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# Aeronautical Decision Making in Helicopter Emergency Medical Systems (HEMS): The Effect of Mission Orientation and Local Base Finances on the Go/No Go Decision

Paul Cline

# AERONAUTICAL DECISION MAKING IN HELICOPTER EMERGENCY MEDICAL SYSTEMS (HEMS): THE EFFECT OF MISSION ORIENTATION AND LOCAL BASE FINANCES ON THE GO/NO GO DECISION

By

Paul E. Cline, RN, CFRN
Diploma, Presbyterian/St. Luke's School of Nursing, 1986
Bachelor of Arts, University of North Dakota, 2005

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This thesis submitted by Paul E. Cline in partial fulfillment of the requirements for the Degree of Master of Science 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.

Ernest Anderson, J.D.
Chairperson

Warren Jensen, M.D.

Paul Lindseth, Ph.D.

This thesis is being submitted by the appointed advisory committee as having met all of the requirements of the Graduate School at the University of North Dakota and is hereby approved.

Wayne Swisher
Dean of the Graduate School

________________________________________
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ABSTRACT

Helicopter Emergency Medical Services (HEMS) is among the most dangerous type of flying in the United States today. In 2008 it was safer to fly medical evacuation missions in Iraq and Afghanistan than in the Continental United States. This study is designed to test whether the financial performance of the local base and a hyper mission orientation have a negative effect on aeronautical decision making among HEMS crews.

A Likert type survey was administered to HEMS pilots and medical crews to ascertain their thoughts and feelings regarding the two questions under investigation. While the data clearly showed that poor financial performance at the base level and an acute desire to complete the mission do not have a negative effect on aeronautical decision making among HEMS crews, it did reveal a distinct divide among attitudes between pilots and medical crews.

# CHAPTER 1

## INTRODUCTION

Helicopter Emergency Medical Services (HEMS) is among the most dangerous type of flying in commercial aviation today. In 2008 there were twelve accidents and twenty nine fatalities (NTSB, 2009). This compared with twelve aviation related fatalities for the entire United States Army during the same period (US Army, 2011). In 2008 it was safer to fly medical evacuation missions in Iraq than in the continental United States. It is important to note that these military accidents occurred at a time when the United States military was involved in two major wars and experiencing an operational tempo “five times” greater than would be expected during peacetime (Army News Service, April 25, 2011).

While 2008 was record-breaking, it was not an aberration. In 2007 being a crewmember aboard a HEMS aircraft bypassed commercial fishing as the most dangerous occupation in America (Bluman, 2009). Between 1972 (the year the first civilian HEMS program in the United States began operating) and 2008 there were 264 HEMS accidents involving 794 individuals and 264 fatalities (Blumen, 2009). Between 1988 and 1997 HEMS averaged 5 accidents per year. From 1998 to 2008 this number exploded to 12.4 accidents per annum (Blumen, 2009).

HEMS earned its position as one of the most dangerous occupations in America because the vast majority of fatalities were among crew members, not patients. Over

50% of all HEMS accidents occur with no patient on board the aircraft (NTSB, September 24, 2009).

The reasons for this dismal safety record are multifaceted and complex. There is no one universally accepted explanation for the large number of accidents and fatalities. This author will argue the financial pressures facing HEMS operators, as well as the belief that HEMS operations may be the difference between life and death (a condition referred to as the Kelly effect, after the "Father of Dust-off," Vietnam medical evacuation pilot Major Charles L. Kelly) combine to negatively influence aeronautical decision making among HEMS pilots and medical crews.

## Framing the Problem

The National Transportation Board (NTSB) has convened no less than three formal public hearings and roundtable discussions to address HEMS safety issues and make recommendations to the Federal Aviation Administration (FAA).

> In 1988, the Board adopted a Safety Study, *Commercial Emergency Medical Service Helicopter Operations*, which reviewed 59 HEMS accidents that occurred from 1978 through 1986. From that study, the Board issued 19 safety recommendations to the FAA, the National Weather Service, and two associations … The late 1990s and early 2000s saw a rapid growth of HEMS operations and the number of accidents began to rise. Prompted by this rise, the NTSB completed a special investigation report on *Emergency* Medical Services Operations in January

> 2006. This report analyzed 55 EMS accidents (41 of which were HEMS accidents and 14 airplane EMS accidents) that had occurred during the previous 3 years, claiming 54 lives; of these, 39 fatalities occurred during HEMS operations. Analysis of the accidents indicated that 29 of 55 accidents could have been prevented with corrective actions identified in the report … Immediately following adoption of the 2006 special investigation report, the number of HEMS accidents decreased. In calendar year 2006, 3 fatal HEMS accidents occurred with a total of 5 fatalities. The following year, there were 2 fatal HEMS accidents with a total of 7 fatalities, but in calendar year 2008, there were 8 fatal HEMS accidents, with a total of 29 fatalities … Prompted by this recent rise in the number of fatal HEMS accidents, the Safety Board held a 4-day public hearing this past February to address the issues associated with HEMS safety (NTSB September 1, 2009).

HEMS apologists have sought to explain away the increase in accidents as a function of flight time. They argue that there is a linear relationship between flight hours and accident rate. Dick Wright, a pilot writing in Rotor magazine (2005) argued that “the number of lives that are unfortunately lost as a result of accidents during HEMS operations remains truly low when the total scale of operations is considered … yes, the number of HEMS accidents has increased, but is this due to a failure of safety within the industry, or is it perhaps due to an increase in flight operations and thus greater exposure to risk?” (pp. 6).

This argument is overly simplistic and begs the evidence generated by the United States Army in Iraq and Afghanistan. During the past decade, the Army's aviation related accident rate has been remarkably stable, despite the crushing operational tempo. In fact, between 2001 and 2010, the Army's total aviation related accident rate (Class A, B, & C) has actually decreased from 10.2 accidents per 100,000 flight hours in 2001 to 7.5 accidents per 100,000 flight hours in 2010 (US Army, 30 April 2011).

This is in sharp contrast to the civilian HEMS community. The NTSB's Special Investigative Report on Emergency Medical Services Operations (2006) clearly shows that not only has the total number of accidents increased during the past two decades, but the number of accidents per 100,000 flight hours has increased as well. "Although the number of flight hours flown by EMS helicopter operations has increased from about 162,000 in 1991 to an estimated 300,000 in 2005, the average accident rate has also increased from 3.5 accidents per 100,000 flight hours between 1992 and 2001 to 4.5 accidents per 100,000 flight hours between 1997 and 2001" (NTSB, January 25, 2006, p. vii). Likewise, the FAA found that "the number of HEMS accidents nearly doubled between the mid-1990s and the HEMS industry's rapid growth period from 2000-2004. There were nine accidents in 1998, compared with 15 in 2004, five of which resulted in 17 fatalities" (FAA, June 8, 2010).

If the relationship between flight time and accidents was linear, there would be no concurrent increase in the number of accidents per 100,000 flight hours. As these data clearly shows, factors other than total flight time are responsible for civilian HEMS accidents.

*The HEMS Operational Environment.*

The HEMS flight environment is unique. "The pressure to safely and quickly conduct … operations in various environmental conditions … makes EMS operations inherently dangerous" (NTSB, January 25, 2006, p. vii). Off airport operations, low altitude flight environment, remote and/or challenging locations, spotty or inaccurate weather data along the route of flight, and little or no warning before mission dispatch are all factors which add to the complexity of HEMS flying (Zuccaro, 2009).

In its Notice of Proposed Rule Making (October 12, 2010), the FAA summed up the dangers facing HEMS operations: "Helicopter air ambulance operations present several unique operating characteristics that make them distinct from other types of part 135 helicopter operations. Such operations are often time-sensitive and crucial to getting a critically ill or injured patient to a medical facility as efficiently as possible … Remote-site landings [also] pose additional challenges. These remote sites are often unfamiliar to a pilot and, unlike an airport or heliport, may contain hazards such as trees, buildings, towers, wires, and uneven terrain" (p. 62642).

While there are many factors which make the HEMS flight environment distinctive, none are in and of themselves prohibitive. Rather, it is the accumulation of factors which result in unsafe flying conditions. Because of this, there is no single "Silver Bullet" that will result in a dramatic decrease in the HEMS accident rate (NTSB, January 25, 2006; September 1, 2009). Since the problem is multifaceted, the solution must be as well.

After an extensive review of HEMS accidents that occurred between 2002 – 2008, the NTSB determined the main causes of HEMS accidents were "controlled flight into terrain (CFIT), inadvertent operation into instrument meteorological conditions and pilot spatial disorientation/lack of situational awareness in night operations" (FAA, June 8, 2010). All three of these primary causes can be accurately categorized as human error. "In two NTSB studies … the pilot was cited as a cause or factor in more than 64 percent of rotorcraft accidents … [with] decision/judgment errors accounting for 41 percent of the pilot-error accidents" (Harris, 1994). Likewise, a study of accidents by Bell Helicopter involving their aircraft found "poor judgment was the common factor in all human-error accidents (Harris, 1994).

In an appendix to its 2006 Special Investigation Report, the NTSB described the problem this way:

> The HEMS role is a very demanding and time critical/mission oriented operation … 'soft skills' often refers to proficiencies that go beyond technical knowledge and psychomotor skills necessary to operate a helicopter. Soft skills are often the first line of defense … against accidents caused by lapses in human performance. Soft skills include adherence to standard operating procedures, decision making, judgment, air medical resource management (AMRM) (Similar to CRM), and professionalism. These skills are not easily or quickly conveyed in training programs but are developed through the continuing commitment of corporate managers,

trainers, pilots, mechanics, and medical staff (NTSB, January 25, 2006, Appendix D, p. 33).

The majority of HEMS accidents occur during low visibility conditions – at night or during inadvertent flight into instrument meteorological conditions (IMC). According to the Government Accountability Office (2007) "Available data confirm that air ambulance accidents are often related to their unique operating environment. For example, fatal crashes involving air ambulances occur most often at night, and air ambulance helicopters are four times more likely to have weather-related crashes than helicopters used by other operators flying under the same set of regulations [Part 135].

*Industry Response to the Crisis*

The Commission on Accreditation of Medical Transport Services (CAMTS) standards require that certified programs adhere to a "3 to go, 1 to say no" philosophy. Under this system each member of the crew is equally responsible for the "go/no go" decision. The company, via written policy and procedures, guarantees that no employee will be penalized for refusing to take a flight they feel would jeopardize their safety.

HEMS missions are usually conducted under conditions that are much stricter than traditional Part 135 operations. Weather and visibility minimums are greater than or equal to those required by the FAA. For CAMTS certified programs, minimums are 1000 ft ceilings and three mile visibility for day flight and 1000 ft ceilings and five mile visibility at night. Air medical crew comfort levels are often much higher. Ceilings below 2000 – 3000 feet are routinely rejected.

Additional safeguards in place include the development and staffing of an Emergency Operations Centers (EOC), Air Medical Resource Management (AMRM) for all flight crew members, night vision equipment, more conservative fuel minimums, and conducting all aspects of a flight under the more stringent Part 135 rather than part 91 weather minimums.

In the past HEMS operations would routinely conduct the dead leg portion of a flight (either to the scene to pick up the patient or back to base after delivering the patient) under Part 91 rules. Research has since clearly demonstrated that over 50% of all fatal HEMS accidents occur with no patient on board (NTSB, September 24, 2009). To address this problem the NTSB has recommended and much of the industry has embraced the requirement that all portions of a patient transport flight must be conducted under Part 135 minimums.

> 05.02.00 ALL "PATIENT TRANSPORT FLIGHTS"* must be conducted under FAA Part 135 regulations for weather minimums and flight crew duty time limitations. *Patient transport flight is defined as any flight segment conducted by rotor or fixed wing equipment that is necessary for transporting patients and the medical teams required to care for such patients. Flight segments included in this definition are: flights for refueling and repositioning for a specific patient transport (including organ donor transports); picking up and returning medical teams to an assigned base; the actual flight segment involving patient movement; and any time medical teams are on board (CAMTS, 2011).

Despite these efforts, aeromedical crews continue to accept flights in conditions which invite disaster. The realization that there are very real financial consequences for refusing to accept a flight may encourage faulty aeronautical decision making.

## The Profit Motive

### *Economic Landscape.*

There are very real financial consequences of turning down a flight. In the United States, the vast majority of HEMS operations are private rather than public entities. Even those that are titularly "not for profit" must produce a surplus in order to stay in business.

The number of HEMS operations has skyrocketed in the last twenty years. In 1991 there were approximately 225 helicopters involved in HEMS operations (Wright, 2004). Today, there are 840 medical service helicopters in operation (FAA, June 8, 2010), accounting for over 400,000 patient transports every year (Flight Safety Foundation, 2009). Since 2000 it is estimated that the number of HEMS aircraft operating in the United States has increased by 50 percent (Ludwig, 2008).

There are many reasons for this explosive growth, not the least of which is an increase in demand brought about by the closure and downsizing of small, rural healthcare facilities (Ludwig, 2008). Another and perhaps more overarching reason for the increase in air medical assets is an increase in reimbursement. In 2000, the Centers for Medicare and Medicaid Services (CMS) – the government agency that determines Medicare and Medicaid reimbursement rates – changed the formula in use for determining adequate compensation for air medical services; resulting in more generous reimbursements (National Association of State EMS Officials, 2009).

A dramatic side effect of this change has been an altering of the HEMS corporate landscape. Prior to 2000, the growth in the HEMS industry had been fairly slow and predictable, with the majority of services either not for profit or government owned. Following 2000 there has been a dramatic increase in private, for—profit companies entering the market. Because many of these companies failed, or were financially weak, there has also been an explosion of mergers and acquisitions (National Association of State EMS Officials, 2009).

One byproduct of this prodigious growth has been the virtual saturation of HEMS resources in certain areas of the country. Arizona is a prime example. The Phoenix metropolitan area encompasses over 3200 square miles and is comprised of Maricopa and Pinal counties. It has a population of approximately 4.2 million people (US Census Bureau, 2010).

Serving this area are four adult and one pediatric American College of Surgeons Level 1 Trauma Centers (the highest level designation for trauma services) and no fewer than 9 rotor wing and 2 fixed wing Emergency Medical aircraft. Because of the disbursement of the trauma centers, there is no area of the metropolitan area that is farther than one to one and a half hours by ground from state of the art trauma care. In comparison, there are no Level 1 Trauma Centers and very few HEMS assets in all of North Dakota, South Dakota, Nebraska, or Montana (American College of Surgeons, 2011).

Southern Arizona is equally saturated. The Southeast Arizona Emergency Medical Services Region (SAEMS) is the state authorized agency that oversees EMS operations in all or part of Pima, Greenlee, Graham, Cochise, and Santa Cruz counties. This area, encompassing over 23,000 square miles and consisting of a population of approximately 1.3 million people, is served by sixteen private air ambulances and one public law enforcement helicopter that is authorized to conduct rescues and transport patients as needed.

In addition to the above resources, state and local authorities have the option of requesting help from the United States Air Force Para-Rescue detachment (Air Force personnel who are trained as paramedics and whose primary job is the rescue of downed airmen behind enemy lines) at Davis Monthan Air Force Base in Tucson, Arizona as well as the Department of Homeland Security's Customs and Border Patrol air assets, including BORSTAR agents who are paramedics. There are more helicopters in central and southern Arizona than in all of Canada – where twenty helicopters serve 21 million people in four provinces (NTSB, 2009).

All of the HEMS assets within Arizona, with the exception of one hospital based program in Flagstaff, Arizona, are community based services. These bases are private Part 135 operators, and as such they are free to "base" wherever the organization sees a need. In the Phoenix metropolitan area, the majority of HEMS assets are based in the outlying suburbs, with few resources directly downtown. Population density and the close proximity of trauma services negate the need for air transportation assets in the core of the city.

In southeastern Arizona, thirteen of the sixteen helicopters are based in small, rural communities outside of the Tucson metropolitan area (the main population center, accounting for approximately half of the overall population in the region).

The competition for patients among HEMS providers in Arizona is fierce. With such a large number of air assets competing for flights, one or two calls per week can mean the difference between success and failure for any single base.

*Operational Expenses.*

HEMS bases are astronomically expensive to equip and maintain. Most of the HEMS providers in Arizona use either the Eurocopter A-Star 350 B3 or Bell 407. Both of these aircraft are versatile and cost effective platforms. However, they are not cheap: both aircraft average between $1.5 million to $3 million before any of the modifications necessary to produce a functioning HEMS aircraft. On average, each HEMS aircraft costs roughly $2000 per hour to operate, excluding personnel and equipment costs associated with the mission (Wilder, 2012).

The specialized equipment needed to operate in the aeromedical environment is also expensive. The average cost for cardiac monitoring equipment alone is over $40,000 per aircraft. All told, each HEMS asset has in excess of $100,000 worth of specialized equipment and medication on board; much more than the average ground based Advanced Life Support ambulance (Wilder, 2011).

Another factor influencing the cost of HEMS services is the quality and training of the air medical crew members. CAMTS (2011) requires that each air medical crew member have a minimum of three to five years critical care nursing or relevant field experience prior to hire. Initial flight training lasts between six weeks and three months for most services. This is simply an average. Air Life in Denver, Colorado can spend up to six months training new crew members before they are released to function independently (Abel, 2011).

After training, each air medical crew member is required to maintain a myriad of advanced certifications as well as an extensive amount of yearly continuing education requirements (CAMTS, 2011). The average air medical crewmember must maintain, at a minimum: Certified Flight Registered Nurse (CFRN) or Certified Flight Paramedic (CF-P); Basic Life Support (CPR); Advanced Cardiac Life Support (ACLS); Pediatric Advanced Life Support (PALS); Neonatal Resuscitation Program (NRP); and a nationally recognized trauma certification (Basic Trauma Life Support, International Trauma Life Support, Transport Nurse Advanced Trauma Course). On top of these mandatory certifications, each air medical crew member averages an additional forty hours of clinical time per year to maintain their skills in such specialty areas as high risk obstetrics and advanced airway techniques and invasive procedures (chest thoracostomy, surgical cricothyrotomy, and central line placement). These requirements represent a significant investment in time and treasure for both the individual provider and the HEMS operator.

Things are no different on the aviation side of the house. HEMS pilots are required to have a minimum of 2000 hours in order to be considered for employment. PHI Air Medical (2011) has published the following minimum qualifications for their HEMS pilots: 2000 hours total time, 1500 helicopter, 1000 helicopter PIC and 500 hours turbine engine helicopter time, and 100 hours night unaided flight time. In addition to the air medical pilot and crew, each HEMS base also has a dedicated mechanic who maintains the aircraft at a level at or above Part 135 minimums (Wilder, 2011).

Because of the large investment necessary to equip and maintain a successful HEMS operation, the cost of the service is equally large. In Arizona EMS providers are required to publish their rates for the consumer. In 2011, the average cost of a HEMS transport was $13,250 before mileage (AZ Department of Health Services, 2011). This is in stark contrast to the amount Medicare pays HEMS operators:

> The Medicare ambulance reimbursement fee structure differs between rural and urban services. Rural providers have a higher reimbursement fee structure because rural HEMS operators have less volume and longer distances to fly. The fixed rate for an urban area is $3,308 per trip plus $21.53 per mile. In rural areas, Medicare pays 50 percent more ($4,962 per trip plus $32.30 per mile) (NTSB, 2009, p. 9).

The extremely high operational costs coupled with uncertain reimbursements make HEMS operations financially tenuous at best.

### *Financial Performance and Employee Morale*

For much of the twentieth century, business literature tended to describe the causal relationship between employee morale/job satisfaction and organizational performance as flowing from the employee to the organization. In this model the lines of causation are linear and unidirectional: the more satisfied the employee is, the more productive he or she becomes, and as a result, the more successful the organization is overall (Denison, 1990; March & Sutton, 1997).

Recent studies have begun to question this linear, unidirectional relationship. Schneider, et.al., (2003) argue that, "models that draw the causal arrows from employee attitudes to performance at the organizational level of analysis are at best too simplistic and at worst wrong" (p. 846). Rather, they describe a more reciprocal relationship; one where employee satisfaction flows in part from the financial success of the organization.

Under this model, financially successful organizations are more appealing to current and prospective employees. Not only are these organizations able to pay more and provide better benefits, but there is less concern over future economic security. This in turn results in lower employee turnover and a higher quality of applicant (Schneider, et.al., 2003).

The social contract between employer and employee changed dramatically following World War II. No longer is it customary for an employee to stay with one company throughout their working career. Karnes (2009) quotes Mark Mattox, Human Resource Manager for Dr. Pepper Snapple Group to make this argument: "Thirty to forty years ago there was an unwritten natural order of progression in society which businesses, government and the populous followed. It held that you went to school, got a job, married your sweetheart, had children, raised your kids, sent them to college, and retired after fifty years with one company" (p. 191).

That is no longer the case. Rather, "In this fast-paced, dog-eat-dog world, the thought of having commitment between employers and employees seems pretty farfetched" (Karnes, 2009, p. 191). Robert Reich, former Secretary of Labor in the Clinton administration, describes just how insecure many modern employees have become: "Companies no longer offer job security. Now they routinely down-size their workforces, or resort to what might be called 'down-waging' and 'down-benefitting' (Reich, 2002, p.14) in order to remain competitive. This has had a profoundly destabilizing effect on the workforce. Where once employee loyalty was simply assumed and taken for granted, there is now a willingness among employees to "leave at the first sign of trouble" (Karnes, 2009, p. 192). Employee insecurity can be a self-fulfilling prophecy and have a dramatic effect on an organization's bottom line: employees who fear for their financial future are constantly on the lookout for their next position. This in turn leads to increased employee turnover and dramatically higher human resource costs (Phillips, 1996).

Anecdotal evidence regarding the effect of financial solvency on aeronautical decision making can be seen in this conversation regarding maintenance practices at one HEMS base. The base in question had come under increased scrutiny because of excessive operating cost. Despite being 105% over budget in terms of flight volume, the base was severely in the red overall.

An in-depth financial analysis revealed that over $150,000 of that deficit was due to unplanned major maintenance, including replacement of a tail rotor and rotor head on aircraft assigned to the base. The remainder of the short fall was due to less than projected reimbursement and the cost of transitioning the base from an A Star 350 to a Bell 407.

Information regarding the bases finances was shared with the staff during a specially called meeting by management, including reasons for the deficit and plans to bring the base back to solvency. During these discussions a pilot stated quite honestly, "I won't do this, but you telling me this makes me feel like next time I see something minor, I don't want to report it" (Confidential Correspondence, 2011).

This hesitancy to report minor mechanical concerns could be catastrophic to the safety of everyone involved. As discussed above, the vast majority of HEMS accidents are human factors related. Mechanical problems are an extremely rare event. This will only continue to be the case as long as problems are identified, reported, and addressed.

## The Kelly Effect

Another factor which may affect the "go/no go" decision among HEMS crews is what I refer to as the Kelly effect. Also known by the more pejorative nickname "hero syndrome," this tag refers to the internal compulsion to accept a flight in marginal conditions or at the ragged edges of the flight envelope because of the belief that lives are at stake.

Major Charles L. Kelly is known as the "Father of Dust Off" (Zabecki, 2009). His exploits were larger than life, and set a standard that effects HEMS operations to this day. Medical evacuation missions in Vietnam were called "dust off" missions. The name comes from a quirk of fate. When the first air ambulance unit arrived in Vietnam ($57^{th}$ Medical Detachment – Air Ambulance), they simply went by the moniker "Army," and did not have a standard, assigned radio frequency. The new commander, Major Spencer, found this situation intolerable and set about fixing it. He went to the Navy

Support Activity in Saigon, who was responsible for assigning all call signs in South Vietnam. After being handed a dictionary of unused call words, he stumbled across "dust off." Given that during the dry season the unit's landing zones were often parched, and the rotor wash made dust and debris fly everywhere, Major Spencer thought the name apropos (Dorland & Nanney, 1982).

The third commander of the 57th Medical Detachment – Air Ambulance, Major Charles L. Kelly, is credited with creating the "Dust Off" mystique. A tough, no nonsense commander, he did not suffer fools and did not let obstacles get in his way while completing a mission. As American involvement in Vietnam increased, so did the operational tempo. To keep up with demand, and avoid being grounded, Major Kelly and his pilots intentionally falsified their flight logs; omitting hours flown to stay under regulatory requirements (Dorland & Nanney, 1982).

Major Kelly and his pilots also gained the reputation of going where other aircrews refused in order to pick up injured soldiers and civilians. One 1 July 1964 Major Kelly responded to a call by a South Vietnamese Army unit requesting evacuation of their American advisor who had been injured by shrapnel and several Vietnamese soldiers. As Major Kelly approached the area, the ground forces tried to wave him off because of enemy activity in the area. In what has become the iconic image of the Dust Off pilot in Vietnam, Major Kelly is reported to have responded, "when I have your wounded," and continued in towards the landing zone (LZ). As the helicopter got closer to the LZ, small arms fire intensified, and a round struck Major Kelly in the chest, killing him almost instantly. Major Kelly was posthumously awarded him the Distinguished

Service Cross for his gallantry and valor (Dorland & Nanney, 1982; Dust Off Association, 1997).

Major Kelly's belief that the mission must be completed regardless of the rules, or the cost, has been a two edged sword for civilian HEMS. The Dust Off mystique is still pervasive, despite organizational efforts to diminish its influence.

*Mission Orientation and Professional Motivation*

There are several reasons for this mission oriented mindset, not the least of which is the belief that what HEMS does matters. In their work on effective government organizations, Rainey and Steinbauer (1999) postulate a "Public Service Motivation" that is different from that found in the civilian sector. They define this motivation as "a general altruistic motivation to serve the interests of a community of people, a state, a nation, or humankind" (p. 23).

Building upon this work, University of North Carolina Professor Bradley Wright (2007) argues "that employee reward preferences coincide with the function served by the sector in which they are employed. Public sector employees have repeatedly been found to place a lower value on financial rewards and a higher value on helping others (public service) than their private sector counterparts" (p. 54). He goes on to state that "studies that have found similar levels of work motivation among public and private employees suggest that the importance employees place on contributing to the public service mission of their organization may provide intrinsic rewards" not usually associated with private sector employment (p. 54).

Using these definitions as a framework, it is easy to see that although predominantly private; HEMS professionals share many common characteristics with their public sector counterparts. The high degree of "mission motivation" can be attributed in part to a very high degree of "mission valence," or the belief that what one does is worthwhile. Employees that believe in the organization's mission are "motivated to contribute to the achievement of the mission" (Rainey & Steinbauer, 1999, p. 25). Professor Wright describes the phenomena this way: "the extent to which an individual accepts a performance goal and is determined to reach it, even if confronted with setbacks or obstacles" (Wright, 2007, p. 55).

Other researchers dismiss the public/private sector divide and instead argue that the intrinsic motivators associated with public service workers can just as easily be found in the private sector (Kjeldsen, 2010). In a paper delivered before the Fourteenth Annual Conference of the International Research Society for Public Management, Professor Kjeldsen of Aarhus University in Denmark argues that a commitment to the public interest, self-sacrifice, and compassion are more a function of occupation than sector.

In her study Professor Kjeldsen (2010) found that nurses who were employed by private agencies had motivations similar to those nurses employed by the National Health Service. Motivations emanated "from their educational background, and they feel an obligation to continuously upgrade their skills in this regard. Two of the nurses mention that duty to serve the public interest is specified in their authorization as nurses. This clearly points to educational and professional socialization as important antecedents for determining occupational differences in Public Service Motivation" (p. 11).

This occupational orientation is especially relevant to HEMS. Multiple studies of pilot personality traits reveal similar characteristics: "The person who wishes to be an aviator, the folklore tells us, must possess supernormal levels of courage, audacity, self-discipline, aggressiveness, dominance, self-reliance, and above all self-confidence" (Retzlaff & Giberini, 1987, pp. 383). As stereotypical as this description sounds, there is evidence of its veracity.

Assessments of military pilots using the Minnesota Multiphasic Personality Inventory (MMPI) found military pilots to be more "social, aggressive, self-confident, and intellectually-striving than normal while displaying less hypochondriasis, anxiety, and schizoid and antisocial tendencies" (Retzlaff & Gibertini, 1987, pp. 384-385).

Other less well known studies of personality traits have found military pilots to be more achievement oriented, dominant, dependable, practical, and pragmatic (Retzlaff & Gibertini, 1987). While pilots are not a homogenous group, most successful aviators have proven to be intelligent, emotionally mature and stable, action oriented and reasonably adaptable (Ganesh & Joseph, 2005).

Likewise there is a well-defined "rescue personality" (Mitchell & Bray, 1990). People that choose Emergency Services as a profession "have a high need for stimulation, are risk takers, are highly dedicated, and have a need to help others" (Salters-Pedneault, Ruef, & Orr, 2010, p. 210).

These characteristics are close enough to those displayed by successful aviators to be synergistic. Each member of the aeromedical flight crew has a predisposition to completing the mission. Rather than tempering the willingness of another crewmember to take an unacceptable risk, the personality make up of HEMS crews may in fact "feed into" each other's need to complete the mission, with the potential for disastrous results.

*Objective Evidence of the Kelly Effect in HEMS*

The National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System (ASRS) offers proof of just how pervasive the Kelly effect is. The following examples from the ASRS database are instructive (Connell & Patten, 1993):

> 'We were on an air ambulance flight...picked up a team of organ removal surgeons in XYZ...and flew them to ABC to remove the heart from a donor. The weather was clear and forecast to remain so. We understood... [that] the heart has a very short lifetime between removal from the donor and installation in the recipient, so when the recovery team arrived back at the ABC airport it would be necessary to expedite as much as possible...The F/O...[and I] readied the aircraft for the return leg and then went into the FBO to wait...Shortly before the medical team's departure from the airport...the fog began to roll into the area. Upon [their] arrival, the visibility was down to 4000 RVR... [but] our operations specifications call for minimum 5000 RVR for departure. I felt it was necessary to depart below minimums based on our medical emergency...I felt the decision to depart below minimums was the only one available to me under the circumstances. If we had waited

for improved visibility, the heart would have been ruined, and the receiving patient may have died' (ACN 221023)

'...High risk delivery, mother in distress. I allowed patient's condition to influence my decisions. Got above layer, had to descend IFR in a non-certified but well-equipped aircraft' (ACN 58837)

'...Quick EMS helicopter responses, numerous interruptions during start-up, added pressure of a dying person, causing pilot to make emotional decisions instead of safe ones and the pilot allowing this to happen. Most likely a pilot would not fly unless under excessive pressure to do so-- not by anyone (else), but self-imposed' (ACN 118240)

These examples clearly show the self-imposed internal pressure faced by many HEMS pilots and air medical crewmembers. I do not argue that the Kelly effect is inherently bad; rather I believe it is an intrinsic part of what motivates aviation and medical professionals to practice in this unique environment. That said it is important to recognize the detrimental effect this motivation may have on the safety of flight.

## CHAPTER TWO

## LITERATURE REVIEW

### Aeronautical Decision Making

As discussed above, pilot decision errors are the number one cause of HEMS related accidents and fatalities. Likewise, sub-optimal decision making is the primary cause of major accidents and fatalities in General Aviation (Goh & Wiegmann, 2001; Madhavan & Lacson, 2006; FAA, 2008; Hunter & Stewart, 2009). According to Goh & Wiegmann (2001), "fatal aviation accidents are more often associated with decision errors than minor accidents, which tend to be associated with procedural execution errors" (p. 360).

The Federal Aviation Administration (FAA) describes aeronautical decision making as a "Systematic approach to the mental process of evaluating a given set of circumstances and determining the best course of action" (FAA, 1991, p. ii). Jensen (1995) defines pilot judgment as "the mental process that we use in making decisions" (p. 27).

In the past there has been a "which came first: the chicken or the egg?" type of quandary in terms of aeronautical decision making. Many pilots believe that good judgment "is a natural process that is attained through experience. At the same time they are generally convinced that if you don't have enough of the former, you will not live long enough to gain the latter (Jensen, 1989, p. 4).

In an effort to understand why pilots and crew members make decisions that may ultimately lead to disaster, researchers have offered many different insights (Jensen, 1995; Goh & Wiegmann, 2001; Li & Harris, 2001; Madhavan & Lacson, 2006). One of the most frequently cited models for decision making was developed by Jensen (1995) who described an eight step process. In this model, decision making proceeds sequentially from:

1. *Problem Vigil*: The baseline state of awareness that the pilot or crewmember are in so that they can detect changes in the environment.

2. *Recognition*: The realization that changes in the environment may affect the safety of flight.

3. *Diagnosis*: The pilot and crew members attempt to understand the nature of the problem (change in the environment).

4. *Alternative Identification*: This is the problem solving stage. Various courses of action are identified and considered.

5. *Risk Assessment*: The pilot and crewmembers attempt to evaluate each alternative identified in the previous stage according to the risks they may engender.

6. *Background Factor*: This is where the pilot's and crew member's experiences and prejudices are incorporated.

7. *Decision Making*: The pilot and/or crewmembers make a decision.

8. *Action*: The decision is put into practice.

Jensen's model can be broken into two distinct phases: "rational judgment" which encompasses the first five steps and "motivational judgment" which accounts for the last three tasks. According to this model, rational judgment is the "ability to discover and establish the relevance of all available information relating to problems of flight, to diagnose these problems, to specify alternative course of action and to assess the risk associated with each alternative," while motivational judgment is the ability to "choose and execute" a suitable course of action within the available time frame (Hunter, 2003, p. 375).

Attempting to capture and measure a pilot's driving force in the decision making process is important because it is at this stage that "the motivational forces that keep us from following purely rational decisions" (Jensen, 1995, p. 46) comes into play. While looking at the problem of Visual Flight Rules (VFR) flight into Instrument Meteorological Conditions (IMC), Goh and Wiegmann (2001) postulate that "pilots may diagnose and perceive the risks accurately, but other motivational factors bias their decisions … to continue with the flight even though an assessment of the situation suggests otherwise" (p. 361).

In their study Goh and Wiegmann gave a group of non-instrument rated private pilots a predetermined scenario utilizing a flight simulator. The subjects each flew two routes. The first route was flown to allow the pilot to familiarize themselves with the controls; the second route was flown to gauge their reactions to the experimental condition.

Approximately 45 minutes into the second flight the subject was forced to deal with deteriorating weather conditions. Subjects had a five minute window from the time the weather conditions fell below VFR minimums to make their decision whether or not to terminate the flight. If the pilot had not made the decision to terminate the flight by the end of the five minute window, he or she was considered to have made the decision to continue with the flight and the experiment was ended (Goh & Wiegmann, 2001).

Surprisingly 22/32 (68.75%) of the subjects chose to continue the flight despite the deteriorating weather conditions. Analysis of the data, including a post flight questionnaire, showed that:

> Pilots who chose to continue with the flight had higher ratings of skill and judgment, suggesting that they had greater confidence in their abilities to control the aircraft than the pilots that chose to divert. Furthermore, pilots who chose to continue rated themselves as more willing to take risks than pilots who chose to divert. Together these two group differences suggest that because of greater confidence in their own piloting abilities, the pilots who continued were more willing to risk flying into adverse weather (Goh & Wiegmann, 2001, p. 376).

These findings are consistent with a study conducted in the United Kingdom by the Civil Aviation Authority "who cited the psychological factors contributing to pilot errors in bad weather included 'excessive optimism,' a 'reluctance to admit limited capability,' and 'lack of appreciation of real dangers'" (Madhavan & Lacson, 2006, p. 53).

Wichman and Ball (1983) describe this phenomenon as a confluence between Locus of Control (LOC) and Self Serving Bias (SSB). According to the authors, SSB is a protective mechanism and "can be viewed as a tendency to make attributional responses which protect and maintain one's self esteem. This seems related to other finding characterizing what has now come to be called the fundamental attribution error – making dispositional attributions rather than situational attributions, or the tendency to attribute one's own failures to external factors and one's successes to internal factors" (p. 507).

The author's rely upon Rotter's definition to explain LOC:

> When a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate …we have labeled this a belief in external control. If the person perceives that the event is contingent upon his own behavior or his own relatively permanent characteristics, we have termed this a belief in internal control (Wichman & Ball, 1983, p. 507).

In their research Wichman and Ball administered a series of tests designed to measure both LOC (internal versus external) and SSB to three separate groups of pilots.

Their results showed that the pilots believed themselves to have a less than average chance of being in an accident and to have greater than average piloting skills. "Aviators with more experience and exposure develop stronger self-serving biases. These people tend also to be more internal in locus of control. So their way of handling dangers is not just to make light of them, but to actively do something about reducing the dangers" (1983, p. 509).

### *Male Pilot Personalities*

There have been no published studies that directly relate to the go-no go decision in HEMS. However, as the discussion above clearly shows, there have been numerous attempts to describe and quantify problems associated with aeronautical decision making.

Human Factors experts have been studying the effect of personality traits and attitudes on aeronautical decision making for decades. Research on certain key attitudes that may predispose a pilot to making unwise or hazardous judgments is voluminous (Retzlaff & Gibertini, 1987; Vail, 1988; Dukes, Hulbert-Johnson, Newton, & Overstreet, 1991; Davey & Davidson, 2000; Johnson, 2003; Ganesh & Joseph, 2005; Vermeulen & Mitchell, 2007).

Personality may be defined as the "the complex of characteristics that distinguishes an individual or a nation or group; *especially*: the totality of an individual's behavioral and emotional characteristics b: a set of distinctive traits and characteristics" (Merriam-Webster, 2009). Likewise attitudes can be viewed as "learned and relatively enduring perception, expressed or unexpressed, influencing a person to think or behave in a fairly predictable manner toward objects, persons, or situations" (Wilkening, 1973, p. 28).

Retzlaff & Gibertini (1987) state that pilots are more achievement oriented, dominant, dependable, practical, and pragmatic. While pilots are not a homogenous group, most successful aviators have proven to be intelligent, emotionally mature and stable, action oriented and reasonably adaptable (Ganesh & Joseph, 2005).

A study involving 2485 military pilots and navigators found that these men scored higher on global measures of psychological well-being than the civilian control group. "Variables that were associated with psychological well-being were better overall health, lack of perceived time pressure, more competitive behavior and a positive attitude towards physical fitness" (Retzlaff & Gibertini, 1987, pp. 385).

In a study using the 'Occupational Personality Questionnaire,' a test developed specifically for the workplace, the majority of military pilots fell into one of three groups or clusters. The first group, comprising 48 percent of the pilots tested, were labeled as "methodical extroverts' and had strong needs to master their environment and strong desire for novelty and change." The second group of pilots (36%) was known as "introverted worriers." These men were described as "apprehensive, emotionally controlled, inhibited and socially retiring." The third and smallest cluster of pilots, comprising only 16% of the total sample size was labeled "competitive individualists." They were "competitive, highly independent, and decisive" (Ganesh & Joseph, 2005, pp. 56).

The fact that over one third of the pilots tested (36%) displayed traits counter to the hyper-masculine stereotype, shows the heterogeneity among military pilots; a prerequisite of operational success. "Pilots, in addition to being competitive, dominant, and achieving, must possess a fair degree of self-control and level headedness in order to function within the highly structured military environment" (Retzlaff & Gibertini, 1987, pp. 396).

*Female Pilot Personalities*

In their study, Ganesh and Joseph (2005), found that there were "relatively large differences between female pilots and non- pilot females, whereas there were small differences between male and female pilots" (p.57). These results give credence to the suggestion that there is an "aviator personality type" (Dukes, Hulbert-Johnson, Newton, & Overstreet, 1991, pp. 722) that is independent of gender.

Studies of female United States Air Force aviators found them to be "generally calm, emotionally resilient, extraverted, outgoing, active, high-spirited, open to new experiences, competitive, tough-minded, dependable, and moderately well-organized" (Chappelle, et.al., 2010, p. 162). What is interesting is that the authors report a sense among many Air Force personnel that there is a difference in personality among the female pilots according to the type of airframe they command.

> It has been reported that female fighter and bomber pilots appear to be more aggressive, competitive, extroverted, and excitement seeking than female pilots assigned to other airframes. USAF female pilots assigned to tanker and transporter airframes with

> large aircrews tend to be perceived as more interpersonally warm, gregarious, and trusting, as well as less aggressive and competitive … however, there are no published studies assessing personality differences between USAF female pilots according to the airframe they are assigned to fly to clarify this issue (Chappelle, et.al., 2010, p. 162).

Using data from the NEO Personality Inventory – Revised (NEO PI-R), Chappelle, et.al. (2010) compared the scores of 512 female and 9,630 male Air Force pilots on active duty at the time of the study. These scores were compared to a group of 500 civilian non pilot females who acted as a control group. The NEO PI-R is a 240 question tool designed to test normal personality characteristics along five domains: neuroticism, extraversion, agreeableness, openness, and conscientiousness. It has been administered to all Air Force pilot candidates since 1994.

Chappelle, et.al.'s results are consistent with those of Ganesh and Joseph (2005). United States Air Force female aviators have more in common with their male counterparts than the civilian control group. Specifically, Chappelle, et.al. (2010) found that:

> They [female U.S. Air Force pilots] are more interpersonally gregarious, assertive, outgoing, excitement-seeking, and expressive of positive emotions. As a group, they are more open to new experiences, inner feelings, and emotions and are more willing to consider new and perhaps unconventional ideas. However, they are

> more inclined to be tough minded, straightforward, proud, competitive, achievement oriented, and self-confident. As a group, the test scores for female pilots also indicate that they are more open to inner feelings and emotions while also being more capable of handling stress and remaining composed in difficult and highly challenging situations … It should be noted the differences between female and male USAF pilots are not the usual male–female sex differences one typically obtains. For example, a review of male–female differences from the civilian normative data for the NEO PI-R reveals that females tend to be more trusting, altruistic, modest, tender minded, self-conscious, and vulnerable to negative emotional states. This finding further exemplifies how different USAF female pilots are as a group from females in the general population (p. 168).

This study, though fascinating, has several significant shortfalls. First is the educational preparation of the participants. All of the pilot participants held at least a four year college degree (16 years of formal education); the average education level for the female control group was 13.6 years.

There is also the potential compounding variable of military service. While the presence of a "pilot personality" is well established, there is also the shared mores and folkways found among those who choose the military as a career (Kelty, Kleykamp, & Segal, 2010). It would be beneficial to see a comparison similar to the one conducted above, but using female, non-pilot, military officers as the control group. This framework would eliminate the concerns aroused by the different educational levels between groups, as well as neutralize any effects from shared military ethos.

*Five Hazardous Attitudes*

In Advisory Circular AC-60-22 "Aeronautical Decision Making," (1991), the Federal Aviation Administration (FAA) outlines what it considers to be the five most dangerous attitudes and offers guidance to pilots on how to mitigate the negative effects of these traits. Research conducted by Wetmore and Lu (2006) concluded that "hazardous attitudes have a measurable, negative effect on a pilot's ADM [Aeronautical Decision Making] and CRM [Cockpit Resource Management] skills that can be summarized as follows: (a) more willing to accept high risk flights; (b) more prone to making bad decisions; (c) more likely to commit pilot errors; and (d) less likely to use all of the available cockpit resources" (p. 165).

Five hazardous attitudes were initially identified by a team from Embry-Riddle Aeronautical University working under contract with the FAA to develop training material aimed at lessening the effect of poor pilot decision making (Murray, 1999; Lester & Bombaci, 1984). AC- 60-22 describes these five attitudes as:

1. Antiauthority: Do not tell me what to do
2. Impulsivity: Do something - anything
3. Invulnerability: It will not happen to me
4. Macho: I can do it
5. Resignation: What is the use?

In a follow on study, Lester and Bombaci (1984) reported, “The finding that almost half of the subjects displayed a predominantly invulnerable hazardous thought pattern suggests that this may be a major mediator of irrational pilot judgment” (p. 570). In their conclusion they argue that people with a “resigned” attitude rarely complete pilot training and are thus less of a danger than those with anti-authoritarian, invulnerable, and impulsive personality traits (Lester & Bombaci, 1984).

Steven R. Murray (1999) has gone so far as to suggest that a sixth hazardous attitude be added to the FAA’s original five. He argues the need to save “face” can have a profound effect on a pilot’s aeronautical decision making. According to Murray, “face” is a universal phenomenon and deals with the individual’s assessment of how others view him/her. “The universality of face and the negative consequences of loss of face are well known and acknowledged. Although pilots have been shown to have clearly different personality profiles than the population at large, there is no evidence to suggest that pilots are any less likely to … suffer the negative consequences of loss of face” (p. 405). He goes on to say that “the aviation community is a fraternity, or group, in which shame and humiliation are visited upon the pilot who violates its high standards … which leads to risk taking behavior” (p. 406).

The idea of face is closely aligned with that of the macho, invulnerable, and antiauthoritarian personality traits previously identified by the FAA. As mentioned above, in their study of pilot personalities, Ganesh & Joseph (2005) found sizable differences between female pilots and their civilian counterparts, but a much smaller difference between male and female pilots, giving credence to the assertion that the stereotypical “pilot personality” is independent of gender.

*Invulnerable Hazardous Attitude*

Invulnerability has been cited as a causal factor in drivers as well. Rather than a personality trait per se, Jonah (1986) found that the sense of invulnerability had as much to do with risk perception and tolerance as motivation. Risk perception is the recognition of the risk inherent in any given activity. Risk tolerance is the amount of risk an individual is willing to accept in the pursuit of a goal. Both may independently adversely affect aeronautical decision making (Hunter, 2002).

Risk perception is subjective. It is mediated by both the situation and the viewer. "Underestimation of the external situation and overestimation of personal capacity leads to a misperception of the risk and is frequently seen as a factor in aircraft accidents" (Hunter, 2002, p. 3). Likewise, risk tolerance is also mediated by personal experience. It is influenced to a large extent by the value the person assigns to a particular activity. "For example, in one survey, pilots indicated that they would take more risks in order to return home for the Thanksgiving and Christmas holidays than they would for flying medicine to a remote village" (Hunter, 2002, p. 3).

To study the interaction between risk assessment and risk tolerance, Hunter (2002) administered a series of scenarios to a self-selected group of pilots. Each scenario was designed to test the pilot's ability to identify risks as well as his/her tolerance for those dangers. "In real aviation settings, in order to get where one wants to go, it is not possible to sit forever on the ground (taking zero risk) or to fly headlong through all obstacles on the most direct route (ignoring all risks). Rather, it is necessary to consider the risks in the context of the desired outcome, and to expose oneself to the minimum risk necessary to accomplish the goal" (p. 6).

Hunter found that the more experience the pilot had, the less likely it is they would view a particular situation as risky. This finding suggests that to some extent, experience breeds a sense of invulnerability. This is consistent with the "Zero Risk Theory" which holds that "as self-confidence increases (largely as a function of increased experience in the situation), perceived risk diminishes to the point of zero perceived risk" (Hunter, 2002, p. 1).

Hunter's findings are also consistent with the relationship between risk perception and tolerance described by Jonah (1986). "Pilots with a low perception of risk tended to be involved in more hazardous events" (p. 20). He goes on to insist that, from a regulatory point of view, "it is far better to have a problem caused by pilot skill deficiencies than to have a problem caused by pilot personality traits, because the former are far easier to change than the latter" (p. 21).

*Macho Hazardous Attitude*

In addition to a mistaken sense of invulnerability, pilots, regardless of gender, can fall victim to an illogical and unsupportable belief in their ability to complete a task – the macho hazardous attitude. The work on hyper-masculinity and machismo is extensive (Tomkins, 1987; Mosher & Tomkins, 1988; Mosher, 1991; Krahe & Fenske, 2002). What is unique in this discussion is its application across traditional gender lines.

Mosher and Sirkin (1984) define a "macho personality" as one that refers to an exaggerated endorsement of the hyper-masculine stereotype and involves three distinct elements: calloused sexual attitudes toward women, the perception of violence as being manly, and the view that danger is exciting. They found these traits to have a significant positive correlation with aggression and impulsivity and a negative relationship to understanding and harm avoidance.

Krahe and Fenske (2002) argue that these traits serve a purpose. They believe the predisposition to violence and risk taking is a throwback to the "intense reproductive competition among ancestral men." Young men engage in violent and risky behaviors in order to establish "a reputation of prowess and strength that makes them attractive mating partners to women and fends off potential male rivals" (p. 22).

This 'man as Neanderthal' view is exemplified in the classic macho view of women. "The view of masculinity as heroic is joined with a conception of women as dominion and as sexual object who exist as reward for the conquering hero … calloused sex attitudes embody some men's attitudes that sexual intercourse with women establishes masculine power and female submission, and is to be achieved without empathic concern for the female's subjective experience" (Mosher & Sirkin, 1984, p. 151, 152).

Likewise, the propensity to violence and the belief that danger is exciting can be seen as "a manly display of masculine power over the dangerous environment … any situation that challenges or threatens masculine identity activates this structure, thereby motivating and organizing the personality for participation in hyper masculine behaviors such as dangerous risk taking, exploitive sex, or violence" (Mosher & Sirkin, 1984, p. 152).

Mosher and Tompkins (1988) described these innate, almost subconscious responses to external stimuli (threats) as scripts. "The macho man creates, interprets, and responds to scenes that threaten, challenge, or afford opportunities to enact his role as a macho man according to the set of rules in the macho script … the macho is living a life in accordance with his macho script. To enact the macho script is to live macho scenes, is to celebrate the ideology of machismo" (p. 62). This scripting is not just individual, it is cultural.

> The cultural descendent of the nomadic warrior is the macho man. The ideology of machismo is a warrior's ideology. The macho warrior holds dominion over all he has conquered – he is master and patriarch. Slaves, wives, and children are his property, owing him respect and fealty. To maintain that dominion, the macho man must be prepared to risk all by acts of great daring, to compel enemy men to submit through violence, and to dominate female adversaries through callous sex … the ideological script of the macho man is socially inherited within a macho culture by virtue of being male" (Mosher & Tompkins, 1988, p. 64).

The above discussion of the macho personality is glaringly misogynistic. Its emphasis on the subjugation and exploitation of women is uncomfortable to read, yet these views remain largely entrenched in western society. It is not an accident that the prototypical pilot personality contains many of the macho personality traits detailed above.

As with most things, it is a matter of degree. Combat aviators are by definition aggressive (Paullin, Katz, Bruskiewicz, Houston, & Damos, 2006; Chappelle, Novy, Sowin, & Thompson, 2010), yet it is this same aggression that may be a liability in terms of safety and appropriate aeronautical decision making.

What is left unanswered by the above studies is how female aviators fit into this decidedly androcentric mold. Given Ganesh and Joseph (2005) and Chappelle et.al's (2010) findings that female aviators have more in common with their male counterparts than with the female control group, it is clear that the "pilot personality" is a socialized phenomenon rather than an inbred predisposition. This is a rich area for further research.

*Anti-Authoritarian Hazardous Attitude*

The anti-authoritarian hazardous attitude is very similar to, and often overlaps with, the invulnerable and macho hazardous attitudes. According to Advisory Circular 60-22, "This attitude is found in people who do not like anyone telling them what to do. In a sense they are saying no one can tell me what to do. They may be resentful of having someone tell them what to do or may regard rules, regulations and procedures as silly or unnecessary" (p. 11).

Aviation is one of the most heavily regulated industries in the United States. From aircraft and airman certification, operational checklists, maintenance practices, airport operations, airspace issues, and air traffic control; almost every aspect of flying is governed by one or more regulatory interventions. "All modern societies manage their relationship with technology through expert mediators, who are usually state regulatory bodies such as the FAA. These regulators have become a twenty-first century clergy, standing between the public and the esoteric knowledge with which they must contend" (Downer, 2010, p. 84).

Callous disregard for "the rules of the road" in the unforgiving environment of aviation is lethal. For this reason the FAA and other regulatory agencies are given the power to not only devise regulations, but punish transgressors.

> Although our society has undeniably considered aviation safety regulation important, there are always those few who would rather see governmental insouciance concerning matters of safety … the [FAA] Administrator has been given a statutory mandate to suspend, modify or revoke certificates or to impose civil penalties for the violation of regulations. In the enforcement of these regulations the FAA institutes approximately 5000 proceedings a year for infractions by pilots, mechanics, air carriers, air taxis and others who hold various types of certificates issued by the FAA (Pangia, 1981, p. 574).

Weitman (1962) conducted a study comparing pro-authoritarian, anti-authoritarian, and non-authoritarian personality types. His results, though dated, are nonetheless instructive. His study showed that of the three personality types, pro-authoritarians and anti-authoritarians are actually very similar; both having an abnormal fixation with authority. The difference was solely that of emphasis: the pro-authoritarian personality usually submitted to authority while the anti-authoritarian rebelled. By contrast the non-authoritarian had a much more balanced outlook towards authority, displaying neither a propensity to submit or protest.

Interestingly, there are more studies dealing with pro-authoritarian personalities than anti-authoritarian traits. While this is curious, if these studies are valid, the converse of the conclusions should be largely correct.

In a review of the literature, Peterson and Zurbriggen (2010) found "those scoring high on authoritarianism [pro-authoritarians] (1) adhere strongly to conventional moral values, (2) are submissive to established authorities, and (3) are willing to aggress against others if they are perceived as unconventional or threatening" (p. 1802). They are hostile to challenges to the status quo. Therefore, pilots who score high on tests of authoritarianism should be less likely to view rules, regulations, and standard operating procedures as recommendations or optional. This assumption is supported by Retzlaff and Gibertini (1987) who found that "while they [military aviators] are high on dominance and achievement, pilots are relatively low on autonomy … they function as part of a team and are expected to subordinate their own desires to the task at hand i.e., the mission" (p. 396).

Additionally, those individuals who score high in authoritarian traits "live in a rigidly gendered world, one in which gender roles are narrowly defined and firmly enforced, attractiveness centers around traditional conceptions of masculinity and femininity, conventional sexual mores are prescribed, and traditional life paths (e.g., concerning education and career) are embraced" (Peterson & Zurbriggen, 2010, p. 1820). As such, feminist ideology is rejected.

This world view has profound implications for female aviators. By definition, for a woman to succeed in the highly androcentric world of aviation, especially military aviation, she must possess some degree of antiauthoritarianism. This belief is supported by Chappelle et.al's findings regarding female United States Air Force aviators (2010). In their research they found female Air Force pilots to be "more interpersonally gregarious, assertive, outgoing, excitement-seeking, and expressive of positive emotions. As a group, they are more open to new experiences, inner feelings, and emotions and are more willing to consider new and perhaps unconventional ideas" than the civilian female control group (p. 168).

According to Hanrahan and Antony (2005), "Feminism is, at least partly, an *antiauthoritarian* movement: it is and has been historically a movement that calls into question received views, that challenges the legitimacy of existing hierarchies, and that unmasks many traditional "authorities" as arbitrary and ungrounded" (p. 60). Its very existence is an affront to the conservative, pro-authoritarian view expressed above.

As with the invulnerable and macho hazardous attitudes, antiauthoritarianism's danger is dependent upon motivation and degree. Tests of personality show most pilots to be team players. Research also shows they possess a large degree of independence and an increased capacity for critical thinking. Because of this they are less likely to blindly accept authoritative pronouncements without first being given the underlying rationale. These traits transcend gender. In fact, as discussed above, some degree of antiauthoritarianism is required of females wishing to join this male dominated, traditionally masculine profession.

The history of aviation is the history of failure. It is the story of catastrophic accidents and tragic losses (Shappell & Wiegmann, 2000). In 1853 Louis Charles Letur built a parachute glider: the first pilot-controlled, heavier than air machine. He made several successful flights before suffering a fatal crash in London in 1854 (Spartacus Educational, 2000).

Following their first successful powered flight on December 17, 1903 (Crouch, 2010), the Wright brothers gave aviation its first passenger fatality on September 17, 1908. The fatality was Army Lieutenant Thomas E. Selfridge, a U.S. Military Academy graduate and the "Army's foremost expert in aeronautics … [who had] written several papers on the future military use of the airplane" (Regan, 1999, p. 15).

The early days of aviation are synonymous with high profile crashes. Harriet Quimby, the first woman to fly the English Channel, was killed during the 1912 Harvard – Boston Aviation Meet. Her French Bleriot monoplane went out of control during an exhibition flight and she was thrown from the aircraft; falling to her death (Gwynn-Jones, 1984). Similarly tragic was the death of Bessie Coleman, the first female African American pilot in 1926. Like Quimby, Coleman was thrown to her death when her plane became uncontrollable in flight (Creasman, 1997).

Aviation has always been an international affair, with countries placing a great deal of national pride in their aviators. This attention could have disastrous results. Mexican Army Captain Emilio Carranza, known as the "Mexican Lindbergh," died in 1928 after flying into a thunderstorm while returning from a goodwill flight to

Washington, D.C. Prior to take off Captain Carranza had received several telegrams inquiring about his progress and encouraging him to keep to the prearranged schedule (Gilliam, 2005).

The 1930s also saw no shortage of high profile, celebrity aviation fatalities. In 1931Knute Rockne, famed Notre Dame Football coach, was killed in a crash attributed to bad weather while on a flight to California (Time, 1931). Will Rogers died in 1935 in a crash near Point Barrow Alaska with longtime friend and pilot Wiley Post (Columbia Electronic Encyclopedia, 2011). Perhaps the most famous aviation death during this time was Amelia Earhart in 1937. As one author describes her:

> Perhaps the best-known female pilot, Amelia Earhart (1897-1937) gained international attention for her aerial feats. In 1928, she became the first woman to cross the Atlantic by airplane. (Though she had her license, Earhart did not pilot the aircraft.) In 1932, she piloted a solo transatlantic flight. Earhart wrote best-selling books and popular columns about her experiences, endorsed commercial products, and lectured in the aviation department at Purdue University in 1935 (Bix, 2010, p. 40).

She died in 1937 while attempting to circumnavigate the globe. Her remains have never been found.

As these examples show, the early years of aviation were synonymous with superhuman daring, tragedy, and death. “In the early years of aviation, it could reasonably be said that, more often than not, the aircraft killed the pilot. That is, the aircraft were intrinsically unforgiving and, relative to their modern counterparts, mechanically unsafe. However, the modern era of aviation has witnessed a reversal of sorts. It now appears to some that the aircrew themselves are more deadly than the aircraft they fly" (Shappell & Wiegmann, 2000, p. 1).

It is with this dramatic change that we will deal with here. For much of the twentieth century, accident investigators focused on the human portion of the equation, looking for the specific behavior or attitude that contributed to the crash. This made sense since studies have shown that between 70% and 80% of "aviation accidents can be attributed, at least in part, to human error" (Shappell & Wiegmann, 2000, p. 1).

That said, simply writing off these crashes to pilot error is overly simplistic and dangerous (Reason, 1990; Shappell & Wiegmann, 2000; Hollnagel & Amalberti, 2001). "The theoretical arguments have little by little been supplemented by a growing realization that the process of searching for 'human error', and indeed the searching for any kind of root cause, is misguided since it corresponds to an oversimplified conception of how events occur" (Hollnagel & Amalberti, 2001, p. 2). Rather, "aviation accidents are the end result of a number of causes, only the last of which are the unsafe acts of the aircrew" (Shappell & Wiegmann, 2000, p. 1).

*Reason's Swiss Cheese Model*

A comprehensive model of the structural and human factors that lead to aviation accidents continues to elude researchers (Senders & Moray, 1991; Shappell & Wiegmann, 2000). One of the most common models cited in the literature is James Reason's "Swiss Cheese" model of human error (2008). According to Reason, "frontline personnel are not so much the instigators of a bad event, rather they are the inheritors of latent conditions (or resident pathogens) that may have been accumulating for a long time previously" (p. 93).

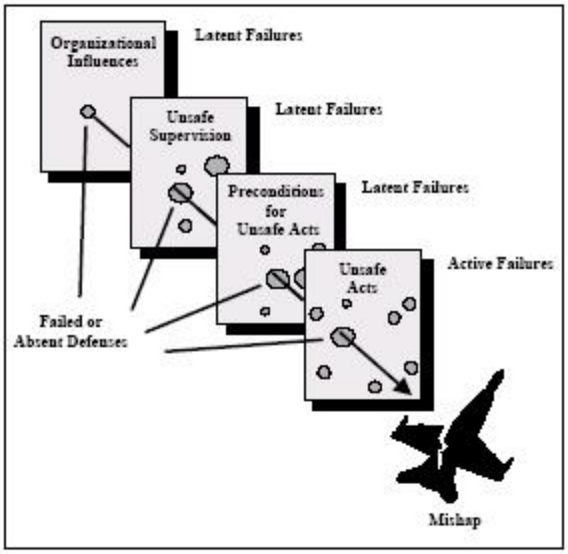


**Figure 1: Reason's Swiss Cheese Model**

Reason's Swiss Cheese Model is not one model, but an evolution. Beginning in the 1980s, Professor Reason began exploring his thoughts on a systems approach to accident investigation. Prior to that time, most models concentrated on a chain of events that resulted in an error, "missing the essence of organizational accidents." Over time these models evolved from "the simple minded … to views that more truly reflect the complex and combinatorial nature of these events" (Reason, 2008, p. 95).

In his model Reason distinguishes between latent failures – "resident pathogens within the system" – and active failures or unsafe acts. Rather than placing blame on the individual actor, Reason argues that:

> The basic premise of the model was that organizational accidents have their primary origins in the fallible decisions made by designers, builders and top level management. These are then transmitted via the intervening productive elements – line management deficiencies, the psychological precursors of unsafe acts, the unsafe acts themselves – to the point where these upstream influences combine with local triggers and defensive weaknesses to breach the barriers and safeguards (p. 96)

In his model Reason describes four distinct levels of human interaction, each influencing the next. What is unique with this model is not just Reason's insistence on the structural contributions to accidents and unsafe acts, but how each successive layer is designed to block these untoward occurrences from happening. In order for an accident or error to take place, failures in each of the four levels must occur.

> Each slice – like Emmenthale – has holes in it; but unlike cheese the gaps are in continuous motion, moving from place to place, opening and shutting. Only when a series of holes 'line up' can an accident trajectory pass through the defenses to cause harm to people, assets and the environment. The holes arise from unsafe acts (usually short-lived windows of opportunity) and latent conditions. The later occur because the designers, builders, managers and operators cannot foresee all possible accident scenarios. They are much more long-lasting than the gaps due to

> active failures and are present before an adverse event occurs" (Reason, 2008, p. 101).

Reason's model has become the dominant paradigm safety professionals use to discuss accidents and errors. Its ubiquitousness is illustrated in the following testimony by Dr. Ronald Westrum (2000) before the Department of Health and Human Services Advisory Committee on Blood Safety and Availability,

> Reason's model has become the common language through which complex accidents can be understood. I remember being at one conference where six speakers in a row got up and showed Swiss cheese diagrams as a kind of academic overkill. The popularity of this model obviously comes from its wide application. It's generally felt, as I said, this provides a common ground for discussing system safety.

*Human Factors Analysis and Classification System*

Because of its widespread acceptance, many have borrowed from and expanded upon Reason's original work. One of the most popular permutations of Reason's model is the Human Factors Analysis and Classification System (HFACS). Initially developed for the United States Navy, the HFACS system has become "the most widely used human factors analysis framework" in the world (Harris and Li, 2011, p. 109).

One frequent criticism of Reason's model is that it did not offer remedial solutions (Shappell and Weigmann, 2000). HFACS seeks to remedy this shortfall by offering a framework that "bridges the gap between theory and practice by providing safety professionals with a theoretically based tool for identifying and classifying human errors … the system focuses on both latent and active failures and their interrelationships and by doing so it facilitates the identification of the underlying cause of human error" (Harris and Li, 2011, p. 109).

The HFACS system examines human error from four distinct viewpoints (levels), each building upon the last.

1. Unsafe Acts of Operators: Active failures proximal to the accident or error.
2. Preconditions for Unsafe Acts: This level focuses on both latent and active failures.
3. Unsafe Supervision: Latent failures of the system up to the level of the line supervisor.
4. Organizational Influences: The latent failures at this level are the hardest to uncover and come to grips with. They involve the fallible decisions of upper management which trickle down through line managers to the individual employee.

The first and second levels of this framework are where the majority of accident investigation has traditionally been spent. The first level looks for violations of established policies, procedures, and safety practices. To add a degree of sophistication missing from previous work, Shappell and Weigmann (2000) subdivide these acts into two main, and five subcategories:

1. Errors: "The mental or physical activities of individuals that fail to achieve their intended outcome" (p. 3).

a. Skill based errors. “Stick and rudder” skills that occur without conscious thought. Vulnerable to failures of attention and/or memory.

b. Decision errors. “Intentional behavior that proceeds as intended, yet the plan proves inadequate or inappropriate for the situation” (p. 4). Also known as ‘honest mistakes.’ Decision errors can be further delineated into:

   i. Procedural errors: rule based mistakes. These errors occur when a situation is either not recognized or misdiagnosed.

   ii. Poor choices: as the name implies, these errors occur from a faulty decision making process. These types of errors are most common when there is a lack of experience on the part of the operator and/or excessive external considerations such as time constraints.

   iii. Problem solving errors: these errors occur when the problem is poorly understood and there are no procedures to assist in the decision making process. In these situations a novel solution is required. Because of time constraints, these types of decisions are often fraught with errors.

c. Perceptual errors. These types of errors occur when “sensory input is degraded or ‘unusual,’ as is the case with visual illusions and spatial disorientation or when aircrew simply misjudge the aircraft’s altitude, attitude, or airspeed” (p.5). When discussing perceptual errors it is important to remember it is not the perception itself that is classified as an error; rather the pilot's erroneous response to the illusion or disorientation.

2. Violations: "Willful disregard for the rules and regulations that govern safe flight and, fortunately, occur much less frequently since they often involve fatalities" (p.5). These types of behavior can be further subdivided to include:

    a. Routine violations. Also known as 'bending the rules,' they are tolerated to the point of being sanctioned. A common example would be the driver who regularly drives 5-10 miles over the speed limit. By definition, if a routine violation is identified as a potential causal factor in an error or accident, one must look farther up the chain of command to the level where the infraction is condoned.

    b. Exceptional violations. These abuses are far more serious than routine violations. They are "isolated departures from authority, not necessarily indicative of individual's typical behavior pattern nor condoned by management" (p. 6). Flying under a bridge would be an example of an exceptional violation.
    It is not the degree of the infraction that makes these violations exceptional. Rather, it is the fact that the behavior does not reflect a person's usual conduct, and the action is not condoned by management that qualifies it as exceptional.

Building upon Reason's original contributions, and realizing that unsafe acts do not happen in a vacuum, Shappell and Wiegmann (2000) designed the HFACS framework to take into account the systemic features that allowed the unsafe act to occur. As outlined above under the section discussing violations, routine violations can only occur with the acceptance and support of the authorities.

The second, third, and forth levels of HFACS attempt to uncover and deal with these structural impediments. HFACS's second level (Preconditions for Unsafe Acts) can be further subdivided into two main and five subordinate categories.

1. Substandard Conditions of Operators: These conditions affect the person's readiness to complete the task assigned. They include:

    a. Adverse mental states. "Mental conditions that affect performance" (p. 7). Distraction, fatigue, get-home-it is, and task saturation are all examples of this precondition.

    b. Adverse physiological states. "Medical or physiological conditions that preclude safe operations" (p. 7). Examples include fatigue, illness, and spatial disorientation.

    c. Physical/mental limitations. This refers to "those instances when mission requirements exceed the capabilities of the individual at the controls" (p. 8). Examples include impaired night vision or mental saturation and processing difficulties.

2. Substandard Practices of Operators: These are the things that "we do to ourselves that set up these substandard conditions" (p. 8). These practices can be roughly categorized as failures of :

    a. Communication – Crew Resource Mismanagement. This category encompasses misfires in communication at all levels: within the aircraft, between aircraft, between the aircraft and air traffic control, and between the aircraft and ground support units.
    The "classic" example of this type of precondition was the tragic crash of a commercial airliner into the Florida Everglades in 1972 "as the crew was busily trying to troubleshoot what amounted to a burnt out indicator light. Unfortunately no one in the cockpit was monitoring the aircraft's altitude … as they entered a slow, unrecognized, descent into the Everglades, resulting in numerous fatalities" (p. 9).

    b. Personal readiness. These failures occur when "individuals fail to prepare physically or mentally for duty" (p. 9). Examples include violation of the prohibitions against alcohol and drug use, violations of crew rest requirements and self-medication with over the counter preparations.

The third HFACS level, unsafe supervision, deals with the latent failures that predispose personnel to errors and accidents. These behaviors include inadequate supervision, planned inappropriate operations (requiring behaviors that may be appropriate during an emergency during normal business operations), the failure to address known problems, and supervisory violations of established policies and procedures (for example: allowing unauthorized or unlicensed personnel to operate company assets).

It is at this third level that both Reason (2008) and Shappell and Wiegmann (2000) place a great deal of emphasis. Unlike previous models, Reason's and Shappell and Wiegmann's work highlights the preconditions that must be met in order for an accident/error/unsafe act to take place.

> The role of any supervisor is to provide the opportunity to succeed. To do this, the supervisor, no matter at what level of operation, must provide guidance, training opportunities, leadership, and motivation, as well as the proper role model to be emulated … the lack of guidance and oversight has proven to be the breeding ground for many of the violations that have crept into the cockpit (Shappell and Wiegmann, 2000, p. 10).

The fourth and final level in HFACS is concerned with organizational influences. These are the strategic decisions that have a profound effect on corporate culture, leadership practices, and attitudes on the shop floor. Organizations are changing as never before. "For example, more than 85% of US Fortune 1000 companies downsized in the period 1987 – 1991 and 80% of managers surveyed for the British Institute of Management had experienced one or more restructuring programs in the previous five years" (Clark, 2003, p. 40). These changes have a radical effect on an organization's attitude towards safety, errors, and accidents.

A major strategic goal of any business or enterprise is resource management. This "encompasses the realm of corporate-level decision making regarding the allocation and maintenance of organizational assets such as human resources (personnel), monetary assets, and equipment/facilities" (Shappell and Wiegmann, 2000, p. 11). During times of plenty balancing the needs of safety and profitability are easily accomplished. However, during times of economic austerity, "safety is often the loser …[with] safety and training the first to be cut in organizations having financial difficulties" (p. 11).

The climate – culture or atmosphere – of an organization is also a strategic responsibility of upper management. It is the "unofficial or unspoken rules, values, attitudes, beliefs, and customs of an organization. Culture is the 'way things really get done around here" (Shappell and Wiegmann, 2000, p. 13). In terms of safety, this can and does have a profound effect on the individual employee.

A culture that is dedicated to reducing the amount of errors and accidents it experiences has to be willing and able to learn from its mistakes.

> The learning culture which surrounds learning from error is often compounded by the adoption of strategic defense routines, used to pretend that learning has occurred when in actuality there has been little understanding and/or a covering up of mistakes, in order to avoid "embarrassment" or "threat." These defense routines become normative over time and lead to a range of unwanted consequences, such as the repetition of mistakes (Dee and Williams, 2011, p. 439).

An organization's policies are also a barometer of its overall safety orientation. "When policies are ill-defined, adversarial, or conflicting, or when they are supplanted by unofficial rules and values, confusion abounds … [and] safety is bound to suffer" (Shappell and Wiegmann, 2000, p. 13).

Finally, the operational processes put in place by upper management set the tone for all employees. "The establishment and use of standardized operating procedures and formal methods for maintaining checks and balances (oversight) between the workforce and management" are examples of these processes (Shappell and Wiegmann, 2000, p. 13).

Reason's Swiss Cheese Model and HFACS are but two of a myriad of attempts to understand the personal and systemic influences that affect aeronautical decision making. As this field of inquiry matures, more sophisticated models will be developed that will help explain why pilots and air crew members make the decisions they do.

# CHAPTER 3

# METHODOLOGY AND RESULTS

## Research Questions

This research is being conducted in an attempt to understand the effect local base finances and mission orientation (the Kelly Effect) have on the go/no go decision in HEMS. As the above discussions have shown, the vast majority of HEMS accidents are the result of faulty decision making, not mechanical issues. This research is designed to examine the effect of these factors on aeronautical decision making.

The majority of HEMS operators in the United States operate under a "3 to go, 1 to say no" philosophy. This means everyone aboard the aircraft, not just the Pilot in Command, is responsible for the decision to accept or reject a flight. For this reason both aeromedical crew members as well as pilots have been included in this study.

The research questions posed by this study are:

1. Do negative base finances (a base that is doing poorly financially and may be in danger of closing) adversely influence the go/no go decision? Are pilots and aeromedical crewmembers more likely to accept a flight under marginal conditions if their base is performing poorly financially than those crewmembers that are located at a base that is financially stable?

2. Does a commitment to completing the mission, regardless of the cost, negatively influence the go/no go decision? Are pilots and aeromedical crew members with a high degree of mission valence more likely to accept a flight under marginal conditions than those pilots and crewmembers who do not share a similar "mission is sacrosanct" orientation?

## Hypothesis

1. A base's poor financial performance will negatively impact a pilot's or aeromedical crew member's decision making process. A pilot or crewmember from a base that is in danger of being closed because of poor financial performance will be more likely to accept a flight under marginal conditions than a pilot or crewmember from a more financially solvent base.

2. Pilots and crewmembers who have a high degree of mission orientation and mission valence will be more likely to accept a flight under marginal conditions than a pilot or crew member who does not have as great an internal compulsion to complete the mission.

## The Survey

To test the above hypothesis, a Likert type survey was developed to measure the emphasis HEMS pilots and aeromedical crew members placed on financial considerations and mission orientation (Appendix A). Besides a very limited amount of general demographic information, the survey consists of a series of statements the participants are asked to rate on a scale of 1-5, with one being strongly disagree and 5 being strongly agree.

Although a total of twenty-one questions were included on the survey, one question "As PIC, if I think the mission is doable I will try and convince the medical crew to accept the flight, even if they are hesitant" was dropped because it applied only to pilots.

*Survey Construction*

Surveys have long been a staple of social science research (Allen & Seaman, 2007; Hodge & Gillespie, 2007; Ison, 2010). They are "an apposite method when trying to gather attributes of large populations … [and to] make comparisons among subgroups of the population and gather statistically representative data" (Ison, 2010, p. 5).

Likewise, Likert scales are a common format for surveys (Allen & Seaman, 2007; Hodge & Gillespie, 2007). Developed by Rensis Likert, these scales are used to measure attitudes. "An individual is confronted with statements which are essentially value judgments. The value judgments may concern the individual's reflections of reality or the individual's psychic dispositions as feelings, wants, desires, conative dispositions. The individual is invited to define his attitude towards each statement by choosing among a number of r grades (scores, degrees) on the r-grade Likert scale" (Gob, McCollin, & Fernanda Ramalhoto, 2007, p. 604). These types of surveys are common not only in the social sciences, but in customer satisfaction surveys where they are employed to measure a stakeholders attitudes about a product or service.

One difficulty with Likert surveys is the statistical analysis of the data. Statisticians have traditionally grouped data into four main categories: nominal data is that which is purely descriptive in nature; it is the broadest category and is useful for categorization. Ordinal data is used to rank responses, but there is no indication of distance between the rankings; "the intervals between values cannot be presumed equal" (Jamieson, 2004, p. 1217). Conversely, interval data has a defined interval between the ranking points and ratio data is that which "meaningful ordering, distance, decimals and fractions between variables is possible" (Allen & Seaman, 2007, p. 64).

By these definitions the data recovered using Likert scales is purely ordinal in nature. This limits the data's usefulness. As ordinal, the only analysis available to the researcher is rough groupings and number plots showing the frequency of a particular response. While this is valuable in making comparisons between groups, it does not allow for more sophisticated statistical analysis.

While there is no agreed upon standard (Gob, et.al., 2007), some researchers believe it is appropriate to treat the ordinal data gathered in Likert surveys as interval, opening up the possibility of parametric testing (Pell, 2005; Blaikie, 2003). According to Pell (2005), "the numbers have no memory of how they were generated, and some procedures are more robust than others, … where there is an equivalent non-parametric test, it should be remembered that these are less powerful than the corresponding parametric test, so care should be exercised in drawing inference from any test statistics close to the critical value."

As stated above, the treatment of ordinal data as interval is not without its detractors. Allen and Seaman (2007) believe in a limited use and application for this practice. "While Likert scale variables usually represent an underlying continuous measure, analysis of individual items should use parametric procedures only as a pilot analysis."

Cognizant of this controversy, the author of this study has chosen to use basic parametric testing on a very limited basis, comparing the average responses between groups. The majority of the analysis is more descriptive in nature, keeping with the standard conventions of dealing with ordinal data.

*Survey Validity*

Validity can be defined as "the extent to which a measure or test encompasses a specified content area" (Porter, 2011, p.46). In other words, does the tool being used actually measure desired data point being sought?

According to Ison (2010), one way to test the validity of an instrument is to use a panel of experts to assess the questions being asked. Towards this end the author of this study used a sample of coworkers of varying disciplines to evaluate the survey statements before they were uploaded onto the internet survey site.

Two pilots and three medical crew members (a respiratory therapist who is also a regional HEMS manager, a Registered Nurse, and a Paramedic) all agreed to take the survey and offer their comments. The team's comments were incorporated into the final survey design.

## Participants

Participation in the survey was anonymous and completely voluntary. To collect data for this study, emails containing a link to an electronic survey were sent to individuals via the corporate email system of a major, multinational HEMS provider. This provider is the second largest provider of HEMS services in the United States, with bases across the country and in several foreign countries. Recipients of the corporate email were also asked to forward the link to other HEMS providers not associated with the company. An effort to enhance participation was made by listings and a link to the survey placed on social network sites and user groups dedicated to HEMS professionals.

## Protection of Human Subjects

Participants who volunteered their time and opinions did so at no jeopardy to themselves. Participants remained anonymous throughout the entire process except for the generalized demographic data queried at the beginning of the survey and could have withdrawn at any time during the process without consequence. The study author notified and received written permission from the management of the HEMS provider to conduct the survey. In the letter introducing the study to the organization's employees, the letter expressly stated that participation was voluntary and not a requirement of employment. None of the questions in the survey will enable any person to identify either the pilot or air medical crewmember or where they practice. Finally, the Institutional Review Board at the University of North Dakota reviewed and approved the project including the survey questions, proposed sample, and research methods.

## Results

There were a total of 176 responses: 77 pilots and 99 air medical crew members. There is a distinct breakdown by sex, with 94.8% of the pilots and 64.6% of air crew members being male (figure 1). The most common age among air medical crew members was 36-45 while that of pilots was slightly older: 46-55.

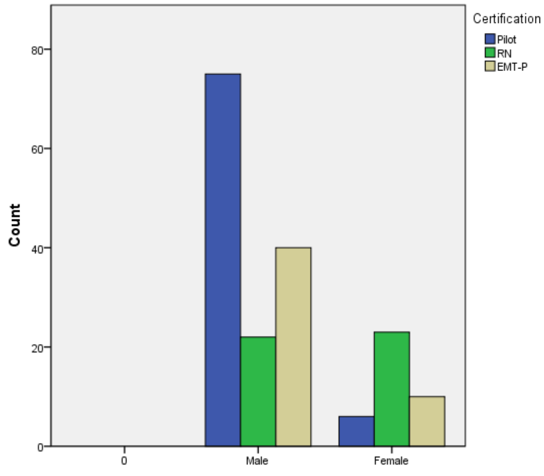


**Figure 2: Gender Breakdown by Occupation**

The responses to the twenty Likert statements, delineated by profession, and graphed, are found in Appendix B. A brief summation follows.

The overall responses to the statements regarding mission orientation (Likert statements number 1, 2, 3, 5, 6, 9, 10, 11, 13, 15, 16, 18, 19, and 20) showed no particular affinity for taking excessive risks in order to complete the mission. This would seem to disprove the hypothesis that "pilots and crewmembers who have a high degree of mission orientation and mission valence will be more likely to accept a flight under marginal conditions than a pilot or crew member who does not have as great an internal compulsion to complete the mission."

Even though the overall results disprove the hypothesis, there is a noticeable, although not always statistically significant, difference between professions in terms of the results. On Likert statement # 1: "Completing the Mission is my Highest Priority," a total of 58.6% of all respondents indicated that they either disagreed or strongly disagreed with the statement (Table 1). However, as a percentage of the total occupational category, pilots were more likely to be neutral (by 10 percentage points) or agree than either RN or Paramedics.

Table 1: Likert statement # 1 with Percentages

| | | | Certification | | | Total |
|---|---|---|---|---|---|---|
| | | | Pilot | RN | EMT-P | |
| Completing the mission is my highest priority | Strongly Disagree | Count | 14 | 11 | 12 | 37 |
| | | % within Completing the mission is my highest priority | 37.8% | 29.7% | 32.4% | 100.0% |
| | | % within Certification | 19.2% | 28.2% | 26.7% | 23.6% |
| | | % of Total | 8.9% | 7.0% | 7.6% | 23.6% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Disagree | Count | 25 | 15 | 15 | 55 |
| | | % within Completing the mission is my highest priority | 45.5% | 27.3% | 27.3% | 100.0% |
| | | % within Certification | 34.2% | 38.5% | 33.3% | 35.0% |
| | | % of Total | 15.9% | 9.6% | 9.6% | 35.0% |
| | Neutral | Count | 22 | 8 | 8 | 38 |
| | | % within Completing the mission is my highest priority | 57.9% | 21.1% | 21.1% | 100.0% |
| | | % within Certification | 30.1% | 20.5% | 17.8% | 24.2% |
| | | % of Total | 14.0% | 5.1% | 5.1% | 24.2% |
| | Agree | Count | 10 | 4 | 7 | 21 |
| | | % within Completing the mission is my highest priority | 47.6% | 19.0% | 33.3% | 100.0% |
| | | % within Certification | 13.7% | 10.3% | 15.6% | 13.4% |
| | | % of Total | 6.4% | 2.5% | 4.5% | 13.4% |
| | Strongly Agree | Count | 2 | 1 | 3 | 6 |
| | | % within Completing the mission is my highest priority | 33.3% | 16.7% | 50.0% | 100.0% |
| | | % within Certification | 2.7% | 2.6% | 6.7% | 3.8% |
| | | % of Total | 1.3% | .6% | 1.9% | 3.8% |
| Total | | Count | 73 | 39 | 45 | 157 |
| | | % within Completing the mission is my highest priority | 46.5% | 24.8% | 28.7% | 100.0% |
| | | % within Certification | 100.0% | 100.0% | 100.0% | 100.0% |
| | | % of Total | 46.5% | 24.8% | 28.7% | 100.0% |

A similar disparity can be found with Likert statement # 2: “Minimums Are Absolute, I Do Not Push Them.” Again, as with Likert Statement # 1, the preponderance of responses disproved the hypothesis that excessive mission orientation leads pilots and air medical crew members to take inappropriate risks when deciding to accept or reject a flight. While over 90% of all respondents either agreed or strongly agreed, a very small percentage of pilots were either neutral or disagreed (Table 2), this compared with zero Registered Nurses and only one Paramedic.

Table 2: Likert statement #2 with Percentages

| | | | Certification | | | |
|---|---|---|---|---|---|---|
| | | | Pilot | RN | EMT-P | Total |
| Minimums are absolute. I do not push them. | Disagree | Count | 2 | 0 | 1 | 3 |
| | | % within Minimums are absolute. I do not push them. | 66.7% | .0% | 33.3% | 100.0% |
| | | % within Certification | 2.7% | .0% | 2.2% | 1.9% |
| | | % of Total | 1.3% | .0% | .6% | 1.9% |
| | Neutral | Count | 4 | 0 | 0 | 4 |
| | | % within Minimums are absolute. I do not push them. | 100.0% | .0% | .0% | 100.0% |
| | | % within Certification | 5.4% | .0% | .0% | 2.5% |
| | | % of Total | 2.5% | .0% | .0% | 2.5% |
| | Agree | Count | 21 | 6 | 12 | 39 |
| | | % within Minimums are absolute. I do not push them. | 53.8% | 15.4% | 30.8% | 100.0% |
| | | % within Certification | 28.4% | 15.4% | 26.7% | 24.7% |
| | | % of Total | 13.3% | 3.8% | 7.6% | 24.7% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Strongly Agree | Count | 47 | 33 | 32 | 112 |
| | | % within Minimums are absolute. I do not push them. | 42.0% | 29.5% | 28.6% | 100.0% |
| | | % within Certification | 63.5% | 84.6% | 71.1% | 70.9% |
| | | % of Total | 29.7% | 20.9% | 20.3% | 70.9% |
| Total | | Count | 74 | 39 | 45 | 158 |
| | | % within Minimums are absolute. I do not push them. | 46.8% | 24.7% | 28.5% | 100.0% |
| | | % within Certification | 100.0% | 100.0% | 100.0% | 100.0% |
| | | % of Total | 46.8% | 24.7% | 28.5% | 100.0% |

In a One Way ANOVA conducted on the data, Likert statement # 2 produced a statistically significant difference (.035) between the various occupational groups (Appendix C). Post Hoc Tukey and Bonferroni testing shows that the difference lays between the RN and pilot responses.

Statistically significant differences between the means can be found in Likert statements 2, 3, 9, 12, 13 and 20. In every case except Likert Statement # 9, the difference lies between the pilot and a member of the medical crew. For Likert Statement # 9, the difference was between the RN and the Paramedic.

# CHAPTER 4

# DISCUSSION

The problem of faulty aeronautical decision making in HEMS is well documented and researched. What has yet to be determined is why these accidents continue to happen despite an unprecedented amount of attention by the FAA, NTSB, and industry organizations.

The purpose of this study is to determine what role, if any, local base finances and mission orientation play in the go/no go decision among HEMS aircrews.

The data from this study clearly rejects the two experimental hypotheses: those personnel from financially tenuous bases are more likely to undertake flights in marginal conditions compared to crewmembers from more financially stable bases; and a hyper sense of mission valence – the Kelly Effect – would encourage HEMS pilots and medical personnel to accept flights under marginal conditions.

In every instance, the pilots and medical crews rejected both hypotheses. Their answers to the Likert statements were overwhelmingly in keeping with established safety practices. What is interesting is the difference in responses by occupation. There is a statistically significant difference between pilot and air medical crew responses in 25% of the Likert statements.

One reason for this difference may be the comfort level of each crewmember in relation to the flight environment. As one HEMS pilot succinctly put it, "if I am worried about how things are going, you will probably be terrified" (Clark, 2012).

As detailed previously, all HEMS pilots have at a minimum a Commercial Pilot certificate and 2000 hours total flight time. Most have considerably more. In comparison, the medical crew may be experiencing their first flight in a helicopter the day they are released from the training academy. There is no requirement for previous flight experience among medical crewmembers.

Because of this, many medical crew members are hesitant aviators at best. The flight environment is unique: the sights, sounds, and sensations are unlike any experienced in the course of a "normal," non-aviation medical career. Just as a pilot becomes more comfortable with his/her role as Pilot In Command (PIC) with experience, medical crew members become more familiar – and accepting – of the peculiarities of flying as their experience grows.

Because of the flight experience requirements, HEMS is a "second career" for many pilots. In the past, the majority of HEMS pilots came from the military; many having flown in Vietnam or Iraq during the first Gulf War.

Today, this is not necessarily the case. Many of the new generation of HEMS pilots come from a strictly civilian background; working their way up through the ranks as flight instructors and/or tour pilots in either Las Vegas or the Grand Canyon.

PHI Air Medical is a subsidiary of Petroleum Helicopters Incorporated (PHI), the largest operator of helicopters in the United States outside of the Department of Defense.

PHI's main business is moving men and material to and from the oil rigs in the Gulf of Mexico. Because of this, a large number of PHI Air Medical pilots have spent time flying in "the Gulf," where low ceilings, rain, and a hostile flight environment are the norm. This has a profound effect on their comfort level and willingness to venture into marginal weather conditions.

This experience may be a factor in the disparity between pilots and medical crew on Likert statement number two: "Minimums are absolute. I do not push them."

To a novice crewmember, marginal ceilings or rain may be a cause for concern simply because of the novelty of the situation. Having never flown through rain before, the medical crewmember may be fearful of its effect, especially if their only exposure to the subject is the scant weather lecture given during initial training. In comparison, to a seasoned pilot, especially one who flew in the Gulf of Mexico, marginal ceilings and rain are hardly a cause for concern.

Comfort level in the flight environment may also be a contributing factor to the statistically significant difference between pilots and medical crew members on Likert statement number thirteen: "Just because another aircraft has turned down the flight is no reason to think we cannot do it."

This question reflects the regional nature of HEMS. In many areas of the country there is only one provider or one aircraft servicing a particular area. In other areas, such as Arizona, there are multiple providers and multiple aircraft servicing the same geographic area.

In these situations, unless a specific aircraft or provider is requested by the ground crew (scene call) or facility (inter facility transfer), the call goes to the closest aircraft. After receiving the request, the dispatch center then must check with the pilot to see whether or not crew is willing to accept the flight.

Because it is rare to have several aircraft co-located at the same airport or within a few miles of each other, depending upon the type of weather that caused the first aircraft to refuse the flight (isolated thunderstorms), it is possible that another aircraft can indeed complete the flight safely.

"Helicopter shopping" by the requesting agency has been reported by the NTSB (2009) as a causative factor in several HEMS crashes. Because of this, CAMTS standards require that the pilot and medical crew be made aware that the flight was turned down by another aircraft before accepting the mission. As with the marginal ceilings example given above, a pilot's increased comfort with the flight environment when compared to the medical crew may lead the pilot to believe it is safe to "go and check it out," and accept a flight that has been turned down by another aircraft or provider.

In addition to the issue of comfort level with the flight environment, the author of this study believes an occupational culture geared towards accepting a flight, even when conditions are approaching organizational or legislated minimums is a powerful motivating force for pilots.

As discussed previously, many HEMS pilots come from a military background. In the military, completing the mission is primary. Major Kelly's willingness to falsify records in order to keep flying is illustrative of this mindset. As one blogger put it, "Duty, mission, and service are all at the heart of the military mindset and serve as focal points in training across the Armed Forces … These ideals are the motivators that drive young men and women to push their limits of endurance and risk their lives in service to the country" (Connell, 2009).

Commercial pilots are also occupationally enculturated to complete the mission unless it is absolutely prohibitive to do so. In the hyper-competitive commercial airline industry, not flying often means not getting paid. It can also mean disrupting the lives of passengers and crew down the line as one flight cancellation snowballs into tens or hundreds of missed flights and/or connections.

Medical crewmembers are not necessarily trained with this same hyper-vigilant mindset. In fact, paramedics are specifically trained to avoid entering situations that are potentially dangerous until the threat has been allayed. "Is the scene safe?" is the first question a paramedic is taught to ask before approaching any patient encounter.

This emphasis on "scene safety" is a hallmark of Emergency Medical Services. Nurses, emergency medical technicians and paramedics are all trained with the belief that dead or injured rescuers are not only of no use to the people they were dispatched to help, but are a burden to the crews that must now contend not only with the original victims, but the injured crew members as well.

The collision of these two cultures – one in which the mission is nearly sacrosanct and another that preaches caution in the face of an external threat – may help explain the differences in responses between occupational groups.

## Limitations

The limitations of this study are numerous; not the least of which is the non-representative sample size. There are an estimated 800 aircraft engaged in HEMS in the United States. Each aircraft has a minimum of four pilots, four Registered Nurses and four Paramedics plus one to three mechanics assigned to it. Given the limited sample size of this study, making any broad based judgments is impossible.

The study is also limited by the participant group. Participants in this study were primarily from one company. Although from various geographic areas, the standardized policies and procedures these professionals operate under may unduly bias the responses. For this reason it is impossible to make large, sweeping, generalizations from the available data. It would be helpful to have more broad based participation, especially from other providers who operate nationally and internationally.

Finally, a major limitation of this particular study is the bluntness of the instrument used. Likert type surveys are a respected and validated methodology. That said, relying solely on subjective self-reporting measures leaves much to be desired.

Self-reporting surveys are by definition fraught with problems. One of the largest problems associated with self-reporting is Self-Serving Bias (SSB). Heider (1958) wrote that a person's attributions in any given situation are clouded by their "own needs or wishes" (p. 118). SSB is a defense mechanism designed to protect or enhance one's self-image or concept. At its core, it is the propensity to take credit for personal successes while blaming external forces for personal failures (Campbell & Sedikides, 1999).

In addition to SSB, self-reporting tools must contend with the issue of misinterpretation of the survey questions and errors of "social desirability." In one study, only 29% of the respondents interpreted commonly used survey questions in an acceptable way (Raitasalo, 2003). The respondents simply did not grasp what the question was asking.

This study by necessity includes some fairly technical concepts. The increased technicality of the subject matter can lead to confusion if there is misunderstanding over definitions. Several of the Likert statements deal with weather minimums. Is the medical crew's understanding of weather minimums the same as the pilots, and do both have a similar understanding of the consequences for exceeding these parameters?

For the medical crew, exceeding minimums may simply be a worrisome occurrence during a difficult flight. For a commercial pilot, it may mean termination and the revocation of their pilot certificate.

Social desirability refers to the inclination of the respondent to tell the surveyor what they believe the surveyor wants to hear. This is especially the case if the results may indicate unsavory attitudes or illegal activities (Stat Trek, 2012). This point is especially salient given the nature of the heavily regulated nature of the HEMS industry. Errors of social desirability are lessened the more confident the respondent is that the data is confidential; however, it is impossible to totally erase this bias.

In an effort to avoid as much ambiguity as possible, and to reduce the amount of SSB associated with the questions, the author of this study chose to use short and strongly worded phrases. Unfortunately, there is a trade off with this decision. By using short and declarative statements, the author may have lost a degree of sophistication that would have been present in a more precise and inclusive statements.

## Further Research

The preliminary findings indicating a difference may exist along occupational lines beg further investigation. Since both hypotheses were convincingly rejected, just how great is this difference? Is the difference the result of inborn personality traits (pilot personality) or education? How do Flight Nurses and Flight Paramedics compare to members of their professions who do not fly? Is there a gender difference?

Future research into these questions would best be accomplished with the use of scenario based surveys and simulations. Because setting up realistic scenario based simulations is expensive and time consuming, one technique that offers promise for further research is the use of situational judgment tests to evaluate pilot and medical crew attitudes towards various factors affecting the go/no go decision.

Situational judgment tests can be defined as "any paper –and-pencil test designed to measure judgment in work settings. Some of these tests can be classified as situational, in that a scenario is described and the respondent must identity the appropriate response from a list of alternatives" (McDaniel, Morgeson, Finnegan, Campion, & Braverman, 2001, p. 730).

> A situational judgment test typically consists of scenarios depicting an often-complex situation that reflects the dimensions of interest. Some number of alternative solutions (usually four or five) to each situation are presented from which the person being assessed must

> choose the best, and sometimes the worst, solution. The person's performance is scored by reference to the solutions recommended by a panel of subject matter experts (Hunter, 2003, p. 376).

These tests were first developed in the 1990s, and their efficacy has been well documented (Hunter, 2003). Situational judgment tests have the advantage of presenting the subject with a complex, real life scenario without the cost and inconvenience of attempting to recreate these same scenarios in a laboratory setting.

Of course the "Gold Standard" of any further research would be a detailed scenario based simulation during which a representative aircrew (pilot, nurse, and paramedic or respiratory therapist) was presented with a scenario that entailed either accepting or rejecting a flight based on available information, or terminating a flight mid-mission because of a safety concern (weather, mechanical malfunction).

Inherent in any live, scenario based testing is the danger of the Hawthorne Effect skewing the results. The Hawthorne Effect is the propensity of the subject to change their behavior simply because they know they are being observed. McCarney, Warner, Iliffe, Haselen, Griffin, & Fisher (2007) describe it this way:

> The Hawthorne Effect was first reported following an extensive research programme investigating methods of increasing productivity in the Western Electrical Company's Hawthorne Works in Chicago during the 1920s and 30s. The finding of enduring interest was that no matter what change was introduced to working conditions, the result was increased productivity … It has

been defined as 'an increase in worker productivity produced by the psychological stimulus of being singled out and made to feel important' (p. 731).

To mitigate the deleterious consequences of the Hawthorne Effect, such scenario based testing would best be carried out in a confidential setting where the researchers were not readily apparent. A mockup of a crew quarters area or aircraft hangar that was equipped with video and audio recording equipment, as well as internet access for checking the simulated weather conditions and a radio/phone link with dispatch and/or the EOC would be ideal.

## Conclusion

Helicopter Emergency Medical Systems is among the most dangerous type of flying in the United States today. The reasons for this are complex, multifaceted, and remain poorly understood. At the crux of the problem is poor aeronautical decision making.

This study attempts to discover what effect, if any, poor base finances and a hyper-mission orientation had on the go/no go decision. Utilizing a Likert type survey tool, the author of this study queried HEMS professionals from across the country to assess their attitudes.

The data clearly and unambiguously rejects both hypotheses under study. Of great interest was the discovery of a statistically significant difference in responses between air medical crew members and pilots in 25% of the Likert statements. The reasons for these differences are unclear and not adequately answered by this study.

Possible reasons for the differences include: an increased comfort level with the overall flight environment by pilots when compared to medical crew, and a different occupational enculturation regarding mission valence and mission completion between commercial pilots and air medical crewmembers.

This study expands the knowledge base regarding decision making in HEMS by showing that poor base finances and a hyper sense of mission orientation do not negatively affect the go/no go decision overall. It also points out several areas that beg further study.

The author of this study believes further exploration of the difference in survey responses between occupational categories is paramount. Towards this goal the author of this study would suggest further surveys be conducted using situational judgment tests and live scenario based simulations to gauge participant reactions under carefully recreated conditions.

It is the author's contention that the triangulation afforded by these different modalities would offer the most comprehensive and useful data.

APPENDIX A

Survey Tool

**Demographics:**

| | | | | | |
|---|---|---|---|---|---|
| Sex (Gender) | M | F | | | |
| Age | 18-25 | 26-35 | 36-45 | 46-55 | >55 |

**Pilot:**

| | | | | | |
|---|---|---|---|---|---|
| Highest Certificate Presently Held | Commercial | Instrument | CFI | ATP | |
| Total Hours | 0 -1999 | 2000-3999 | 4000-5999 | 6000-7999 | 8000-9999 |
| Total Helicopter Hours | 0-1999 | 2000-2999 | 3000-3999 | 4000-4999 | >5000 |
| How would you describe your program? | Traditional | Community | | | |
| Does your organization have a Safety Management System in place | Y | N | | | |
| Does your organization have an Emergency Operations Center capable of vetoing a flight | Y | N | | | |
| Does your organization adhere to a "3 to go, 1 to say no" philosophy? | Y | N | | | |

**Air Medical Crewmember:**

| | | | | | |
|---|---|---|---|---|---|
| Highest Certification/Licensure Presently Held | MD | RN | Paramedic | RT | Other |
| Total years in your specialty | 0-4 | 5-9 | 10-14 | 15-19 | >20 |
| Total years flying EMS missions | 1-2 | 3-5 | 6-10 | 11-15 | >15 |
| How would you describe your program* | Traditional | Community | | | |
| Does your organization have a Safety Management System in place | Y | N | | | |
| Does your organization have an Emergency Operations Center capable of vetoing a flight | Y | N | | | |
| Does your organization adhere to a "3 to go, 1 to say no" philosophy? | Y | N | | | |

*A traditional program is one owned and operated by a hospital or healthcare entity. The hospital provides the medical staff and a third party vendor usually provides the aircraft, flight crew, maintenance services and Part 135 certificate. A community based program is 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.

## Survey Questions

| | Strongly Agree | | | | Strongly Disagree |
|---|---|---|---|---|---|
| Completing the mission is my highest priority | 5 | 4 | 3 | 2 | 1 |
| Minimums are absolute. I do not push them. | 5 | 4 | 3 | 2 | 1 |
| The patient's / customer's needs come first | 5 | 4 | 3 | 2 | 1 |
| I routinely review my base's financial performance | 5 | 4 | 3 | 2 | 1 |
| It is not my emergency | 5 | 4 | 3 | 2 | 1 |
| I would duck below minimums to complete the mission | 5 | 4 | 3 | 2 | 1 |
| I worry about the possibility of my base being closed because of poor performance | 5 | 4 | 3 | 2 | 1 |
| During the past month I have asked about a patient's payer status | 5 | 4 | 3 | 2 | 1 |
| I never turn down a flight on the basis of radar data alone; I prefer to actually see what it actually going on. | 5 | 4 | 3 | 2 | 1 |
| I would consider dipping into my fuel reserve in order to successfully complete the flight | 5 | 4 | 3 | 2 | 1 |
| Regulations do not promote safety | 5 | 4 | 3 | 2 | 1 |
| The base's financial performance is not my problem | 5 | 4 | 3 | 2 | 1 |
| Just because another aircraft has turned down the flight is no reason to think we cannot do it. | 5 | 4 | 3 | 2 | 1 |
| As PIC, if I think the mission is doable I will try and convince the medical crew to accept the flight, even if they are hesitant. | 5 | 4 | 3 | 2 | 1 |
| The Emergency Operations Center is a resource, I am PIC, I decide whether or not to accept a flight | 5 | 4 | 3 | 2 | 1 |
| Turning down a flight equates to revenue we cannot afford to lose. | 5 | 4 | 3 | 2 | 1 |
| They do not call us unless they need us. If they call it is our responsibility to get the job done | 5 | 4 | 3 | 2 | 1 |
| I do not accept a flight unless I am sure we can | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| complete it safely and within the standards | | | | | |
| I do not know whether or not my base is in the black (making a profit) | 5 | 4 | 3 | 2 | 1 |
| If the weather is marginal, I do not mind waiting till it clears; the patient will still be there | 5 | 4 | 3 | 2 | 1 |
| During the last year I have deviated from the operations manual in order to complete a flight | 5 | 4 | 3 | 2 | 1 |

APPENDIX B

LIKERT RESPONSES

**Completing the mission is my highest priority * Certification Crosstabulation**

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| Completing the mission is my highest priority | Strongly Disagree | 14 | 11 | 12 | 37 |
| | Disagree | 25 | 15 | 15 | 55 |
| | Neutral | 22 | 8 | 8 | 38 |
| | Agree | 10 | 4 | 7 | 21 |
| | Strongly Agree | 2 | 1 | 3 | 6 |
| Total | | 73 | 39 | 45 | 157 |

Table 3: Likert statement # 1

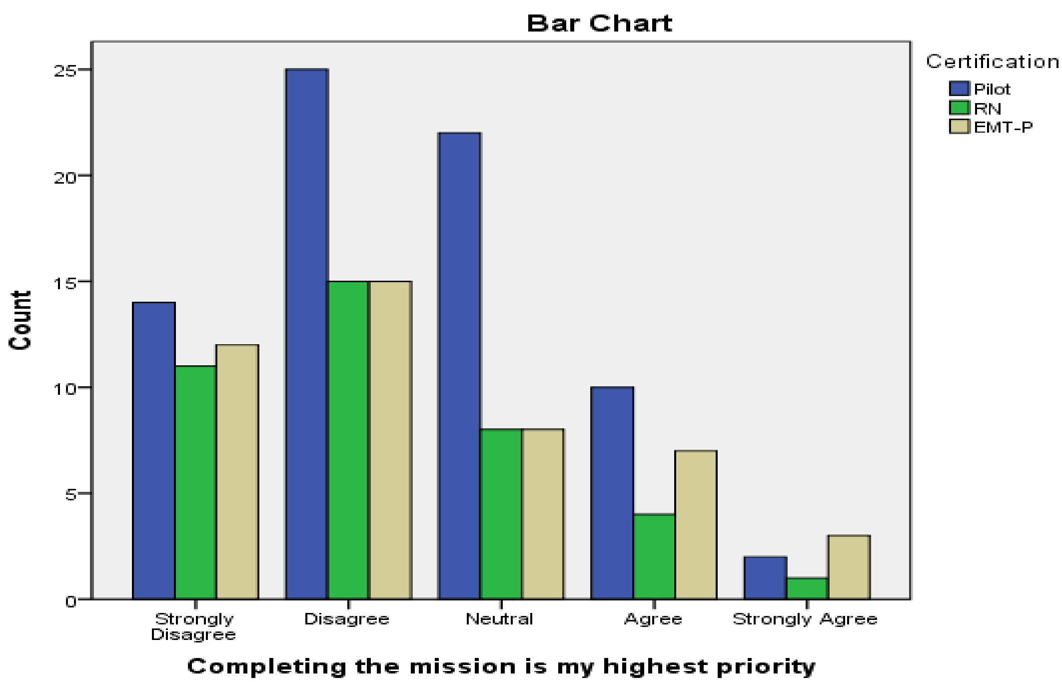


**Figure 3: Likert statement # 1**

**Minimums are absolute. I do not push them. * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| Minimums are absolute. I do not push them. | Disagree | 2 | 0 | 1 | 3 |
| | Neutral | 4 | 0 | 0 | 4 |
| | Agree | 21 | 6 | 12 | 39 |
| | Strongly Agree | 47 | 33 | 32 | 112 |
| Total | | 74 | 39 | 45 | 158 |

Table 2: Likert statement # 2

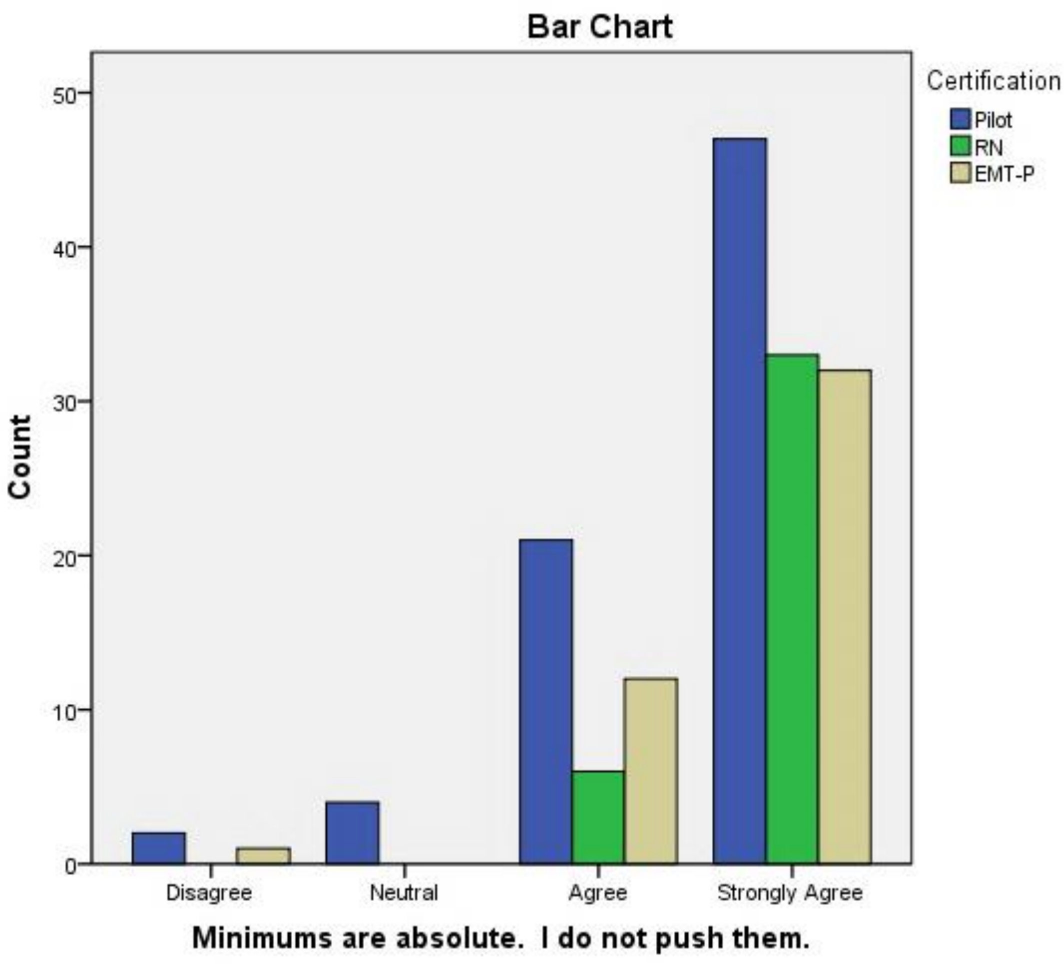


**Figure 4: Likert statement # 2**

*Statement #2 produced a statistically significant difference in responses between groups (.035). Post hoc testing showed the difference to be between the pilot and RN.

**The patient's / customer's needs come first * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| The patient's / customer's needs come first | Strongly Disagree | 9 | 7 | 2 | 18 |
| | Disagree | 35 | 14 | 13 | 62 |
| | Neutral | 17 | 6 | 13 | 36 |
| | Agree | 7 | 9 | 13 | 29 |
| | Strongly Agree | 5 | 3 | 4 | 12 |
| Total | | 73 | 39 | 45 | 157 |

Table 5: Likert statement # 3

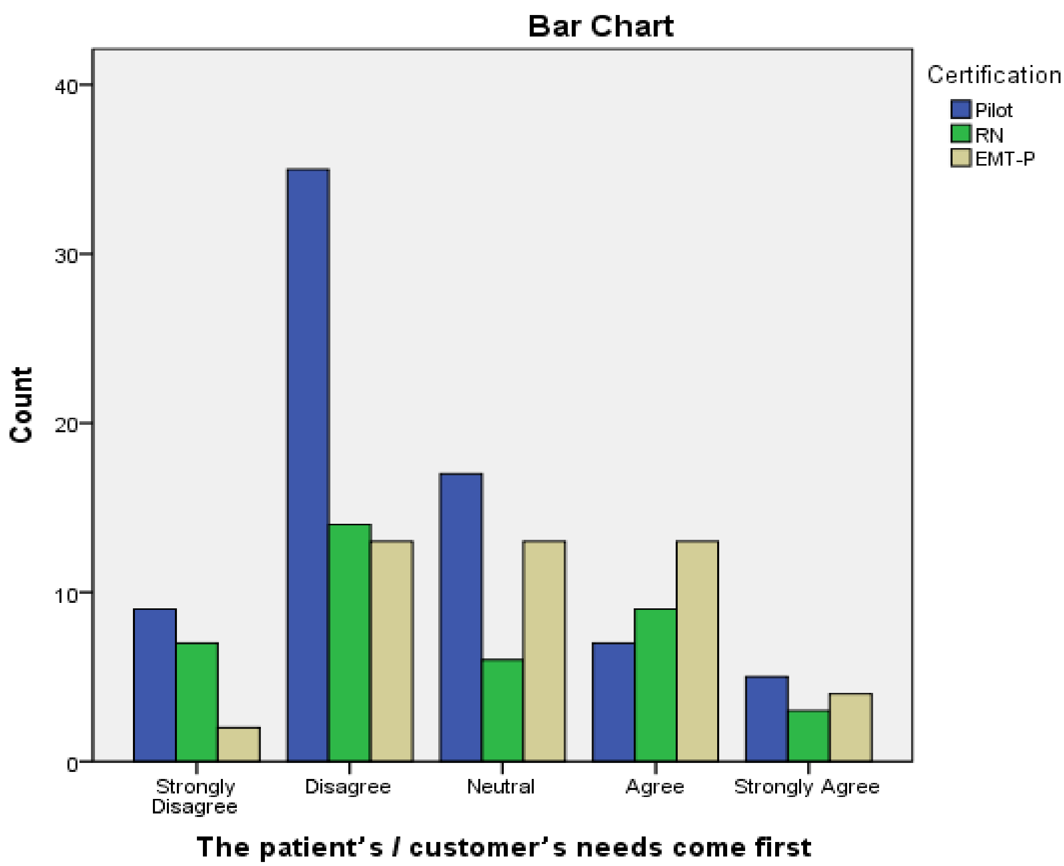


**Figure 5: Likert statement # 3**

*Statement #3 produced a statistically significant difference in responses between groups (.022). Post hoc testing showed the difference to be between the pilot and paramedic.

**I routinely review my base's financial performance * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| I routinely review my base's financial performance | Strongly Disagree | 24 | 9 | 10 | 43 |
| | Disagree | 18 | 6 | 11 | 35 |
| | Neutral | 15 | 10 | 11 | 36 |
| | Agree | 14 | 11 | 7 | 32 |
| | Strongly Agree | 3 | 2 | 6 | 11 |
| Total | | 74 | 38 | 45 | 157 |

Table 6: Likert statement # 4

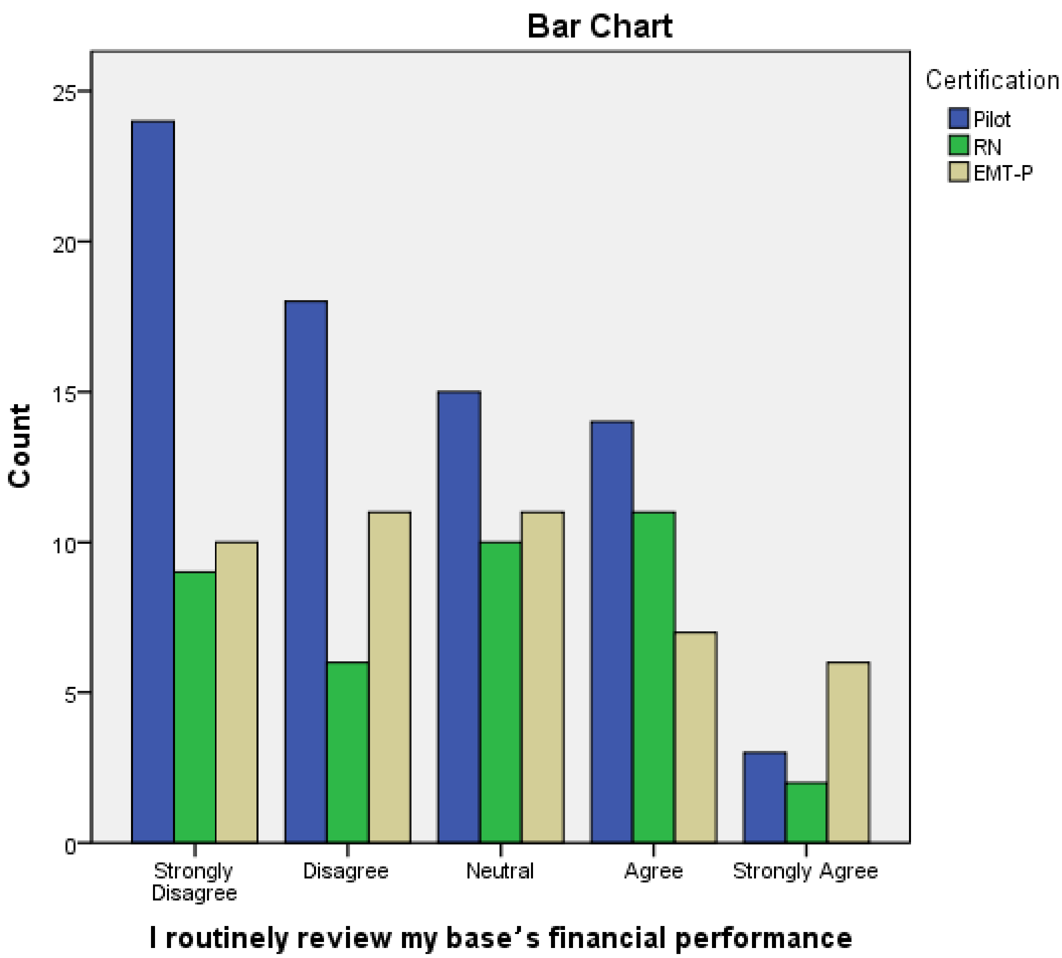


**Figure 6: Likert statement # 4**

**It is not my emergency * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| It is not my emergency | Strongly Disagree | 6 | 2 | 1 | 9 |
| | Disagree | 4 | 6 | 8 | 18 |
| | Neutral | 14 | 13 | 8 | 35 |
| | Agree | 32 | 12 | 12 | 56 |
| | Strongly Agree | 18 | 6 | 16 | 40 |
| Total | | 74 | 39 | 45 | 158 |

Table 7: Likert statement # 5

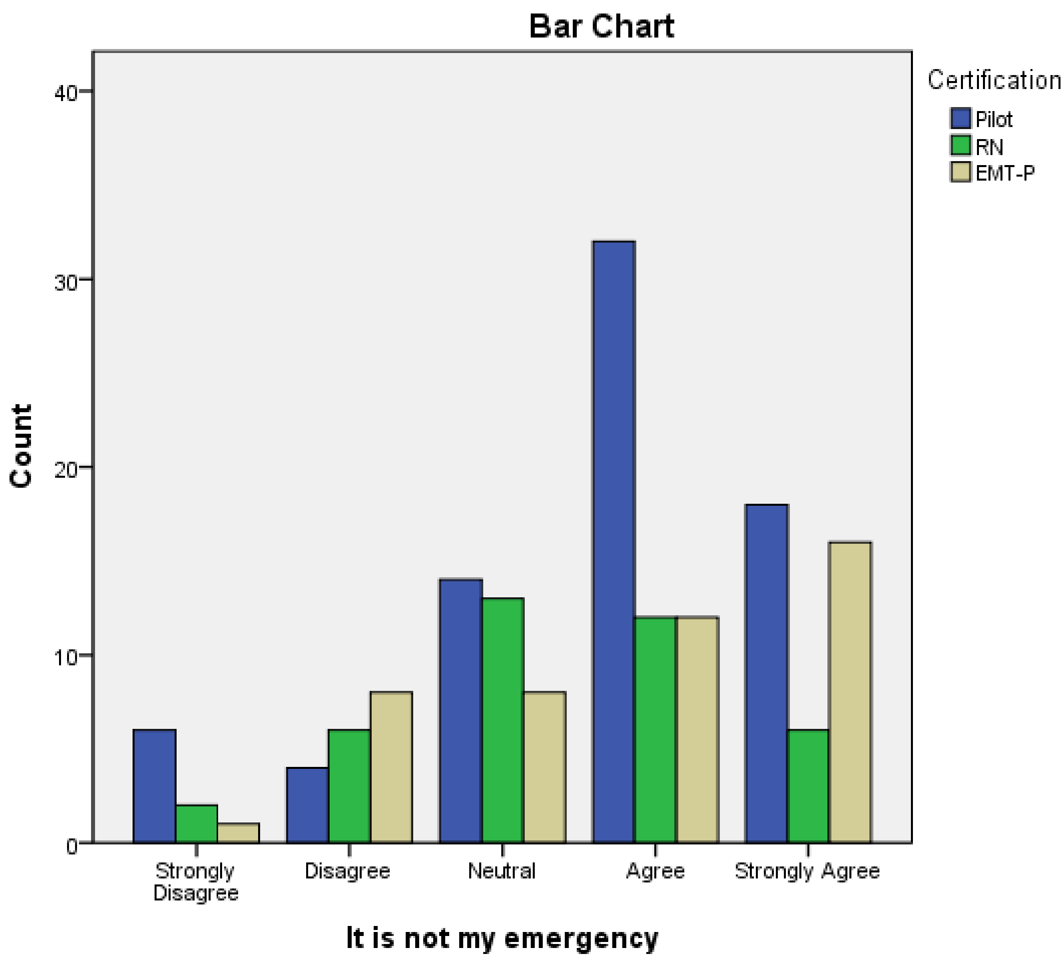


**Figure 7: Likert statement # 5**

**I would duck below minimums to complete the mission * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| I would duck below minimums to complete the mission | Strongly Disagree | 42 | 27 | 30 | 99 |
| | Disagree | 25 | 9 | 13 | 47 |
| | Neutral | 7 | 3 | 2 | 12 |
| Total | | 74 | 39 | 45 | 158 |

Table 8: Likert statement # 6

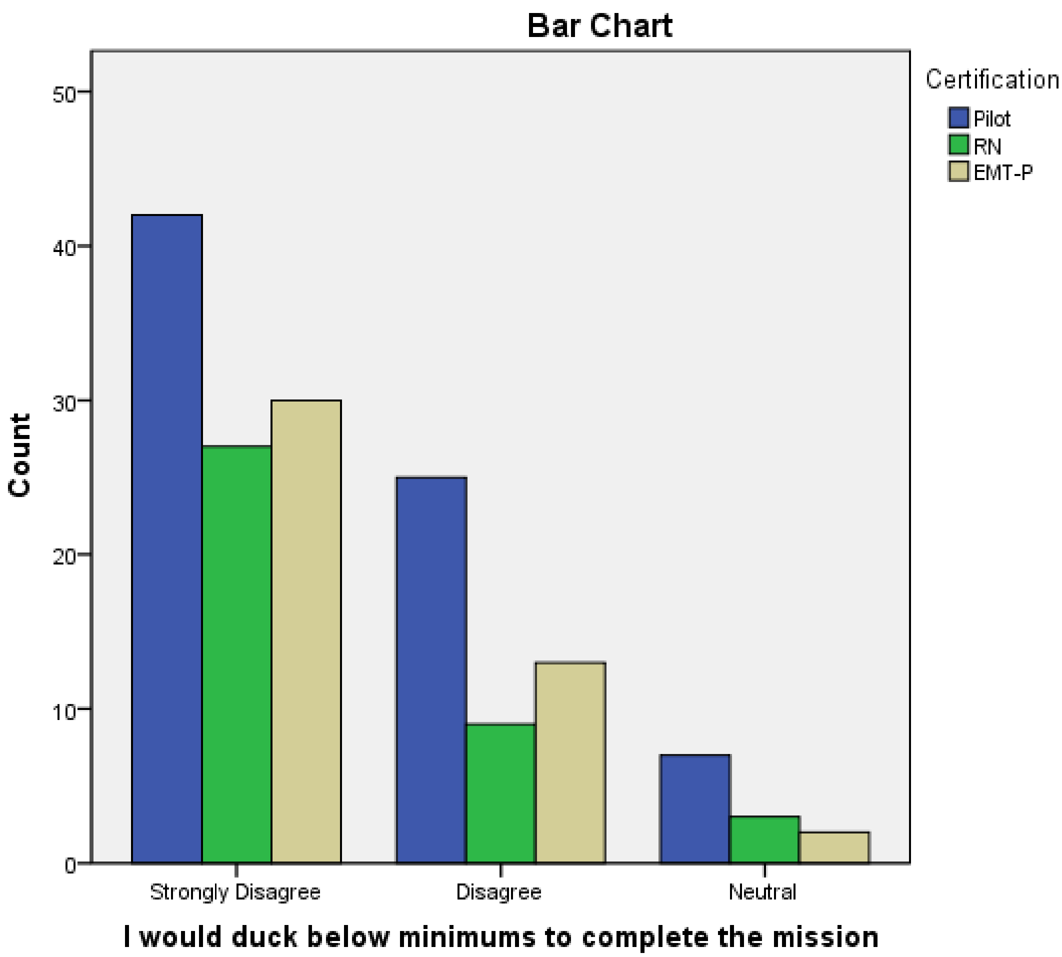


**Figure 8: Likert statement # 6**

**I worry about the possibility of my base being closed because of poor performance * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| I worry about the possibility of my base being closed because of poor performance | Strongly Disagree | 10 | 9 | 13 | 32 |
| | Disagree | 19 | 13 | 14 | 46 |
| | Neutral | 17 | 7 | 6 | 30 |
| | Agree | 23 | 7 | 10 | 40 |
| | Strongly Agree | 4 | 3 | 2 | 9 |
| Total | | 73 | 39 | 45 | 157 |

Table 9: Likert statement # 7

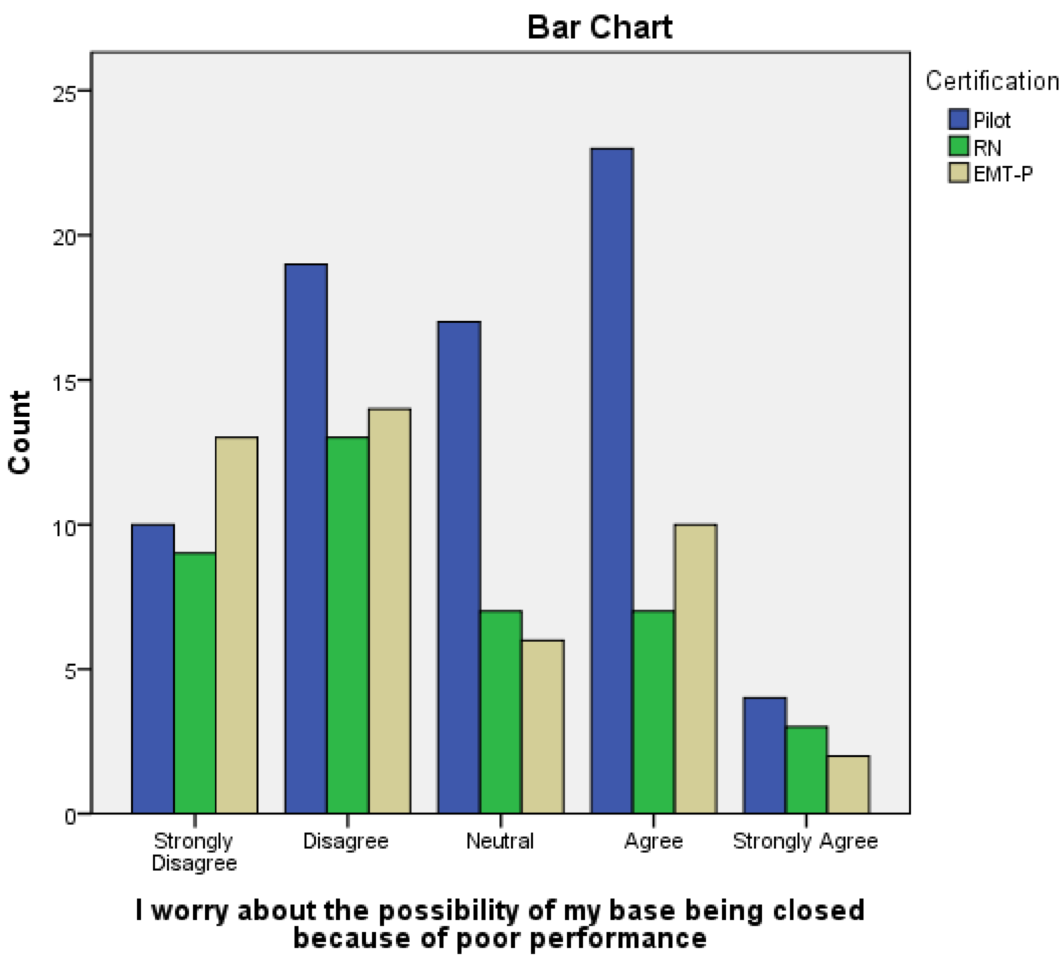


**Figure 9: Likert statement # 7**

**During the past month I have asked about a patient's payer status * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| During the past month I have asked about a patient's payer status | Strongly Disagree | 32 | 25 | 19 | 76 |
| | Disagree | 18 | 8 | 15 | 41 |
| | Neutral | 7 | 0 | 1 | 8 |
| | Agree | 16 | 5 | 7 | 28 |
| | Strongly Agree | 1 | 1 | 3 | 5 |
| Total | | 74 | 39 | 45 | 158 |

Table 10: Likert statement # 8

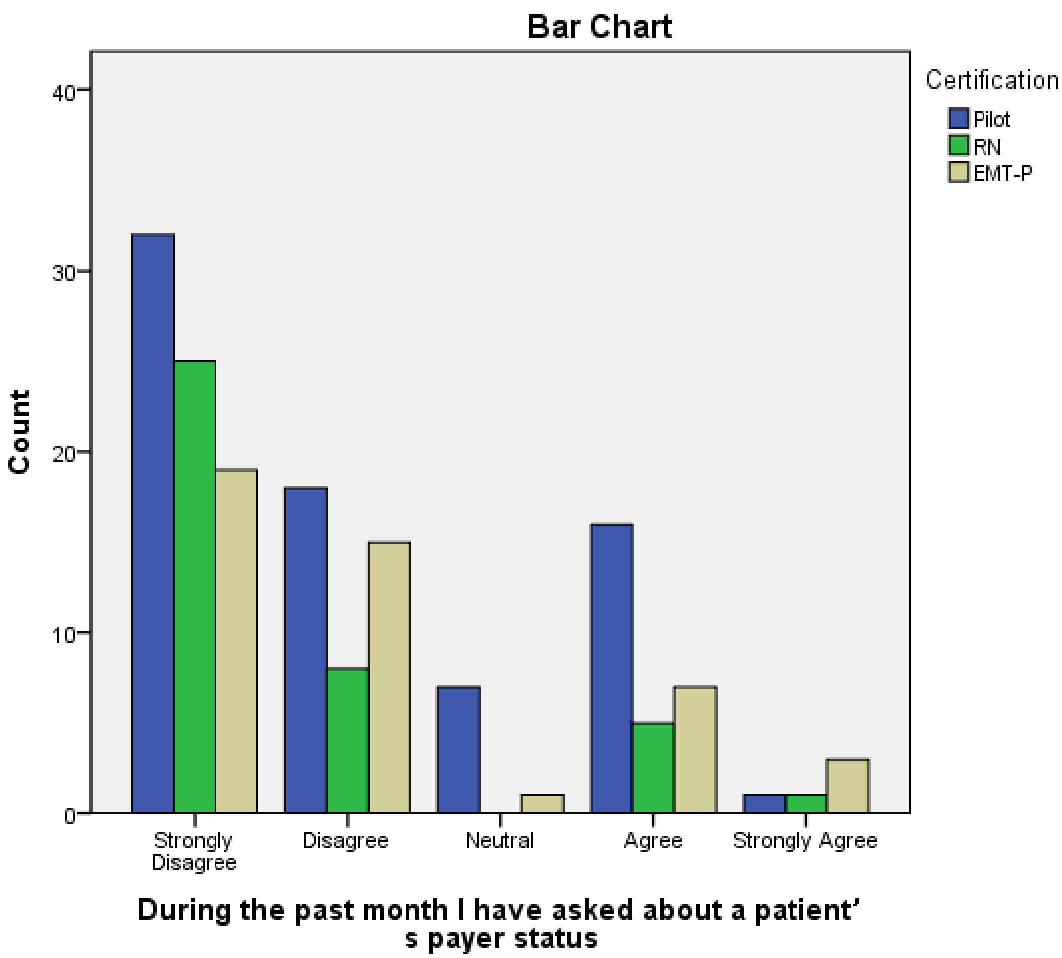


**Figure 10: Likert statement # 8**

**I never turn down a flight on the basis of radar data alone; I prefer to actually see what it actually going on. * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| I never turn down a flight on the basis of radar data alone; I prefer to actually see what it actually going on. | Strongly Disagree | 21 | 16 | 7 | 44 |
| | Disagree | 30 | 16 | 21 | 67 |
| | Neutral | 10 | 5 | 7 | 22 |
| | Agree | 10 | 2 | 7 | 19 |
| | Strongly Agree | 2 | 0 | 2 | 4 |
| Total | | 73 | 39 | 44 | 156 |

Table 11: Likert statement # 9

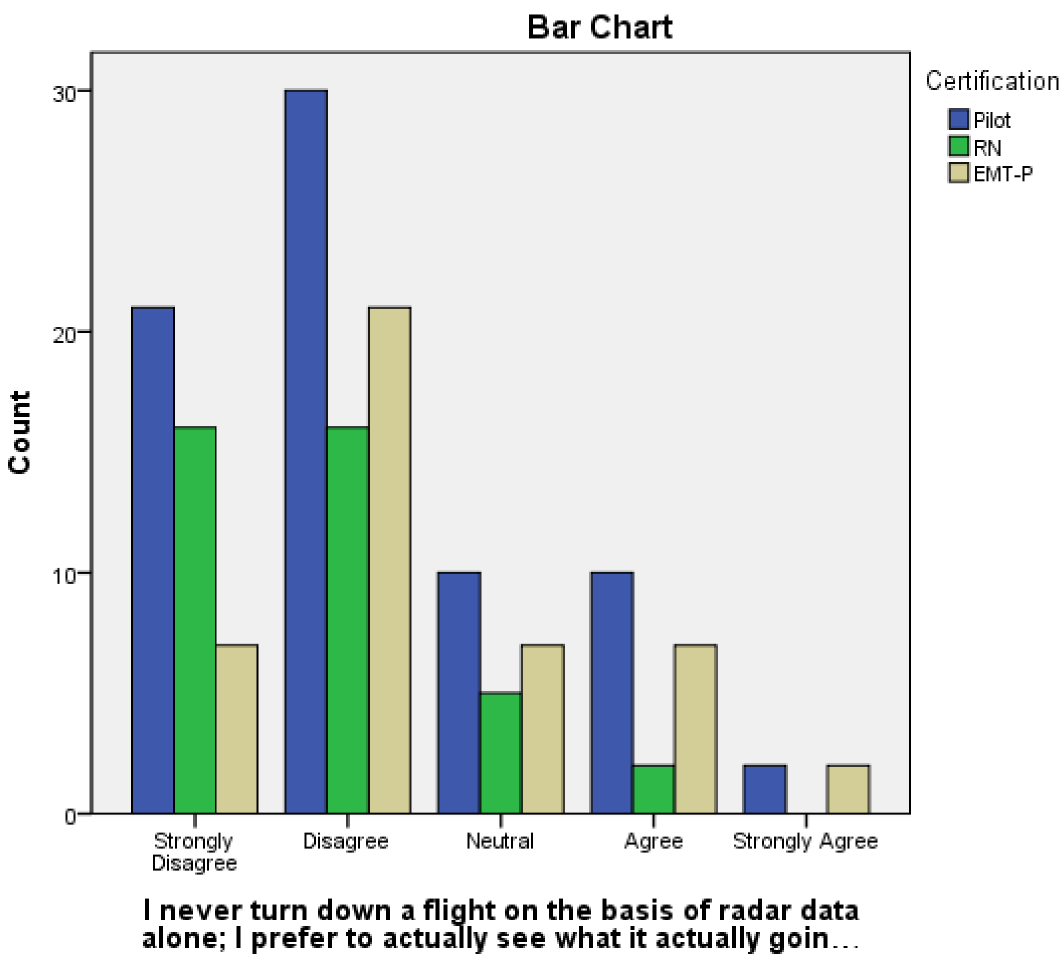


**Figure 11: Likert statement # 9**

*Statement #9 produced a statistically significant difference in responses between groups (.022). Post hoc testing showed the difference to be between the RN and Paramedic.

**I would consider dipping into my fuel reserve in order to successfully complete the flight * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| I would consider dipping into my fuel reserve in order to successfully complete the flight | Strongly Disagree | 34 | 28 | 25 | 87 |
| | Disagree | 30 | 7 | 15 | 52 |
| | Neutral | 7 | 2 | 1 | 10 |
| | Agree | 2 | 2 | 2 | 6 |
| | Strongly Agree | 0 | 0 | 1 | 1 |
| Total | | 73 | 39 | 44 | 156 |

Table 12: Likert statement # 10

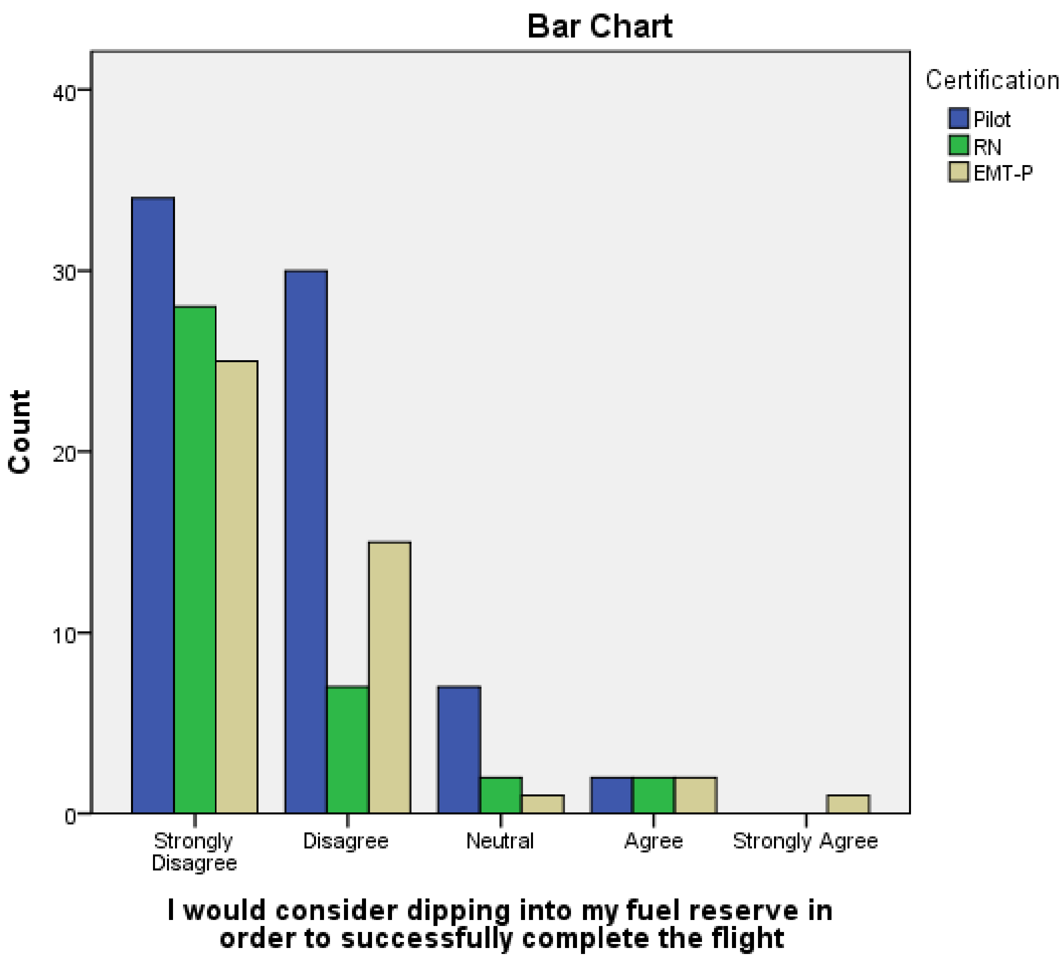


**Figure 12: Likert statement # 10**

**Regulations do not promote safety * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| Regulations do not promote safety | Strongly Disagree | 29 | 22 | 20 | 71 |
| | Disagree | 22 | 9 | 15 | 46 |
| | Neutral | 12 | 6 | 4 | 22 |
| | Agree | 7 | 1 | 5 | 13 |
| | Strongly Agree | 3 | 0 | 1 | 4 |
| Total | | 73 | 38 | 45 | 156 |

Table 13: Likert statement # 11

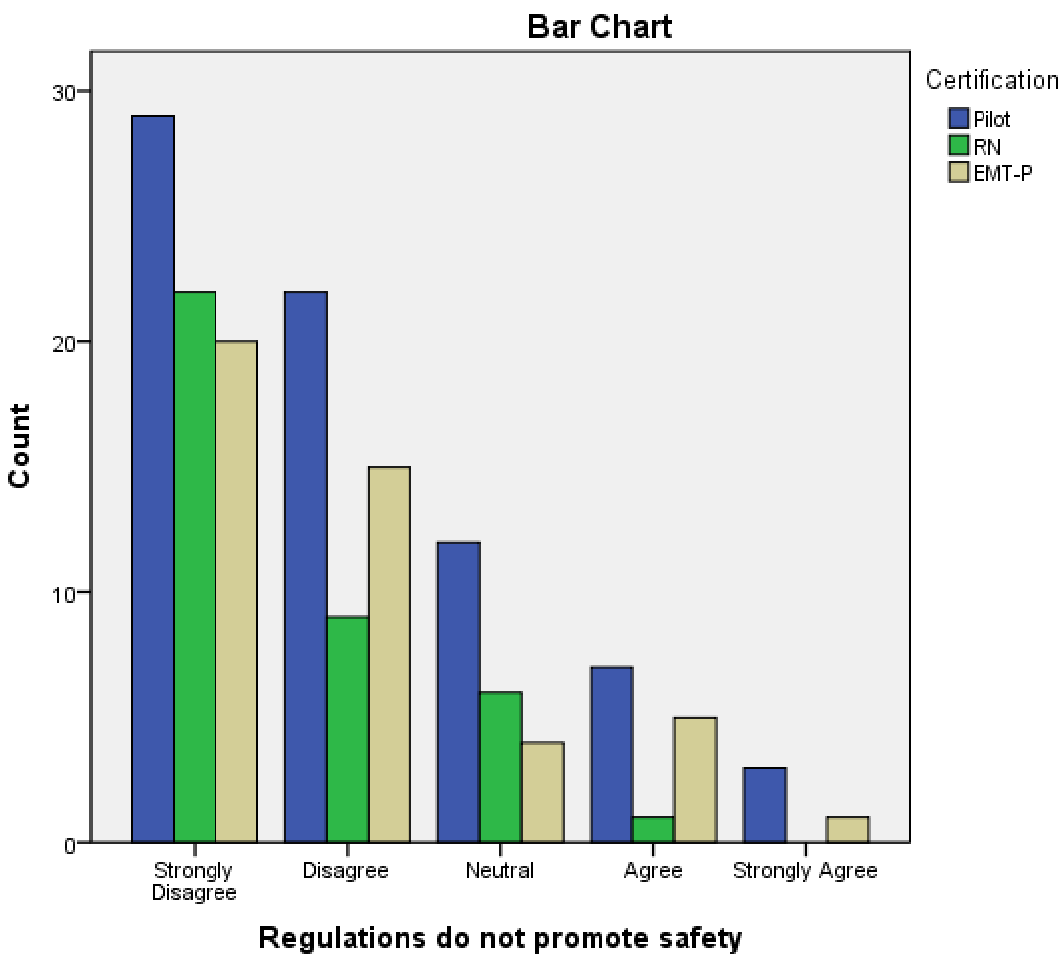


**Figure 13: Likert statement # 11**

**The base's financial performance is not my problem * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| The base's financial performance is not my problem | Strongly Disagree | 8 | 10 | 6 | 24 |
| | Disagree | 24 | 17 | 20 | 61 |
| | Neutral | 20 | 10 | 6 | 36 |
| | Agree | 11 | 2 | 9 | 22 |
| | Strongly Agree | 11 | 0 | 4 | 15 |
| Total | | 74 | 39 | 45 | 158 |

Table 14: Likert statement # 12

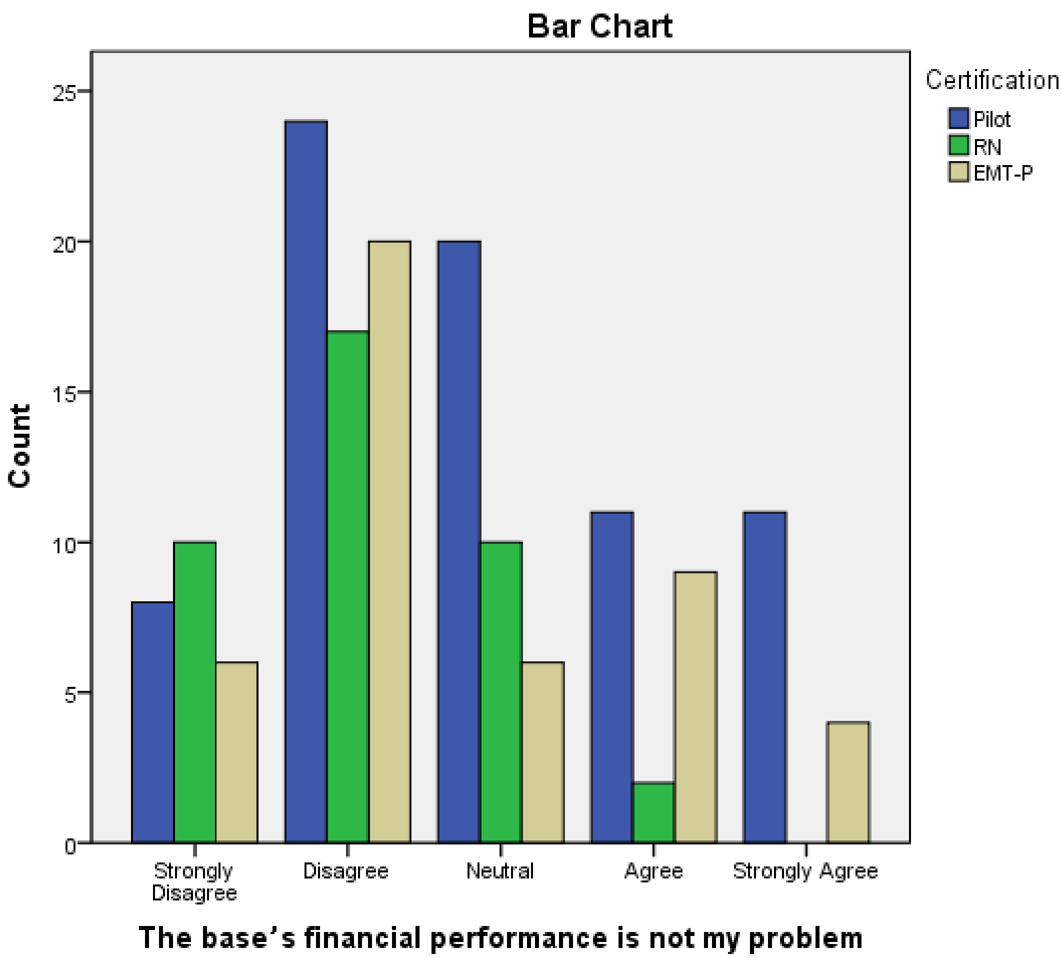


**Figure 14: Likert statement # 12**

*Statement #12 produced a statistically significant difference in responses between groups (.002). Post hoc testing showed the difference to be between the pilot and RN.

**Just because another aircraft has turned down the flight is no reason to think we cannot do it. * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| Just because another aircraft has turned down the flight is no reason to think we cannot do it. | Strongly Disagree | 8 | 9 | 10 | 27 |
| | Disagree | 23 | 21 | 12 | 56 |
| | Neutral | 19 | 5 | 11 | 35 |
| | Agree | 20 | 4 | 9 | 33 |
| | Strongly Agree | 3 | 0 | 3 | 6 |
| Total | | 73 | 39 | 45 | 157 |

Table 15: Likert statement # 13

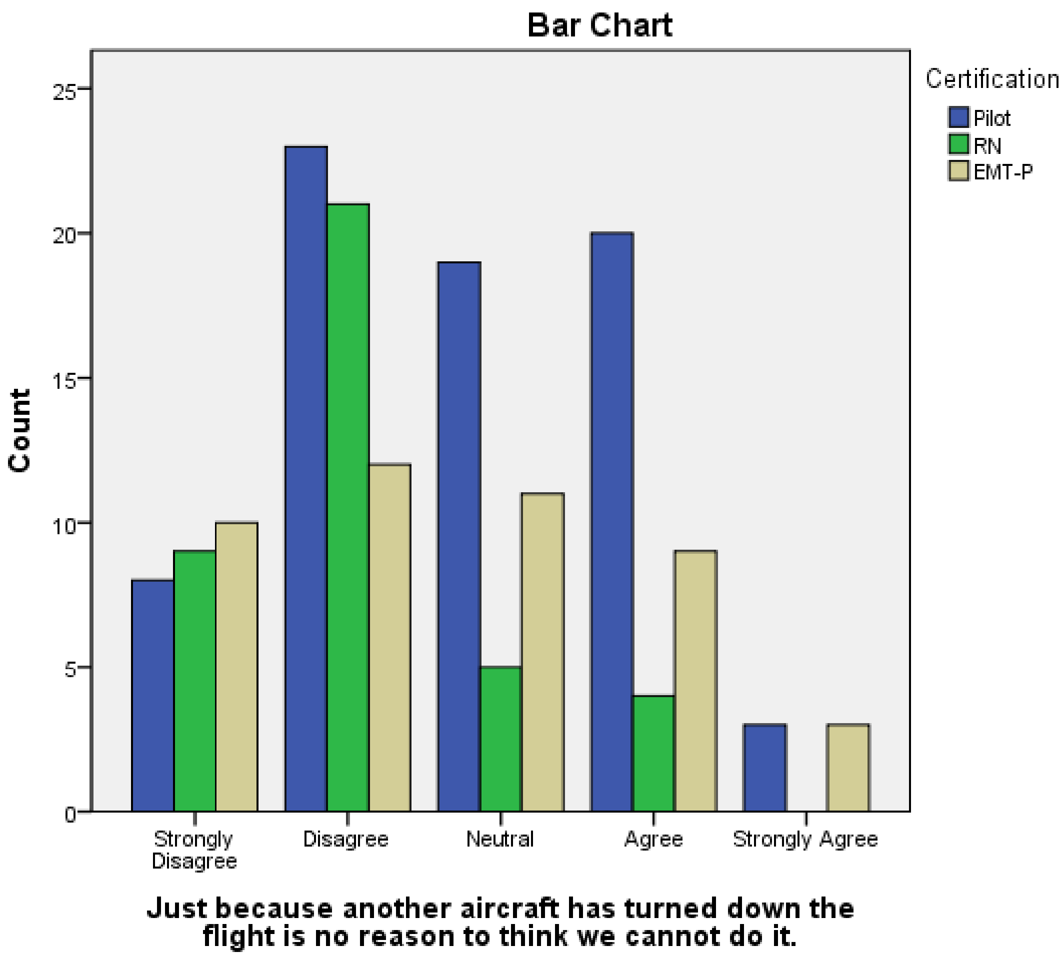


**Figure 15: Likert statement # 13**

*Statement #13 produced a statistically significant difference in responses between groups (.004). Post hoc testing showed the difference to be between the pilot and RN.

**Turning down a flight equates to revenue we cannot afford to lose. * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| Turning down a flight equates to revenue we cannot afford to lose. | Strongly Disagree | 27 | 19 | 20 | 66 |
| | Disagree | 30 | 15 | 14 | 59 |
| | Neutral | 12 | 4 | 7 | 23 |
| | Agree | 5 | 0 | 2 | 7 |
| | Strongly Agree | 0 | 1 | 0 | 1 |
| Total | | 74 | 39 | 43 | 156 |

Table 16: Likert statement # 14

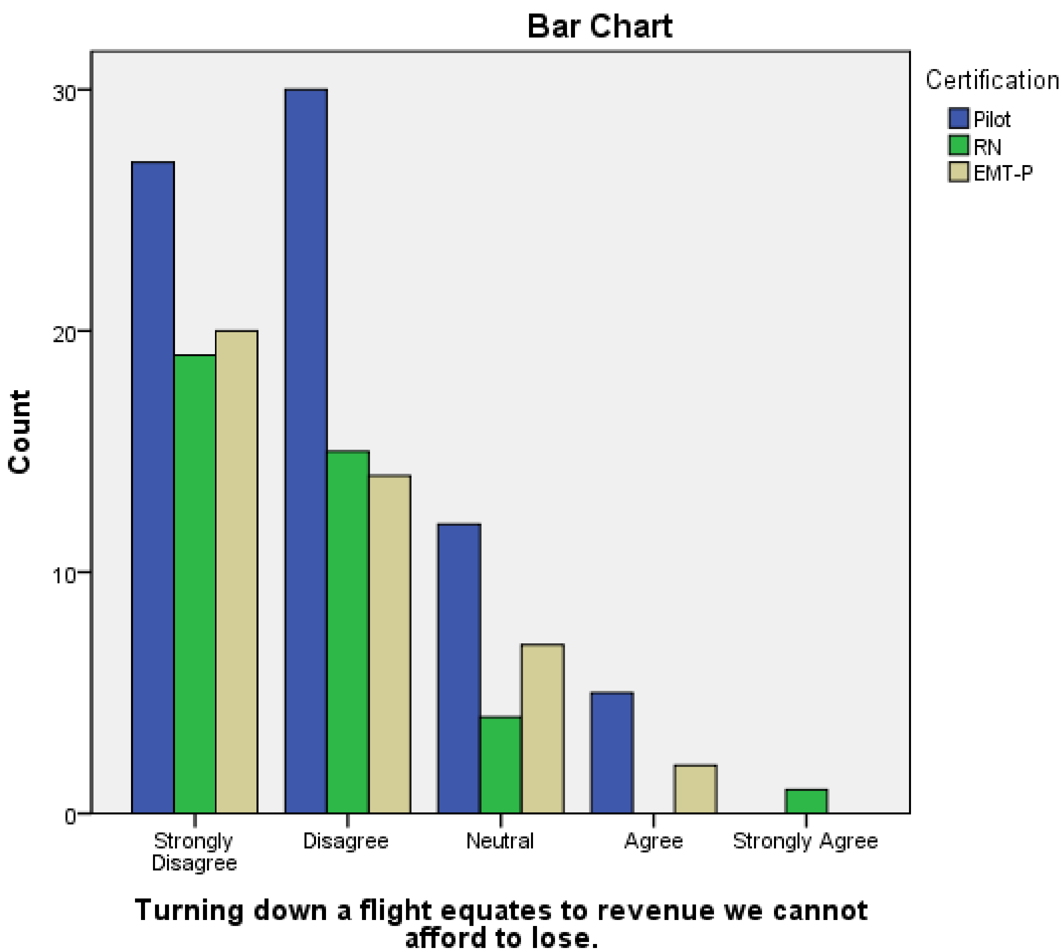


**Figure 16: Likert statement # 14**

**They do not call us unless they need us.  If they call it is our responsibility to get the job done * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| They do not call us unless they need us.  If they call it is our responsibility to get the job done | Strongly Disagree | 13 | 9 | 15 | 37 |
| | Disagree | 35 | 19 | 19 | 73 |
| | Neutral | 17 | 9 | 3 | 29 |
| | Agree | 9 | 0 | 5 | 14 |
| | Strongly Agree | 0 | 2 | 2 | 4 |
| Total | | 74 | 39 | 44 | 157 |

Table 17: Likert statement # 15

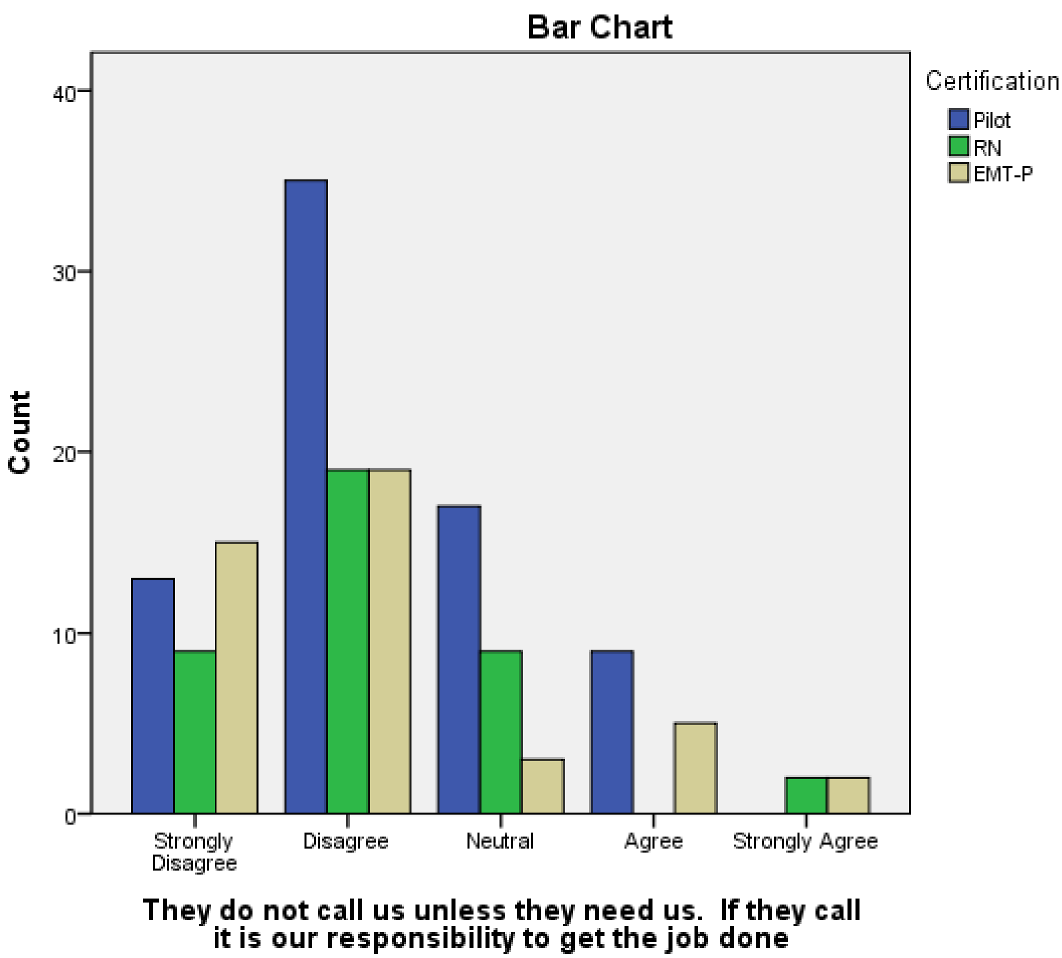


**Figure 17: Likert statement # 15**

**I do not accept a flight unless I am sure we can complete it safely and within the standards * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| I do not accept a flight unless I am sure we can complete it safely and within the standards | Disagree | 2 | 0 | 1 | 3 |
| | Neutral | 2 | 0 | 0 | 2 |
| | Agree | 16 | 10 | 11 | 37 |
| | Strongly Agree | 54 | 29 | 32 | 115 |
| Total | | 74 | 39 | 44 | 157 |

Table 18: Likert statement # 16

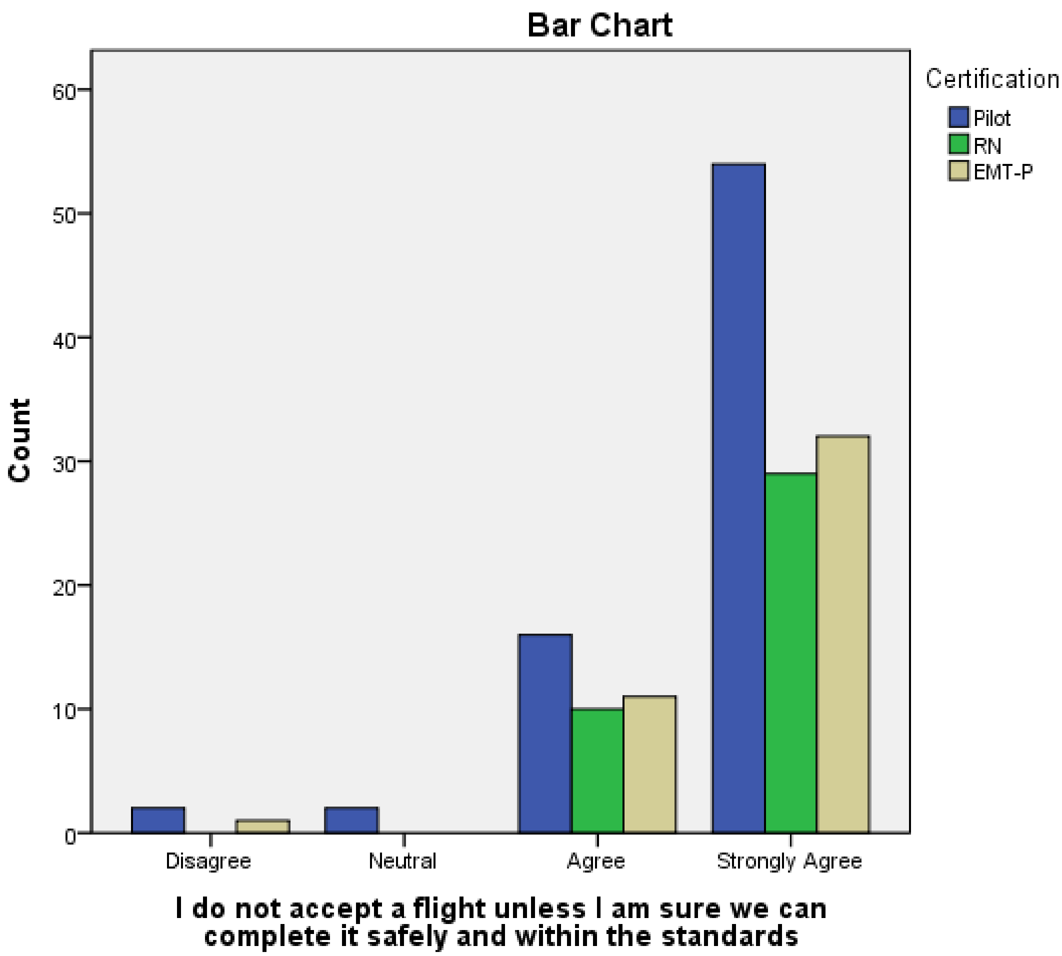


**Figure 18: Likert statement # 16**

**I do not know whether or not my base is in the black (making a profit) * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| I do not know whether or not my base is in the black (making a profit) | Strongly Disagree | 9 | 4 | 5 | 18 |
| | Disagree | 22 | 15 | 16 | 53 |
| | Neutral | 19 | 12 | 8 | 39 |
| | Agree | 12 | 5 | 8 | 25 |
| | Strongly Agree | 12 | 3 | 6 | 21 |
| Total | | 74 | 39 | 43 | 156 |

Table 19: Likert statement # 17

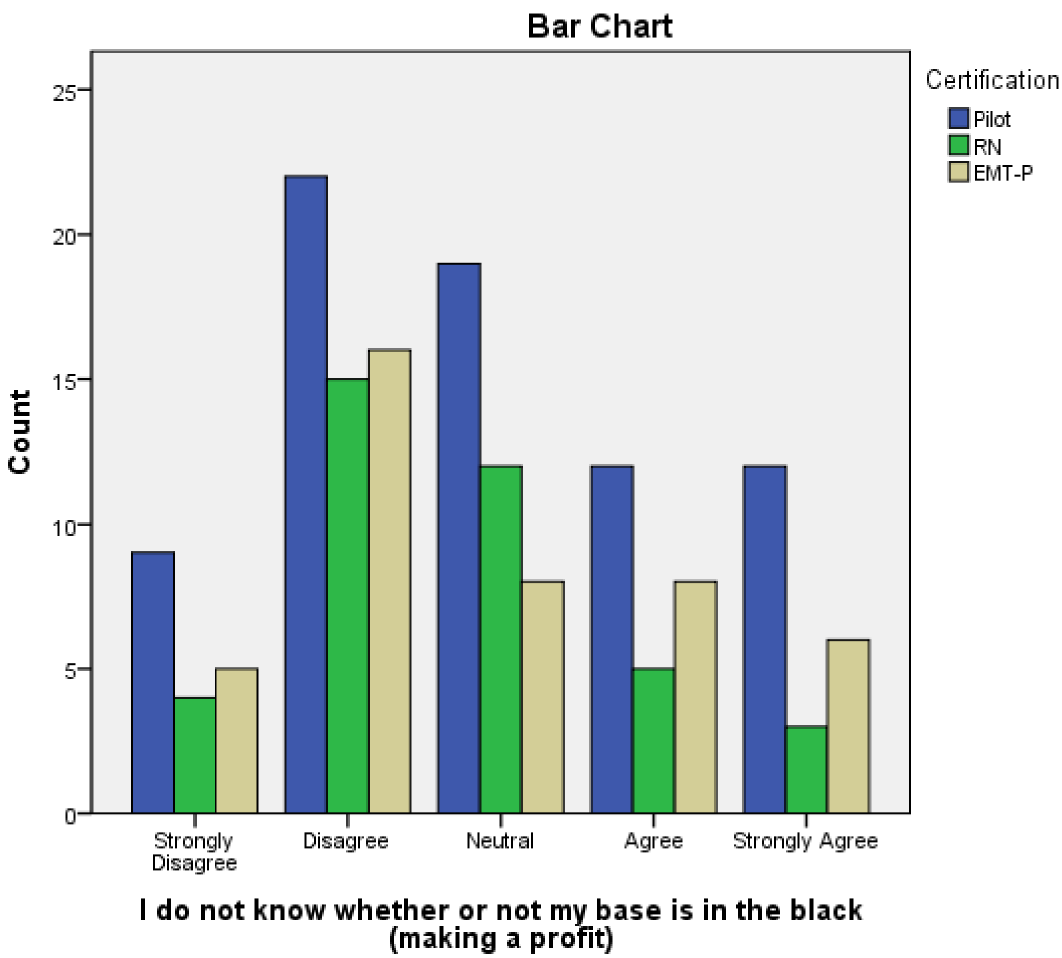


**Figure 19: Likert statement # 17**

**If the weather is marginal, I do not mind waiting till it clears; the patient will still be there * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| If the weather is marginal, I do not mind waiting till it clears; the patient will still be there | Strongly Disagree | 0 | 1 | 0 | 1 |
| | Disagree | 2 | 2 | 2 | 6 |
| | Neutral | 18 | 8 | 11 | 37 |
| | Agree | 36 | 16 | 19 | 71 |
| | Strongly Agree | 18 | 12 | 12 | 42 |
| Total | | 74 | 39 | 44 | 157 |

Table 20: Likert statement # 18

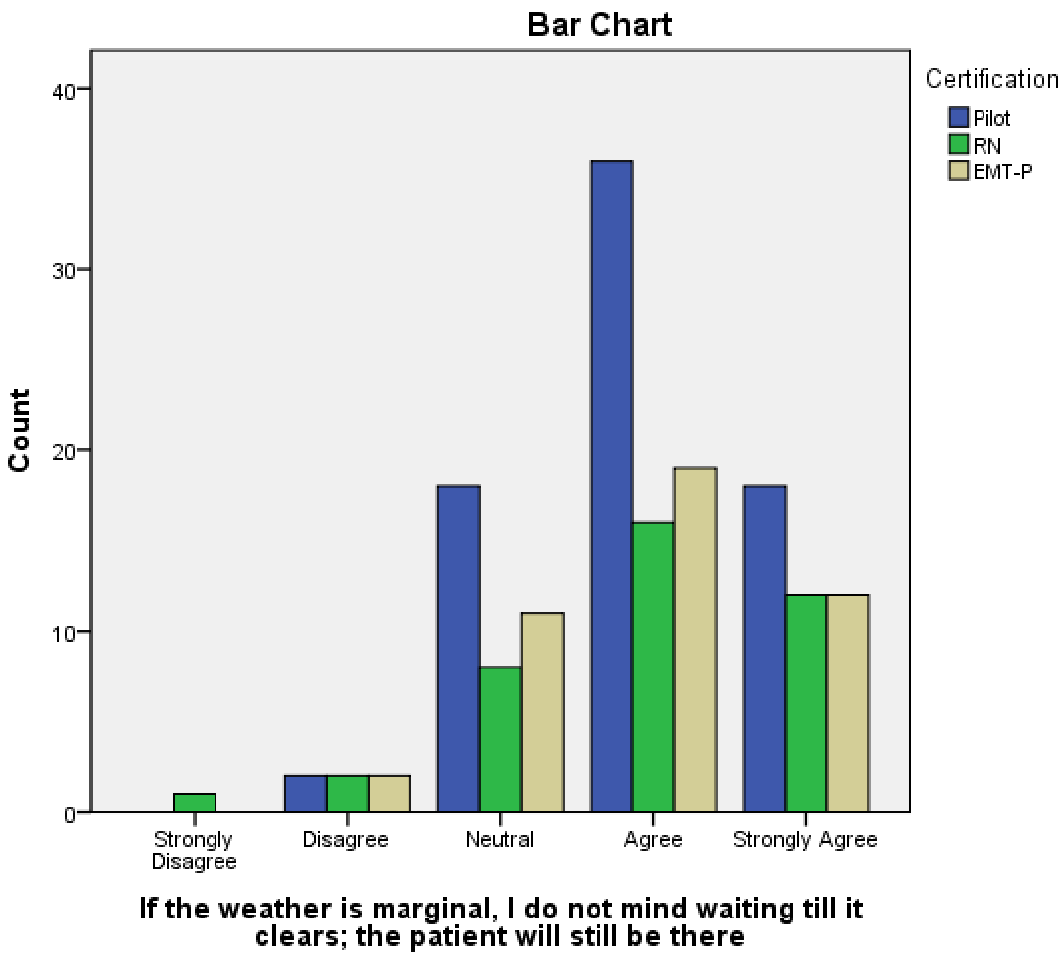


**Figure 20: Likert statement # 18**

**During the last year I have deviated from the operations manual in order to complete a flight * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| During the last year I have deviated from the operations manual in order to complete a flight | Strongly Disagree | 36 | 24 | 22 | 82 |
| | Disagree | 23 | 8 | 19 | 50 |
| | Neutral | 9 | 4 | 0 | 13 |
| | Agree | 6 | 2 | 2 | 10 |
| Total | | 74 | 38 | 43 | 155 |

Table 21: Likert statement # 19

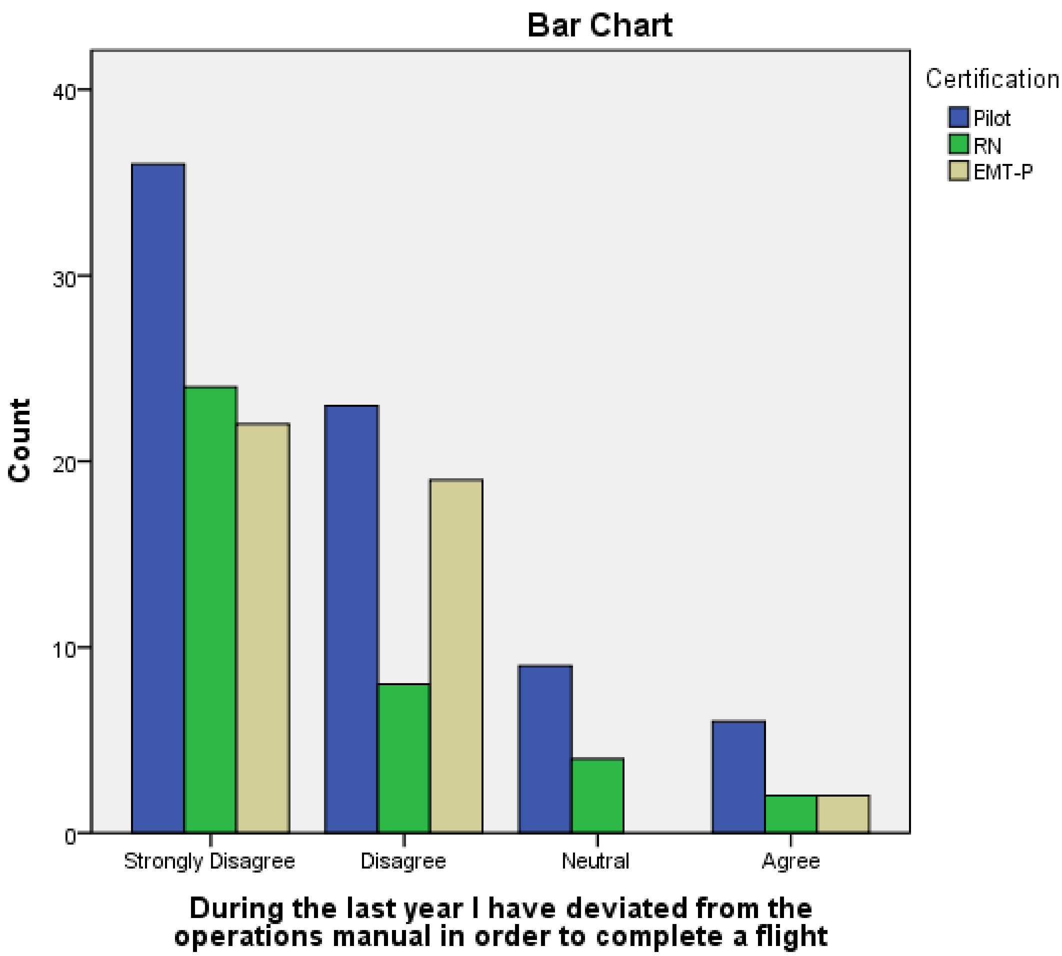


**Figure 21: Likert statement # 19**

**The Emergency Operations Center is a resource, I am PIC, I decide whether or not to accept a flight * Certification Crosstabulation**

Count

| | | Certification | | | Total |
|---|---|---|---|---|---|
| | | Pilot | RN | EMT-P | |
| The Emergency Operations Center is a resource, I am PIC, I decide whether or not to accept a flight | Strongly Disagree | 9 | 12 | 10 | 31 |
| | Disagree | 16 | 6 | 16 | 38 |
| | Neutral | 17 | 8 | 5 | 30 |
| | Agree | 23 | 5 | 5 | 33 |
| | Strongly Agree | 8 | 1 | 3 | 12 |
| Total | | 73 | 32 | 39 | 144 |

Table 22: Likert statement # 20

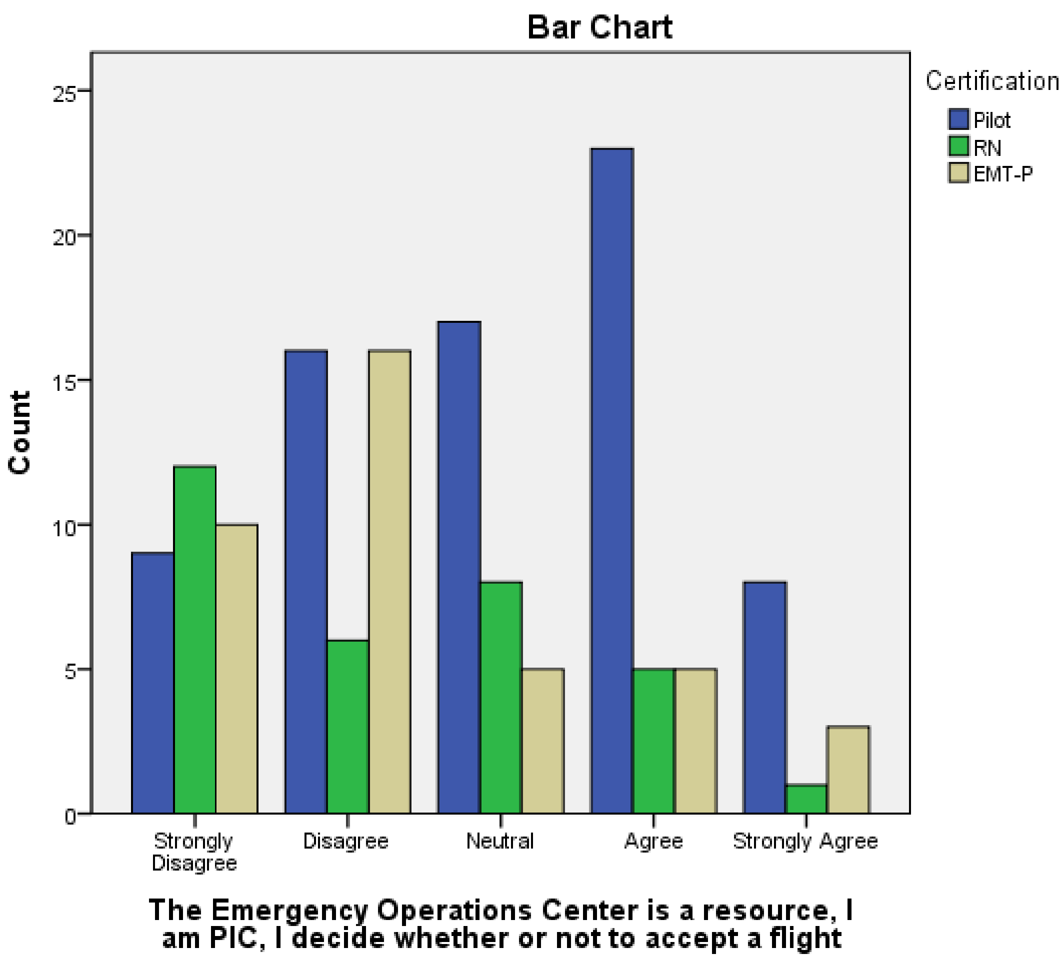


**Figure 22: Likert statement # 20**

*Statement #20 produced a statistically significant difference in responses between groups (.002). Post hoc testing showed the difference to be between the pilot and RN.

APPENDIX C
ANOVA

One Way ANOVA

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Completing the mission is my highest priority | Between Groups | 1.798 | 2 | .899 | .738 | .480 |
| | Within Groups | 187.501 | 154 | 1.218 | | |
| | Total | 189.299 | 156 | | | |
| Minimums are absolute. I do not push them. | Between Groups | 2.629 | 2 | 1.315 | 3.423 | .035 |
| | Within Groups | 59.523 | 155 | .384 | | |
| | Total | 62.152 | 157 | | | |
| The patient's / customer's needs come first | Between Groups | 9.544 | 2 | 4.772 | 3.898 | .022 |
| | Within Groups | 188.558 | 154 | 1.224 | | |
| | Total | 198.102 | 156 | | | |
| I routinely review my base's financial performance | Between Groups | 5.334 | 2 | 2.667 | 1.649 | .196 |
| | Within Groups | 249.074 | 154 | 1.617 | | |
| | Total | 254.408 | 156 | | | |
| It is not my emergency | Between Groups | 3.964 | 2 | 1.982 | 1.515 | .223 |
| | Within Groups | 202.745 | 155 | 1.308 | | |
| | Total | 206.709 | 157 | | | |
| I would duck below minimums to complete the mission | Between Groups | .840 | 2 | .420 | 1.046 | .354 |
| | Within Groups | 62.254 | 155 | .402 | | |
| | Total | 63.095 | 157 | | | |
| I worry about the possibility of my base being closed because of poor performance | Between Groups | 6.984 | 2 | 3.492 | 2.382 | .096 |
| | Within Groups | 225.793 | 154 | 1.466 | | |
| | Total | 232.777 | 156 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| During the past month I have asked about a patient's payer status | Between Groups | 5.542 | 2 | 2.771 | 1.825 | .165 |
| | Within Groups | 235.401 | 155 | 1.519 | | |
| | Total | 240.943 | 157 | | | |
| I never turn down a flight on the basis of radar data alone; I prefer to actually see what it actually going on. | Between Groups | 8.404 | 2 | 4.202 | 3.907 | .022 |
| | Within Groups | 164.570 | 153 | 1.076 | | |
| | Total | 172.974 | 155 | | | |
| I would consider dipping into my fuel reserve in order to successfully complete the flight | Between Groups | 1.584 | 2 | .792 | 1.168 | .314 |
| | Within Groups | 103.775 | 153 | .678 | | |
| | Total | 105.359 | 155 | | | |
| Regulations do not promote safety | Between Groups | 5.075 | 2 | 2.538 | 2.217 | .112 |
| | Within Groups | 175.149 | 153 | 1.145 | | |
| | Total | 180.224 | 155 | | | |
| The base's financial performance is not my problem | Between Groups | 16.509 | 2 | 8.255 | 6.336 | .002 |
| | Within Groups | 201.928 | 155 | 1.303 | | |
| | Total | 218.437 | 157 | | | |
| Just because another aircraft has turned down the flight is no reason to think we cannot do it. | Between Groups | 13.237 | 2 | 6.618 | 5.636 | .004 |
| | Within Groups | 180.852 | 154 | 1.174 | | |
| | Total | 194.089 | 156 | | | |
| Turning down a flight equates to revenue we cannot afford to lose. | Between Groups | 1.581 | 2 | .790 | 1.007 | .368 |
| | Within Groups | 120.086 | 153 | .785 | | |
| | Total | 121.667 | 155 | | | |
| They do not call us unless they need us. If they call it is our responsibility to get the job done | Between Groups | 1.305 | 2 | .652 | .669 | .514 |
| | Within Groups | 150.173 | 154 | .975 | | |
| | Total | 151.478 | 156 | | | |
| I do not accept a flight unless I am sure we can complete it safely and within the standards | Between Groups | .230 | 2 | .115 | .317 | .729 |
| | Within Groups | 55.846 | 154 | .363 | | |
| | Total | 56.076 | 156 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| I do not know whether or not my base is in the black (making a profit) | Between Groups | 1.643 | 2 | .822 | .548 | .579 |
| | Within Groups | 229.254 | 153 | 1.498 | | |
| | Total | 230.897 | 155 | | | |
| If the weather is marginal, I do not mind waiting till it clears; the patient will still be there | Between Groups | .015 | 2 | .007 | .010 | .990 |
| | Within Groups | 111.348 | 154 | .723 | | |
| | Total | 111.363 | 156 | | | |
| During the last year I have deviated from the operations manual in order to complete a flight | Between Groups | 1.822 | 2 | .911 | 1.177 | .311 |
| | Within Groups | 117.688 | 152 | .774 | | |
| | Total | 119.510 | 154 | | | |
| The Emergency Operations Center is a resource, I am PIC, I decide whether or not to accept a flight | Between Groups | 20.059 | 2 | 10.030 | 6.731 | .002 |
| | Within Groups | 210.101 | 141 | 1.490 | | |
| | Total | 230.160 | 143 | | | |

Table 23: One Way ANOVA

APPENDIX D

POST HOC TUKEY/BONFERRONI

| Dependent Variable | | (I) Certification | (J) Certification | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|---|
| Completing the mission is my highest priority | Tukey HSD | Pilot | RN | .261 | .219 | .460 | -.26 | .78 |
| | | | EMT-P | .044 | .209 | .976 | -.45 | .54 |
| | | RN | Pilot | -.261 | .219 | .460 | -.78 | .26 |
| | | | EMT-P | -.217 | .241 | .642 | -.79 | .35 |
| | | EMT-P | Pilot | -.044 | .209 | .976 | -.54 | .45 |
| | | | RN | .217 | .241 | .642 | -.35 | .79 |
| | Bonferroni | Pilot | RN | .261 | .219 | .707 | -.27 | .79 |
| | | | EMT-P | .044 | .209 | 1.000 | -.46 | .55 |
| | | RN | Pilot | -.261 | .219 | .707 | -.79 | .27 |
| | | | EMT-P | -.217 | .241 | 1.000 | -.80 | .37 |
| | | EMT-P | Pilot | -.044 | .209 | 1.000 | -.55 | .46 |
| | | | RN | .217 | .241 | 1.000 | -.37 | .80 |
| Minimums are absolute. I do not push them. | Tukey HSD | Pilot | RN | -.319* | .123 | .027 | -.61 | -.03 |
| | | | EMT-P | -.140 | .117 | .460 | -.42 | .14 |
| | | RN | Pilot | .319* | .123 | .027 | .03 | .61 |
| | | | EMT-P | .179 | .136 | .384 | -.14 | .50 |
| | | EMT-P | Pilot | .140 | .117 | .460 | -.14 | .42 |
| | | | RN | -.179 | .136 | .384 | -.50 | .14 |
| | Bonferroni | Pilot | RN | -.319* | .123 | .030 | -.62 | -.02 |
| | | | EMT-P | -.140 | .117 | .705 | -.42 | .14 |
| | | RN | Pilot | .319* | .123 | .030 | .02 | .62 |
| | | | EMT-P | .179 | .136 | .562 | -.15 | .51 |
| | | EMT-P | Pilot | .140 | .117 | .705 | -.14 | .42 |
| | | | RN | -.179 | .136 | .562 | -.51 | .15 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| The patient's / customer's needs come first | Tukey HSD | Pilot | RN | -.160 | .219 | .747 | -.68 | .36 |
| | | | EMT-P | -.582* | .210 | .017 | -1.08 | -.09 |
| | | RN | Pilot | .160 | .219 | .747 | -.36 | .68 |
| | | | EMT-P | -.422 | .242 | .192 | -1.00 | .15 |
| | | EMT-P | Pilot | .582* | .210 | .017 | .09 | 1.08 |
| | | | RN | .422 | .242 | .192 | -.15 | 1.00 |
| | Bonferroni | Pilot | RN | -.160 | .219 | 1.000 | -.69 | .37 |
| | | | EMT-P | -.582* | .210 | .019 | -1.09 | -.07 |
| | | RN | Pilot | .160 | .219 | 1.000 | -.37 | .69 |
| | | | EMT-P | -.422 | .242 | .249 | -1.01 | .16 |
| | | EMT-P | Pilot | .582* | .210 | .019 | .07 | 1.09 |
| | | | RN | .422 | .242 | .249 | -.16 | 1.01 |
| I routinely review my base's financial performance | Tukey HSD | Pilot | RN | -.385 | .254 | .286 | -.99 | .22 |
| | | | EMT-P | -.355 | .240 | .305 | -.92 | .21 |
| | | RN | Pilot | .385 | .254 | .286 | -.22 | .99 |
| | | | EMT-P | .030 | .280 | .994 | -.63 | .69 |
| | | EMT-P | Pilot | .355 | .240 | .305 | -.21 | .92 |
| | | | RN | -.030 | .280 | .994 | -.69 | .63 |
| | Bonferroni | Pilot | RN | -.385 | .254 | .395 | -1.00 | .23 |
| | | | EMT-P | -.355 | .240 | .426 | -.94 | .23 |
| | | RN | Pilot | .385 | .254 | .395 | -.23 | 1.00 |
| | | | EMT-P | .030 | .280 | 1.000 | -.65 | .71 |
| | | EMT-P | Pilot | .355 | .240 | .426 | -.23 | .94 |
| | | | RN | -.030 | .280 | 1.000 | -.71 | .65 |
| It is not my emergency | Tukey HSD | Pilot | RN | .344 | .226 | .285 | -.19 | .88 |
| | | | EMT-P | -.053 | .216 | .968 | -.56 | .46 |
| | | RN | Pilot | -.344 | .226 | .285 | -.88 | .19 |
| | | | EMT-P | -.397 | .250 | .255 | -.99 | .20 |
| | | EMT-P | Pilot | .053 | .216 | .968 | -.46 | .56 |
| | | | RN | .397 | .250 | .255 | -.20 | .99 |
| | Bonferroni | Pilot | RN | .344 | .226 | .393 | -.20 | .89 |
| | | | EMT-P | -.053 | .216 | 1.000 | -.58 | .47 |
| | | RN | Pilot | -.344 | .226 | .393 | -.89 | .20 |
| | | | EMT-P | -.397 | .250 | .345 | -1.00 | .21 |
| | | EMT-P | Pilot | .053 | .216 | 1.000 | -.47 | .58 |
| | | | RN | .397 | .250 | .345 | -.21 | 1.00 |
| I would duck below minimums | Tukey HSD | Pilot | RN | .142 | .125 | .494 | -.15 | .44 |
| | | | EMT-P | .149 | .120 | .428 | -.13 | .43 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| to complete the mission | | RN | Pilot | -.142 | .125 | .494 | -.44 | .15 |
| | | | EMT-P | .007 | .139 | .999 | -.32 | .33 |
| | | EMT-P | Pilot | -.149 | .120 | .428 | -.43 | .13 |
| | | | RN | -.007 | .139 | .999 | -.33 | .32 |
| | Bonferroni | Pilot | RN | .142 | .125 | .774 | -.16 | .45 |
| | | | EMT-P | .149 | .120 | .644 | -.14 | .44 |
| | | RN | Pilot | -.142 | .125 | .774 | -.45 | .16 |
| | | | EMT-P | .007 | .139 | 1.000 | -.33 | .34 |
| | | EMT-P | Pilot | -.149 | .120 | .644 | -.44 | .14 |
| | | | RN | -.007 | .139 | 1.000 | -.34 | .33 |
| I worry about the possibility of my base being closed because of poor performance | Tukey HSD | Pilot | RN | .352 | .240 | .310 | -.22 | .92 |
| | | | EMT-P | .468 | .229 | .106 | -.07 | 1.01 |
| | | RN | Pilot | -.352 | .240 | .310 | -.92 | .22 |
| | | | EMT-P | .116 | .265 | .899 | -.51 | .74 |
| | | EMT-P | Pilot | -.468 | .229 | .106 | -1.01 | .07 |
| | | | RN | -.116 | .265 | .899 | -.74 | .51 |
| | Bonferroni | Pilot | RN | .352 | .240 | .435 | -.23 | .93 |
| | | | EMT-P | .468 | .229 | .129 | -.09 | 1.02 |
| | | RN | Pilot | -.352 | .240 | .435 | -.93 | .23 |
| | | | EMT-P | .116 | .265 | 1.000 | -.52 | .76 |
| | | EMT-P | Pilot | -.468 | .229 | .129 | -1.02 | .09 |
| | | | RN | -.116 | .265 | 1.000 | -.76 | .52 |
| During the past month I have asked about a patient's payer status | Tukey HSD | Pilot | RN | .443 | .244 | .168 | -.13 | 1.02 |
| | | | EMT-P | .024 | .233 | .994 | -.53 | .58 |
| | | RN | Pilot | -.443 | .244 | .168 | -1.02 | .13 |
| | | | EMT-P | -.419 | .270 | .269 | -1.06 | .22 |
| | | EMT-P | Pilot | -.024 | .233 | .994 | -.58 | .53 |
| | | | RN | .419 | .270 | .269 | -.22 | 1.06 |
| | Bonferroni | Pilot | RN | .443 | .244 | .214 | -.15 | 1.03 |
| | | | EMT-P | .024 | .233 | 1.000 | -.54 | .59 |
| | | RN | Pilot | -.443 | .244 | .214 | -1.03 | .15 |
| | | | EMT-P | -.419 | .270 | .367 | -1.07 | .23 |
| | | EMT-P | Pilot | -.024 | .233 | 1.000 | -.59 | .54 |
| | | | RN | .419 | .270 | .367 | -.23 | 1.07 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I never turn down a flight on the basis of radar data alone; I prefer to actually see what it actually going on. | Tukey HSD | Pilot | RN | .385 | .206 | .150 | -.10 | .87 |
| | | | EMT-P | -.249 | .198 | .421 | -.72 | .22 |
| | | RN | Pilot | -.385 | .206 | .150 | -.87 | .10 |
| | | | EMT-P | -.634* | .228 | .017 | -1.17 | -.09 |
| | | EMT-P | Pilot | .249 | .198 | .421 | -.22 | .72 |
| | | | RN | .634* | .228 | .017 | .09 | 1.17 |
| | Bonferroni | Pilot | RN | .385 | .206 | .190 | -.11 | .88 |
| | | | EMT-P | -.249 | .198 | .631 | -.73 | .23 |
| | | RN | Pilot | -.385 | .206 | .190 | -.88 | .11 |
| | | | EMT-P | -.634* | .228 | .018 | -1.19 | -.08 |
| | | EMT-P | Pilot | .249 | .198 | .631 | -.23 | .73 |
| | | | RN | .634* | .228 | .018 | .08 | 1.19 |
| I would consider dipping into my fuel reserve in order to successfully complete the flight | Tukey HSD | Pilot | RN | .249 | .163 | .282 | -.14 | .64 |
| | | | EMT-P | .071 | .157 | .893 | -.30 | .44 |
| | | RN | Pilot | -.249 | .163 | .282 | -.64 | .14 |
| | | | EMT-P | -.178 | .181 | .590 | -.61 | .25 |
| | | EMT-P | Pilot | -.071 | .157 | .893 | -.44 | .30 |
| | | | RN | .178 | .181 | .590 | -.25 | .61 |
| | Bonferroni | Pilot | RN | .249 | .163 | .388 | -.15 | .64 |
| | | | EMT-P | .071 | .157 | 1.000 | -.31 | .45 |
| | | RN | Pilot | -.249 | .163 | .388 | -.64 | .15 |
| | | | EMT-P | -.178 | .181 | .984 | -.62 | .26 |
| | | EMT-P | Pilot | -.071 | .157 | 1.000 | -.45 | .31 |
| | | | RN | .178 | .181 | .984 | -.26 | .62 |
| Regulations do not promote safety | Tukey HSD | Pilot | RN | .451 | .214 | .092 | -.06 | .96 |
| | | | EMT-P | .149 | .203 | .744 | -.33 | .63 |
| | | RN | Pilot | -.451 | .214 | .092 | -.96 | .06 |
| | | | EMT-P | -.302 | .236 | .409 | -.86 | .26 |
| | | EMT-P | Pilot | -.149 | .203 | .744 | -.63 | .33 |
| | | | RN | .302 | .236 | .409 | -.26 | .86 |
| | Bonferroni | Pilot | RN | .451 | .214 | .111 | -.07 | .97 |
| | | | EMT-P | .149 | .203 | 1.000 | -.34 | .64 |
| | | RN | Pilot | -.451 | .214 | .111 | -.97 | .07 |
| | | | EMT-P | -.302 | .236 | .607 | -.87 | .27 |
| | | EMT-P | Pilot | -.149 | .203 | 1.000 | -.64 | .34 |
| | | | RN | .302 | .236 | .607 | -.27 | .87 |
| The base's financial | Tukey HSD | Pilot | RN | .803* | .226 | .001 | .27 | 1.34 |
| | | | EMT-P | .239 | .216 | .512 | -.27 | .75 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| performance is not my problem | | RN | Pilot | -.803* | .226 | .001 | -1.34 | -.27 |
| | | | EMT-P | -.564 | .250 | .065 | -1.16 | .03 |
| | | EMT-P | Pilot | -.239 | .216 | .512 | -.75 | .27 |
| | | | RN | .564 | .250 | .065 | -.03 | 1.16 |
| | Bonferroni | Pilot | RN | .803* | .226 | .002 | .26 | 1.35 |
| | | | EMT-P | .239 | .216 | .811 | -.28 | .76 |
| | | RN | Pilot | -.803* | .226 | .002 | -1.35 | -.26 |
| | | | EMT-P | -.564 | .250 | .076 | -1.17 | .04 |
| | | EMT-P | Pilot | -.239 | .216 | .811 | -.76 | .28 |
| | | | RN | .564 | .250 | .076 | -.04 | 1.17 |
| Just because another aircraft has turned down the flight is no reason to think we cannot do it. | Tukey HSD | Pilot | RN | .719* | .215 | .003 | .21 | 1.23 |
| | | | EMT-P | .200 | .205 | .595 | -.29 | .69 |
| | | RN | Pilot | -.719* | .215 | .003 | -1.23 | -.21 |
| | | | EMT-P | -.520 | .237 | .076 | -1.08 | .04 |
| | | EMT-P | Pilot | -.200 | .205 | .595 | -.69 | .29 |
| | | | RN | .520 | .237 | .076 | -.04 | 1.08 |
| | Bonferroni | Pilot | RN | .719* | .215 | .003 | .20 | 1.24 |
| | | | EMT-P | .200 | .205 | .997 | -.30 | .70 |
| | | RN | Pilot | -.719* | .215 | .003 | -1.24 | -.20 |
| | | | EMT-P | -.520 | .237 | .090 | -1.09 | .05 |
| | | EMT-P | Pilot | -.200 | .205 | .997 | -.70 | .30 |
| | | | RN | .520 | .237 | .090 | -.05 | 1.09 |
| Turning down a flight equates to revenue we cannot afford to lose. | Tukey HSD | Pilot | RN | .240 | .175 | .359 | -.17 | .66 |
| | | | EMT-P | .142 | .170 | .682 | -.26 | .54 |
| | | RN | Pilot | -.240 | .175 | .359 | -.66 | .17 |
| | | | EMT-P | -.098 | .196 | .870 | -.56 | .37 |
| | | EMT-P | Pilot | -.142 | .170 | .682 | -.54 | .26 |
| | | | RN | .098 | .196 | .870 | -.37 | .56 |
| | Bonferroni | Pilot | RN | .240 | .175 | .518 | -.18 | .66 |
| | | | EMT-P | .142 | .170 | 1.000 | -.27 | .55 |
| | | RN | Pilot | -.240 | .175 | .518 | -.66 | .18 |
| | | | EMT-P | -.098 | .196 | 1.000 | -.57 | .38 |
| | | EMT-P | Pilot | -.142 | .170 | 1.000 | -.55 | .27 |
| | | | RN | .098 | .196 | 1.000 | -.38 | .57 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| They do not call us unless they need us. If they call it is our responsibility to get the job done | Tukey HSD | Pilot | RN | .143 | .195 | .744 | -.32 | .61 |
| | | | EMT-P | .206 | .188 | .517 | -.24 | .65 |
| | | RN | Pilot | -.143 | .195 | .744 | -.61 | .32 |
| | | | EMT-P | .063 | .217 | .955 | -.45 | .58 |
| | | EMT-P | Pilot | -.206 | .188 | .517 | -.65 | .24 |
| | | | RN | -.063 | .217 | .955 | -.58 | .45 |
| | Bonferroni | Pilot | RN | .143 | .195 | 1.000 | -.33 | .62 |
| | | | EMT-P | .206 | .188 | .822 | -.25 | .66 |
| | | RN | Pilot | -.143 | .195 | 1.000 | -.62 | .33 |
| | | | EMT-P | .063 | .217 | 1.000 | -.46 | .59 |
| | | EMT-P | Pilot | -.206 | .188 | .822 | -.66 | .25 |
| | | | RN | -.063 | .217 | 1.000 | -.59 | .46 |
| I do not accept a flight unless I am sure we can complete it safely and within the standards | Tukey HSD | Pilot | RN | -.095 | .119 | .706 | -.38 | .19 |
| | | | EMT-P | -.033 | .115 | .955 | -.30 | .24 |
| | | RN | Pilot | .095 | .119 | .706 | -.19 | .38 |
| | | | EMT-P | .062 | .132 | .887 | -.25 | .38 |
| | | EMT-P | Pilot | .033 | .115 | .955 | -.24 | .30 |
| | | | RN | -.062 | .132 | .887 | -.38 | .25 |
| | Bonferroni | Pilot | RN | -.095 | .119 | 1.000 | -.38 | .19 |
| | | | EMT-P | -.033 | .115 | 1.000 | -.31 | .24 |
| | | RN | Pilot | .095 | .119 | 1.000 | -.19 | .38 |
| | | | EMT-P | .062 | .132 | 1.000 | -.26 | .38 |
| | | EMT-P | Pilot | .033 | .115 | 1.000 | -.24 | .31 |
| | | | RN | -.062 | .132 | 1.000 | -.38 | .26 |
| I do not know whether or not my base is in the black (making a profit) | Tukey HSD | Pilot | RN | .254 | .242 | .548 | -.32 | .83 |
| | | | EMT-P | .085 | .235 | .930 | -.47 | .64 |
| | | RN | Pilot | -.254 | .242 | .548 | -.83 | .32 |
| | | | EMT-P | -.168 | .271 | .809 | -.81 | .47 |
| | | EMT-P | Pilot | -.085 | .235 | .930 | -.64 | .47 |
| | | | RN | .168 | .271 | .809 | -.47 | .81 |
| | Bonferroni | Pilot | RN | .254 | .242 | .890 | -.33 | .84 |
| | | | EMT-P | .085 | .235 | 1.000 | -.48 | .65 |
| | | RN | Pilot | -.254 | .242 | .890 | -.84 | .33 |
| | | | EMT-P | -.168 | .271 | 1.000 | -.82 | .49 |
| | | EMT-P | Pilot | -.085 | .235 | 1.000 | -.65 | .48 |
| | | | RN | .168 | .271 | 1.000 | -.49 | .82 |
| If the weather is marginal, I do not | Tukey HSD | Pilot | RN | .023 | .168 | .990 | -.38 | .42 |
| | | | EMT-P | .014 | .162 | .996 | -.37 | .40 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| mind waiting till it clears; the patient will still be there | | RN | Pilot | -.023 | .168 | .990 | -.42 | .38 |
| | | | EMT-P | -.009 | .187 | .999 | -.45 | .43 |
| | | EMT-P | Pilot | -.014 | .162 | .996 | -.40 | .37 |
| | | | RN | .009 | .187 | .999 | -.43 | .45 |
| | Bonferroni | Pilot | RN | .023 | .168 | 1.000 | -.38 | .43 |
| | | | EMT-P | .014 | .162 | 1.000 | -.38 | .41 |
| | | RN | Pilot | -.023 | .168 | 1.000 | -.43 | .38 |
| | | | EMT-P | -.009 | .187 | 1.000 | -.46 | .44 |
| | | EMT-P | Pilot | -.014 | .162 | 1.000 | -.41 | .38 |
| | | | RN | .009 | .187 | 1.000 | -.44 | .46 |
| During the last year I have deviated from the operations manual in order to complete a flight | Tukey HSD | Pilot | RN | .218 | .176 | .430 | -.20 | .63 |
| | | | EMT-P | .216 | .169 | .409 | -.18 | .62 |
| | | RN | Pilot | -.218 | .176 | .430 | -.63 | .20 |
| | | | EMT-P | -.002 | .196 | 1.000 | -.47 | .46 |
| | | EMT-P | Pilot | -.216 | .169 | .409 | -.62 | .18 |
| | | | RN | .002 | .196 | 1.000 | -.46 | .47 |
| | Bonferroni | Pilot | RN | .218 | .176 | .647 | -.21 | .64 |
| | | | EMT-P | .216 | .169 | .608 | -.19 | .62 |
| | | RN | Pilot | -.218 | .176 | .647 | -.64 | .21 |
| | | | EMT-P | -.002 | .196 | 1.000 | -.48 | .47 |
| | | EMT-P | Pilot | -.216 | .169 | .608 | -.62 | .19 |
| | | | RN | .002 | .196 | 1.000 | -.47 | .48 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| The Emergency Operations Center is a resource, I am PIC, I decide whether or not to accept a flight | Tukey HSD | Pilot | RN | .787* | .259 | .008 | .17 | 1.40 |
| | | | EMT-P | .710* | .242 | .011 | .14 | 1.28 |
| | | RN | Pilot | -.787* | .259 | .008 | -1.40 | -.17 |
| | | | EMT-P | -.078 | .291 | .961 | -.77 | .61 |
| | | EMT-P | Pilot | -.710* | .242 | .011 | -1.28 | -.14 |
| | | | RN | .078 | .291 | .961 | -.61 | .77 |
| | Bonferroni | Pilot | RN | .787* | .259 | .008 | .16 | 1.41 |
| | | | EMT-P | .710* | .242 | .012 | .12 | 1.30 |
| | | RN | Pilot | -.787* | .259 | .008 | -1.41 | -.16 |
| | | | EMT-P | -.078 | .291 | 1.000 | -.78 | .63 |
| | | EMT-P | Pilot | -.710* | .242 | .012 | -1.30 | -.12 |
| | | | RN | .078 | .291 | 1.000 | -.63 | .78 |

Table 24: Post Hoc Tukey/Bonferroni

RESOURCES


Abel, Elisabeth (2011). Private conversation with Elisabeth Abel, Educator, Air Life, Denver, Colorado on 9/29/2011.

Allen, I.E. & Seaman, C.A. (2007). Likert scales and data analysis. *Quality Progress*, 40 (7), 64-65.

American College of Surgeons (2011). *Verified Trauma Centers*. Accessed 11/26/2011. http://www.facs.org/trauma/verified.html.

Arizona Department of Health Services (2011). *Arizona Air Ambulance Rate Schedule*. Accessed October 15, 2011. www.azdhs.gov/bems/ambul-pdf/airambulancerates.pdf

Bix, A.S. (2010). Beyond Amelia Earhart: Teaching about the history of women aviators. *OAH Magazine of History*, 24 (3), 39-44.

Blaikie, N. (2003). *Analysing Quantitative Data*. London: Sage Publications.

Blueman, Ira (2009). *Analysis of HEMS Accidents and Accident Rates*. Transcript of a presentation before the National Transportation Safety Board, February 2009. Washington, DC.

Campbell, W.K. & Sedikides, C. (1999). Self-threat magnifies the self-serving bias: A meta- analytic integration. *Review of General Psychology*, 3 (1), 23-43.

CAMTS (2011). *8th Edition Accreditation Standards*. Committee on Accreditation of Medical Transport Systems.

Chappelle, W.L., Novy, P.L., Sowin, T.W., & Thompson, W.T. (2010). NEO PI-R normative personality data that distinguish U.S. Air Force female pilots. *Military Psychology*, 22, p. 158-175. DOI: 10.1080/08995600903417308.

Clark, S. (2003). The contemporary workforce: Implications for organizational safety culture. Personnel Review, 32 (1), p. 40-57.

Clark, T. (2012). Private conversation with the author. Conversation took place in March 2012 during the course of a normal business day. Air Evac 5, Buckeye, AZ.

Confidential Correspondence (2011). A confidential conversation that took place on December 8, 2011 in Phoenix, Arizona.

Connell, D. (2009). *The mission continues*. Retrieved April 27, 2012 from http://blog.leadertoleader.org/post/Duty2c-Mission2c-and-Service-The-Heart-of-the-Military-Mindset.aspx

Connell, L. & Patten, M. (1993). Emergency 911: EMS Helicopter Operations. *ASRS Directline*, Issue 6 (August). Retrieved from http://asrs.arc.nasa.gov/publications/directline/dl6_ems.htm

Creasman, K. (1997). Black birds in the sky: The legacies of Bessie Coleman and Dr. Mae Jemison. *The Journal of Negro History*, 82 (1), 158-168.

Crouch, T.D. (2010). A machine of practical utility. *American Heritage,* (59) 4, 68-69.

Davey, C.L. & Davidson, M.J. (2000). The right of passage? The experience of female pilots in commercial aviation. *Feminism & Psychology*, 10 (2), 195-225.

Death of Rockne (1931). *Time Magazine*, 17 (14), p. 26.

Dee, G. & Williams, S. (2011). From blaming to learning: Re-Framing organizational learning from adverse incidents. *The Learning Organization*, 18 (6), 438-453.

Denison, D.R. (1990). *Corporate culture and organizational effectiveness*. New York: Wiley.

Dorland, P., & Nanney, J. (1982). *Dust off: Army aeromedical evacuations in Vietnam*. Washington, D.C.: Center of Military History, U.S. Army, Government Printing Office, pp. 3-20.

Downer, J. (2010). Trust and technology: The social foundations of aviation regulation. *The British Journal of Sociology*, 61 (1), 83-106.

Dukes, R. L., Hulbert-Johnson, R., Newton, H., and Overstreet, S. (1991). Stereotypes of pilots and apprehension about flying with them: A study of commercial aviation scenarios. *Aviation, Space, and Environmental Medicine*, 62(8), 722-726.

Dust Off Association. (1997). *Charles L. Kelly*. Retrieved from http://www.dustoff.org/hall-of-fame/Citations/kelly-citation.htm

Federal Aviation Administration (1991). *Aeronautical Decision Making*, Advisory Circular AC-60-22. Washington, DC: US Department of Transportation.

Federal Aviation Administration (2008). *Pilot's Handbook of Aeronautical Knowledge*. FAA-H-8083-25. Washington DC: US Department of Transportation.

Federal Aviation Administration (June 8, 2010). *Fact Sheet – Helicopter Emergency Medical Service Safety*. Washington, DC: US Department of Transportation.

Federal Aviation Administration (October 12, 2010). Notice of Proposed Rulemaking: Air Ambulance and Commercial Helicopter Operations, Part 91 Helicopter Operations, and Part 135 Aircraft Operations; Safety Initiatives and Miscellaneous Amendments. *Federal Register*, 75 (196), p.62640-62674.

Flight Safety Foundation. (2009). *Helicopter emergency medical services (HEMS) industry risk profile*. Foundation of Air Medical Research & Education.

Ganesh, A. and Joseph, C. (2005). Personality studies in aircrew: An overview. *Journal of Aerospace Medicine*, 49(1), 54-62.

Gilliam, R. (2005). Viva la aviacion nacional! *Aviation History*, 15 (3), 46-52.

Gob, R., McCollin, C., & Fernanda Ramalhoto, M. (2007). Ordinal methodology in the analysis of Likert scales. *Quality & Quantity*, 41, 601-626. doi: 10.1007/s11135-007-9089-z

Goh, J. and Wiegmann, D. A. (2001). Visual flight rules flight into instrument meteorological conditions: An empirical investigation of the possible causes. *The International Journal of Aviation Psychology*, 11 (4), 359-379.

Government Accountability Office (February, 2007). Improved data collection needed for effective oversight of air ambulance industry. *Report to the Chairman, Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives*. Government Printing Office, Washington, D.C.

Gwynn – Jones, T. (1984). For a brief moment the world seemed wild about Harriet. *Smithsonian*, 14 (10), 112-126.

Hanrahan, R. & Antony, L. (2005). Because I said so: Toward a feminist theory of authority. *Hypatia*, 20 (4), 59-79.

Harris, D. & Li, W. C. (2011). An extension of the Human Factors Analysis and Classification System for use in open systems. *Theoretical Issues in Ergonomics Science*, 12 (2), 108-128.

Harris, J.S. (1994). Improved Aeronautical Decision Making Can Reduce Accidents. *Helicopter Safety*, 20 (2), March/April, 1-6.

Heider, F. (1958). *The psychology of interpersonal relations*. New York: Wiley.

Hodge, D.R. & Gillespie, D.F. (2007). Phrase completion scales: A better measurement approach than Likert scales? *Journal of Social Service Research*, 33 (4), 1-12, doi: 10.1300/J079v33n04_01

Hollnagel, E. & Amalberti, R. (2001). *The emperor's new clothes or whatever happened to 'human error?'* A paper delivered before the 4th International Workshop on Human Error, Safety, and Systems Development, Linkoping, Sweden, June 11-12, 2001.

Hunter, D.R. (2002). *Risk perception and risk tolerance in aircraft pilots*. Federal Aviation Administration, Office of Aerospace Medicine, DOT/FAA/AM-02/17, Washington, DC.

Hunter, D.R. (2003). Measuring general aviation pilot judgment using a situational judgment technique. International Journal of Aviation Psychology, 13 (4), 373-386.

Hunter, D.R. (2005). Measurement of hazardous attitudes among pilots. *The International Journal of Aviation Psychology*, 15 (1), 23-43.

Hunter, D.R. & Stewart, J.E. (2009). *Technical Report 1260: Locus of control, risk orientation, and decision making among US Army aviators*. United States Army Research Institute for the Behavioral and Social Sciences: Arlington, VA.

Ison, D.C. (2010). *Development and Validation of an Aviation Research Survey*. Unpublished manuscript, Rocky Mountain College.

Jamieson, S. (2004). Likert scales: how to (ab)use them. *Medical Education*, 38 (12), 1217.

Jonah, B.A. (1986). Accident risk and risk taking behavior among young drivers. *Accident Analysis and Prevention*, 18 (4), 255-271.

Jensen, R.S. (1989). *Aeronautical decision making – cockpit resource management*. Federal Aviation Administration. Washington, DC: US Department of Transportation.

Jensen, R.S. (1995). *Pilot judgment and crew resource management*. Aldershot, UK: Ashgate.

Johnson, B.L. (2003). *History of women's air racing in America*. A paper delivered to the 41st Aerospace Sciences Meeting, January 6-9, Reno, Nevada.

Karnes, R.E. (2009). A change in business ethics: the impact on employer-employee relations. *Journal of Business Ethics*, 87, 189-197. DOI: 10.1007/s10551-008-9878-x

Kelty, R., Kleykamp, M., Segal, D.R. (2010). The military and the transition to adulthood. *The Future of Children*, 20 (1), 181-207.

Khounsary, A. (1999). Driving or flying? *Newton Ask a Scientist, Argonne National Laboratory, Department of Energy, Office of Science*. Accessed 3/20/2012, http://www.newton.dep.anl.gov/askasci/gen99/gen99845.htm .

Kjeldsen, A.M. (2010). *A qualitative study of sector and occupational differences in public service motivation: the importance of a multidimensional perspective*. A paper delivered before the Fourteenth Annual Conference of the International Research Society for Public Management, April 7-9, 2010, Berne, Switzerland.

Krahe, B. & Fenske, I. (2002). Predicting aggressive driving behavior: The role of macho personality, age, and power of car. *Aggressive Behavior*, Vol. 28, p. 21-29.

Lester, L.F. & Bombaci, D.H. (1984). The relationship between personality and irrational judgment in civil pilots. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 26 (5), 565-572. doi: 10.1177/001872088402600508

Ludwig, G. (2008). What is it with all these medical helicopter crashes? Is every medical flight necessary to save a patient's life? *Firehouse*, December 2008, p. 44.

Madhavan, P. and Lacson, F. C. (2006). Psychological factors affecting pilots' decisions to navigate in deteriorating weather. *North American Journal of Psychology*, 8 (1), 47-62.

March, J.G., & Sutton, R.I. (1997). Organizational performance as a dependent variable. *Organization Science*, 8 (6), 698-706.

McCarney, R., Warner, J., Iliffe, S., van Haselen, R., Griffin, M., & Fisher, P. (2007). The Hawthorne Effect: a randomised, controlled trial. *BMC Medical Research Methodology*, *7*30-8. doi:10.1186/1471-2288-7-30

McDaniel, M.A., Morgeson, F.P., Finnegan, E.B, Campion, M.A., & Braverman, E.P. (2001). Use of situational judgment tests to predict job performance: A clarification of the literature. *Journal of Applied Psychology*, 86 (4), 730-740.

Mitchell, J., & Bray, G. (1990). *Emergency services stress: Guidelines for preserving the health and careers of emergency services personnel*. Englewood Cliffs, New Jersey: Prentice Hall.

Mosher, D.L. (1991). Macho men, machismo, and sexuality. *Annual Review of Sex Research*, Vol. 2, p. 199-247.

Mosher, D.L. & Sirkin, M. (1984). Measuring a macho personality constellation. Journal of Research in Personality, 18 (2), 150-163.

Mosher, D.L. & Tomkins, S.S. (1988). Scripting the macho man: Hypermasculine socialization and enculturation. *The Journal of Sex Research*, 25 (1), p. 60-84.

Murray, S.R. (1999). Face: Fear of loss of face and the five hazardous attitudes concept. *The International Journal of Aviation Psychology*, 9 (4), 403-411.

National Association of State EMS Officials. (2009). *Position statement of the National Association of State Emergency Medical Services Officials in support of HR 978, "Helicopter Medical Services Patient Safety, Protection, and Coordination Act*.

National Safety Council (2008). The odds of dying. *Injury and Death Statistics*. Accessed 3/21/2012, http://www.nsc.org/news_resources/injury_and_death_statistics/Pages/TheOddsofDyingFrom.aspx .

National Transportation Safety Board (January 25, 2006). *Aviation Special Investigation Report: Special Investigation Report on Emergency Medical Services Operations*. National Transportation Safety Board, Washington, DC.

National Transportation Safety Board (February 3-6, 2009). Public Hearing: Helicopter Emergency Medical Services. National Transportation Safety Board, Washington, DC.

National Transportation Safety Board (September 1, 2009). *Public Meeting September 1, 2009: Four Safety Recommendation Letters Concerning Helicopter Emergency Medical Services.* National Transportation Safety Board, Washington, DC.

National Transportation Safety Board (September 24, 2009). *Safety Recommendation*. National Transportation Safety Board, Washington, DC.

Osborn, K (April 25, 2011). Aviation Reset Key to Retaining High Ops Tempo. *Army News Service*. Accessed April 30, 2011, http://www.army.mil/-news/2011/04/25/55476-aviation-reset-key-to-sustaining-high-ops-tempo/

Pangia, M.J. (1981). Handling FAA enforcement proceedings: A view from the inside. *Journal of Air Law and Commerce*, 46, p. 573-613.

Paullin, C., Katz, L., Bruskiewicz, K.T, Houston, J., & Damos, D. (2006). Review of Aviator Selection. *Technical Report 1183: United States Army Research Institute for Behavioral and Social Sciences*, Washington,D.C.

Pell, G. (2005). Use and misuse of Likert scales. *Medical Education*, 39, 970.

*Personality* (2009). In Merriam-Webster Collegiate Dictionary, 11 ed. Kindle Edition.

Peterson, B.E. & Zubriggen, E.L. (2010). Gender, sexuality, and the authoritarian personality. *Journal of Personality*, 78 (6), 1801-1826.

PHI (2010). PHI Air Medical Group: *Refusal of Flight by Medical Personnel*. Policy No. 1-8 F. Policy and Procedure Manual.

PHI (2011). *Petroleum Helicopters, Inc Air Medical Pilot Minimum Hiring Requirements*. Accessed October 15, 2011. http://www.phihelico.com/ employment

Phillips, J.J. (1996). *Accountability in human resource management*. Houston: Gulf.

Porter, S.R. (2011). Do college student surveys have any validity? *The Review of Higher Education*, 35 (1), 45-76.

Rainey, H.G. & Steinbauer, P. (1999). Galloping elephants: developing elements of a theory of effective government organizations. *Journal of Public Administration Research and Theory*, 9 (1), 1-32.

Raitasalo, K. (2003). Interpretations of survey questions on one's partner's alcohol consumption. *Contemporary Drug Problems*, 30 (3), 701-723.

Reason, J. (2008). *The human contribution: Unsafe acts, accidents and heroic recoveries*. Burlington, VT: Ashgate.

Regan, Jr. T.F. (1999). In 1908 Army aeronautical expert Lieutenant Thomas Selfridge became the first victim of powered flight. *Aviation History*, 9 (5), 14 - 16.

Reich, R.B. (2002). *I'll Be Short: Essentials for a Decent Working Society*. Boston: Beacon Press

Retzlaff, P. D. and Gibertini, M. (1987). Air Force pilot personality: Hard data on the "Right Stuff." *Multivariate Behavioral Research*, 22(October), 383-399.

Schneider, P., Hanges, D., Smith, B., & Salvaggio, A. N. (2003). Which comes first: employee attitudes or organizational financial and market performance? *Journal of Applied Psychology*. 88 (5), 836-851.

Sebrant, U. (1999). Being female in a health care industry hierarchy: On the social construction of gender and leader identity in a work organization having a predominance of women. *Scandinavian Journal of Caring Sciences*, 13 (3), p. 153-158.

Senders, J.W. and Moray, N.P. (1991). *Human error: Cause, prediction and reduction*. Hillsdale, NJ: Earlbaum.

Shappell, S.A., & Wiegmann, D.A. (2000). *The Human Factors Analysis and Classification System – HFACS*. Office of Aviation Medicine: Washington, D.C., DOT/FAA/AM-00/7.

Spartacus Educational (2000). *Louis Charles Letur*. Accessed 3/20/2012. http://www.spartacus.schoolnet.co.uk/AVletur.htm .

Stat Trek (2012). *Bias in survey sampling*. Retrieved 4/28/2012 from: http://stattrek.com/survey-research/survey-bias.aspx

Tomkins, S.S. (1987). Script theory. In: *The Emergence of Personality* (p. 147-216), New York: Springer Publishing.

United States Army Combat Rediness/Safety Center (30 April 2011). *U.S. Army Accident Indormation: Aviation Accident Statistics, Fiscal Year End Data*. Department of the Army, Washington, D.C.

United States Census Bureau (2010). *2010 American Community Survey*. Accessed 11/29/2011. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk .

Vail, G.J. (1988). *A gender profile: U.S. general aviation pilot-error accidents 1982-1985*. A paper delivered before the 32nd Annual Meeting of the Human Factors Society, October 24-28, Anaheim, California.

Vermeulen, L.P. & Mitchell, J.I. (2007). Development and validation of a measure to assess perceptions regarding gender related pilot behavior. *International Journal of Aviation Psychology*, 17 (2), 197-218.

Wichman, H., & Ball, J. (1983). Locus of control, self-serving biases, and attitudes towards safety in general aviation pilots. *Aviation, Space, and Environmental Medicine. 54*, 507- 510.

Weitman, M. (1962). More than one kind of authoritarian. *Journal of Personality*, 30 (2), 193-208.

Westrum, R. (2000). *Blood safety transcripts: Department of Health and Human Services Advisory Committee on Blood Safety and Supply*. Eleventh Meeting: April 25, 2000, Washington, DC.

Wetmore, M. & Lu C. (2006). The effects of hazardous attitudes on crew resource management skills. *International Journal of Applied Aviation Studies*. 6 (1), 165-182.

Wilder, J.D. (2011). Private conversation with J.D. Wilder, Lead Pilot, PHI Air Medical in Phoenix, Arizona on November 10, 2011.

Wilkening, H.E. (1973). *The psychology almanac*. Monterey, CA: Brooks/Cole.

Will Rogers (2011). Columbia Electronic Encyclopedia, 6th Ed. Accessed 3/23/2012. http://web.ebscohost.com.ezproxy.library.und.edu/ehost/detail?vid=5&hid=112&sid=87675fca-a5c8-46f6-9572-0919f7d6552d%40sessionmgr13&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#db=aph&AN=39028937 .

Wright, B. E. (2007). Public service and motivation: does mission matter? Public Administration Review, 67 (1), 54-64.

Wright, D. (2004). Air Medical Service, An Industry Under Scrutiny. *Rotor*,Winter 2004-2005, pp. 6-9.

Zabecki, D. (2009). The Father of Dustoff. *Military History*, April/May, 26 (1), p. 21.

Zuccaro, M. (2009). *Docket Number SA-530, Exhibit Number 3-D: Testimony before the National Transportation Safety Board*. Helicopter Association International Presentation on Industry Safety Initiatives, February 3-6, 2009, Washington, DC.