

In-flight medical emergencies during airline operations: a survey of physicians on the incidence, nature, and available medical equipment

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Background: Data on the incidence of in-flight medical emergencies on-board civil aircraft are uncommon and rarely published. Such data could provide information regarding required medical equipment on-board aircraft and requisite training for cabin crew. The aim of the present study was to gather data on the incidences, nature, and medical equipment for in-flight medical emergencies by way of a survey of physician members of a German aerospace medical society.

Materials and methods: Using unipark.de (QuestBack GmbH, Cologne, Germany), an online survey was developed and used to gather specific information. Members of the German Society for Aviation and Space Medicine (Deutsche Gesellschaft für Luft- und Raumfahrtmedizin e.V.; DGLRM) were invited to participate in the survey during a 4-week period (21 March 2015 to 20 April 2015). Chi-square test was used for statistical analysis ($p < 0.05$ was considered significant).

Results: Altogether, 121 members of the society responded to the survey ($n = 335$ sent out). Of the 121 respondents, $n = 54$ (44.6%) of the participants (89.9% male and 10.1% female; mean age, 54.1 years; $n = 121$) were involved in at least one in-flight medical emergency. Demographic parameters in this survey were in concordance with the society members' demographics. The mean duration of flights was 5.7 hours and the respondents performed 7.1 airline flights per year (median). Cardiovascular (40.0%) and neurological disorders (17.8%) were the most frequent diagnoses. The medical equipment (78.7%) provided was sufficient. An emergency diversion was undertaken in 10.6% of the cases. Although using a different method of data acquisition, this survey confirms previous data on the nature of emergencies and gives plausible numbers.

Conclusion: Our data strongly argue for the establishment of a standardized database for recording the incidence and nature of in-flight medical emergencies. Such a database could inform on required medical equipment and cabin crew training.

Keywords: in-flight medical emergencies, medical assistance, emergency medical equipment, on-board emergencies, first aid

Background

According to the International Civil Aviation Organization (ICAO), approximately 3 billion people travelled by commercial airline transportation worldwide in 2014¹⁻³ and approximately 193 million were transported in Germany.⁴ Although airline travel is quite safe from a technical point of view, passenger health issues (eg, advancing age or preexisting diseases) as well as the increasing number of passengers aboard larger aircraft in recent years¹, and long-distance flights¹ increase the likelihood of in-flight medical emergencies. Some studies even suggest that the frequency of these emergencies is rising.⁵ Therefore, medical issues during air travel have gained significant interest over recent years.

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While in-flight medical emergencies frequently occur in commercial airline operations, detailed data on incidence, diagnosis, or treatment options are few, and literature on the subject is limited.^{2,6–8} Some recent studies reported the incidence of in-flight emergencies as one event per 14,000–39,600 passengers.^{8–10} However, most of the published data represent retrospective analyses by single carrier,^{1,11–14} and no data exist concerning individual countries or worldwide occurrence. Furthermore, data for single airlines suffer two limitations: 1) a relatively small number of operations and 2) regional carriers may fly shorter distances and hence shorter times en route.

Several studies on the content of medical equipment have been published in recent years but these fail to address the utility of the equipment in context of the medical emergency.^{15,16} Put another way, the usefulness of any emergency medical equipment onboard will depend on the nature of the in-flight medical emergency.

The aim of the present study was to gather data on incidence, nature, and medical equipment for in-flight medical emergencies by performing an online survey of aviation medicine physicians in Germany. Since currently data have been rarely published and were presented by specific airlines only,^{1,11–14} the present study may enhance knowledge on in-flight medical emergencies.

Materials and methods

Survey

Using the online survey tool www.unipark.de (QuestBack GmbH, Cologne, Germany), an online survey was developed and used to gather specific information. This online survey tool provides a platform to compile specific questionnaires using different patterns for questions and answers. After finishing the survey questions, they can be accessed by an internet link.

The working group “Emergency Medicine and Air Rescue” of the German Society for Aviation and Space Medicine (DGLRM) designed 31 questions on recent in-flight medical emergencies. Ethical approval was obtained from the Ethical Committee of the University Hospital Cologne for the study. After designing and pre-testing the survey, it was open for participation. All persons participating were aware that they were free to decline to complete the survey, and agreed voluntarily to participate.

Participants

N=335 members of the German Society for Aviation and Space Medicine (DGLRM) with an email address on record

were invited to participate in the survey by email over a 4-week period (21 March 2015 to 20 April 2015). After 1 week, a standardized reminder was sent out to enhance participation. Analysis was performed after the planned duration of the survey.

Statistical analysis and data presentation

SPSS (Version 22; IBM Corporation, Chicago, USA) and descriptive statistics (absolute numbers and percentages) were used to analyze answers and data. Chi-square test was used for statistical analysis; $p < 0.05$ was considered statistically significant.

Results

Participant characteristics

Of the participants, 89.9% (n=71) were male and 10.1% (n=8) were female which is in congruency to the members of the society. The mean age was 54.1 ± 11.4 years (range, 31–76 years; n=79). Participants were specialists in a specific medical field (n=65; 53.7%), in specialization training (n=8; 6.6%), or gave no indication (n=48; 39.7%). They worked in the field of General Medicine (31.8%), Internal Medicine (19.3%), Anesthesia (18.2%), and others (19.3%; no answers, 11.4%). Participants were additionally qualified as specialists for Aviation Medicine (n=39; 32.2%), Emergency Medicine (n=27; 22.3%), and others (n=40; 33.1%; multiple answers possible); 32.9% had other Emergency Medicine qualifications. The mean experience in their specific medical field was 25.6 ± 11.6 years (range, 1–50 years).

Emergency case characteristics

The mean duration of flights in which an in-flight medical emergency occurred was 5.7 ± 4.1 hours (range, 1–8 hours); 68.8% (n=33) of in-flight emergencies occurred on intercontinental flights; 22.9% (n=11) on European flights; and 6.26% (n=3) on domestic flights (others, n=1; no answer, n=2). In all, 61.2% (n=30) of the participants were personally asked for assistance by crewmembers. It was unclear in 73.5% (n=36) if the cabin crew had specific emergency medical training. The mean number of doctors on-board was given as 1.9 ± 1.6 (range, 1–10).

Patient related data and medical treatment

Of the patients 46.3% (n=25) were male and 40.7% (n=22) were female (missing value, n=7; total, N=54). Mean patient age was 54.1 ± 15.7 years (range, 15–79 years). Male patients had a mean age of 53.8 ± 16.6 years as compared to female

patients with a mean age of 54.4 ± 15.1 years ($p=0.898$; non-significant [ns]). There was no significant difference in age of patients requiring a diversion as compared to patients where the flight continued as planned (53.2 ± 14.4 years, $n=5$ vs 54.2 ± 16.0 years, $n=35$; $p=0.896$; ns).

Cardiovascular disorders (40.0%) and neurological problems (17.8%) were the most frequent diagnoses in the present study (Table 1). Concerning cardiovascular problems, collapse (24.4%) and chest pain (13.3%) were reported most often, followed by neurological problems such as altered mental status (13.3%).

In-flight emergency medical resources were considered to be adequate in 75.9% ($n=41$) of the cases. On-board medical equipment (eg, first aid kit, medical kit, doctor's kit) was used in 46.3% of cases ($n=25$). In 68.5% ($n=37$) the on-board medical equipment was considered to be sufficient by the participants. Teleconsultation was not used in any of these cases. In $n=2$ cases, teleconsultation was available and offered, but not used.

Medical equipment and emergency organization

A defibrillator was reported to be available on-board in 24.1% ($n=13$; unclear, $n=25$). In 25.9% ($n=14$) no standardized form for case documentation was available, whereas it was used in 29.6% ($n=16$) of cases.

An emergency diversion due to an in-flight medical emergency was performed in 10.6% of the cases. In these cases circulatory collapse (12.5%), chest symptoms (6.8%), and altered mental status (6.8%) were most often reported.

Table 1 Number and percentages of diagnoses and detailed causes of in-flight medical emergencies

Diagnosis	Detailed causes of in-flight emergencies		
Cardiovascular $n=18$ 40.0%	Chest symptoms $n=6$ 13.3%	Collapse $n=11$ 24.4%	High blood pressure $n=1$ 1.1%
Gastrointestinal $n=3$ 6.7%	Abdominal pain $n=3$ 6.7%		
Neurological $n=8$ 17.8%	Altered mental status $n=6$ 13.3%	Dizziness/ epilepsy $n=2$ 4.4%	
Others $n=16$ 35.6%	Derangement of blood glucose $n=4$ 8.9%	Respiratory symptoms $n=5$ 11.1%	Others $n=7$ 15.6%

In-flight medical emergency experience

Altogether, 54 of 121 participants indicated they had been involved in an in-flight medical emergency, and were pursued for further analysis. Using the participants' median number of airline flights per year (7.1; range, 4–50 years) and the time span from the last in-flight emergency remembered (8.9 ± 7.5 years), the annual probability of an in-flight medical emergency was calculated as 0.11/year and per person. Furthermore, the probability for an in-flight medical emergency was calculated as one emergency per 63 flights.

Taking into account that $n=121$ participants (having 7.1 flights per year) gave answers and the last medical emergency was 8.9 years ago, a total (theoretical) number of 7,646 flights were analyzed in the present study.

Discussion

In the present study, by gathering data using an online survey from members of the DGLRM, incidences, nature, and medical equipment options were analyzed. This is the first study of its kind and is unique in using participants comprised entirely of experts in aerospace and emergency medicine as a data source for the interpretation of in-flight emergencies. The main finding was that cardiovascular problems in middle aged travelers/patients are most frequent and that flight diversions are necessary in approximately 11% of the cases.

Incidence and diagnoses

In a recent study, Peterson et al showed that the most common problems were syncope or presyncope (37.4% of cases), respiratory symptoms (12.1%), and nausea or vomiting (9.5%).³ Also Weinlich et al reported collapse as the most common in-flight medical incident, followed by gastroenteritis (8%), psychiatric problems (4%), pain (4%), and epilepsy (2%).¹⁷ The data mirror the findings in the present study, where cardiovascular problems followed by neurological problems were reported most often.

When calculating the incidence of medical incident with the numbers gathered in the present study (7.1 flights per year and 8.9 years since last incident), one in-flight medical incident occurred every 63 flights.

Emergency diversions: incidence and causes

In the present study, a medical diversion was carried out in 10.6% of cases. This percentage is well in agreement with other published studies. Medically related diversions of aircraft following an in-flight emergency may occur in up to 7–13% of cases.¹⁸

Delaune et al reported 1 out of 12.6 (7.9%) medical emergencies led to a diversion.¹⁹ Another study by Chandra and Conry reported a percentage of 1.1–9.7%.¹³ Peterson et al published that aircraft diversions due to medical emergencies occurred in 7.3% whereas³ Cummins and Schubach⁹ reported 3.7% and Weinlich et al 3% for Lufthansa.¹⁷ Collectively, the percentage of for in-flight medical emergencies necessitating a diversion ranged between 1.1% and 13%.

On the basis of flight operations, Delaune et al calculated 1 diversion for every 4,754 flights. The present study indicated a higher diversion rate (ie, 1 diversion per 579 legs).¹⁹

The medical causes underlying the flight diversion merits discussion. The numbers in the present study were modest and precluded calculations. However, there are a few studies analyzing detailed causes for medical diversions. Valani et al reported the four most common categories culminating in diversions were cardiac (26.4%), neurological (19.5%), gastrointestinal (11.4%), and syncope (10.0%).¹² Only 6.8% of all diversions were due to cardiac arrest. Hung et al reported neurological problems (39.1%), cardiac problems (23.9%), and gynecological/obstetric problems (13.0%) to be the causes of diversions of a large commercial airline based in Hong Kong.¹⁴ All these data are well in agreement with the present study.

Registry

The lack of an international registry with valid data and sound denominator data impedes quality research in this area. To date, neither a national nor a European/international standardized registry on in-flight medical emergencies exist. Presently, only company registers of specific airlines are available toward this end (are these in the public domain – if not might be worth stating). For this purpose, standardized documentation and parameter collection is essential and we urge for establishment of an international, central database on in-flight medical emergencies. The availability of such high-quality data could inform on preventive strategies for pre-flight medical assessment,^{6,20} and required/suitable emergency medical equipment.²¹

Limitations

The present study was not without limitations. First, the study is based on a retrospective analysis of secondary data (survey of doctors) rather than on primary data recorded in real-time. This could lead to inaccuracies in recall. Second, the group of survey invitees was selective (members of a German aerospace medical association) and the number of participants was modest. Third, it is possible that physicians

are likely to be on longer distance trips as compared to a “standard passenger”. However, results are mainly congruent to previous studies and this can confirm data correctness. Finally, invitees recently involved in an in-flight medical incident may have been more likely to answer as compared to those never involved in on-board emergencies that could skew incidence rates calculated herein. Notwithstanding these limitations, the main advantage of this study was that our data was not limited to a single airline, but was inclusive of a broad spectrum of airlines and worldwide flights.

Conclusion

Cardiac problems and syncope followed by neurological problems represented the most frequent medical problems during commercial airline travel. The incidence of approximately one emergency in 63 flights is higher than that computed in other studies a difference likely to reflect at least in part, the absence of denominator data a problem plaguing aviation research.²² Our findings argue for the future implementation of an international registry of in-flight emergencies using standardized documentation and parameter collection.

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Author contributions

Idea: JH and CN; setting up the survey: JH, CN, LB, SK, and SB; data analysis: JH and SB; drafting the manuscript: JH and SB; significant manuscript improvement: CN, LB, SK. Overall coordination: JH. All authors contributed toward data analysis, drafting and revising the paper and agree to be accountable for all aspects of the work.

Disclosure

The authors have no conflicts of interest in this work.

References

1. Graf J, Stüben U, Pump S. In-flight medical emergencies. *Dtsch Aerztebl Int.* 2012;109:591–602.
2. Silverman D, Gendreau M: Medical issues associated with commercial flights. *Lancet.* 2009;373:2067–2077.
3. Peterson D, Martin-Gill C, Guyette F, et al. Outcomes of medical emergencies on commercial airline flights. *N Engl J Med.* 2013;368:2075–2083.
4. Statista – The portal for statistics. Available from: <https://de.statista.com/statistik/daten/studie/12552/umfrage/befoerderte-personen-im-luftverkehr/>. Accessed February 16, 2017.
5. Dowdall N. “Is there a doctor on the aircraft?” *Brit Med J.* 2000;321:1336–1337.

6. Sand M, Bechara FG, Sand D, Mann B. In-flight medical emergencies. *Lancet*. 2009;374(9695):1062–1063.
7. Qureshi A, Porter KM. Emergencies in the air. *Emerg Med J*. 2005; 22:658–659.
8. Hinkelbein J, Spelten O, Wetsch W, Schier R, Neuhaus C. Emergencies in the sky: in-flight medical emergencies during commercial air transport. *Trends in Anaesthesia and Critical Care*. 2013;3(4):179–182.
9. Cummins R, Schubach J. Frequency and types of medical emergencies among commercial air travellers. *J Am Med Assoc*. 1989;261:1295–1299.
10. Ruskin K, Hernandez K, Barash P. Management of in-flight medical emergencies. *Anesthesiology*. 2008;108:749–755.
11. Graf J, Stuben U, Pump S. In-flight medical emergencies. *Dtsch Arztebl Int*. 2012;109:591–601.
12. Valani R, Cornacchia M, Kube D. Flight diversions due to onboard medical emergencies on an international commercial airline. *Aviat Space Environ Med*. 2010;81:1037–1040.
13. Chandra A, Conry S. In-flight medical emergencies. *West J Emerg Med*. 2013;14:499–504.
14. Hung K, Chan E, Cocks R, Ong R, Rainer T, Graham C. Predictors of flight diversions and deaths for in-flight medical emergencies in commercial aviation. *Arch Intern Med*. 2010;170:1401–1402.
15. Hinkelbein J, Neuhaus C, Wetsch WA, et al. Emergency medical equipment on board German airliners. *J Travel Med*. 2014;21: 318–323.
16. Sand M, Gambichler T, Sand D, Thrandorf C, Altmeyer P, Bechara FG. Emergency medical kits on board commercial aircraft: a comparative study. *Travel Med Infect Dis*. 2010;8:388–394.
17. Weinlich M, Nieuwkamp N, Stueben U, Marzi I, Walcher F. Telemedical assistance for in-flight emergencies on intercontinental commercial aircraft. *J Telemed Telecare*. 2009;15:409–413.
18. Cocks R, Liew M. Commercial aviation in-flight emergencies and the physician. *Emerg Med Australas*. 2007;19:1–8.
19. Delaune Er, Lucas R, Illig P. In-flight medical events and aircraft diversions: one airline's experience. *Aviat Space Environ Med*. 2003;74: 62–68.
20. Ruskin KJ. In-flight medical emergencies: time for a registry? *Crit Care*. 2009;13:121.
21. Hinkelbein J, Neuhaus C, Wetsch W, et al. Emergency medical equipment on board German airliners. *J Travel Med*. 2014;21:318–323.
22. Hinkelbein J, Dambier M, Schwalbe M, Glaser E, Neuhaus C. Lack of denominator data in aviation accident analysis. *Aviat Space Environ Med*. 2010;81:77.

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