the quality of safety standards. This variability and lack of oversight has resulted in the deaths of hundreds of our healthcare colleagues and the patients entrusted to their care. The NTSB has made thousands of recommendations to the FAA based on their investigations of hundreds of helicopter EMS accidents. While both agencies share a common goal to maximize the safety of this industry, that common "thinking" has not led to the appropriate actions needed to prevent the lives from being lost. The majority of those past recommendations fell to the wayside. The NTSB and FAA have only recently begun working together and this was evidenced by the fact that the FAA finally made sweeping mandatory regulations for the industry this year.

It is still too early to tell what degree of benefit the HEMS industry will see as a result of these newly enforced guidelines. It will take years for the mandatory guidelines to even be in full effect. Obviously, the cost will be substantial up front, but the long-term savings will be much more, not just in terms of dollars, but in terms of that which cannot be measured, that of the human life.

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