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The Effects of SMS Implementation on Safety Culture Within Helicopter Emergency Medical Services

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THE EFFECTS OF SMS IMPLEMENTATION ON SAFETY CULTURE WITHIN HELICOPTER EMERGENCY MEDICAL SERVICES

by

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This thesis, submitted by Ray W. Gardner in partial fulfillment of the requirements for the Degree of Master of Science in Aviation from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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Ray W. Gardner
2017

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ABSTRACT

Safety Management Systems (SMS) have now become regulation within FAR Part 121 operations with U.S. airports and FAR Part 135 operators coming next. An assessment of the implementation of voluntary SMS programs and their effects on safety culture within major U.S. Helicopter Air Ambulance (HAA) operators was conducted. This study is designed to see if safety management systems, safety culture or the lack thereof changes the perception of HAA operators and crew members.

A Likert style survey was administered to HAA pilots, paramedics, and flight nurses who were asked for their perception on their ability to communicate freely, belief their organization's culture was a Just Culture, and the effectiveness of certain hazard mitigation protocols popular to the industry. The survey data revealed that SMS has been fairly well received by the working roles in these HAA operations. It also showed that some difference in opinion surfaced between the most experienced group (twenty plus years) and less experienced respondents (< twenty years).

Key Words: Safety Management System, FAR, Helicopter Air Ambulance, Likert, Just Culture

CHAPTER I

INTRODUCTION

In April of 2016, a sight-seeing helicopter crashed near the Smoky Mountain National Park on the outskirts of Sevierville, TN, resulting in the death of all on board. While this accident ended in tragedy, helicopters are seen as lifesavers, with the ability to transport an injured individual a short distance from point A to point B. With the versatility and ability to land quickly almost anywhere, you have the perfect combination for emergency medical transport. Helicopter transport is vital in a country where people are spread out, sometimes living great distances from major metropolis' and town centers where medical facilities are located. This need provides opportunity and growth for helicopters, but also a need for safe practices. Safety Management Systems (SMS) are the future of the aviation industry, and will prove vital in the growth of such a large and necessary operation like Helicopter Emergency Medical Services (HEMS).

Statement of the Problem

Fatal accidents have been well documented as being driven by human error with little to no known improvement except by adding expensive new technology. Without measuring Safety Culture -or a "No Pressure Culture"- it is difficult to determine whether new safety mitigations are truly benefitting Helicopter Emergency Medical Services

(HEMS) operations. Thomas, Groke, and Handrahan (2011) see HEMS operations being used in a non-efficient manner in which they are manipulated by the need for generated revenue to pay for those new technological upgrades, "…new technology initially increases the safety margin, it quickly becomes a means to justify the acceptance of additional flights that were previously thought 'too risky' in an attempt to preserve financial viability" (p. 53). This thought process and way of conducting operations is continually putting crews and aircraft in situations that increase the risk of a fatal accident. In most cases proactive measures may have prevented the fatal accident.

Purpose of the Study

The term Safety Culture has become steady vernacular within the aviation industry with companies trying to push a mentality that drives a zero accident rate on the Global Injury Rate (GIR) standard. A lofty goal, yet attainable if employees buy into the statement that a strong safety culture can get them home safe every night. In a world that is heavily scrutinized and under constant watch by media and social media, it is imperative that companies do all they can to, ensure a safe working environment and a clean safety record.

Safety Culture is meant to empower employees by providing a work environment conducive to safe behaviors that protect employees from harm. Safety Culture can create a Just Culture in which those individuals trust their colleagues and management, in which the best possible decisions are made based on safety and ensure employees return home to their families. As Ed Bastian, Delta Air Lines CEO, stated in an interview with Marketplace (2016), his role as CEO is "taking care of our people". A culture of safety

ensures all employees, not just management, believe in safety, achieving a true culture of safety.

Fatal accidents in the HEMS community is a major issue in the aviation industry. There has to be a change in the culture in order to reduce these accidents. As other companies push the zero accident tolerance rule, it is essential that HEMS operators do the same. The purpose of this study is to determine if safety management systems, safety culture or the lack thereof can change the perception of HEMS operators and crew members.

Research Questions

1. Who employs SMS in HEMS operations?
2. How has SMS been embraced by pilots, paramedics, and flight nurses?
    a. How do the Pilots, Paramedics, and Flight Nurses' perceptions compare on aspects of safety culture?
3. Is passage of time a factor in these organizations to acknowledge and accept this change?
4. Do pilots, paramedics, and flight nurses think their service is being overused?
    a. How do the three groups' perceptions compare on certain risk mitigations?

Key Terms

Community HEMS Operator – a stand-alone air ambulance operator, usually for profit, that operates under their own Part 135 certificate and is covered by the Airline Deregulation Act (Cline, 2012, p. 81).

En-Route Decision Protocol – As cloud ceiling or visibility drops, pilot will descend to lower altitudes to maintain visual contact with ground and reduce airspeed to permit observation of obstacles (Winn, Thomas, and Johnson, 2011, p. 82).

Just Culture – A culture in which front-line operators and others are not punished for actions, omissions or decisions taken by them which are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated (Licu, 2014).

No Pressure Initiative – An initiative that focuses on three aspects of an operator (1) safety-minded organizational structure, (2) use of preflight risk assessment tool, and (3) use of the en-route decision protocol (Winn, Thomas, and Johnson, 2011, p. 81).

Preflight Risk Assessment Tool – A risk assessment, of known factors that lead to HEMS accidents, conducted prior to a flight (Winn, Thomas, and Johnson, 2011, p. 81).

Safety Culture – the way safety is perceived, valued and prioritized in an organization. It reflects the real commitment to safety at all levels in the organization (SKYbrary, 2017).

Safety Management System – a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures (SKYbrary, 2016).

Traditional HEMS Operator – an air ambulance operator owned and operated by a hospital or healthcare entity and the hospital provides the medical staff and a third party vendor usually provides the aircraft, flight crew, maintenance services and Part 135 certificate (Cline, 2012, p. 81).

Literature Review

Safety Management Systems

Risk is the probability that some type of hazard will have the opportunity to affect a person, organization, or in this case both along with an aircraft. While there is always risk, risk can be managed in order to reduce the probability of an accident. Prior to this thought process, operators waited until an accident happened and then determined the reason for the accident. Stolzer and Goglia (2015) note this, "In the past, aviation safety improvement was characterized by a fly-crash-fix-fly approach. We would fly airplanes, have the occasional unfortunate crash, and we would investigate the cause(s) to prevent it from happening again" (p. 15). This retrospective action might determine the root cause, but it comes at too high of a price. When losing a crew, passengers, and an aircraft is what operators are willing to pay, the public is left questioning the operator's viability. This has been reiterated through the change from retrospective action to pre-incident mitigation and risk management.

SMS provides an organizational approach to risk management that allows an operation to document and influence their safety culture. SMS is the evolution of safety practices as Esler states (2009) Witowski:

> SMSes strive to coordinate information inside the organization and process it. 'That's difficult because the organization is a living, breathing dynamic organism, and it is hard to change the culture of the people who make it up, as well as all the influencing factors, like regulations…safety management is going to try to recognize all those influences and illuminate them so that organizations can

> determine and evaluate the risks they face from internal and external influences. (SMS: The 'Next Step in Safety' section, para. 2).

The key to producing a productive SMS is in the ability to actively manage safety issues that an operation faces. For the HEMS community, being able to combat human error due to errant pilot beliefs is an important priority. Several mitigations have been brought forth to help with these issues: 1) No Pressure Initiative (NPI), 2) En-Route Decision Protocol (EDP), and 3) Preflight Assessment Score (PRAS). These mitigations are a part of the beginnings of a change in safety culture, providing a baseline for further discussion along with the development of the methodology used in this study.

Defining Safety Culture

Throughout previous studies concerning fatal HEMS accidents a recurring theme surfaces, the decision made by the pilot to continue to push man and machine to its limits and beyond, has been well documented by several authors. Winn, Thomas, and Johnson (2012) state, "Perhaps the most disturbing of HEMS accidents are those that occur when a perfectly fit pilot flies a perfectly airworthy aircraft into the ground or into a ground-based obstruction, killing all on board without any premonition of what was about to occur" (p. 80). What would this look like if that mindset were to change, providing an opportunity for pilots to reflect and decline a flight based on personal limitations?

Organizational background consists of multiple layers, but the overarching theory is Safety Culture. An expert in safety, Reason (1997) defines Safety Culture as, "Shared values (what is important) and beliefs (how things work) that interact with an organization's structures and control systems to produce behavioural norm (the way we do things around here)" (p. 192). Turning back could be seen as cowardly by not

responding to a perceived need or obligation. This could be a difficult change for how flight crews who feel the need, or personal pressure, to be ready at a moment's notice to provide emergency services. Providing service, while being ready to mobilize is essential to communities across the United States. Orgill (2010) defines this concept, "Some casual observers idealize helicopter flight crews with near angelic regard. Yet others have the erroneous belief that they can, and possibly should as a matter of course, heroically defy overwhelming environmental odds to reach and transport critically sick or injured patients. It is difficult to not be influenced and pressured by this kind of stereotype at least occasionally" (p. 250). This creates dangerous precedent in an industry growing exponentially with new operators taking on multiple operations. The result is a name change of Helicopter Emergency Medical Services to Helicopter Air Ambulance (HAA).

Overuse of HEMS?

Helicopters have become a glorified ambulance that may not be providing the best practice when it comes to medical transport. Instead of taking care of those who are truly in need of critical care, there has been a change towards transporting different types of patients. Studies, such as *Medical Helicopter Accidents in the Unites States: A 10-Year Review* by Bledsoe and Smith, highlights the existence of HEMS aircraft transporting patients to the emergency room who end up never being admitted to the hospital, granted the authors do admit to their bias of HEMS inefficiency. Bledsoe and Smith (2004) said, "the increased number of medical helicopter accidents we have reported is noteworthy in that several recent studies have shown that medical helicopters in the United States and other countries are overused" (Discussion section, para. 3). It is beneficial to notice this possible defect in the system, or rather this introduction of a new purpose to the use of

this type of medical aircraft and the cultural acceptance of run-of-the-mill patient transports.

Another layer to the Safety Culture that is commonly discussed is Just Culture. In the vein of defining terms, this one should also be coined for the use of describing HAA culture. Reason (1997) provides a practical definition, "…an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information—but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour" (p. 195). A Just Culture has to exist in order for any change to come to fruition. The ability to trust colleagues, and more importantly management, provide the reliability that if a no-go decision is made, the crew will not be penalized for failure to generate revenue when something is outside of their limitations.

Looking to the Past to Understand the Present Issue

The retroactive analyses that have been cited, were conducted in the last two decades reviewing fatal accident outcomes in HEMS/HAA accidents. These analyses present a particular bias against the overuse of helicopter medical transport, while others look to determine trends in accidents to provide knowledge to combat the fatal accident rate. Bledsoe and Smith (2004) wrote an article reviewing a ten-year span of fatal accidents, in which they positively correlated the increase in HEMS/HAA operations with an increase in the number of accidents. Bledsoe and Smith's (2004) findings are interesting and are viable to current issues surrounding the HEMS community.

Bledsoe and Smith's (2004) methodology utilized the National Transportation Safety Board (NTSB) database in conjunction with the Concern Network database.

Bledsoe and Smith (2004) defined a medical helicopter accident as, "…any incident that significantly damaged the aircraft, resulted in an injury to any person that required medical evaluation, resulted in death of any person, or impacted patient care" (Methods section, para. 3). Using this definition, Bledsoe and Smith (2004) uncovered 84 medical helicopter accidents, where 80 were received from the NTSB database and 4 were collected from the Concern Network Database. Some numbers from their search are as follows: Out of 260 passengers on these flights, 72 fatalities and 64 injuries occurred. Those fatalities and injuries were responsible for over fifty percent of the passengers on these flights. Accidents with fatalities made up 23 percent and 10 percent were a mixture of fatalities and injuries. The Bell 206 Long Ranger was the aircraft in which 20 percent of these accidents occurred and major cause belonged to pilot error at 64 percent. The Bell 206 is a very popular and old airframe in the helicopter industry and this information is vital to the improvement of the HEMS industry.

During Bledsoe and Smith's (2004) research, the authors saw a spike in accidents between the years of 2000 and 2002. Bledsoe and Smith (2004) refer to Shatney stating, "Shatney and colleagues reported a retrospective review of 947 consecutive trauma patients transported to their trauma center in the Silicon Valley of California, finding that only 22.8 percent of study patients possibly benefitted from helicopter transport" (Discussion section, para. 3). Bledsoe and Smith (2004) claim, based on the evidence presented by Shatney (2002), Eckstein (2002), and Wills (2000), the growth of the HEMS industry has resulted in helicopter medical transport overuse.

Shatney et al. (2002) completed an assessment on the utility of helicopter transport in an urban environment, which provided a detailed description of the Silicon

Valley in California. The freeway system, trauma centers, and medical transport available in the area were metered against the number of patients, their Injury Severity Score (ISS), and how cluttered freeways would be during certain hours of the day. The years of data the study used were between 1990 and 2001. The assessment identified, "…947 trauma victims were transported by helicopter from the injury scene to [their] trauma center" (p. 818). Helicopter transport was determined to only provide 54.7 percent faster transportation time than ground transport. Ground transport was faster in 45.3 percent of the events. The group found that helicopter medical transport use is "excessive" (Shatney, Homan, Sherck, & Ho, 2002). Shatney et. al (2002) determined two primary reasons why overuse occurs, "First, the misconceptions that the helicopter is always faster than ground transportation and that air evacuation saves lives are common among paramedics and other first responders" (p. 820). This is a cultural belief that runs through multiple organizations and refers directly back to Orgill's (2010) point that helicopter crews are held as an almost guardian angel type of rescue.

Can Risk Be Engineered Out?

Fatal crashes can dampen the appeal of helicopter medical transport. The irony behind this is that helicopter medical transport is supposed to save lives, yet can bring the opposite, which has been studied by many in academia. Multiple avenues have been explored, namely the introduction of ever-evolving technology to make pilot lives easier, such as terrain awareness systems, autopilot systems, and night vision goggles. This particular path leads to an "effect that can be described as the 'HEMS technological safety spiral'" (Thomas, Groke, & Handrahan, 2011), where the introduction of new and expensive equipment requires operators to take on more at risk flights in order to pay for

the new technology. While the recommendation of new technology systems seems valid and the right direction to pursue, the validation of the new equipment has not yet been completed.

Post-crash fire issues have been determined as factors in fatal injury outcomes and leads to the next topic of discussion within engineering risk out, crashworthiness. New technology is usually a great addition to an operation, but what about the bare necessities of the aircraft itself? Multiple studies have produced research on the survivability and needed measures for post-crash fire. Baker et. al (2006) study on what causes fatal outcome said the following, "Postcrash fire increased the odds of fatal outcome 16-fold more than any other factor. Nineteen percent of crashes and 39 percent of all deaths were associated with postcrash fire" (p. 355). This issue highlights another path that needs to be pursued, which is the need for an in-depth analysis of crashworthiness on older aircraft being used in this type of operation. This study by Baker et. al (2006) found that crashes having at least one survivor could be a catalyst for determining better crashworthiness standards. Crashworthiness is another mitigation to engineering out fatalities in accidents and presents more facets for determining the best combination of safety protocol.

Continuing in the vein of engineering risk out, knowing the age and amenities of working medical aircraft is something that can be of use in determining further mitigations and provide corrections to current policy and procedure. Medical helicopters can go through extensive modification to support the life-saving transportation operation they are meant to conduct. Many aircraft have been in service for decades and have to be retrofitted in order to meet the expectations of the operation. This can lead to crashworthiness issues, such as a lack of shoulder harnesses or a reconfigured bay in the

cabin to load patients. When an aircraft, or any vehicle for that matter, is extensively modified from its original format, the integrity of that ship has become something other than what it was intended to be. Baker et. al (2006) found, "…crewmembers in the main cabin of EMS helicopters were at more than four times the risk of injury in survivable crashes compared with crewmembers in the cabins of non-EMS helicopters, in part because of cabin modifications for patient care and transport" (p. 355). If post-crash fire and crashworthiness are problematic contenders in creating fatal accidents, there should be regulation and motivation for operators to provide better equipment to their crews. This is an essential part of safety assurance, and provides the crews the reassurance that are flying the best ship intended for their use out there.

When given the best product for the environment in which a crew member works, it not only provides assurance, but a desire to do their best work and return the product in the best shape possible. Not only does that add to the appreciation of the ship, but also would create an aircraft specifically designed for the operation. Baker et. al (2006) commented, "Energy-attenuating seats, unavailable for the medical crew in many helicopters because they are required only for newly certificated helicopters, could reduce the vertical forces to survivable levels in many crashes" (p. 355). Manufacturers moving forward must involve this type of engineering mitigation into their new aircraft development.

Pilot Decision Making and its Effects

Through the studies conducted on fatal injuries in HEMS/HAA operations presented in this literature review (such as *When Discretion is the Better Part of Valor* and *Knowing Our Limits)*, human error/pilot error is the primary cause found. Crews

operating with negative behaviors make a change in culture necessary. There are several initiatives that have been circulating throughout the industry. Those ideas consist of crews being allowed to have some control over the decision making process by making a go/no-go decision while en-route, and not taking a flight if the crew will be performing outside their limitations.

En-Route Decision Protocol (EDP Protocol)

The first of these mitigations is the En-Route Decision Point Protocol (EDP Protocol). Orgill (2010) presents the topic of EDP Protocol. A comparison is made between the almost angelic appearance of helicopter medical transport and the reality of what can really happen on certain flights. Crews have different perceptions of operations they conduct. Some see it as a mission, or an obligation, considering many pilots are military veterans. Orgill (2010) states, "internal pressures, such as fear of failure, the personal need to prevail, the need to maintain stature in the eyes of our peers and managers, and the critical needs of the patient, then mission completion can become the overriding priority in the minds of both pilot and crew" (pp. 250 – 251). All branches of the military are known for their standardization and ability to complete the mission in an efficient manner, typically in a hostile environment, and to return safely back to base ready to go on the next mission. How are highly standardized groups, such as military pilots, able to produce a productive environment in which their units fly thousands of missions without fail? Is it truly an issue of human error or could it be a cultural issue?

The EDP Protocol is intended to give flight crews the opportunity to establish minimums in order to make decisions en-route. In many cases, these operations are conducted on short notification with the expectation of precision and efficiency. Weather

or landing zones may not be current or available to the crew at the time of departure. This addition will allow flight crews to determine easily while in flight if there is a need to turn around because the flight cannot or should not be continued. Orgill (2010) gives the parameters of the protocol, "The rule is the 90-knot/300-foot en-route decision point (EDP). If flight conditions require a descent below 300 feet above ground level, or deceleration below 90 knots to maintain comfortable visual contact with the route ahead, a decision to reverse course is triggered, land, and call for reinforcements, or to make the transition to instrument flight rules…at night it is extended to 90 knots and 500 feet" (p. 251). This type of protocol also provides guidance for moments of white-out or brown-out conditions, which can be common in snowy or loose dirt conditions.

Stress can be self-induced, from a desire to meet an obligation, or a must-do attitude. EDP is intended to take the guesswork or stress out of making a decision regarding the outcome of a flight. Orgill (2010) says, "EDP adds an element of methodical, checklist-type certainty to the weather-related en-route decision-making process…It does not require the lengthy mental processing of a detailed weather minimums table, such as the one found in Federal Aviation Regulation 91.155" (p. 251). Pilots are used to checklists, and with the addition of the EDP checklist, it can become routine, creating a deterrent to errant beliefs or fear of not living up to expectations. Given the freedom, and security that their decision will not be penalized, will provide a better working environment. The crew will be relied upon to do what is best in a particular situation and can better handle what they come across, rather than making a blank statement regarding go or no go decisions.

EDP was tested by a select group of 14 individuals, who after use, approved the concept. Orgill (2010) reported some of the comments received from the group, "It is a great interceptor for someone who might have the propensity to push on. It takes the hard decision out of my hands so I don't feel the pressure associated with turning back. If I can't maintain the airspeed and altitude criteria, it is just time to go home" (p. 252). While this is a small user group, it is a group of individuals who have spent significant time flying and their perception of this protocol is promising. The attitude is one that is positive and receptive of this type of intervention protocol and provides a solid baseline for implementation. Pilots' comments reflect a desire to make the operation simpler and reduce stressors received while inflight. The EDP Protocol will provide a great status update with the different organizations that the survey will be provided. If protocols of this nature are being implemented throughout the industry, it may be possible to determine positive trends from operators making use of the intervention.

No Pressure Initiative

The second mitigation observed is the No Pressure Initiative. The studies and research cited regarding mitigations to help reduce these fatal accidents, Controlled Flight Into Terrain (CFIT) is cited as a major outcome in these accidents. Winn, Thomas, and Johnson (2012) stated, "…after reviewing NTSB reports for HEMS accidents from 1998 to 2008, identified 31 CFIT accidents that occurred during the en route phase of flight, claiming 79 lives" (p. 80). With that said, another topic reviewed to uncover a root cause, lack of experience or flight time is not usually an indicator of the accidents. However, the data presented would say that more experienced pilots are putting their aircraft in the ground. So, why are experienced pilots making decisions that put them in a terrible

situation? The National EMS Pilots Association (NEMSPA) wanted to uncover the cause. Winn, Thomas, and Johnson (2012) provided a survey to 250 HEMS pilots in the U.S. The survey revealed, "…one-in-three respondents was susceptible to 'internal' pressures and one-in-four pilots admit to feeling 'external' pressures to fly in questionable weather conditions" (p. 81). The recurrent trend of internal and external pressures only reinforces the fact that culture is the underlying issue concerning fatal HEMS/HAA accidents. From this survey, Winn, Thomas, and Johnson (2012) created the No Pressure Initiative and consists of three elements, "1) a safety-minded organizational culture, 2) the use of a formal preflight risk assessment tool to evaluate flight risks, and 3) the implementation of an en-route decision protocol (EDP) to assist pilots in determining when conditions are no longer safe for continued flight" (p. 81). This literature supports the implementation of Safety Culture, EDP, and the last of the new mitigations: preflight risk assessment.

Preflight Risk Assessment Score (PRAS)

The last of the mitigations is the Preflight Risk Assessment Score (PRAS). A HEMS flight cannot be accepted until it scores within the parameters of the PRAS. Winn, Thomas, and Johnson (2012) outline the necessities of the PRAS:

> "An effective pre-flight risk assessment must incorporate those elements of risk that are known to be factors in HEMS accidents. It should also generate a mission-specific index of risk that would require that a pilot consult with another pilot or with a higher level of aviation management (e.g. Chief Pilot…) before making a decision on whether or not to accept a flight under conditions of elevated risk" (p. 81).

The tool also looks at pilot experience, weather, day or night conditions, local or nonlocal, fatigue, and knowledge of a familiar route. This tool is not standardized and therefore does not provide an opportunity for trending at the moment, but can be a baseline for the FAA to develop a standard that allows operators to incorporate the PRAS into their Safety Culture. The development of this tool, if made mandatory, would provide another layer in risk mitigation for these organizations. It is recommended that PRAS be further studied in order to help determine the needed standardization of this tool.

The development of these mitigations will provide the opportunity for a robust and mutli-layered Safety Management System along with the development of Safety Cultures throughout the HEMS/HAA industry. Fatal accidents are still a major influence on U.S. HEMS operations. The literature points to human error as the biggest indicator of these accidents, but a further look directs the root cause to a weak culture, or lack thereof, surrounding HEMS operations. It is natural that humans are fallible, but if given the opportunity in a safe and less stressful environment, crews can make better decisions regarding the operation. Mission mentality is apparent among flight crews throughout the U.S., and presents a block to crews managing their Safety Culture. With this literature, it is determined that surveying operations on their safety culture is the best manner to determine where holes exist in their safety management.

CHAPTER II

METHODOLOGY

Helicopters are typically not certified for IFR conditions, yet they can be outfitted to work in those conditions. HEMS operations are never scripted or have particular routes, as the destination, and landing zones, for these aircraft are sporadic. Accidents happen often. According to the International Helicopter Safety Team (2016), the 2015 accident rate was 2.79 accidents per 100,000 flight hours and the fatal accident rate for 2015 was 1.27 accidents per 100,000 flight hours (Helicopter Accidents, slide 3). The International Helicopter Safety Team found that 18.20 percent of accidents occurring between 2005 and 2015 were due to "a poor assessment of the weather" (Helicopter Accidents, slide 6). Many of the highly trained pilots who enter the air ambulance field have received their instrument rating and have the ability to fly under such conditions, if current, but if the aircraft is not outfitted, nor certified for the circumstance, the flight should not be attempted. Pilots can sometimes act in a "macho" attitude in which they believe they can fly in any type of weather condition, or in the case of air ambulance operators, the need to complete the mission and move the critically injured to healthcare. For HEMS types of missions to be successful, they must have a focus on safety. The aviation community has moved towards a more proactive approach to safety, which is SMS for Part 121 per the regulation (Part 5). SMS is not yet required for Part 135 operators, but the aviation community and FAA are moving in that direction. Some

HEMS operations have begun to use SMS methods to try and change the mentality and culture of their respective organizations. The purpose of this study is to produce a Pilot, Paramedic, and Flight Nurse perspective of the application of SMS and whether the implementation, or the lack thereof, of SMS has provided the necessary means for a just culture and a belief in the safety culture of that organization.

Population

The study allows both SMS-implemented and non SMS-implemented FAR Part 135 Helicopter Emergency Medical Service operators to participate. The difference in operations can provide a greater picture to the overall health of safety cultures. The study includes both traditional and community style operators.

Included in the population are pilots, flight paramedics, and flight nurses from HEMS operators across the United States. These crew members have spent at least one year in their respective position. Management and safety officials within the operation were excluded from the study. The study is intended to ask for a bottom-up perception from the working roles (Pilots, Paramedics, Flight Nurses) on the policies implemented by management.

An important aspect of this survey is to collect pilot and crew responses. The medical crew can see the operation from a non-aviation aspect. Crew members have spent a significant time around the aircraft and this style of medical treatment, and crew are looking at the pilot as not only the Pilot In Command (PIC), but also the leader of the operation. This type of relationship mirrors that of a traditional First Officer to a Captain, as seen in airlines. The medical crews' willingness to participate and voice their opinion

on the go/no go decision of a mission is just as vital to the safety culture as the pilots' decision as the PIC.

Sample

The study surveyed pilots, flight paramedics, and flight nurses from Part 135 Helicopter Air Ambulance operators. There was no incentive to take the survey and participation was completely voluntary. The survey was accessible via the internet via Qualtrics®, which is an internet-based survey tool. The survey was accessed by a link provided to the participants by email and/or a social media post. Responses that did not answer all the questions or answered none of the demographics questions were removed.

Study Design

The operators have been identified through the assistance of the FAA and personal contacts of the principal investigator. Five individuals were identified, with the assistance of the FAA, to continue the process of determining the population. Those five individuals represented major HAA providers. Through the personal contacts of the principal investigator, other major HAA providers were contacted.

Once the operators were determined, they were given the link to forward their crews. A recruitment email was sent providing the title, background, and an overview of the study. The online survey was used for two very distinct reasons, 1) to provide ease of distribution and access to the survey from anywhere in the United States where the participant had access to the internet, and 2) allowed the participants anonymity. With the generic recruitment email sent to each operator, each organization has anonymity.

Once each participant followed the link to the survey, the first page made available to them was an information sheet outlining details of the survey, including the

principal investigator and the advisor of this study along with their contact information for questions. The information sheet reminded the participants that their participation would be anonymous, voluntary and they could quit at any time. The survey was available for four weeks.

The survey was written using primarily qualitative questions using a Likert scale to allow for coding during the analyzation period of the study. Eighteen questions were asked, they were divided into three blocks: demographics, perception of safety culture, and use of risk mitigations.

Method and Data Collection

The study will use the online survey program Qualtrics® in order to question HEMS operators on their Safety Culture. Upon completion of the survey, Qualtrics recorded the information and an array of data for use in the data analyzation period of the study.

Data Analysis

The data will be analyzed to determine if the working groups (Pilots, Paramedics, Flight Nurses) are effected by implementation of certain safety culture and risk mitigation efforts. The data groups were compared using a one-way ANOVA for each survey question in Blocks 2 and 3 to determine any significant change between groups.

Limitations

The survey was created by the principal investigator and therefore was based on research conducted for the literature review of this project along with the investigator's experience working with a FAR Part 121 Safety Management System. The application of experience gained from Part 121 to Part 135 can be viewed as a limitation with the

different areas serving a wider array of operations, but the focus was on the pilot and medical crews' perception and the application of SMS rather than the difference in user base. The survey was validated by the principal investigator's advisor.

In order to preserve anonymity, questions asking for particular information were limited. More specific questions might affect the final results of the survey and whether or not participants would complete the survey. Questions were asked broadly in order to preserve the participants' trust in the principal investigator's intent.

There was no gatekeeper or monitoring system to determine whether participants only took the survey once. The survey link did not have a unique identifier, therefore providing a single link for the entire survey. This also could leave the results vulnerable to being lopsided towards one operator.

Protection of Human Rights

All the participants were directed to an information page at the beginning of the survey outlining the details of the project. Participants were in no harm by taking this survey. A statement of confidentiality was given to participants via the information page reassuring that no identifiable information, neither individual participants nor naming them to a particular organization, would be recorded. Participants were able to leave the survey at any time without penalty by closing the tab they were taking the survey in. The information page acted as the consent form from the participants. By participants clicking the continue button on the survey they acknowledged they had read the information page, understood its instructions and agreed to its terms. This project including the survey, survey recruitment email, data storage, and participants were approved by the University of North Dakota's Institutional Review Board.

CHAPTER III

RESULTS

Prior to conducting tests, the questions in the survey were listed out and a variable type was assigned. This was a necessary practice to determine the type of statistical tests needed for this study (Table 1).

Table 1. Variable List

Variable Type	Abbreviated Question	Answer
Categorical	1. Role in Operation	Pilot, Paramedic, Flight Nurse
Binary	2. Gender	Male/Female
Categorical	3. Age	18-30, 31-45, 46-59, 60+
Categorical	4. Years of Experience	1-5, 6-9, 10-15, 15-19, 20+
Binary	5. Implemented SMS	Yes/No
Binary	6. Operation is..	Traditional/Community
Interval	7.1 Strong focus on safety 7.2 Just Culture 7.3 Open communication 7.4 Comm for go/no go dec. 7.5 Med crew confidence in pilot 7.6 Crew dec. making importance 7.7 HEMS accidents retrospective 7.8 Safety culture belief	Likert Scale 1-5 1 = Strongly Agree 2 = Agree 3 = Do not agree, nor disagree 4 = Disagree 5 = Strongly Disagree

Table 1. cont.

Variable Type	Abbreviated Question	Answer
Interval	8.1 Use of NPI 8.2 Mgt respects crew go/no go dec. 8.3 Personal min. are vital 8.4 Tech avail. to crew 8.5 Tech upgrades necessary to do job effectively 8.6 Belief tech upgrades make crew safe 8.7 PRAS used 8.8 EDP used 8.9 EDP mitigates IFC cond.	Likert Scale 1-5 1 = Strongly Agree 2 = Agree 3 = Do not agree, nor disagree 4 = Disagree 5 = Strongly Disagree

Demographics, Block 1

Twenty-six pilots, five paramedics, and ten flight nurses (N = 45) completed the survey. Of those forty-five initiated responses, .76 (34 responses) met completion. Sixteen (n = 16) were removed prior to analysis. Thirty-four responses were completed, but not all answers were recorded. The removed survey responses are weighted thusly (Table 2).

Table 2. Responses Removed from Survey and Justification.

Number Removed	Reason Removed
12	Partially answered responses. The responses were submitted without answering all questions.
4	Surveys were started and submitted without answering any of the questions.

Table 2. cont.

16	Total Removed

With the removal of the partial responses, twenty-nine (N = 29) responses remained. The survey's first six questions were demographic in nature, including role, gender, age, years of experience, if an operational SMS exists, and whether the operation was traditional or community.

The survey focused on the operational roles of HAA operators. Those positions include Pilots, Paramedics, and Flight Nurses. Sixteen Pilots accounted for 55 percent (16 responses) of the total responses. The Flight Nurse response rate, 28 percent (8 responses) was nearly double that of the Paramedic group's response rate, .17 (5 responses) (Table 3).

Table 3. Survey Response Count by Role (Pilot, Paramedic, Flight Nurse).

Category	Response Rate (%)	Response Count
Pilot	55.17	16
Paramedic	17.24	5
Flight Nurse	27.59	8
Total	100	29

The second demographic question asked for the gender of the survey responder. Male responders heavily outweighed female responders by making up 83 percent (24

responses) of the total responses. The female responses recorded at 17 percent (5 responses) of the total responses (Table 4).

Table 4. Survey Response Count by Gender.

Category	Response Rate (%)	Response Count
Male	82.76	24
Female	17.24	5
Total	100	29

The third demographic question asked for the age of the survey responder. This question was asked in a range of ages in order to help protect the responders' anonymity. Those ranges can be seen in the following table. The leading age range was the 31-45 category with 52 percent (15 responses) of the total responses (Table 5).

Table 5. Survey Response Count by Age.

Category	Response Rate (%)	Response Count
18-30	13.79	4
31-45	51.72	15
46-59	24.14	7
60+	10.34	3
Total	99.99	29

The fourth demographic question asked for years of experience. This was also asked in a range, not only to protect anonymity, but also to provide a baseline in years, rather than flight hours, for the Paramedic and Flight Nurse respondents (Table 6).

Table 6. Survey Response by Years of Experience.

Category	Response Rate (%)	Response Count
1-5 year	34.48	10
6-9 years	24.14	7
10-15 years	17.24	5
15-19 years	13.79	4
20+ years	10.34	3
Total	99.99	29

The leading experience range was 1-5 years accounting for 34 percent (10 responses) of the total responses. Nearly 59 percent (17 responses) of total respondents had under ten years' experience in their respective career field.

Research Question 1

The first research question is, "Who employs SMS in HEMS operations?" This was phrased as a yes or no question in the survey as Q5 – Your operation implements a functional SMS? The following table breaks out the three respondent groups with their answer to the above question (Table 7).

Table 7. Response to Functional SMS by Operational Role.

Q1 – Role in Operation	Q5 – Functional SMS		Response Rate (%)	
	Yes	No	Yes	No
Pilot	14	2	48.28	6.89
Paramedic	5	-	17.24	-
Flight Nurse	8	-	27.59	-
Total	27	2	93.11	6.89

The Pilot group had the highest response rate of 'Yes' at 48 percent (14 responses) of the total responses. It must be noted that the Pilot group was also the largest respondent group in the survey. The Pilot group was also the only group to have any 'No' responses which accounted for 7 percent (2 responses) of the total responses in the survey. It must be noted that these one of those responses was an international response (Saudi Arabia).

Research Question 2, Block 2
Perception of Safety Culture

A one-way ANOVA was performed to compare the perception of job roles to the effectiveness of a strong focus on safety in the work environment. Participants were divided into three groups based upon their specific role in the operation (Group 1 – Pilots; Group 2 – Paramedics; Group 3 – Flight Nurses). The assumption of homogeneity

of variances was tested and satisfied based on Levene's *F* test, $F(2, 23) = .2.08$, $p = .148$. There was not a statistically significant difference in the effectiveness of a strong safety focus in the work environment for the three groups ($F(2, 23) = .611$, $p = .55$). There was not a statistically significant difference in necessity of communication for the three roles ($F(2, 23) = .611$, $p = .55$) (Table 8).

Table 8. ANOVA Result between Operational Role and Focus on Safety in the Working Environment.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.23	.439	.97	1.50
Paramedic	1.40	.548	.72	2.08
Flight Nurse	1.13	.354	.83	1.42

A one-way ANOVA was performed to compare the perception of job roles to the belief that their particular operation has a "Just Culture". Groups one through three were used. The assumption of homogeneity of variances was tested and satisfied based on Levene's *F* test, $F(2, 20) = .127$, $p = .88$. There was not a statistically significant difference in the belief in "Just Culture" of the three groups ($F(2, 20) = .033$, $p = .97$). There was not a statistically significant difference in necessity of communication for the three roles ($F(2, 20) = .03$, $p = .97$) (Table 9).

Table 9. ANOVA Result between Operational Role and Existence of Operational Just Culture.

Table 9. cont.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.20	.422	.90	1.50
Paramedic	1.20	.447	.64	1.76
Flight Nurse	1.25	.463	.86	1.64

A one-way ANOVA was performed to compare the perception of job roles to the participants' ability to communicate between one another without reprimand. Groups 1 – 3 were utilized. The assumption of homogeneity of variances was tested and was not satisfied based on Levene's *F* test, $F(2, 21) = 3.77$, $p = .04$. There was not a statistically significant difference in necessity of communication for the three roles ($F(2, 21) = 1.01$, $p = .380$) (Table 10).

Table 10. ANOVA Result between Operational Role and Open Communication without Reprimand.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.46	.519	1.15	1.78
Paramedic	1.20	.447	.64	1.76

Table 10. cont.

			Confidence Interval	
Group	M	SD	Lower	Upper
Flight Nurse	1.17	.408	.74	1.60

A one-way ANOVA was performed to compare the perception of job roles to the necessity of communication between the specific roles to make a go / no go decision. Groups one through three were utilized. The assumption of homogeneity of variances was tested and was not satisfied based on Levene's *F* test, $F(2, 25) = 46.43$, $p = .000$. There was not a statistically significant difference in necessity of communication for the three roles ($F(2, 25) = 2.90$, $p = .074$) (Table 11).

Table 11. ANOVA Result between Operational Role and Importance of Communication on Go / No Go Decision.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.33	.488	1.06	1.60
Paramedic	1.00	.000	1.00	1.00
Flight Nurse	1.00	.000	1.00	1.00

A one-way ANOVA was performed to compare the perception of job roles to the effectiveness of crew decision-making as compared to technological upgrades. Groups one through three were utilized. The assumption of homogeneity of variances was tested

and was satisfied based on Levene's *F* test, $F(2, 20) = .848$, $p = .443$. There was a statistically significant difference in necessity of communication for the three roles ($F(2, 20) = 3.59$, $p = .047$). Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Paramedics, was significantly different from Flight Nurses. Pilots did not differ significantly from Paramedics or Flight Nurses (Table 12).

Table 12. ANOVA Result between Operational Role and Effectiveness of Crew Decision-Making Compared to Technological Upgrades.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.73	.467	1.41	2.04
Paramedic	1.20	.477	.64	1.76
Flight Nurse	1.86	.378	1.51	2.21

A one-way ANOVA was performed to compare the perception of job roles to the effectiveness of the use of HEMS accidents as an opportunity to reevaluate the operation's processes and culture. Groups one through three were utilized. The assumption of homogeneity of variances was tested and was satisfied based on Levene's *F* test, $F(2, 22) = .055$, $p = .947$. There were no statistically significant differences in necessity of communication for the three roles ($F(2, 22) = .310$, $p = .737$) (Table 13).

Table 13. ANOVA Result between Operational Role and Effectiveness of the Use of Past HEMS Accidents to Reevaluate Current Processes.

			Confidence Interval	

Table 13. cont.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.62	.506	1.31	1.92
Paramedic	1.40	.548	.72	2.08
Flight Nurse	1.57	.535	1.08	2.07

A one-way ANOVA was performed to compare the perception of job roles to the participants' belief in their respective organization's safety culture. Groups 1 – 3 were utilized. The assumption of homogeneity of variances was tested and was not satisfied based on Levene's *F* test, $F(2, 21) = 94.66$, $p = .000$. There were no statistically significant differences in necessity of communication for the three roles ($F(2, 21) = .2.147$, $p = .142$) (Table 14).

Table 14. ANOVA Result between Operational Role and Focus on Safety in the Working Environment.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.42	.515	1.09	1.74

Table 14. cont.

			Confidence Interval	
Group	M	SD	Lower	Upper
Paramedic	1.40	.548	.72	2.08
Flight Nurse	1.00	.000	1.00	1.00

Research Question 3
Years of Experience Affect Change?

A one-way ANOVA was performed to compare the years of experience to the belief that their respective operation has a "Just Culture". Group One (1 – 5 years), Group Two (6 – 9 years), Group Three (10 – 15 years), Group Four (15 – 19 years), and Group Five (20+ years). The assumption of homogeneity of variances was tested and was not satisfied based on Levene's *F* test, $F(4, 18) = 13.311$, $p = .000$. There was statistically significant differences in years of experience for the five ranges of years ($F(4, 18) = 3.952$, $p = .018$). Post-hoc comparisons using the Tukey HSD test indicated that Group Five (20+ years) was statistically different from Groups One (1 – 5 years) and Four (15 – 19 years). Groups Two (6 – 9 years) and Three (10 – 15 years) did not differ significantly from any other group (Table 15).

Table 15. ANOVA Result between Years of Experience and Existence of an Operational Just Culture.

Table 15. cont.

			Confidence Interval	
Group	M	SD	Lower	Upper
1 – 5 Years	1.00	.000	1.00	1.00
6 – 9 Years	1.33	.516	.79	1.88
10 – 15 Years	1.25	.500	.45	2.05
15 – 19 Years	1.00	.000	1.00	1.00
20+ Years	2.00	.000	2.00	2.00

Research Question 4, Block 3
Perception On HEMS Use and Mitigations

A one-way ANOVA was performed to compare the perceptions of the three job roles to the use of the No Pressure Initiative. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was not satisfied based on Levene's *F* test, $F(2, 20) = 428.649$, $p = .000$. There were no statistically significant differences between the three groups ($F(2, 20) = 1.580$, $p = .231$) (Table 16).

Table 16. ANOVA Result between Operational Role and Focus on Safety in the Working Environment.

Table 16. cont.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.46	.519	1.15	1.78
Paramedic	1.00	.000	1.00	1.00
Flight Nurse	1.50	.548	.93	2.07

A one-way ANOVA was performed to compare the perceptions of the three job roles to the belief that their management respected their crews' go / no go decisions. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was satisfied based on Levene's *F* test, $F(2, 21) = 1.629$, $p = .220$. There were no statistically significant differences between the three groups ($F(2, 21) = .470$, $p = .631$) (Table 17).

Table 17. ANOVA Result between Operational Role and Belief that Management Respects Crews' Go / No Decisions.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.50	.519	1.20	1.80
Paramedic	1.25	.500	.45	2.05

			Confidence Interval	
Group	M	SD	Lower	Upper
Flight Nurse	1.33	.516	.79	1.88

A one-way ANOVA was performed to compare the perceptions of the three job roles to personal minimums always being followed. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was satisfied based on Levene's *F* test, $F(2, 21) = 2.887$, $p = .078$. There were no statistically significant differences between the three groups ($F(2, 21) = .778$, $p = .472$) (Table 18).

Table 18. Result between Operational Role and that Personal Minimums are Always Used.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.42	.515	1.09	1.74
Paramedic	1.20	.447	.64	1.76
Flight Nurse	1.57	.535	1.08	2.07

A one-way ANOVA was performed to compare the perceptions of the three job roles to the belief that personal minimums are vital to the operation. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was satisfied based on Levene's *F* test, $F(2, 24) = .221$, $p = .803$. There were no statistically significant differences between the three groups ($F(2, 24) = .050$, $p = .951$) (Table 19).

Table 19. ANOVA Result between Operational Role and Belief that Personal Minimums are Vital to the Operation.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.20	.414	.97	1.43
Paramedic	1.20	.447	.64	1.76
Flight Nurse	1.14	.378	.79	1.49

A one-way ANOVA was performed to compare the perceptions of the three job roles to the availability of cutting edge technology. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was not satisfied based on Levene's *F* test, $F(2, 25) = 3.409$, $p = .049$. There were no statistically significant differences between the three groups ($F(2, 25) = .969$, $p = .393$) (Table 20).

Table 20. ANOVA Result between Operational Role and the Availability of Cutting Edge Technology.

Table 20. cont.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.13	.342	.94	1.31
Paramedic	1.25	.500	.45	2.05
Flight Nurse	1.38	.518	.94	1.81

A one-way ANOVA was performed to compare the perceptions of the three job roles to their belief that technological upgrades are necessary. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was satisfied based on Levene's *F* test, $F(2, 25) = 1.219$, $p = .313$. There were no statistically significant differences between the three groups ($F(2, 25) = .206$, $p = .816$) (Table 21).

Table 21. ANOVA Result between Operational Role and the Necessity of Technological Upgrades.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.33	.488	1.06	1.60
Paramedic	1.20	.447	.64	1.76

			Confidence Interval	
Group	M	SD	Lower	Upper
Flight Nurse	1.38	.518	.94	1.81

A one-way ANOVA was performed to compare the perceptions of the three job roles to the use of Preflight Assessment Scores. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was satisfied based on Levene's *F* test, $F(2, 24) = .570$, $p = .573$. There were no statistically significant differences between the three groups ($F(2, 24) = .125$, $p = .883$) (Table 22).

Table 22. ANOVA Result between Operational Role and the Use of Preflight Risk Assessment Scores.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.21	.426	.97	1.46
Paramedic	1.20	.447	.64	1.76
Flight Nurse	1.13	.354	.83	1.42

A one-way ANOVA was performed to compare the perceptions of the three job roles to the belief that the use of Preflight Assessment Scores are enough to ground a flight. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was satisfied based on Levene's *F* test, $F(2, 16) = 1.978$, $p = .171$. There were no statistically significant differences between the three groups ($F(2, 16) = .471$, $p = .632$) (Table 23).

Table 23. ANOVA Result between Operational Role and the Advocacy of Preflight Assessment Scores Grounding Flights.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.38	.518	.94	1.81
Paramedic	1.20	.447	.64	1.76
Flight Nurse	1.50	.548	.93	2.07

A one-way ANOVA was performed to compare the perceptions of the three job roles to the use of En-Route Decision Protocol. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was not satisfied based on Levene's *F* test, $F(2, 15) = 95.278$, $p = .000$. There were no statistically significant differences between the three groups in either Q8_1_10 ($F(2, 15) = 1.509$, $p = .253$) or Q8_3_10 ($F(2, 3) = .500$, $p = .650$) (Tables 24 and 25).

Table 24. ANOVA Result between Operational Role and the Use of the En-Route Decision Protocol (Q8_1_10).

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.50	.527	1.12	1.88
Paramedic	1.00	.000	1.00	1.00
Flight Nurse	1.60	.548	.92	2.28

Table 25. ANOVA Result between Operational Role and the Use of the En-Route Decision Protocol (Q8_3_10).

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.50	.577	.58	2.42

A one-way ANOVA was performed to compare the perceptions of the three job roles to the belief that the use of En-Route Decision Protocols mitigates issues concerning IFC conditions. Group One (Pilots), Group Two (Paramedics), and Group Three (Flight Nurses) were used. The assumption of homogeneity of variances was tested and was not satisfied based on Levene's F test, $F(2, 11) = 14.119$, $p = .001$. There were

no statistically significant differences between the three groups in either Q8_1_11 ($F(2, 11) = 2.099$, $p = .169$) or Q8_3_11 ($F(2, 1) = .250$, $p = .816$) (Table 26 and 27).

Table 26. ANOVA Result between Operational Role and Advocacy that EDP mitigates Pilots getting into IFC Conditions (Q8_1_11).

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.67	.516	1.12	2.21
Paramedic	1.00	.000	1.00	1.00
Flight Nurse	1.60	.548	.92	2.28

Table 27. ANOVA Result between Operational Role and Focus on Safety in the Working Environment.

			Confidence Interval	
Group	M	SD	Lower	Upper
Pilot	1.50	.707	-4.85	7.85

CHAPTER IV

DISCUSSION

It has been discussed that helicopter accidents, especially Helicopter Air Ambulance accidents, are ever present. These accidents provide a retrospective analysis for current operators, but proactive approaches to safety are the future of the aviation industry from General Aviation to Commercial Operations. With 14 CFR Part 5, we see the introduction of a mandatory SMS for all Part 121. That has proven to be a long and arduous process for that industry to continually try to achieve validation with the FAA. Along with 121, airports are likely to receive their regulation next as they serve all aviation proprietors. That leaves the rule for Part 135 operations, and specific to this study HAA, with their regulation most likely coming after airports. As an aside, these operations do have access to the Voluntary Safety Programs, which help develop the framework for a potential SMS. This study did not request the source of the SMS documentation, but with the strong representation of having an SMS, these respondents have spent a significant amount of time in the realm of proactive approaches of safety.

Four research questions were asked in this study to help understand how well these inaugural SMS systems have been received by Part 135 HEMS/HAA operators. The survey used was divided into three blocks: demographics, safety culture, and risk mitigations. These blocks were used in conjunction with one another to help provide

analysis of the three respondent groups (Pilots, Paramedics, and Flight Nurses) answers to a Likert Scale questionnaire. With this survey, assumptions have been made as the statistical power of the ANOVA tests were not conclusive.

Research Question 1

The first question asked was: "Who employs SMS in HEMS operations?" This was a direct question asked in the survey under the demographics block: "Your operation implements a functional SMS?" With the answers available being binary in nature (Yes / No). Twenty-nine respondents were left after sixteen responses had to be removed due to not fully answering the survey's questions. Of the twenty-nine respondents, 93 percent (27 responses) answered 'Yes' to this question, that their operation employs a functional SMS. The two respondents, or 7 percent, that answered 'No' were Pilots, with one of them being not U.S. based.

These results were intriguing as it suggests that a major portion of the HAA industry has implemented SMS systems into their everyday operation, yet it opens a door to many more questions. With the overwhelming response of 'Yes', it would seem that Part 135 HEMS operators are moving towards a very proactive approach to safety in a means to help combat future accidents and incidents. This would also seem to work in conjunction with a recent study released by the FAA on the helicopter industry's recent reduction of accidents over the last three years. FAA Administrator, Michael Huerta, had this to say, "The FAA and the helicopter industry have worked together to educate the civil helicopter community about safe practices, to drive these improved results. The FAA and the industry also are taking an active role in advancing safety through new technology, collaborative policy changes and proactive outreach" (FAA, 2017). Looking

at the raw data the accident rate fell to 3.19 accidents per 100,000 flight hours in 2016 compared to that of 2015's 3.67, whereas the fatal accident rate fell slightly from .52 (2015) to .51 (2016). While the drop between 2015 and 2016 was marginal, there has been a significant drop from 2013, 1.02 fatal accident rate, to 2016's 52 percent. (FAA, 2017)

Collaborative groups such as, IHST and the U.S. Helicopter Safety Team have been leading the charge with the FAA in order to help prevent further accidents through several means: "Creating a culture of safety, cutting the red tape, new technology, collaborative rule-making, and the FAA International Rotorcraft Safety conference". These initiatives were used a baseline in this study's survey as a way to reach out to those who use these ships every day and provide a service the American public. These initiatives will be discussed in the following three sections.

Research Question 2

The second question asked was: "How has SMS been embraced by pilots 1), paramedics 2), and flight nurses 3)? 2a. How do the three groups' perceptions compare on aspects of safety culture?" To address this question in the survey, block 2 "Safety Culture" was developed. Seven questions asked the opinion, or perception, of the three operating roles (Pilots, Paramedics, and Flight Nurses) on the strength of certain aspects of their operations' safety culture. As reported in the previous chapter, one-way between groups ANOVA were conducted on each of the seven questions in order to compare each groups' responses (Table 28).

Table 28. Comparison of Operating Roles against Perceptions on Aspects of Safety Culture.

#	Question	Strongly Agree		Agree		Do not Agree, nor Disagree		Disagree		Strongly Disagree		Total
1	Strong Focus on Safety	68.97	20	20.69	6	3.45	1	3.45	1	3.45	1	29
2	Just Culture Exists	62.07	18	17.24	5	13.79	4	0.00	0	6.90	2	29
3	Can Openly Communicate	55.17	16	27.59	8	10.34	3	3.45	1	3.45	1	29
4	Communication Vital to Go/No Go Decision	79.31	23	17.24	5	3.45	1	0.00	0	0.00	0	29
5	Crews' Decisions > Tech Upgrades	27.59	8	51.72	15	17.24	5	0.00	0	3.45	1	29
6	Past HEMS Accidents Vital to Future Processes	37.93	11	48.28	14	13.79	4	0.00	0	0.00	0	29
7	Belief in Safety Culture	56.67	17	23.33	7	10	3	3.33	1	6.67	2	30
	Total Count	55.39	113	29.41	60	10.29	21	1.47	3	3.43	7	204

According to the ANOVA conducted on question five, there was statistical significance between Groups Two (Paramedics) and Three (Flight Nurses). These two groups were much closer in number of respondents than that of Group One (Pilots). This could be a factor in why there was some statistical significance. A deeper analysis would show that four of the five Paramedics answered 'Strongly Agree' and the one remaining chose 'Agree', while six of the eight Flight Nurses answered 'Agree' and the two remaining chose 'Strongly Agree'. Through this survey there is no real answer as to why the Paramedic and Flight Nurse groups differed so much on the importance of crews' decisions over technological upgrades. It could be that the Paramedic group believes that Pilot decision-making is a stronger factor in safety rather than that of technology.

'Strongly Agree' received the most responses for Block Two, Safety Culture, with fifty-five percent (113 responses) which would suggest that the majority of respondents believe they have an extremely strong culture of safety within their respective operations. A total of eighty-four percent of the respondents' either said they 'Strongly Agree' or 'Agree' that their operation has strong Safety Culture through their communication and decision-making which would equal their "Just Culture" (the way they do things) (Figure 1).

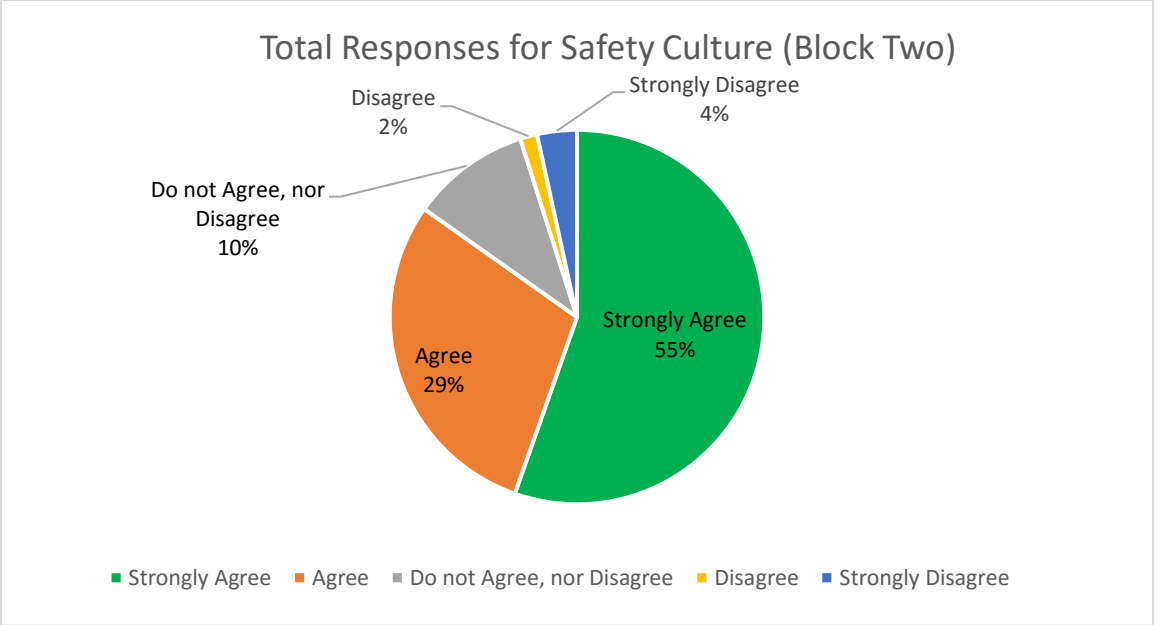

Figure 1 Total Responses for Safety Culture (Block 2).

Research Question 3

The third question asked was: "Is time a factor in these organizations to acknowledge and accept this change?" A one-way between groups ANOVA was performed using the demographic question regarding years of experience and the respondents' perception of "Just Culture" within their operations. The ANOVA revealed statistical significance of .018 with the Post-hoc Tukey HSD test showing significance between Group Five (20+ years) and Groups One (1 – 5 years) and Four (15 – 19 years). During the survey's development, it was assumed that the more experienced respondents would differ from the lesser experienced groups. That difference could have been either that their way was the most efficient and proper, or that they have seen too many accidents and support the implementation of SMS. On initial analysis it would seem that the eldest group (20 Plus), according to the statistical analysis, definitely has a different opinion from their younger counterparts.

The following table is a deeper analysis into the five groups answers to the question of "Just Culture". With the significance recorded by the post-hoc test and this view of the answers by group, it can be seen that the Group Five respondents did not believe in their "Just Culture" as strongly as any of the other lesser experienced groups. The comparison between Group Five and Groups One and Four shows that 'Agree' held the majority (67 percent) of Group 5's responses, whereas it held nil responses for both Groups One and Four (Table 29).

Table 29. Comparison of Years of Experience to Existence of an Operational Just Culture (Total Count).

#	Group	Strongly Agree		Agree		Do not Agree, nor Disagree		Disagree		Strongly Disagree		Total
1	1 – 5 years	80.00	8	0.00	-	10.00	1	0.00	-	10.00	1	10

Table 29. cont.

#	Group	Strongly Agree		Agree		Do not Agree, nor Disagree		Disagree		Strongly Disagree		Total
2	6 – 9 years	57.14	4	28.57	2	14.29	1	0.00	-	0.00	-	7
3	10 – 15 years	60.00	3	20.00	1	20.00	1	0.00	-	0.00	-	5
4	15 – 19 years	75.00	3	0.00	-	0.00	-	0.00	-	25.00	1	4
5	20+ years	0.00	-	66.67	2	33.33	1	0.00	-	0.00	-	3
	Total Count	62.07	18	17.24	5	13.79	4	0.00	-	6.90	2	29

'Strongly Agree' held the highest response rate for the total count at sixty-two percent. A combined seventy-nine percent (23 responses) of respondents believe their operation has a "Just Culture" as compared to 21 percent (6 responses) felt they either could not answer that question or that they did not have a "Just Culture" altogether (Figure 2). With this small of a sample size, twenty-nine, it could be that the 4 'undecided' answers could be individuals who are not sure of what a "Just Culture" is. It should be noted that those 'undecided' were nearly evenly spread out between the experience ranges. The final notable observation is that none of the five groups selected 'Disagree' as an answer and only two respondents chose 'Strongly Disagree'. Both respondents answered 'Yes' to having a functional SMS.

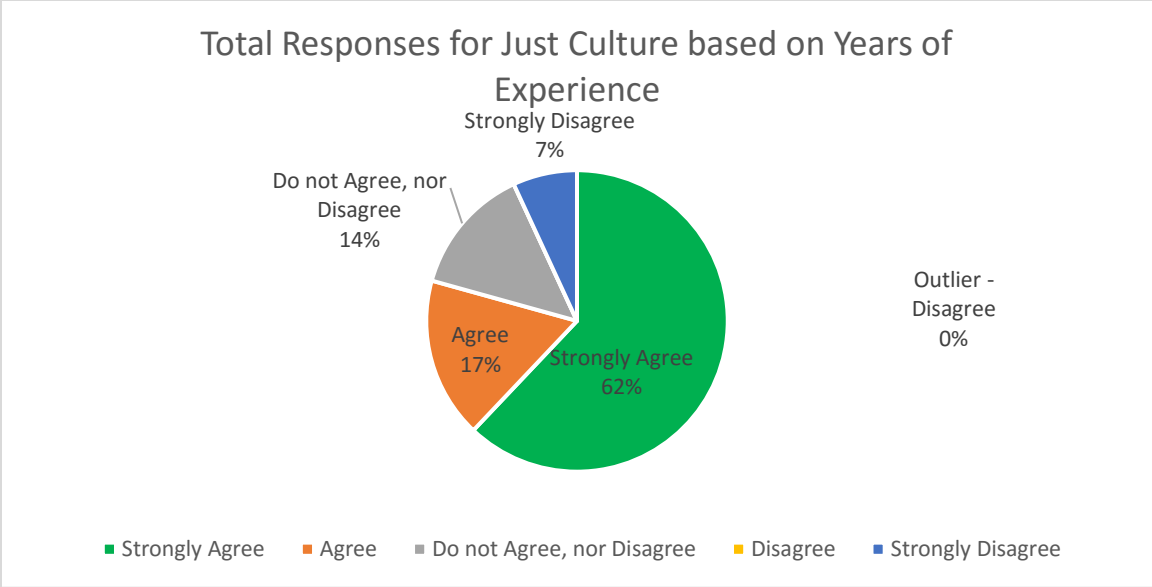

Figure 2 Total Responses for Just Culture based on Years of Experience.

Research Question 4

The fourth and final question asked was: "Do pilots, paramedics, and flight nurses think their service is being overused? 4.a How do the three groups' perceptions compare on certain risk mitigations?" This question was focused on in the third block of the survey, "Risk Mitigations". Ten questions were asked of the operating roles' (Pilots, Paramedics, and Flight Nurses) opinions, or perceptions, on the strength of certain aspects of their operations' use of common risk mitigations in the industry right now.

A one-way ANOVA was performed on each question comparing the independent variables, the operating roles (Pilots, Paramedics, and Flight Nurses). No significance was found. Looking at the total count 'Strongly Agree' and 'Agree' received 52 percent and 25 percent, respectively, of the overall response rate. This section is slightly skewed to several respondents answering some questions with multiple answers. That issue was not found until further analysis was performed (Table 30). It was noted that the total amount of answers (301) was higher than it should be (N = 29 x 10 Questions = 290).

This discrepancy makes it hard to assess the true nature of the numbers. Questions eight through ten have data affected by the above issue. Noting that discrepancy and the higher response rate for "Do not Agree, nor Disagree" would suggest the respondent either was not sure of their answer, were in a hurry, did not understand the question, or any multitude of situations (Table 30).

Questions two through five and seven had the correct amount of answers (N = 29). Looking at those questions, there is a trend of similar answers. For two and three, respondents answered 'Strongly Agree' with fourteen responses (48 percent). Questions four, five, and seven, respondents answered 'Strongly Agree' with twenty-two responses (76 percent). Once again, the overall narrative surfaces, the majority of respondents believe in the mitigations and culture put forth by their respective organizations.

Table 30. Comparison of Operating Roles to Certain Risk Mitigations.

#	Question	Strongly Agree	Groups 1/2/3	Agree	Groups 1/2/3	Do not Agree, nor Disagree	Groups 1/2/3	Disagree	Groups 1/2/3	Strongly Disagree	Groups 1/2/3	Total
1	NPI Us	46.67	7/4/3	30.00	6/-/3	13.33	2/-/2	6.67	1/1/-	3.33	1/-/-	*30
2	Management Accepts Go/No Go Decisions	48.28	7/3/4	34.48	7/1/2	10.34	1/-/2	3.45	-/1/-	3.45	1/-/-	29
3	Personal Min. Recognized	48.28	7/4/3	34.48	5/1/4	10.34	2/-/1	6.90	2/-/-	0.00	-/-/-	29
4	Personal Min. Vital	75.86	12/4/6	17.24	3/1/1	6.90	1/-/1	0.00	-/-/-	0.00	-/-/-	29
5	New Tech. Available	75.86	14/3/5	20.69	2/1/3	3.45	-/1/-	0.00	-/-/-	0.00	-/-/-	29
6	Tech. Upgrades Necessary	59.38	10/4/5	28.13	5/1/3	10.34	3/-/-	3.13	1/-/-	0.00	-/-/-	*32

Table 30. cont.

#	Question	Strongly Agree	Groups 1/2/3	Agree	Groups 1/2/3	Do not Agree, nor Disagree	Groups 1/2/3	Disagree	Groups 1/2/3	Strongly Disagree	Groups 1/2/3	Total
7	PRAS Use	75.86	11/4/7	17.24	3/1/1	0.00	-/-/-	0.00	-/-/-	6.90	2/-/-	29
8	PRAS/Ground Flight	38.71	5/4/3	22.58	3/1/3	25.81	5/-/3	9.68	3/-/-	3.23	1/-/-	*31
9	EDP Use	30.30	5/3/2	24.24	5/-/3	27.27	5/1/3	12.12	2/1/1	6.06	2/-/-	*33
10	EDP/IFC Cond.	23.33	2/3/2	23.33	4/-/3	40.00	9/1/2	10.00	1/1/1	3.33	1/-/-	*30
	Total Count	51.83	80/36/40 156	25.25	43/7/26 76	14.95	28/3/14 45	5.32	10/4/2 16	2.66	8/-/- 8	301

*After analysis, it has been noted that this question recorded multiple answers for this question by one or more respondents.

Limitations

This research was under a time restriction and therefore did not get the sample size that could provide real difference in perception. Respondents represented several regions of the U.S., yet did not have a strong enough representation from each region to get a consensus of the U.S. industry (Southeast heavy). This can be corrected in further research.

The survey was not based on any other study surveys and was built from questions stemmed from the literature review, but the survey needs to be refined. While the basis of the questions was cohesive, more pointed direction is needed for the principal investigator's edification. This survey had a lot of good data, but was spread out too much. This survey tried to cover a very broad topic (SMS) and should have been narrowed down to a more specific topic. Four research questions were asked and this thesis could have spent more time and resources on either one or two research questions.

Another flaw noted in answering Research Question 4, respondents were able to select more than one answer per question. That is something that would need to be addressed in future research by this principal investigator.

Future Research

The FAA's recent findings on the three-year decline of accidents and fatal accidents could be mirrored with this research concerning the amount of U.S. HEMS operators now implementing SMS. For that research it would need a much bigger sample size than the one presented here to get a more cohesive representation of the HEMS population. That research could possibly provide a stronger basis and statistical power to the legitimization of SMS within the industry.

Each section of this survey could be broken down and be explored as a single research item, such as the culture against each of the demographic proportions. There are also many, many more mitigations being used and created every day in the HEMS community. This includes manufacturers like Bell and Airbus. Those manufacturers could be stakeholders in a technological upgrade study alongside Honeywell to take a deeper dive into the future of helicopter airframes.

A possible comparison of fatal crashes between military medical transport and civilian medical transport could also warrant further research. At the very least a comparison of safety implementations would be beneficial to see what U.S. HEMS/HAA operators can do better within their organizations to continue to develop robust safety systems to prevent tragic, fatal accidents.

Conclusion

Helicopters are inherently prone to risk, but the U.S. has seen a booming market for Helicopter Air Ambulance services. Sadly, the severity of many of these accidents are fatal and leave a lasting mark on the industry. With that severity and the likelihood rising from the growth of the industry, it is more likely for fatal accidents to occur. Cooperative efforts like the International Helicopter Safety Team and the U.S. Helicopter Safety Team with the FAA has spent a lot of time, retrospectively, attempting to identify all the issues that can be presented when rotorcraft are deployed in this field, but a change is on the horizon.

Safety Management Systems provide a proactive approach to these issues by establishing triggers to catch failing or non-existent barriers preemptively. While the regulation to mandate FAR Part 135 is not in the forefront, considering how many people are transported versus FAR

Part 121 world, there is recognition and collaborative efforts being established to promote mitigation and a focus on strong safety culture.

This research study, even with limited participation, has shown there is a legitimate call for U.S. operators from FAR Part 91 to FAR Part 141 to implement an SMS. At the core of SMS is the people who run the day-to-day of the operation. They need a "Just Culture" that can allow them the opportunity to work at their best. The direction the FAA is taking as the legislator and enforcement is moving towards a much more cooperative entity, which will only help push the progress of safety forward.

APPENDICES

Appendix A

Survey Recruitment Email

Hello,

My name is Ray Gardner and I am a graduate student at the University of North Dakota. I am writing to you to ask for your help on my graduate thesis. The thesis is entitled, "The Effects of SMS Implementation on Safety Culture within Helicopter Emergency Medical Services". You have been chosen because you are either, a) a member of a flight crew or b) a member of a medical crew with a Helicopter Air Ambulance operator. I have written a survey asking for your perception of the Safety Management System (SMS) that has been implemented at your operation. Your perception is important in knowing whether the SMS has had an effect on your operation's safety culture, because you and your crew determine how safe the culture is within your organization. Your culture defines how daily tasks are completed and could be the difference between a successful or unsuccessful mission in transporting our nation's critically sick and injured.

Please follow the link to take the survey.
https://und.qualtrics.com/SE/?SID=SV_8xqNyEsLQggcc0R

I want to thank you for taking the time to respond to this survey and helping me complete my thesis.

Sincerely,
Ray

Ray W. Gardner
University of North Dakota | School of Graduate Studies, Aviation | O: 404.773.5372 | ray.gardner@und.edu | rwgardner154@gmail.com

Appendix B

Survey Recruitment Social Media Post

Facebook UND Helicopter page:

UND Helo Grads! I wonder if you could help a fellow rotorhead out?

I'm a graduate student trying to complete my thesis and I need your help!

My thesis is called "The Effects of SMS Implementation on Safety Culture within Helicopter Emergency Medical Services" and I'm looking for HAA pilots and medical crew to take a short 5-minute survey on their perception of either having an SMS or not within their operation.

To take the survey follow this link:
https://und.qualtrics.com/SE/?SID=SV_8xqNyEsLQggcc0R

Even if you're not in the HAA industry, but know someone who is, please share the link!

You have my many thanks for helping me finish my thesis…and graduating on time!

Ray

LinkedIn:

Pilots, Flight Paramedics, and Flight Nurses,

I'm a graduate student at the University of North Dakota trying to complete my thesis and I need your help!

My thesis is called "The Effects of SMS Implementation on Safety Culture within Helicopter Emergency Medical Services". I'm looking for HAA pilots and medical crew, like you, to take a short 5-minute survey on your perception of either having an SMS or not within your operation and its effect on your safety culture.

To take the survey follow this link: **https://lnkd.in/dDEqcrA**

Even if you're not in the HAA industry, but know someone who is, please share the link! You have my many thanks for helping me finish my thesis!

Ray

Appendix C

Qualtrics-based Survey with Information Page

HEMS Safety Culture Research Survey

Title:
The Effects of SMS Implementation on Safety Culture within Helicopter Emergency Medical Services

Principal Investigator: Ray Gardner, (404) 773-5372, ray.gardner@und.edu
Advisor: Mark Dusenbury, (701) 777-5495, dusenbur@aero.und.edu

Purpose of the Study:
The purpose of this research study is to determine that through mitigation efforts, both technological upgrades and safety management systems, safety culture or the lack thereof can change the perception of HEMS operators and crew in order to provide a way to drive fatal accidents down.

Procedures to be followed:
You will be asked to answer 18 questions, with some having follow up questions. These questions are divided up by the categories of: Demographics, Safety Culture, and Risk Mitigations.

Risks:
There are no risks in participating in this research beyond those experienced in everyday life.

Benefits:
1. You might learn more about yourself by participating in this study. You might have a better understanding of how important a safety culture is to you. You might realize that others have had similar experiences as you have. You may also see through this organizational introspective evaluation how strong or weak your organization is concerning their safety culture and habits.
2. This research might provide a better understanding of the need for a strong safety culture. This information could help plan programs, or make your SMS/Safety Program better. This information might assist other operators in transitioning to an SMS Program.

Duration:
It will take about 10-15 minutes to complete the questions.

Statement of Confidentiality:

This survey will not ask for any personal information that would identify who the responses belong to. Therefore, your responses are recorded anonymously. If this research is published, no

information that would identify you will be included since your name is in no way linked to your responses.

All survey responses that we receive will be treated confidentially and stored on a secure server. However, given that the surveys can be completed from any computer (e.g., personal, work, school), we are unable to guarantee the security of the computer on which you choose to enter your responses. As a participant in our study, we want you to be aware that certain "key logging" software programs exist that can be used to track or capture data that you enter and/or websites that you visit.

Right to Ask Questions:

The researcher conducting this study is Ray Gardner. You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Ray Gardner at (404) 773-5372 during the day. You may also contact Ray's Advisor, Mark Dusenbury at (701) 777-5495.

If you have questions regarding your rights as a research subject, you may contact The University of North Dakota Institutional Review Board at (701) 777-4279. You may also call this number with problems, complaints, or concerns about the research. Please call this number if you cannot reach research staff, or you wish to talk with someone who is an informed individual who is independent of the research team.

General information about being a research subject can be found on the Institutional Review Board website "Information for Research Participants" http://und.edu/research/resources/human-subjects/research-participants.cfm

Compensation:

You will not receive compensation for your participation.

Voluntary Participation:

You do not have to participate in this research. You can stop your participation at any time. You may refuse to participate or choose to discontinue participation at any time.

You do not have to answer any questions you do not want to answer.

You must be 18 years of age older to consent to participate in this research study.

Completion and return of the survey implies that you have read the information in this form and consent to participate in the research.

Please keep this form for your records or future reference.

Q1 What is your role in the operation?

- ❍ Pilot (1)
- ❍ Paramedic (2)
- ❍ Flight Nurse (3)

Q2 Are you...

- ❍ Male (1)
- ❍ Female (2)

Q3 What is your age?

- ❍ 18-30 (1)
- ❍ 31-45 (2)
- ❍ 46-59 (3)
- ❍ 60+ (4)

Q4 Years of experience in the field...

- ❍ 1-5 year(s) (1)
- ❍ 6-9 years (2)
- ❍ 10-15 years (3)
- ❍ 15-19 years (4)
- ❍ 20+ years (5)

Q5 Your operation implements a functional SMS?

- ❍ Yes (1)
- ❍ No (2)

Q6 Your operation is...

- ❍ Traditional (1)
- ❍ Community (2)

Q7 Please answer the following about your interpretation of the your operation's Safety Culture:

	Agree		Disagree		Neutral
	Strongly Agree (1)	Agree (2)	Disagree (1)	Strongly Disagree (2)	Do not Agree, nor Disagree (1)
Your operation provides a work environment with a strong focus on safety (1)	❍	❍	❍	❍	❍
You believe your operation has a "Just Culture" (2)	❍	❍	❍	❍	❍
You feel that your crew can openly communicate between one another without reprimand (3)	❍	❍	❍	❍	❍
It is vital that communication between flight crews and medical crews (paramedics and flight nurses) to make go or no go decisions concerning the flight (4)	❍	❍	❍	❍	❍
Medical crews have the utmost confidence in their pilots' abilities to perform under duress (5)	❍	❍	❍	❍	❍

You feel that crews' decision making is more important to management than the use of technological upgrades (6)	❍	❍	❍	❍	❍
Recent HEMS accidents provide the organization an opportunity to evaluate its processes and culture (7)	❍	❍	❍	❍	❍
You believe in your organization's safety culture (8)	❍	❍	❍	❍	❍

Q8 Please answer the following about your interpretation of the your operation's Risk:

Mitigations

	Agree		Neutral	Disagree	
	Strongly Agree (1)	Agree (2)	Do not Agree, nor Disagree (1)	Disagree (1)	Strongly Disagree (2)
Your operation exercises the "No Pressure Initiative" (1)	❍	❍	❍	❍	❍
You feel that management embraces the crews' decisions concerning go or no go to particular flights (2)	❍	❍	❍	❍	❍
Personal minimums are always recognized by pilot and medical crew (3)	❍	❍	❍	❍	❍
You feel that personal minimums are vital to the safe operation of every flight (4)	❍	❍	❍	❍	❍
Cutting edge technology is available to the crew (i.e. Terrain Awareness Warning Systems, night vision goggles, etc.) (5)	❍	❍	❍	❍	❍

You feel that technological upgrades are necessary to provide flight crews with the right tools for the job (6)	❍	❍	❍	❍	❍
Tech upgrades are necessary as they make the crew feel safe (7)	❍	❍	❍	❍	❍
Preflight Assessment Scores are utilized (8)	❍	❍	❍	❍	❍
You feel that Preflight Assessment Scores provide a solid foundation to ground a flight (9)	❍	❍	❍	❍	❍
The operation utilizes the "En-Route Decision Protocol" (10)	❍	❍	❍	❍	❍
You feel confident that the EDP mitigates issues concerning IFC conditions (11)	❍	❍	❍	❍	❍

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