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Fatal Aviation Accidents: Fiscal Years 2009-2013

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Final Report

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16. Abstract Introduction. This report describes the FAA's Autopsy Program Team's efforts to support accident investigation and research conducted within the Civil Aerospace Medical Institute, including descriptive characteristics for fatal aviation accidents and incidents investigated by the Federal Aviation Administration and the National Transportation Safety Board for fiscal years 2009 through 2013. Methods. Autopsy data utilizing the Medical Analysis Tracking Registry database was ordered into the following categories: date of autopsy acquisition, date of accident, region and state of residence, accident type, age, gender, pilot flight hours, aircraft type, and governing operation. Incidental medical findings described in the autopsy reports were classified according to the International Classification of Diseases, Tenth Edition – Clinical Modification (ICD-10-CM) and International Classification of Disease, Procedure Coding System. Results. The Team reviewed 1,330 fatal accidents/incidents from fiscal years 2009 through 2013 and assisted with requests. Additionally, the Team obtained over 95% of autopsy reports for individuals involved in fatal aviation accidents, averaging 266 fatal accidents/incidents per year. The average age of a fatally injured pilot was 55 years, compared to the average age of 45 for the U.S. Civil pilot population. Accidents involving float planes were 2.63% of all fatal accidents. An analysis of 22 Medical Transport fatal accidents revealed 46% occurred during the repositioning phase of the flight. During the time frame of the study, 37 (31.35%) of pilots let their FAA medical certificate lapse in 118 Light Sport aircraft fatal accidents. Summaries of information collected from of fatal accident/incidents are included in the report.					
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PREFACE

This report is an initial five-year program review for the Autopsy Program Team, encompassing fiscal years 2009-2013. A fiscal year is from October 1 through September 30 of the following year. The scope of the program applies to all fatal and high-profile aviation accidents and incidents, beginning October 1, 2008. The content of this report highlights our functions and accomplishments, as well as information about the Autopsy Program.

ACKNOWLEDGMENTS

The Autopsy Program Team acknowledges the work of medical examiners, coroners, and pathologists throughout the United States and Territories. These individuals provide pathological examinations for all fatal aviation accidents. Furthermore, we acknowledge the Federal Aviation Administration (FAA) and National Transportation Safety Board Investigators, FAA Regional Operations Center, as well as the Medical Research Team, and the Management Staff at the Civil Aerospace Medical Institute. We extend our sincere thanks to these individuals because without their contributions this report would not be possible.

The Team gratefully recognizes all the work and insight of Mitchell Selensky, R.N., Supervisory Legal Instrument Examiner, FAA Aerospace Medical Certification Division. His efforts helped to launch the Autopsy Program in 2008 and supported the creation of the autopsy database. We extend special thanks to Nicholas Webster, M.D., for his support and guidance of the Autopsy Program Team. Additionally, we thank CAMI Librarian Roni Anderson, CAMI Research Engineer David Moorcroft, CAMI Health Physicist Kyle Copeland, and FAA Accident Investigator Matt Rigsby for their help and support. We also appreciate the CAMI's i-Zone Team, Rick Butler and Jason Nigh, for graphics creation. Finally, many thanks to Mike Wayda, CAMI Editor, for oversight of this report.

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GLOSSARY BY CATEGORY

General Definitions

Acquisition – The number of autopsy reports requested for pilots or other crewmembers.

Distribution – The number of requests for support from the FAA or NTSB accident investigators.

Fatal Accident - An occurrence to an aircraft or its surroundings in which a person is fatally injured.

Fatal Incident - An occurrence where an occupant of the aircraft or an individual in close proximity dies from injuries or a medical condition unrelated to a crash.

Float Plane – An aircraft that is built with floats or modified to land and takeoff on water.

Incident - An occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operation.

Aerobatics and Airshows

Aerobatic Practice – Practicing aerobatic maneuvers at a location other than an airshow.

Airshow – An aviation event defined as an aerial demonstration by one or more aircraft before an invited assembly of people.

Airshow Practice – The practicing of aerobatic maneuvers at an airshow prior to the event.

Organized Fly-In/Fly-By – A fly-in or fly-by not sanctioned by the FAA.

Federal Aviation Administration Regions

Alaskan (AAL) – Alaska.

Western Pacific (AWP) – California, Nevada, Arizona, and Hawaii.

Northwest Mountain (ANM) – Oregon, Washington, Idaho, Utah, Colorado, Wyoming, and Montana.

Southwest (ASW) – Texas, Oklahoma, New Mexico, Arkansas, and Louisiana.

Central (ACE) – Kansas, Missouri, Iowa, and Nebraska.

Great Lakes (AGL) – South Dakota, North Dakota, Illinois, Minnesota, Michigan, Ohio, Wisconsin, and Indiana.

Southern (ASO) – Kentucky, Tennessee, Mississippi, Georgia, Alabama, Florida, as well as North Carolina and South Carolina.

Eastern (AEA) – Virginia, West Virginia, Maryland, Delaware, Pennsylvania, New York, New Jersey, and Washington, D.C.

New England (ANE) – Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, and Maine.

Light Sport Aircraft

Denied Medical Certificate – Flying in an Aircraft That Meets the Definition of Light Sport With a Pilot Who Met Light Sport Medical: The airman has been denied a valid medical certificate and is usually a passenger when flying with a pilot who has a valid medical certificate.

Denied Medical Certificate – Flying With a Pilot Holding a Current Medical Certificate: The airman has been denied a medical certificate (has medical issues preventing issuance of

the certificate) and is flying with a pilot who has a valid medical certificate. The airman is not actually piloting the aircraft.

No Medical Certificate: Operating an aircraft that meets the definition of Light Sport – requires valid driver's license: This classification meets the definition of the new Light Sport rules (14 CFR § 61.23/53/303). The Light Sport category does not require a medical certificate issued by the FAA, but if an airman has been denied a medical certificate for any class, he or she may not operate an aircraft designated as a Light Sport.

No Medical Certificate – Operating LSA – Requires Valid Driver's License: The airman is legally operating an aircraft that originally met certification as a Light Sport. No valid medical is necessary for this category.

No Medical Certificate – Student Pilot Operating an Aircraft With an Instructor Pilot: This airman may be attending a flight school or may be receiving personal instruction from an instructor pilot.

Out of Date – Flying as a Passenger: The airman allowed the medical certificate expire and is flying as a passenger (no certificate required).

Out of Date – Flying With a Pilot with Current Medical Certificate: The airman has held a valid medical certificate in the past but has allowed the certificate to lapse.

Out of Date – Operating an Aircraft That Meets the Definition of Light Sport: The airman is operating an aircraft that meets the definition of light sport but does not have a valid medical certificate. The certificate has expired, and the airman has chosen not to reapply for a new medical certificate.

Out of Date – Operating a LSA: The medical certificate is out of date (airman has chosen not to reapply) and is operating an aircraft that originally met certification requirements as a Light Sport aircraft.

Out of Date – Operating an Ultralight: The medical certificate is out of date (expired), and the airman is operating an aircraft that qualifies as an Ultralight.

Medical Transport

Angel Flight – A flight that provides free transportation for medical treatment or care.

Doctors Without Borders – A flight that is associated with the non-profit organization to provide medical aid.

Other – Medical Transports that do not meet the definition of repositioning or a flight with a patient on board.

Organ Transport – A flight that has medical personnel on board for the procurement of organs for transplantation.

Patient on Board - A medical transport flight with a medical crew and patient on board.

Post Maintenance – A test flight without the medical crew that is for a post- maintenance inspection.

Repositioning – A flight with the medical crew that is changing positions but does not have a patient on board.

FATAL AVIATION ACCIDENTS: FISCAL YEARS 2009-2013

1.0 BACKGROUND AND HISTORY

The purpose of this report is to summarize statistics and trends in fatal aviation accidents and incidents.

In 2008, the Federal Aviation Administration's (FAA's) Federal Air Surgeon directed that the Autopsy Program be relocated to Oklahoma City, Oklahoma, to centralize the coordination and acquisition of autopsy records for all U.S.-registered civil aircraft accidents involving pilot fatalities. Prior to 2008, this task was performed separately in each of the nine FAA Regions within the United States. Centralization of the program allowed for the medical components of aviation accident investigation to be consolidated at the Civil Aerospace Medical Institute (CAMI). The Autopsy Program Team is currently established within the Office of Aerospace Medicine's Aeromedical Research Division, Bioaeronautical Sciences Research Lab.

The Autopsy Program Team's primary functions are:

- To obtain the final autopsy reports for airmen involved in fatal aviation accidents.
- Assist more than 980 investigators coordinate autopsy services, which includes dissemination of the FAA toxicology box to about 580 medical examiners/coroners.
- Obtain demographic information regarding individuals involved in fatal aviation accidents and incidents.
- Support research activities within the realm of aviation safety.

The Team coordinates data dissemination among FAA and National Transportation Safety Board (NTSB) accident investigators and records findings into a database and requests the final autopsy report. The team utilizes a multi-faceted database called the Medical Analysis Tracking Registry (MANTRA). MANTRA serves the operational function of tracking, trending, and distributing autopsy reports. See appendix A for a flow chart describing the process for determining case eligibility for inclusion into the MANTRA system. Additionally, it supports accident investigation by providing information to FAA/NTSB investigators to aid in determining the probable cause of the accident/incident. The collected data are available for research within the FAA. Autopsy reports are not released to the public by the Autopsy Team. Requests for autopsy or death investigation reports are referred to the Custodian of Records at the medical examiner's or coroner's office.

After receipt of the final autopsy report, a summary of the autopsy and/or the report is distributed to the FAA/NTSB investigators as well as the Medical Case Review Officer. This is an important aspect to accident investigation, since this information provides valuable clues to the medical state of the airman prior to or at the time of the accident.

In 2014, there were 202,865 general aviation aircraft in operation, with an expected growth of an average of 0.5% a year, reaching 225,700 aircraft by 2034. Regional carriers have flown 834.1 billion passenger miles, and this is expected to increase to 1.47 trillion passenger miles by 2034 (FAA, 2014). The ability to catalogue and classify different factors in fatal aviation accidents only serves to make these events understandable, as well as make the industry safer.

2.0 METHODS

The Autopsy Program Team collects information about individuals involved in fatal aviation accidents/incidents. A fatal aviation accident or incident is defined by the International Civil Aviation Organization (ICAO) as an occurrence to an aircraft or its surroundings in which a person is fatally injured (ICAO, 2006). Additionally, ICAO defines an *aircraft accident* as

An occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time as it comes to rest at the end of the flight and the primary propulsion system is shut down, in which: (a) a person is fatally or seriously injured; (b) the aircraft sustains damage or structural failure, or (c) the aircraft is missing or is completely inaccessible.

ICAO also defines an *incident* as "an occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation."

The Autopsy Team defines a *fatal incident* as an occurrence where an occupant of the aircraft or an individual in close proximity dies from injuries or a medical condition unrelated to a crash. An example of a fatal incident could be a crewmember who has a fatal heart attack in flight, but the flight is able to land safely.

Contents of the MANTRA database were reviewed for fiscal years 2009 through 2013. The information was classified and categorized by Autopsy Acquisition Date, Autopsy Performed, Date of Accident, FAA Region of Residence, Mid-Air Accident, Age of Pilot, Gender, Flight Hours at last FAA Physical Form 8500-8, Airman Home State, Float Plane, Medical Transport, Airshow Event, Light Sport Medical Certificate Review, and 14 CFR Part 137 Agriculture. Descriptive statistics are presented for each of these categories. Incidental medical findings described in the autopsy reports were classified according to the International Classification of Diseases, 10th Edition – Clinical Modification (ICD-10-CM) and International Classification of Disease, Procedure Coding System.

2.1 Aviation Operations Classified by Federal Aviation Regulations

Fatal aviation accident data have been classified in MANTRA according to the Code of Federal Regulations (CFR) that governs aviation operations in the United States. These regulations are categorized into Federal Aviation Regulations (FAR) as follows:

- 14 CFR §125 Aircraft operating with 20+ passengers and weighing more than 6,000 pounds
- Part 121 Domestic, Flag, and Supplemental Operations
- Part 129 Foreign Air Carrier
- Part 133 Rotorcraft External Load
- Part 135 Air Taxi
- Part 137 Agricultural Aircraft
- Part 141 Pilot School
- Part 91 General Aviation

Note: Ultralights operating under 14 CFR§103 or Parachute Operations Part 105 are not a part of the MANTRA dataset unless the aircraft meets the definition of a Light Sport.

3.0 RESULTS

3.1 Autopsy Report - Acquisition and Distribution

For this report, the term *acquisition* is defined as the number of autopsy reports requested for pilots or other crewmembers that may have been in control of the aircraft. The term *distribution* is defined as the number of requests for support from the FAA

or NTSB accident investigators. For the period investigated, the Autopsy Program Team averaged 1,175 requests for autopsy reports or assistance from both FAA and NTSB accident investigators every fiscal year. Annual data are shown in Figure 1.

The United States has a mixed medicolegal system that is comprised of both medical examiners and coroners. Local medical examiners and/or coroners who have jurisdiction over the accident/incident site perform autopsy services on behalf of the NTSB. Although infrequent, the Autopsy Team will, on occasion, receive autopsy reports on passengers and ground crew involved in an aviation accident. Thus, there are sometimes more autopsies than requested.

The NTSB investigator-in-charge has the authority to obtain autopsies and other necessary information pertinent to an accident investigation. Occasionally, an autopsy is not performed for a number of reasons (Figure 2). For example, some autopsies are not performed due to provisions of local law in observing religious beliefs. It is interesting to note that in the five years of data collection, there have been only two cases where autopsies have not been performed due to religious beliefs. Other reasons include unrecovered remains. The Autopsy Program Team does not usually handle autopsy reports for accidents outside the U.S. or its territories unless requested by the NTSB.

Prior to the centralization of the program in 2008, CAMI received around 54% of pilot autopsy reports (Ricaurte & Gallimore, 2006). CAMI now obtains around 95% of autopsy

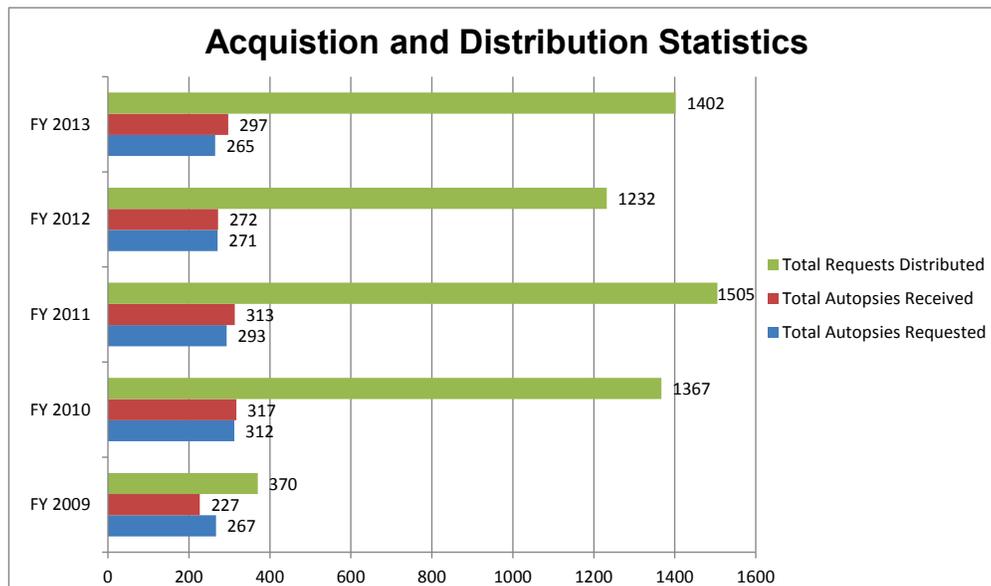


Figure 1. Acquisition and distribution statistics by year

reports involving pilot fatalities. The reasons that an autopsy may not be performed are described in Figure 2.

The average time to receive a completed autopsy report from a Medical Examiner or Coroner is categorized by FAA Region and year in Figure 3. The total average completion time for all Regions is given, stratified by year. OFS is the designation for fatal accidents occurring outside the U.S.

3.2 Abstraction Days

Abstraction of data is the collecting and aggregating of the airman's medical records and other relevant information. This information is collected and stored in the Medical Analysis

Tracking Registry (MANTRA). The collection of data starts immediately after notification of a fatal accident. This information includes logistical data, aircraft details, demographic information about the airman, as well as medical examiner/coroner contact information. Additional medical findings, autopsy results, and toxicology data discovered during the course of the accident investigation are also recorded in MANTRA. MANTRA also utilizes records from the Emergency Operations Network (EON), Safety Performance Analysis System (SPAS), Document Imaging Workflow System (DIWS), NTSB, and Toxicology databases. The MANTRA system did not become operational until 2010, creating a backlog of cases reflected in the year 2009.

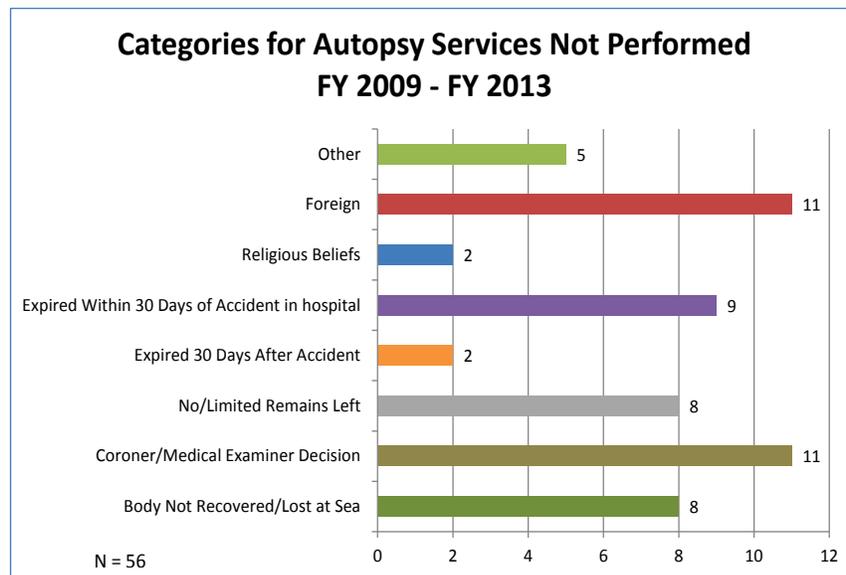


Figure 2. Categories for unperformed autopsies

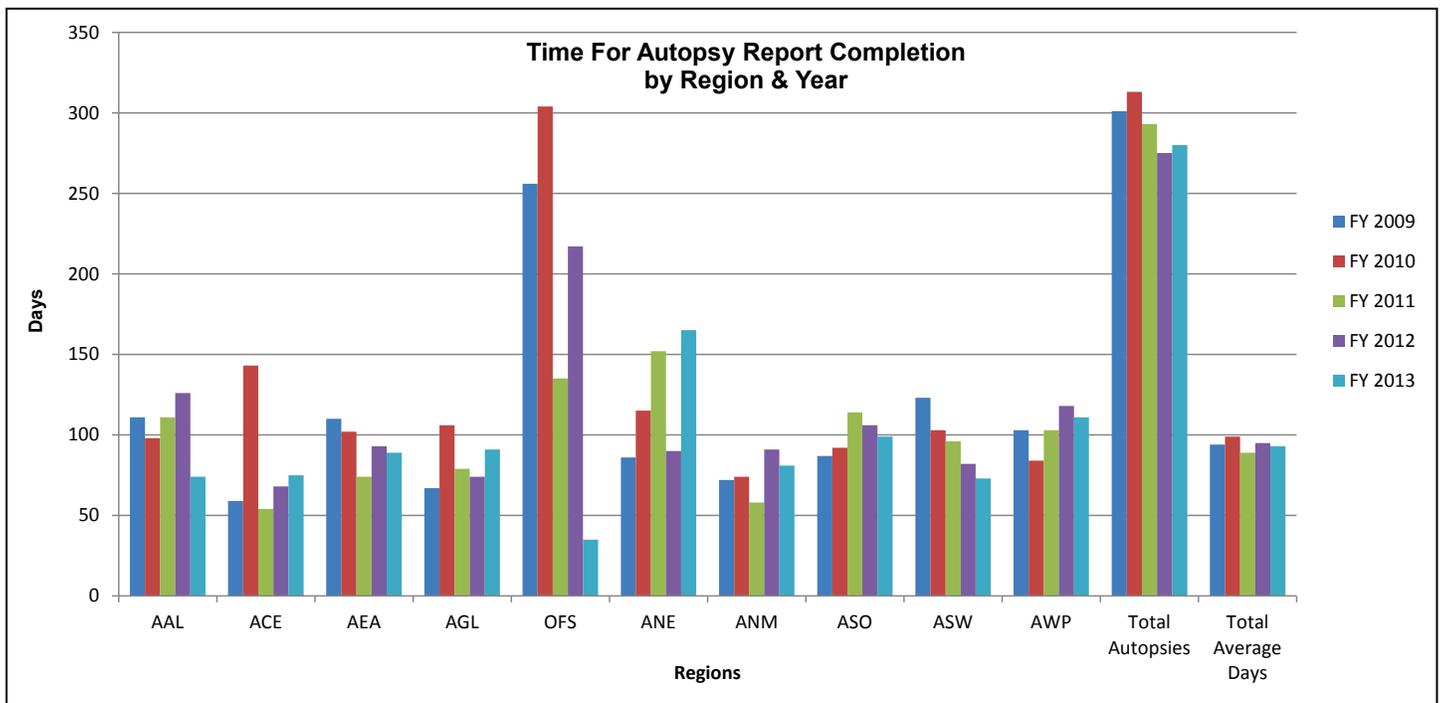


Figure 3. Time in days until autopsy completion, by FAA region

Figure 4 and Table 1 show the delaying effects of the 2009 backlog, as well as the four-week government furlough in 2013.

3.3 Autopsy Medical Findings

Data from autopsy reports are classified and coded according to the International Classification of Diseases, Tenth Edition – Clinical Modification (ICD-10-CM). The top five most frequent incidental medical findings discovered during autopsy are listed in Table 2. These findings are based on a medical review of 965 fatally injured airmen.

Note that there were 401 cases not medically coded in the early part of the program and subsequently excluded in this review. Also, the numbers in Table 2 are not exclusive to any one category. That is, the medical findings at autopsy of a fatally injured airman can contribute to multiple categories. The most common finding was atherosclerotic heart disease of the native coronary artery.

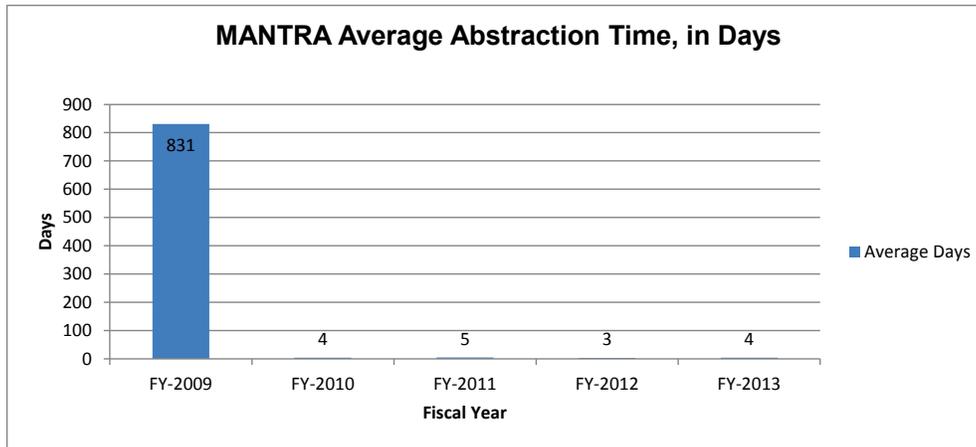


Figure 4. Case abstraction time in days

Table 1. Average number of days for abstraction

Fiscal Year	Total Days	Mean	95% Confidence Interval	Std. Dev.	Min.	Max.
2009	290,917.11	831.19	(794.14, 868.24)	353.62	56.48	1,810.38
2010	1,680.78	4.39	(2.62, 6.16)	17.72	0	96.60
2011	1,709.93	4.77	(3.40, 6.15)	13.26	0	41.55
2012	1,159.63	3.44	(3.42, 3.45)	0.13	0	74.48
2013	1,358.09	4.07	(3.19, 4.93)	8.11	0	79.36

Table 2. Incidental medical findings discovered during autopsy

Number	Autopsy Finding	ICD-10-CM Code
341	Atherosclerotic heart disease of native coronary artery	I 25.1
146	Cardiomegaly	I 51.7
104	Atherosclerosis of aorta	I 70.0
48	Fatty (change of) liver, not elsewhere classified	K 76.0
43	Hypertensive chronic kidney disease with stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease	I 12.9

3.4 Fatal Accidents by Fiscal Year and Quarter

As previously stated, the government fiscal year begins on October 1, ends September 31 and is comprised of four quarters. 1st Quarter: October 1 – December 31, 2nd Quarter: January 1 – March 31, 3rd Quarter: April 1 – June 30, and 4th Quarter: July 1 – September 30. Figures 5 and 6 reveal that the summer months of July, August, and September (4th Quarter) occurred during the greatest number of fatal accidents/incidents. In contrast, the winter months of January, February, and March (2nd Quarter) had the lowest number. Table 3 categorizes the numbers of fatal accidents by FAA Region. FAA Regions are further explained in the glossary. Together, Figures 5, 6, and 7 give different visuals of the distribution of fatal accidents by region, year, and quarter.

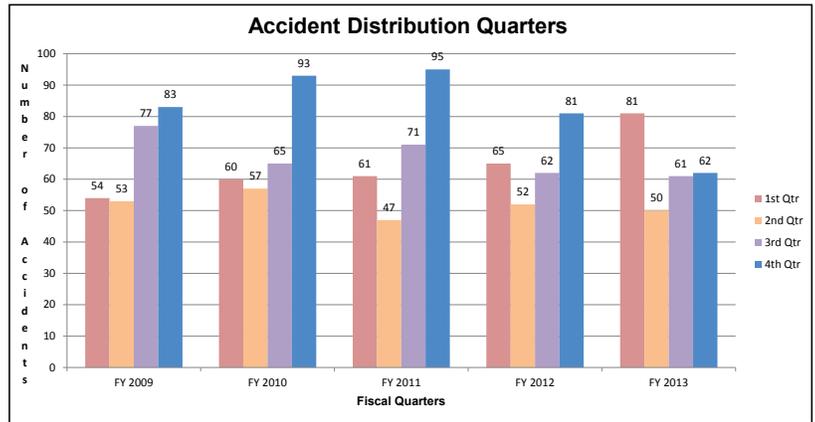


Figure 6. Number of fatal accidents by year and quarter

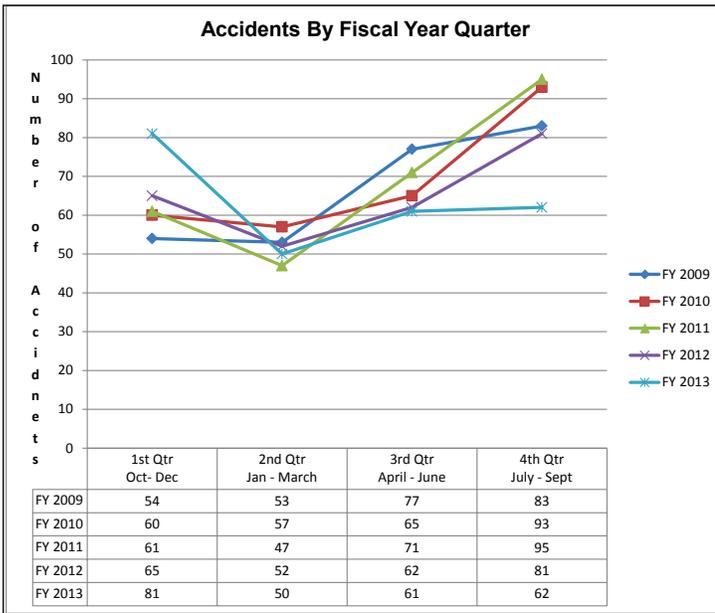


Figure 5. Fatal accidents by quarter and year

Table 3. Number of fatal accidents by region

Region	Accidents
Southern (ASO)	276
Western Pacific (AWP)	217
Northwest Mountain (ANM)	190
Southwest (ASW)	186
Great Lakes (AGL)	170
Eastern (AEA)	111
Central (ACE)	69
Alaska (AAL)	52
New England (ANE)	38
International (OFS) (Not shown)	21

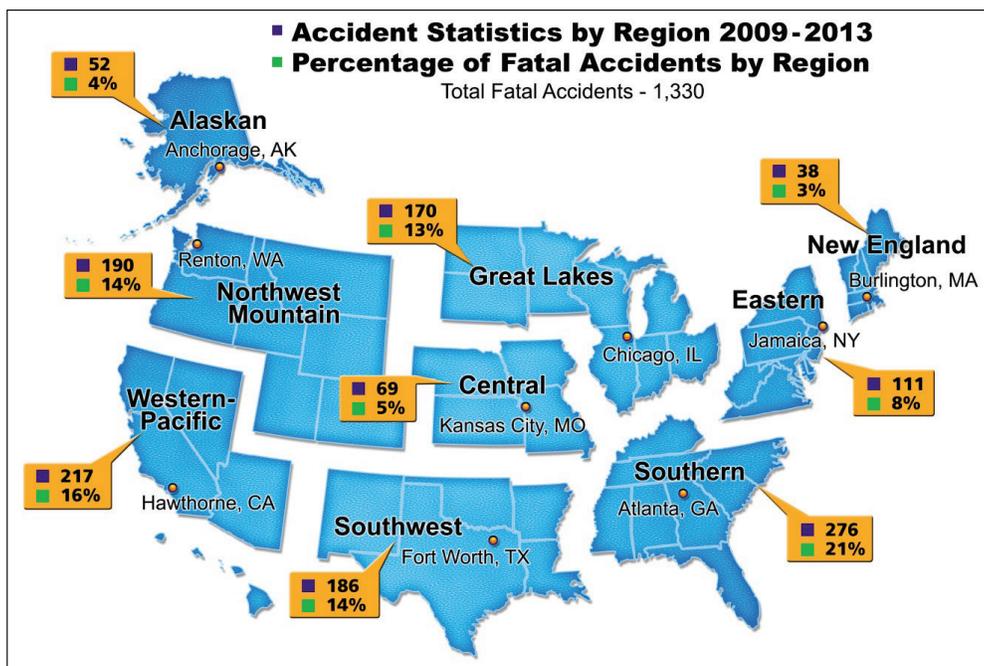


Figure 7. Number of fatal accidents, with percentages by region

3.5 Number of Fatal Accidents by Age Groups

Figure 8 and Table 4 show the total number of pilots involved in a fatal aviation accident by age group. The age groups from 45-54, 55-64, and 65-74 had the highest number of deaths. The average age for a fatal aviation accident pilot is 54.75 years. The average age of the U.S. civil aviation pilot is 44.8 years (FAA, 2013).

3.6 Fatal Aviation Accidents by Gender and Age

During this study period the U.S. civil pilot population consisted of 6.61% females to 93.3% males (FAA, 2013). This distribution helps to explain the difference in fatal aviation accident numbers by gender in Figure 9. Stratifying the age categories in Section 3.6 by gender further reveals that of fatal accidents, 1.6% were females, compared to 98.4% of males.

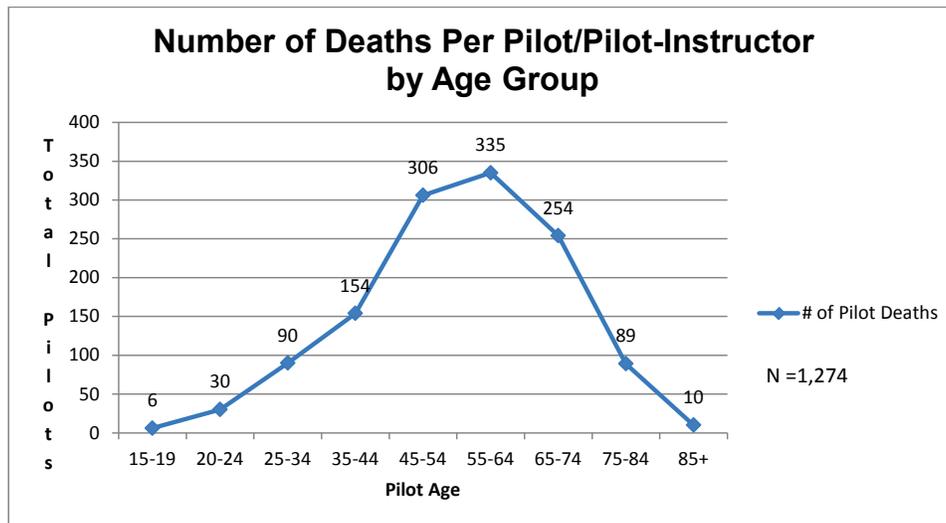


Figure 8. Number of accident pilots and deaths by age group

Table 4. Accidents in airman's home state: the number of accidents in the home state and the regional totals

Region	AAL	AWP	ASW	ACE	AGL	ASO	AEA	ANE	ANM	OFS
(#/Total)	44/52	163/217	122/186	35/96	115/170	174/276	67/111	19/38	105/190	3/21

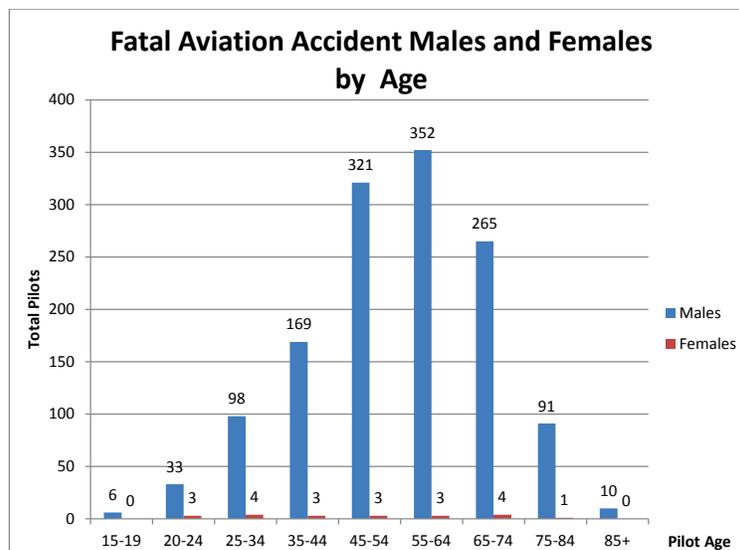


Figure 9. Fatal aviation accidents by age and gender

3.7 Average Self-Reported Flight Hours, by Region

The total self-reported flight hours are obtained from the pilot's last medical application, as reported on Form 8500-8 to the Civil Aerospace Medical Institute. Figure 10 gives the average of these self-reported hours by region. Alaska is different from the lower 48 states in that air taxis are the only way to reach many destinations, which explains the high number of average flight times (Detwiler et al., 2006). Therefore, it is reasonable to assume that this region would have the most self-reported flight hours for airmen involved in a fatal aviation accident. In contrast, the Great Lakes Region had the lowest self-reported number of flight hours by accident airmen.

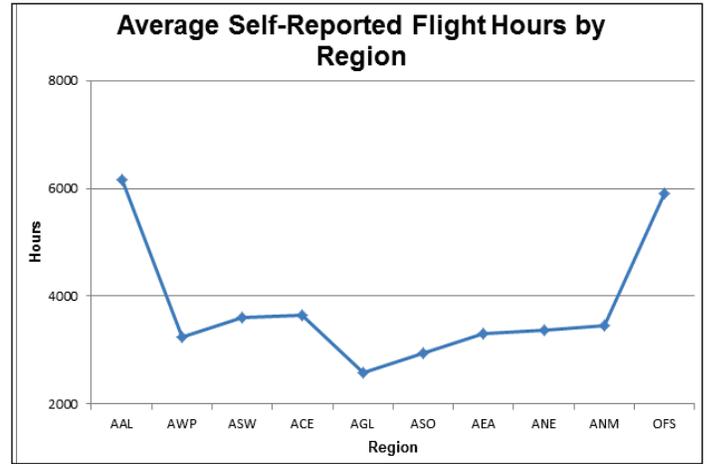


Figure 10. Average self-reported flight hours by region for fatally injured pilots

3.8 Percentage of Accidents in Airman's Home State and Region

We examined the geographical locations of fatal aviation accidents by home state and region as a measure of fatal accident locale. Note that the numbers of fatal accidents by the airman's home state are a subset of the numbers by region. Home state was identified using data from the last medical application of the airman as reported to CAMI. The home state was obtained by collecting the home address reported by airmen on Form 8500-8 and compared to the accident location. Data were examined to determine the number of fatal accidents that occurred only in the airman's home state, as reported at the time of his/her latest medical exam. The results are displayed as a percentage in Figure 11, with the actual values given in Table 4.

This analysis is expanded to also include the airman's home region in Figure 11. The home region corresponds to the group of states according to the FAA's Regional graph (Figure 7). The actual data values are given in Table 5. For example, if an airman's home address is in Texas, then the home region is the Southwest Region (ASW), which includes the states of Texas, New Mexico, Oklahoma, Arkansas, and Louisiana. Note that Alaska (AAL) is both a state and a region.

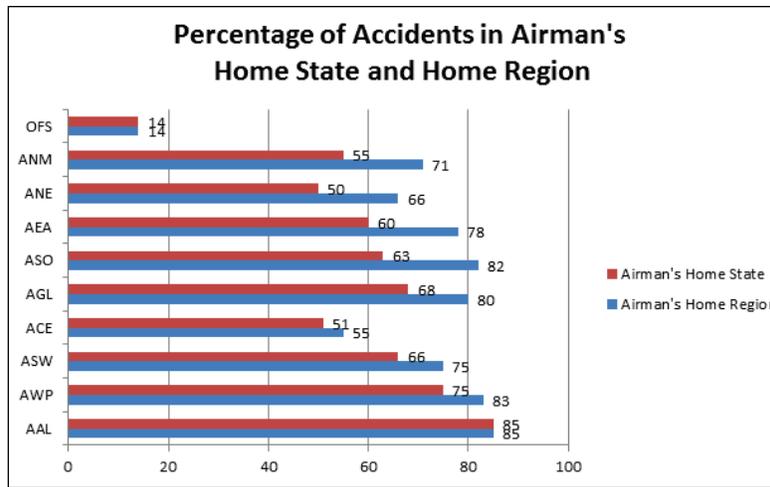


Figure 11. Accidents in airman's home state and region

Table 5. Accidents in airman's home region: Ratios of the number of accidents in the home region to the regional totals

Region	AAL	AWP	ASW	ACE	AGL	ASO	AEA	ANE	ANM	OFS
(#/Total)	44/52	180/217	139/186	38/69	136/170	225/276	87/111	25/38	134/190	3/21

3.9 Float Planes

A *float plane/seaplane* is defined as an aircraft that is originally built with floats or one that has been modified to take off and land on water (FAA, 2004). Many float planes can make landings on both water and a traditional runways. The data revealed that 54% (19 out of 35) of float plane accidents occurred during takeoff or landing on water. Many float plane accidents occurred on water due to failure to retract landing gear.

3.10 Medical Transport

We reviewed the data for any possible trends related to fatal medical transport accidents. Medical transport flights operate under 14 CFR Part 91 (general operating flight rules) or 14 CFR Part 135 (Commuter and on Demand Operations and Rules Governing Persons on Board Such Aircraft). Currently, the NTSB does not classify *Angel Flights*, *Organ Transports*, or *Doctors Without Borders* as Medical Transport flights. For the purposes of this study, we will treat *Angel Flights*, *Organ Transports*, and *Doctors Without Borders* as medical transport flights, since they frequently carry patients. Information and data to support this collection were obtained from the FAA Flight Standards District Office or FAA Office of Accident Investigation and Prevention – investigator-in-charge. Note that the aircraft involved in the medical transport accidents in (Figure 12) consisted of 17 rotorcraft and five fixed wing multi-engine aircraft. Definitions of the terms and categories are provided in the glossary.

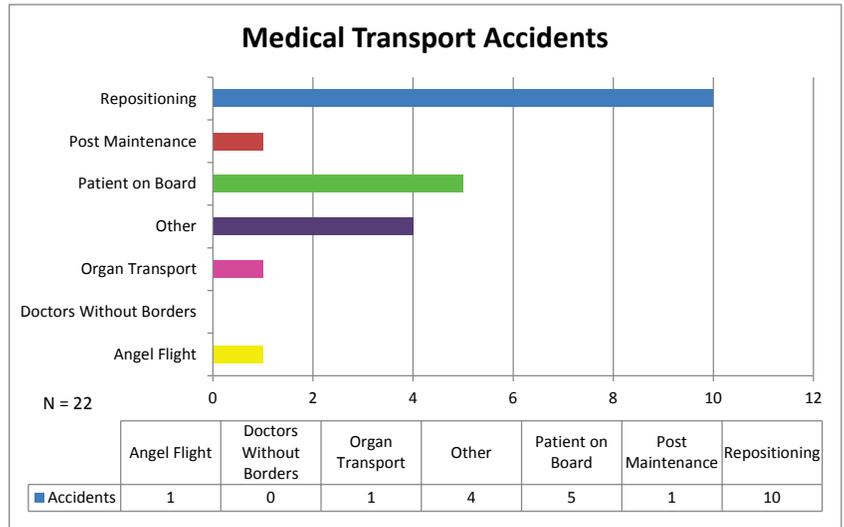


Figure 12. Medical transport accidents

3.11 Aerobatics and Airshows

There were 31 fatal accidents in the 2009 - 2013 time frame involving aerobatic or airshow performance or practice. According to FAA regulations (FAA Order 8900.1), a civil aircraft pilot must show evidence of performing or practicing within the previous 15 days before the actual performance. Figure 13 shows the number of fatal aerobatic and airshow accidents categorized by type of operation. There was a single airshow accident in which the pilot died after surviving for more than 30 days. According to the NTSB, accidents in which any fatality occurs within 30 days after the accident are considered fatal accidents. Technically, in this situation, the pilot survived longer than 30 days, so it was not classified as a fatal accident. An explanation of the terms and labels used in Figure 13 can be found in the glossary.

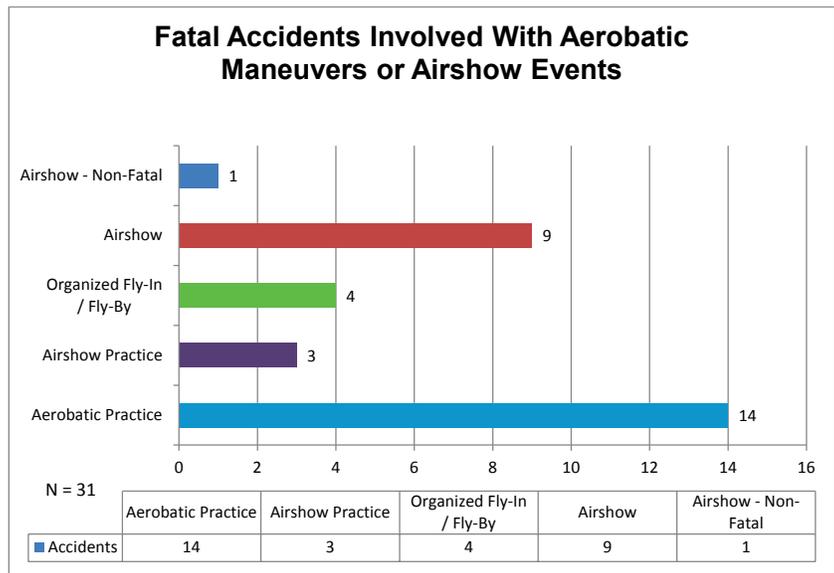


Figure 13. Fatal accidents involving airshows or aerobatics

3.12 Light Sport Aircraft

Within the MANTRA database, Light Sport aircraft (LSA) are classified according to the class and currency of the pilot's medical certificate. This categorization was performed by either the reviewing Medical Officer or by the Autopsy Team. Many pilots flying Light Sport aircraft are exempt from holding a medical certificate. Therefore, fatal accidents involving Light Sport aircraft

consist of aviators with a variety of medical certification levels, ranging from none to that of a first-class medical certificate. An aircraft can be registered as a Light Sport aircraft or simply meet the FAA's definition of the Light Sport classification. For the purposes of this study, aircraft in either one of these categories are classified as Light Sport aircraft. In Figure 14, the Light Sport population is divided into 11 groups that describe the airman's medical certification status. The medical certification status is further explained and described in the glossary.

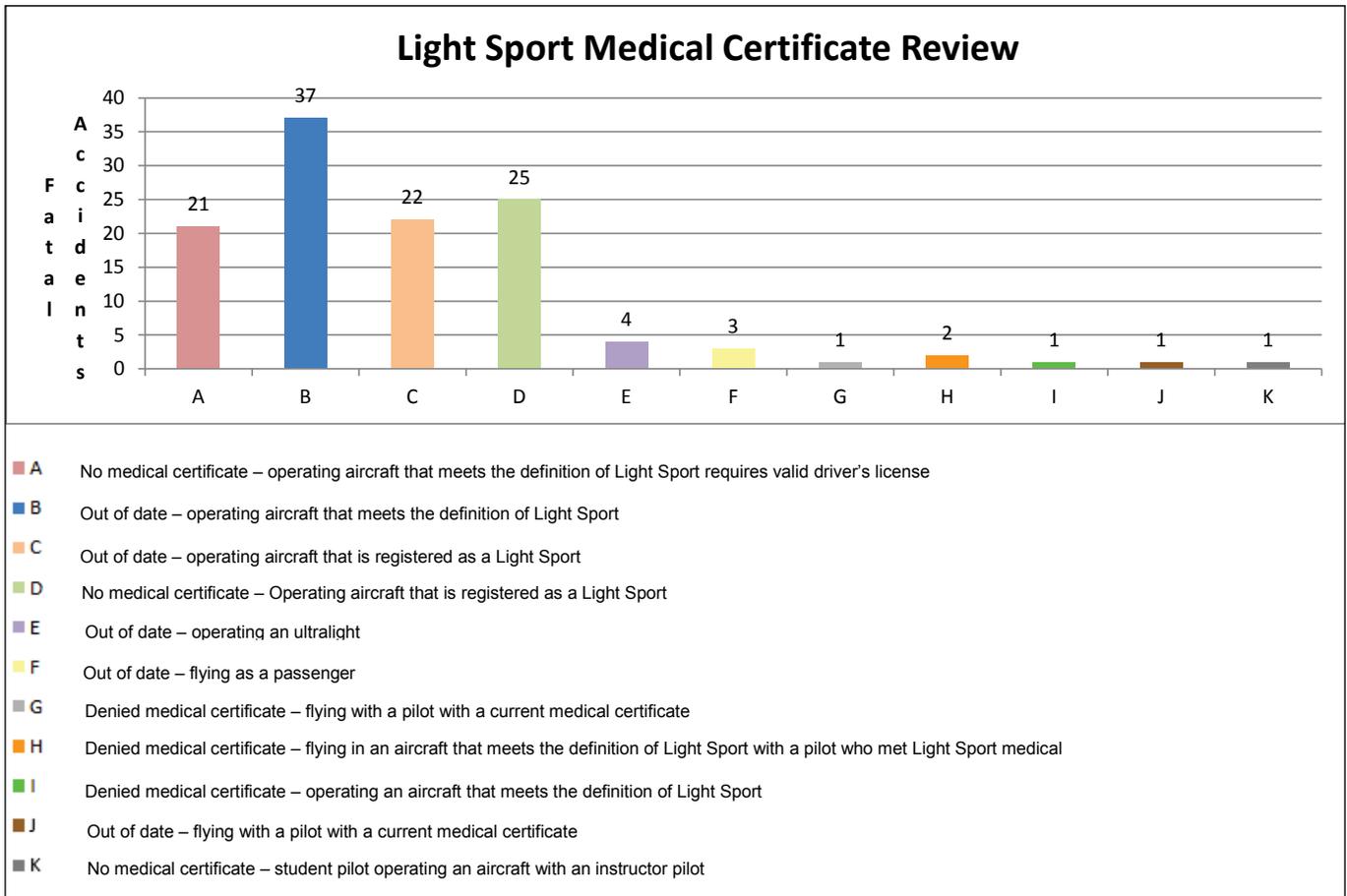


Figure 14. Light Sport fatal accident medical certificate review for reporting period

3.13 Mid-Air Accidents by Region

An aviation accident is classified as a mid-air accident when two or more aircraft collide during flight. The number of mid-air collisions is low, which is reflected in the number of fatal accidents in Figure 15. The values range from 0 to 5 fatal accidents due to mid-air collisions.

3.14 Agricultural Accidents by FAA Region and Airman's Home State

Agricultural operations are conducted under 14 CFR Part 137. Part 137 agricultural operations are a commercial service that has the additional hazards of handling highly concentrated insecticides. Agricultural pilots are required to have special skills and knowledge for handling these chemicals. Part 137 operators,

working commercially, are required to hold at least a second-class medical certificate. Numbers of fatal agricultural accidents were classified by FAA Regions in Figure 16. A total of 25 accidents involved 26 airmen (one accident was a mid-air). The majority of Part 137 agricultural accidents happened in the Central Region.

Figure 16 also displays the fatal Part 137 accidents by the home region of the accident airman, as reported at the time of his/her medical examination on FAA Form 8500-8. Figure 16 revealed that the Southwest Region (ASW) had only two Part 137 accidents. When we classified the accidents by the airman's home region, we see that 10 airmen were from the Southwest Region but had their fatal accident outside of this area. This is due to the migratory and seasonal nature of air agricultural operations.

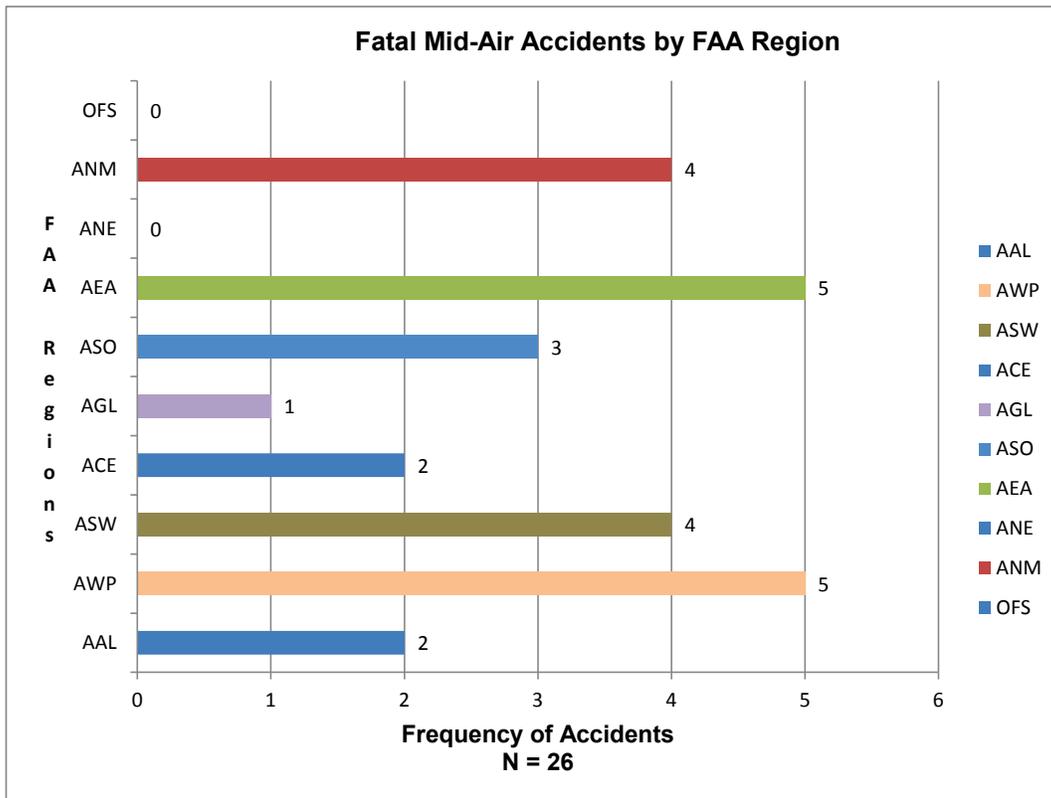


Figure 15. Fatal mid-air accidents by region

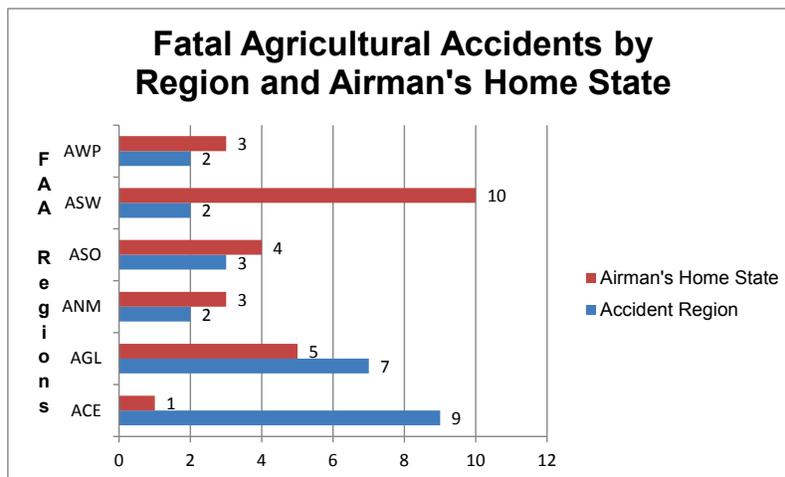


Figure 16. Fatal agricultural accidents by FAA Region and home state of airman

4.0 SUMMARY

4.1 General Accident Statistics

The United States had 1,330 fatal aviation accidents/incidents in fiscal years 2009-2013. Most of the fatal accidents occurred in the fourth quarter (July 1-September 30) of the fiscal year. The data indicated that the FAA Southern Region (Florida, Georgia, Alabama, Mississippi, South Carolina, North Carolina, Tennessee, and Kentucky) sustained the greatest number of fatal accidents and incidents (Figure 7). The New England geographical region had the least number of fatal accidents over this five-year period.

The most common incidental medical finding found on the autopsy reports is atherosclerotic heart disease of the coronary artery (Table 2). Of the 1,274 total pilots, the 55-64 age group had the most deaths (Figure 8.). These two findings are most likely highly correlated.

A gender difference was also observed (Figure 9). The overall U.S. civil pilot population during the reporting period was comprised of 93.3% males and 6.61% females, but the fatal accident population consisted of 98.5% males and 1.5% females.

The greatest self-reported average flight time by Region for fatally injured was 6,000 hours in the Alaskan Region (Figure 10). This is not surprising, as Alaskans depend upon aviation for transport to otherwise inaccessible parts of the state.

The reported statistics by home Region and state are intended to be proximity measures of fatal aircraft accidents. They are intended to explore whether most fatally injured airmen had their accident fairly close or away from their home of record. Alaska is both a state and a Region and had the greatest percentage of fatal accidents, as compared to the other Regions (Figure 11). Alaska is a large state that depends on aviation more so than any other region.

The greatest number of fatal accidents occurred during the summer months of July through September. However, this was not the case in 2013, when the months of October through December had the most fatal accidents.

The average age of a fatally injured pilot was 55 years, compared to the average of 45 for the U.S. civil pilot population. There could be many possibilities for this difference in the age distribution. According to the U.S. Census Bureau, in 2011 (Vornovitsky, Gottschalck, & Smith, N.D), the average median household net worth by age was:

- \$6,676 for age 35 and under
- \$35,000 for age 35-44
- \$84,542 for age 45-54
- \$143,964 for age 55-64
- \$170,516 for age 65 years and over.

It is plausible to consider that individuals in the older age groups may have more disposable income with which to purchase or rent aircraft. Another factor to consider for a spike in fatal

aviation accidents at 45-64 is that perceptual-motor and spatial tasks start to decline after age 40 (Braune & Wickens, 1984). The third factor to consider is that high exposure to flight time is associated with a higher risk of a fatal aviation accident (Booze, 1977). Older pilots, generally speaking, have greater cumulative flight times than younger pilots.

4.2 Float Planes

Float plane pilots had 2.63% of all fatal accidents. There were 35 float plane accidents within the study timeframe with 54% of the accidents occurring during a water takeoff or landing. A common cause of float plane accidents is the airman's failure to retract the landing gear which may explain the slight disparity in accident occurrences on water runways.

4.3 Medical Transport

There were 22 Medical Transport fatal accidents with 46% occurring during a repositioning phase of the flight. Repositioning is defined as a flight with a medical crew, without a patient on board, which is changing its operating location (Figure 12). Repositioning was the most common phase of flight for medical transport accidents. This is similar to a research finding that "slightly more accidents were occurring during the reposition phase" (Boquet, Holcomb, Detwiler, & Hackworth, 2006). Furthermore, Frazer (1999) indicated that the accident crew may have experienced "get home itis" (Frazer, 1999). After long shifts on duty, the focus of these crews was to return to their home or duty station. The aircraft involved in medical transport accidents consisted of 17 rotorcraft and five fixed wing, multi-engine aircraft.

4.4 Aerobatic and Airshow

There were 31 fatal accidents involving aerobatic maneuvers or airshow events. Fourteen (45%) occurred during aerobatic practice, while nine (29%) occurred at an FAA-sanctioned aviation event (Figure 13). De Voogt and Van Doorn (2009) analyzed aerobatic maneuver accidents from 1982-2006 and found that most of them were attributed to stalls, spins, and improper altitudes (De Voogt & Van Doorn, 2009). Additionally, they stated that over the last 25 years, fatal aerobatic accidents have decreased.

4.5 Light Sport

A pilot does not necessarily have to hold a valid medical certificate to fly aircraft in the Light Sport category. Therefore, the Team performed a medical certificate review of Light Sport plane accidents to determine the number of aviators with and without a medical certificate who died in these Light Sport accidents. There were 118 Light Sport aircraft accidents; 37 (31.35%) occurred to pilots with a lapsed FAA medical certificate. There were 25 (21.18%) fatal accidents in aircraft registered as a Light Sport where the pilot utilized a driver's license in lieu of a medical certificate (Figure 14).

4.6 Mid-Air

Twenty-six fatal mid-air accidents occurred within the reporting period, with the Western Pacific and Eastern Regions tied for the most mid-air accidents, having five each (Figure 15). The New England Region did not have any mid-air fatal accidents during the study period. The national average for mid-air accidents during the study period was around 2%. Overall, the number of fatal mid-air accidents was low and considered to be a rare occurrence.

4.7 Agricultural

Part 137 agricultural operations are migratory in nature. Our data confirmed this, finding as roughly 50% of the fatal accidents occurred outside of the airman's home region. Of the 25 fatal accidents involving agricultural operations, 22 aircraft had some form of chemical such as herbicide, fungicide, and/or insecticide on board. It is possible that the hazardous nature of these chemicals may have contributed to impairment or incapacitation of the operator.

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APPENDIX A
Autopsy Program Case Selection Workflow Diagram

