

Aircraft-Assisted Pilot Suicides: Lessons to be Learned

ALPO VUORIO, TANJA LAUKKALA, POOSHAN NAVATHE,
BRUCE BUDOWLE, ANNE EYRE, AND ANTTI SAJANTILA

VUORIO A, LAUKKALA T, NAVATHE P, BUDOWLE B, EYRE A, SAJANTILA A. *Aircraft-assisted pilot suicides: lessons to be learned. Aviat Space Environ Med* 2014; 85:841-6.

Aircraft assisted suicides were studied in the United States, United Kingdom, Germany, and Finland during 1956-2012 by means of literature search and accident case analysis. According to our study the frequency varied slightly between the studies. Overall, the new estimate of aircraft assisted suicides in the United States in a 20-yr period (1993-2012) is 0.33% (95% CI 0.21-0.49) (24/7244). In the detailed accident case analysis, it was found that in five out of the eight cases from the United States, someone knew of prior suicidal ideation before the aircraft assisted fatality. The caveats of standard medico-legal autopsy and accident investigation methods in investigation of suspected aircraft assisted suicides are discussed. It is suggested that a psychological autopsy should be performed in all such cases. Also the social context and possibilities of the prevention of aviation-related suicides were analyzed. In addition, some recent aircraft assisted suicides carried out using commercial aircraft during scheduled services and causing many casualties are discussed.

Keywords: suicide, aircraft, aviation, forensic, fatal, pilot.

THERE HAVE BEEN only a few recent studies on completed suicides in aviation in the United States (4,25,40), Germany (34), and the United Kingdom (8). To reduce pilot-related aviation risks, aviators must fulfill high health requirements, which are evaluated in detail in initial and periodic health care examinations. When established suicide risk factors, such as an earlier suicide attempt, a major depressive episode, and alcohol abuse are observed, aviators' fitness to fly is limited (9,10,39).

A likely reason for the relatively low number of studies related to the use of aircraft as a method for completed suicide is the difficulty in classifying the manner of death (MoD), defined as "the way in which the death was caused," in aviation fatalities. Investigations of sudden and unexpected or suspicious deaths in general, and deaths related to accidents or suicides in particular, belong to the realm of forensic pathologists' and medical examiners' daily work. However, when determining the cause of death (CoD), defined as "an injury or disease that ultimately leads to death," they may have limited external information prior to autopsy and are not always in an optimal position to establish the MoD, i.e., whether the case was suicidal or accidental in nature. Therefore, depending on national CoD investigation and classification systems, it may not be possible to have access to the most accurate data on rare and sensitive incidences. This limitation means that situations, such as aircraft assisted pilot suicides, are even more difficult

to identify. Just as importantly, available official data should be critically assessed.

The most accurate data can be obtained only by combining the information derived from medico-legal autopsies with pilots' lifetime mental and physical health care records, and by assessing risk and protective factors for suicide (14,36). The information used in such investigations may include personal letters, e-mails, notes, and detailed interviews with relatives, close friends, and colleagues. Therefore, psychological autopsy (20,33) should be considered critical in assessing CoD and MoD. This specific method can be used to establish the cause and circumstances of someone's death based on all available information gathered on the deceased from personal documents, police reports, medical and coroner's records, and structured face-to-face interviews with attending health care personnel, families, friends, and others who had contact with the person before death (17,35).

For this article we collected data for general aviation from the United States, the United Kingdom, Germany, and Finland. In particular, scientific literature and accident reports relating to aircraft accidents were analyzed. The United States, United Kingdom, and Germany were selected based on earlier published literature. Finland was selected for this analysis as representing a small aviation country with a relatively high rate of medico-legal autopsies (26) and suicide in the general population (42). We analyzed the proportion of aviation suicides in relation to the total number of fatal aviation accidents in various time series from 1956 to 2012. Additionally, we discuss lessons to be learned for future accident

From Mehiläinen Airport Health Centre, Vantaa and Finnish Institute of Occupational Health, Lappeenranta, Finland; the Centre for Military Medicine, Helsinki, Finland; the Civil Aviation Authority, Canberra, Australia; the Department of Molecular and Medical Genetics, Institute of Applied Genetics, University of North Texas Health Center, Ft. Worth, TX; the Center of Excellence in Genomic Medicine Research, King Abdulaziz University, Jeddah, Saudi Arabia; Trauma Training, Coventry, UK, and the Department of Forensic Medicine, Hjelt Institute, University of Helsinki, Helsinki, Finland.

This manuscript was received for review in March 2014. It was accepted for publication in April 2014.

Address correspondence and reprint requests to: Alpo Vuorio, M.D., Ph.D., Mehiläinen Airport Clinic, Lentäjäntie 1 E, FIN-01530 Vantaa, Finland; alpo.vuorio@gmail.com.

Reprint & Copyright © by the Aerospace Medical Association, Alexandria, VA.

DOI: 10.3357/ASEM.4000.2014

investigations and for the prevention of such cases as well as briefly exploring the social and cultural context of pilot suicides.

METHODS

A PubMed search was performed to identify publications during the period 1990–March 2013. The following search terms were used: “aviation” OR “aviation accident” OR “aircraft accident” AND “suicid*” (which includes suicide, suicidal, suicidality, and other suicide-related terms). This search provided data for the United States for the years 1993–2002, for the United Kingdom for the years 1956–1995, and for Germany for the years 1974–2007.

To identify deaths by suicide caused by aircraft accidents within general aviation operations between the years 2003–2012 in the United States, we used the National Transportation Safety Board (NTSB) database (29) and the interactive search capability for the NTSB database, which allows inputs with suitable preconditions. Those accidents in which suicide was, according to the NTSB, a probable CoD were selected for detailed investigation. To identify aircraft fatalities caused by suicides within general aviation operations between the years 2003–2012 in Finland, statistics available from the Finnish Safety Investigation Authority were used (12). The data were compared for statistical differences using Fisher’s exact test.

RESULTS

The PubMed search review revealed 57 articles with the keywords “aviation” OR “aviation accident” OR “aircraft accident” AND “suicid*.” These were further analyzed to pick data on the pilot suicides. Finally, the data for the United States (25), United Kingdom (8), and Germany (34), and a negative search from the Finnish database (12) were included in this study.

The NTSB aviation accident database and the interactive search capability for the NTSB database revealed 13 potential accident cases in the United States during 2003–2012, and they were further analyzed so that only those in which an aircraft was used as a possible or certain method of suicide (for instance intentional flight into terrain) were included. Finally, 8 cases from 3596 aircraft accidents were accepted into our study. In only two of those cases health care professionals knew of the victim’s suicidal ideation according to the NTSB investigation. Friends or former friends were aware of suicidal ideation in three more cases. Four of the eight victims were intoxicated with alcohol. Two, possibly three, of the victims had a diagnosed and treated current major depressive episode. Personal, legal, and/or relationship problems were mentioned in four investigations. This information was limitedly available to those who assessed fitness to fly (Table I). Cases included U.S. accidents where the NTSB regarded the probable cause of the aircraft accident to be suicide and we did not evaluate cases where the NTSB regarded the probable cause of the accident to be anything else than suicide, for instance undetermined.

Figures regarding fatal aircraft accidents in the United States show that between the years 1993–2002 aircraft-assisted pilot suicides totaled 0.44% (16 of 3648 fatal accidents) (25), which is somewhat higher compared to that found in aircraft assisted suicides in the United States between 2003 and 2012 from the NTSB search engine, namely 0.22% (8 of 3596 fatal accidents). Overall, the new estimate of aircraft assisted suicides in the United States in a 20-yr period (1993–2012) is 0.33% (95% CI 0.21–0.49) (24/7244). In Europe, the longest period of data collection comes from the United Kingdom, where during a 30-yr period (1956–1995), aircraft-assisted pilot suicide frequency was 0.3% (3 of 1000 fatalities) (8). On the other hand, the largest single data source in our study is from Germany, where during 1974–2007 the figure was 0.29% (34). In Finland, between the years 2003 and 2012, none of the 19 fatal accidents was classified as suicidal.

DISCUSSION

Frequency and Occurrence of Aircraft Assisted Suicides

The data collected and analyzed in this study of recent aviation fatalities show that aircraft assisted suicide was identified and discovered in about 0.33% (24 of 7244) of fatal accidents collected from the United States. The figure is likely an underestimation and thus represents a minimum frequency of aircraft assisted pilot suicides, since investigation of aircraft accidents is technically demanding, time and man-power consuming, and often difficult to assess with regard to suicide attempts. A particular aspect in the investigation is the determination of the MoD, particularly in the sensitive case of suspected pilot suicide and the possible consequences. The results from this study suggest a slightly decreasing trend in the United States for pilot suicides by use of aircraft (Table II). However, besides the small total number of fatalities, our data series were not designed to study the trends and there was no statistical support for the differences between the two study sets from the United States. Thus it would be premature to make definite conclusions about the trends in aircraft assisted pilot suicides in the United States.

Suicide may occur without previous warning and studies show that only 22% of individuals committing suicide communicate their intention during their last appointment with health personnel (19). It is, therefore, noteworthy that information derived from the NTSB database suggests that in five out of the eight (63%) completed suicides in our series from the United States during 2003–2012, someone knew of a victim’s suicidal ideation (Table I). Thus, it is important that indications and warnings for suicides be taken seriously, so that effective interventions can be implemented. It has been found that among U.S. Air Force military pilots who attempted suicide, a majority (79%) actually returned to flying duties following aeromedical assessment in which the underlying psychiatric diagnosis was carefully considered (30). Similarly, The Civil Aviation Safety Authority (Australia) do not consider suicide attempts

TABLE I. MOST COMMON ETIOLOGY OF AIRCRAFT ASSISTED SUICIDAL ACCIDENTS IN GENERAL AVIATION OPERATIONS IN THE UNITED STATES BETWEEN 2003-2012.

DoA* (MoLME) [†]	Pilot's Age (years)	Forensic Toxicology	Current Major Depressive Episode	Other Remarks	Description of Intentional Suicide
25/2/2003 (03/2002)	26	None	No	None	Intentional flight into trees/ground
21/7/2003 (04/2003)	45	Ethanol, AD [‡] , AH [§]	Yes	Earlier suicide attempt 3 d before accident	Intentional flight into terrain
16/9/2003 (05/2002)	69	Ethanol	Not known	Prior suicidal thoughts	Intentional flight into the ground
6/2/2006	21	Ethanol	Not known	Relationship issues, suicidal thoughts, and note	Unauthorized use of helicopter, flight into terrain
5/3/2007 (11/2006)	47 and Minor child	None	Not known	Legal problems	Dive toward the ground
26/8/2007 (4/2007)	25	Ethanol, use of AD [‡] , and other**	Yes	Relationship issues, suicidal thoughts	Impacted an open field
27/12/2010 (2/2009)	50	Use of AD [‡]	Possible (based on AD use)	None	Impacted rolling terrain
23/9/2012 ^{††} (5/2012)	48	Not analyzed	Not known	Personal problems, suicidal note	Flight into ocean

Based on The National Transportation Safety Board database (cited 20,140,421).

*DoA = date of accident; [†]MoLME = month of last medical examination; [‡]AD = antidepressant (citalopram and fluoxetine); [§]AH = antihistamine (diphenhydramine); [‡]antidepressant (citalopram); **use of different medications used for seizures, movement disorders, and certain mental conditions;

^{††}neither pilot nor wreckage was discovered.

as disqualifying and holistically include that as an indication of the severity of psychiatric illness. The vast majority of pilots with attempted suicides have been able to resume flying once the underlying psychiatric condition was in remission, provided that the condition itself was not an impediment to medical certification.

Notwithstanding cases of terrorism, passenger aircraft have rarely been used as a method of suicide in commercial flying. One possible commercial flight pilot suicide case is that of Silk Air Flight MI 185, which crashed on 19 December 1997; 97 passengers were killed when the captain in this flight made an extremely rapid descent (21). A particular concern arose after the Indonesia's National Transportation Safety Committee investigation had completed their investigation and therefore the American NTSB carried out its own investigation. The NTSB concluded that the accident could be explained by intentional pilot action (21).

The latest possible case in commercial civil aviation was a recent aircraft accident in Mozambique (37). The captain of a LAM Mozambique Airlines jet put the plane into a dangerously steep dive, seemingly on purpose, killing all 33 aboard. This recent accident, which is still

under investigation, adds to the concern of future accidents in commercial civil aviation carried out as aircraft assisted suicide. The future growth in aviation will happen in Asia and Africa and there is a need for accident investigators to understand the social context of suicides in these cultures when preventive measures are planned.

Physical and Psychological Autopsy

In cases of fatal intoxication, gunshot or sharp wound, or falls from heights, the forensic pathologist or medical examiner may be able to reconstruct the circumstances and other details for establishing the CoD or MoD with reasonable certainty. However, in the case of aircraft fatality, the physical damage to the human body is often so extensive that is impossible to deduce the relevant information for establishing the MoD (e.g., suicide or accident) merely from the autopsy findings. Moreover, when the aircraft is used as a means of inflicting the trauma (crashing the aircraft), even should the damage not be that extensive, the only finding would be death by trauma. To achieve a satisfactory assessment of suicide, psychological autopsies must be carried out in addition

TABLE II. FREQUENCY OF AIRCRAFT ASSISTED SUICIDAL ACCIDENTS IN DIFFERENT COUNTRIES.

Country	Years Analyzed	%, (No. of Suicides/Total No. of Fatal Accidents)	Reference
U.S.	1993-2002	0.44 (16/3648) 0.25-0.71*	Lewis et al. (25)
U.S.	2003-2012	0.22 (8/3596) 0.10-0.44*	this study
U.S.	1993-2012	0.33 (24/7244) 0.21-0.49*	this study
UK	1956-1995	0.30 (3/1000) 0.06-0.87*	Cullen et al. (8)
Germany	1974-2007	0.59 (18 [†] /3058 [‡]) 0.35-0.98*	Schwark et al. (34)
Finland	2003-2012	0 (0/19) 0-17.6*	this study

*95% confidence intervals for the frequency estimates.

[†]Number of deceased in suicides.

[‡]Number of deceased in aircraft accidents.

to the physical autopsy. Psychological autopsy is particularly time-consuming and demands multidisciplinary expertise. The International Civil Aviation Organization's Clinical Practice Guidelines Annex 13 (18) suggests that in accident investigations, pilot information relating to a couple of days preceding the accident should be analyzed. If, however, a suicidal act is suspected, this limited time frame is insufficient. Investigators should carry out further interviews with relatives and examine medical records going back several years. More rigorous explorations will enable a proper psychological autopsy to be performed. However, such examinations are not always possible in each case of general aviation accidents because of the limited time and lack of special skills needed to complete psychological autopsies. Therefore, estimates of the real frequency of suicidal acts by aircraft actually are somewhat limited. Regardless of the accuracy of the frequency of airplane suicidal acts, accident investigation methods can be improved to be able to confirm as many as possible of these kinds of cases so that a better understanding of causes can enable institution of preventive methods.

Research in the United Kingdom into the investigation of suicide more generally has highlighted problems with the use of coroners' records for the establishment of suicide (3). While coroners tend to be willing to assist with studies associated with suicide, there is considerable variation among coroners in the extent of information that is included in their records. Some relatively important items often are not recorded, for example contact with psychiatric services, date of last contact with health care, blood levels for drug overdoses, etc. (13). It is suggested that standardization of information recorded by coroners would be valuable for investigations of suicide. More explicit information would impact investigations of aviation-related as well as other circumstances of death in suspected suicides.

Comparison with Suicides in Road Traffic

There is much more information available on the investigation of road traffic fatalities (32). Especially in analysis of car accidents in northern Sweden with special emphasis on collisions with heavy vehicles, it was noticed that verifying a suspected suicide in road accidents is not always possible (5). When examining rare incidents, a lower classification of suicides (number/count) may be assumed than is actually the case. Indeed, thorough analyses of frequency of suicidal cases in fatal traffic accidents have been estimated to be about two times higher than those in the official records (44). The actual frequency of suicidal cases has usually been estimated to be about 2–4% of all fatal road traffic accidents (5,32,43), but in one study the frequency was estimated to be 8% (16). Naturally, caution should be exercised to avoid bias with suspicions or assumptions of a suicide, for example, information about previous mental health problems does not in itself constitute suicide. Interestingly, it has been shown that the proportion of suicides in road traffic fatalities in Finland has increased from the 1970s

to 1990s (15). There is no explanation for this phenomenon, but the most common mental state among suicide drivers was depression (15).

Aircraft-Assisted Suicide in Social Contexts

A social scientific approach may contribute to a broader understanding of the phenomenon and incidence of pilot suicide. Understanding the factors that contribute to suicide generally has benefitted by being a multidisciplinary approach of study, including sociology, psychology, medical research, and forensic science. A very good example of a multidisciplinary research program is the Oxford Centre for Suicide Research (38).

Suicidology highlights the role of societal and cultural factors and individual risk factors, such as depression, in relation to the causes of suicide. Such research often is linked to prevention strategies focusing on the promotion of resilience and the enhancement of protective factors such as social support. The role of social and organizational as well as individual factors and circumstances are thus likely to be significant areas to explore in further work reviewing and understanding particular cases of pilot suicide. A unique type of suicide was illustrated as a part of collective acts of aggressions, as witnessed most dramatically in recent times by the terrorist attacks of September 11, 2001. The study of martyrdom (11) offers historical and cultural explanations for the motivation and behavior of those involved in such extreme and collective acts and also highlights that suicidal acts involving planes are not a new phenomenon.

Understanding Individual Pilot Suicide

A number of social and cultural factors might be relevant in the consideration of suicidal acts taken by individual pilots in general aviation. A relevant area for further analysis is an exploration of the interaction between general risk factors for suicide and the organizational and occupational setting. For example, studies reviewing different types of pilots, such as private, commercial, and military pilots, and differing circumstances of individual pilots involved in authorized and unauthorized use of an aircraft may be informative. Research into suicide prevalence among other occupational groups such as doctors and farmers, for example, has highlighted the significance of contributory factors such as availability of method, work patterns, social relationships, and levels of occupational stress (13,27,28).

A body of research highlighting the sources and experiences of high levels of occupational and non-occupational stress among commercial pilots, studies highlighting pilot testimony regarding stress and fatigue (2,6), and the significance of levels of social and spousal support (22,41) offer valuable insight into such potentially contributory factors. Indeed, a recent review by a career website in 2011 and 2012 concluded that work-related conditions make being a commercial airline pilot one of the most stressful jobs in the United States (23).

Prevention of Suicides in Aviation

Within military aviation, the U.S. Air Force has a suicide prevention program which aims to reduce stigma and encourage early help-seeking behavior by changing social norms through education and policy (24). When suicide notes from U.S. Air Force personnel were analyzed, identified risk factors included hopelessness and perceived burdensomeness, while interviews with acquaintances of the deceased revealed that thwarted belongingness was most often communicated verbally before death (7). Selection procedures for military pilots should play a substantial role in determining the preparedness of pilots for the rigorous training and work demands of such careers as well as identifying suicide risk and prevention strategies. Among aviators and the general population, lowering barriers to care has a role in suicide prevention (24,31).

Aviation Fatality Investigations and Forensic Suicidology

Although the consultation of a range of experts is very common in accident investigations, the role played by forensic suicidologists in this context is relatively new and infrequent. In terms of future successful investigations in equivocal cases and improving standards there has been a move in the United States toward credentialing expert witnesses in suicidology. The Accreditation Board of Forensic Suicidology was established by the American Association of Suicidology in December 2008, with a charge to develop minimum professional standards for, and a process to provide, certification as a Forensic Suicidologist. By establishing policies, procedures, and agreed-upon criteria to validate and vet the credentials of those seeking such a professional designation, the American Association of Suicidology is striving to enable the courts and lawyers to better identify expertise in the field of suicidology (1).

Conclusion

Social, cultural, and occupational aspects, individual psychological factors, and contributory and explanatory factors all contribute to suicides. All these factors should be considered in investigations in suicides in general and aviation-related ones in particular. Investigators should have a low threshold for getting specialists involved in a suspicious aviation death. Such investigations will lay sounder foundations for the identification of the most appropriate and effective prevention strategies for addressing stress levels of particular pilot groups for the settings, opportunities, and mitigation that lead to aviation-related suicide.

External data collection and the frequency of medico-legal autopsies vary among different countries, and perhaps even within countries, depending on regional or state/province practices and among individual investigators. Data on pilot suicide, therefore, are variable. Establishing a minimum standard of reporting in investigations will enable better estimates of the frequency of pilot suicide and, with better information, there is the opportunity to develop and support preventative programs.

ACKNOWLEDGMENT

Authors and affiliations: Alpo Vuorio, M.D., Ph.D., Mehiläinen Airport Health Centre, Vantaa and Finnish Institute of Occupational Health, Lappeenranta, Finland; Tanja Laukkala, M.D., Ph.D., Chief Psychiatrist, Centre for Military Medicine, Helsinki, Finland; Pooshan Navathe, M.D., Ph.D., Principal Medical Officer, Civil Aviation Safety Authority, and Associate Professor, Australian National University, Canberra, Australia; Bruce Budowle, Ph.D., Professor, Institute of Applied Genetics, Department of Molecular and Medical Genetics, University of North Texas Health Science Center, Ft Worth, TX, and the Center of Excellence in Genomic Medicine Research (CEGMR), King Abdulaziz University, Jeddah, Saudi Arabia; Anne Eyre, Ph.D., Sociologist, Trauma Training, Coventry, UK; and Antti Sajantila, M.D., Ph.D., Professor, Department of Forensic Medicine, Hjelt Institute, University of Helsinki, Helsinki, Finland, and Institute of Applied Genetics, Department of Molecular and Medical Genetics, University of North Texas Health Science Center, Ft Worth, TX.

REFERENCES

1. American Association of Suicidology. AAS homepage. Retrieved 8 August 2013 from <http://www.suicidology.org/home>.
2. Bennett SA. Flight crew stress and fatigue in low-cost commercial air operations—an appraisal. *Int J Risk Assess Manag* 2003; 4:207–31.
3. Bennewith O, Hawton K, Simkin S, Sutton L, Kapur N, et al. The usefulness of coroners' data on suicides for providing information relevant to prevention. *Suicide Life Threat Behav* 2005; 35:607–14.
4. Bills CB, Crabowski JG, Li G. Suicide by aircraft: a comparative analysis. *Aviat Space Environ Med* 2005; 76:715–9.
5. Björnstig U, Björnstig B, Eriksson A. Passenger car collision fatalities – with special emphasis on collisions with heavy vehicle. *Accid Anal Prev* 2008; 40:158–66.
6. Cooper CL, Sloan S. Occupational and psychosocial stress among commercial aviation pilots. *J Occup Med* 1985; 27:570–6.
7. Cox DW, Ghahramanlou-Holloway M, Greene FN, Bakalar JL, Schendel CL, et al. Suicide in the United States Air Force: risk factors communicated before and at death. *J Affect Disord* 2011; 133:398–405.
8. Cullen SA, Drysdale HC, Mayes RW. Role of medical factors in 1000 fatal accidents: case note study. *BMJ* 1997; 314:1592.
9. European Aviation Safety Agency. Acceptable means of compliance and guidance material to Part-Med. 2011; Retrieved 8 August 2013 from <http://easa.europa.eu/agency-measures/docs/agency-decisions/2011/2011-015-R/AMC%20and%20GM%20on%20the%20medical%20certification%20of%20pilots%20and%20medical%20fitness%20of%20cabin%20crew.pdf>.
10. Federal Aviation Administration. Guide for aviation medical examiners; 2013. Retrieved 8 August 2013 from http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/.
11. Fields R. Martyrdom: the psychology, theology, and politics of self-sacrifice. Westport, CT: Praeger; 2004.
12. Finnish Safety Investigation Authority. 2013; Retrieved 1 September from <http://www.turvallisuustutkinta.fi/Etusivu/Tutkintaselostukset/Ilmailu>.
13. Hawton K, Clements A, Simkin S, Malmberg A. Doctors who kill themselves: a study of the methods used for suicide. *QJM* 2000; 93:351–7.
14. Hawton K, Casañas I, Comabella C, Haw C, Saunders K. Risk factors for suicide in individuals with depression: a systematic review. *J Affect Disord* 2013; 147:17–28.
15. Hernetkoski K, Keskinen E. Self-destruction in Finnish motor traffic accidents in 1974–1992. *Accid Anal Prev* 1998; 30:697–704.
16. Hernetkoski KM, Keskinen EO, Parkkari IK. Driver suicides in Finland – are they different in Northern and Southern Finland? *Int J Circumpolar Health* 2009; 68:249–60.
17. Hjelmeland H, Diederud G, Dyregrov K, Knizek BL, Leenars AA. Psychological autopsy studies as diagnostic tools: are they methodologically flawed? *Death Stud* 2012; 36:605–26.
18. International Civil Aviation Organisation. Aircraft accident and incident investigation, 10th ed., Annex 13 to the Convention on International Civil Aviation. Quebec, Canada: International Civil Aviation Organisation; 2010.
19. Isometsä ET, Heikkinen ME, Marttunen MJ, Henriksson MM, Aro HM, Lönnqvist JK. The last appointment before suicide:

- is suicide intent communicated? *Am J Psychiatry* 1995; 152: 919–22.
20. Isometsä ET. Psychological autopsy studies – a review. *Eur Psychiatry* 2001; 16:379–85.
21. Job M. Final flight: SilkAir. *Flight Safety Australia* 2008; Jan-Feb:18–25.
22. Karlins M, Koh F, McCully L. The spousal factor in pilot stress. *Aviat Space Environ Med* 1989; 60:1112–5.
23. Kensing K. The 10 most stressful jobs of 2013. CareerCast.com, 2013; retrieved 8 August 2013 from <http://www.careerassist.com/jobs-rated/10-most-stressful-jobs-2013>.
24. Knox KL, Pflanz S, Talcott GW, Campise RL, Lavigne JE, et al. The US Air Force Suicide Prevention Program: implications of public health policy. *Am J Public Health* 2010; 100:2457–63.
25. Lewis RJ, Johnson RD, Whinnery JE, Forster EM. Aircraft-assisted pilot suicides in the United States, 1993–2002. *Arch Suicide Res* 2007; 11:149–61.
26. Lunetta P, Lounamaa A, Sihvonen S. Surveillance of injury-related deaths: medicolegal autopsy rates and trends in Finland. *Inj Prev* 2007; 13:282–4.
27. Malmberg A, Hawton K, Simkin S. A study of suicide in farmers in England and Wales. *J Psychosom Res* 1997; 43:107–11.
28. Malmberg A, Simkin S, Hawton K. Suicide in farmers. *Br J Psychiatry* 1999; 175:103–5.
29. National Transportation Safety Board. Accident database and synopsis. 2014; Retrieved 21 April 2014 from <http://www.ntsb.gov/aviationquery/index.aspx>.
30. Patterson JC, Jones DR, Marsh RW, Drummond FE. Aeromedical management of U.S. Air Force aviators who attempt suicide. *Aviat Space Environ Med* 2001; 72:1081–5.
31. Pirkola S, Sund R, Sailas E, Wahlbeck K. Community mental-health services and suicide rate in Finland: a nationwide small-area analysis. *Lancet* 2009; 373:147–53.
32. Pompili M, Serafini G, Innamorati M, Montebovi F, Palermo M, et al. Car accidents as a method of suicide: a comprehensive review. *Forensic Sci Int* 2012; 223:1–9.
33. Robins E, Gassner S, Kayer J, Wilkinson RH, Murphy GE. The communication of suicidal intent: a study of 134 consecutive cases of successful (completed) suicide. *Am J Psychiatry* 1959; 115:724–33.
34. Schwark T, Severin K, Grellner W. “I am flying to the stars”—suicide by aircraft in Germany. *Forensic Sci Int* 2008; 179:e75–8.
35. Shneidman ES. Suicide thoughts and reflections, 1960–80. *Suicide Life Threat Behav* 1981; 11:195–364.
36. Suicide Prevention Resource Center (SPRC). Rodgers P. Understanding risk and protective factors for suicide: a primer for preventing suicide. Newton, MA: Education Development Center, Inc.; 2011; retrieved 8 August 2013 from http://www.sprc.org/library_resources/items/understanding-risk-and-protective-factors-suicide-primer-preventing-suicide.
37. The Telegraph. Mozambique airlines captain ‘intentionally’ crashed plane. 2013; Retrieved 10 February 2014 from <http://www.telegraph.co.uk/news/worldnews/africaandindianocean/mozambique/10533239/Mozambique-Airlines-captain-intentionally-crashed-plane.html>.
38. University of Oxford. Centre for Suicide Research. Retrieved 8 August 2013 from <http://cebmh.warne.ox.ac.uk/csr/>.
39. Vuorio A, Laukkala T, Navathe P. Major depression and fitness to fly by different aviation authorities. *Aviat Space Environ Med* 2012; 83:909–11.
40. Weber F, Kron M. Medical risk factors in fatal military aviation crashes: a case-control study. *Aviat Space Environ Med* 2003; 74:560–3.
41. Widyahening IS. High level of work stressors increase the risk of mental-emotional disturbances among airline pilots. *Medical Journal of Indonesia* 2007; 16:117–21.
42. World Health Organization. Mental health. 2012; Retrieved 8 August 2013 from http://www.who.int/mental_health/prevention/suicide/country_reports/en/.
43. Wyatt JP, Squires T, Collis S, Broadley R. Road traffic suicides. *J Forensic Leg Med* 2009; 16:212–4.
44. Öhberg A, Penttilä A, Lönnqvist J. Driver suicides. *Br J Psychiatry* 1997; 171:468–72.