



Incidents in Air Transport

Flight crew incapacitation

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The statistical approach to the question of air transport pilot incapacitation appears to demonstrate the absence of any significant air safety risk. However, investigations of cases of pilot incapacitation reveal the existence of factors that could contribute to accidents, and such occurrences are treated as serious incidents.

“Pilot incapacitation” refers to the effect on the pilot’s activity of deterioration in any psychological, physiological or anatomical structure or function. The medical fitness test is specifically designed to prevent the risk of incapacitation occurring in flight by selecting candidates whose health issues, if any, present no apparent obstacle to flying. However, a pilot’s medical condition evolves over time due to aging, lifestyle, the emergence of chronic diseases or temporary illness, etc. The risk has to be assessed dynamically by the pilots themselves; they must be alert to any disorders that could impact, for however short a period, their ability to fly an aircraft.

One of the corollaries of working as a crew is that it limits the impact on the conduct of the flight if one of the pilots is suddenly incapacitated. However, this benefit presupposes a certain number of conditions, in particular that the medical condition of the pilots is not affected simultaneously, as for example in the case of food poisoning, a seasonal disorder, or deterioration in the flight deck environment (pollution, hypoxia, etc.).

The incidents presented in this IAT show that the risk inherent in medical conditions may sometimes be under-estimated once a medical certificate has been obtained. The decision not to fly, due to what appear to be minor health problems, is a hard one to take, yet such problems can rapidly become incapacitating and disrupt the conduct of the flight.

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First case**History of the Flight**

On February 13, during a stopover, the copilot fell ill with gastroenteritis, leading to dehydration. He took medication and absorbed plenty of water as soon as he could. The next day, a few hours before the pick-up, he noticed a gradual improvement in his symptoms. He felt capable of undertaking the transoceanic flight, and boarded the shuttle taking the crew to the aircraft.

During the transfer, however, he had another problem, and finally decided not to undertake the flight.

The check-in of the 357 passengers was interrupted and the flight was cancelled.

Second case**History of the Flight**

In cruise, on a flight from Dakar to Paris, on February 21, the Captain had violent abdominal pains and nausea. A doctor, responding to the cabin announcement, gave him some injections that momentarily eased the symptoms. The Captain returned to the controls for about one hour, after which the symptoms recurred. He was given the same treatment and rested until the descent.

He then remained under the surveillance of the doctor.

The end of the flight proceeded without difficulty.

Additional Information

The investigation revealed that the Captain had eaten eggs and prepared-meat products around 11:00, that he had begun to feel ill around 17:00, and that his condition had worsened around 21:00, about an hour before departure.

The Captain said that he had consulted a doctor on the ground and had obtained his go-ahead to perform the flight. He added that before embarking, he had checked that there was a doctor on board so that he could seek medical help if the need arose.

Lessons Learned

What are the criteria that enter into the decision to fly or not to fly? How much weight is given to a pilot's medical condition? What consideration should be given to commercial pressures, notably during stopovers? There are no clear answers to these questions.

The afflicted pilot is the only person who can make the decision – a delicate decision in the absence of a reserve crew – not to undertake the flight. Could he not benefit from an outside opinion from an aviation doctor employed by the airline, for example through the intermediary of an OCC, to help him make that decision?

The situation is sufficiently rare for operations to remain substantially unaffected. Just as it is normal to perform a go-around in the event of an Unstabilised approach, the cancelation of the flight should also be seen as a good solution.

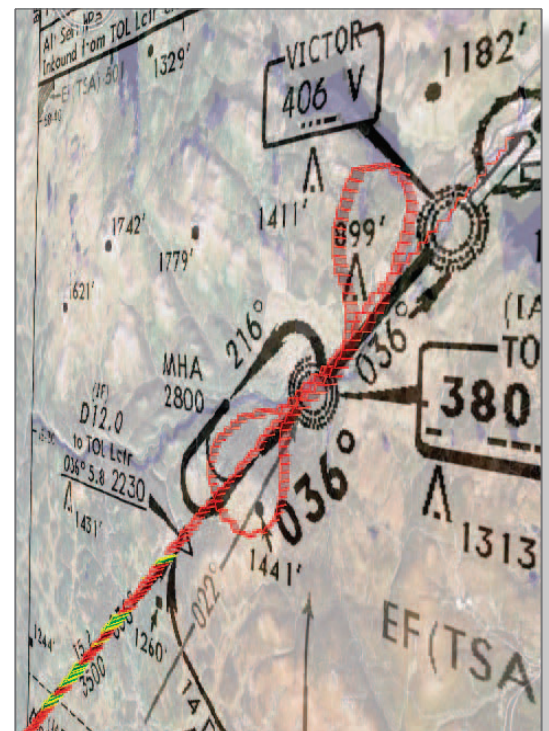
Third case**History of the Flight**

On a flight from Paris Charles-de-Gaulle to Ivalo (Finland), on December 5, the training captain was PNF and was seated on the right, performing a line check on the PF (also Captain) seated on the left.

At the end of the flight, which lasted more than three hours, the crew was authorized to perform an NDB 04 night approach. The descent was late. The aircraft crossed the FAF at high speed and not fully configured. It came in above the glideslope and slightly to the right of the localizer.

At 1,700 feet, in order to abandon an Unstabilised approach, the instructor requested a go-around to join the downwind leg of runway 22.

However, to save time, he then changed his strategy and requested to continue the left turn to come back on the localizer centreline. He informed ATC, which told him to climb immediately to 2,800 feet to avoid high ground. During this manoeuvre, the PF overshot the approach path and went outside the protected area. The crew completed the approach visually.



Trajectographie

Flight path

Additional Information

When he commenced the flight, the Captain under supervision was suffering from the early stages of gastroenteritis. Given the nature of the instruction flight, and the difficulty of rescheduling such flights, he preferred not to inform the instructor.

The latter did not detect the subtle incapacitation⁽¹⁾ of the “trainee”.

Lessons Learned

The pilot under supervision assessed the risk/benefit balance alone. It was difficult for him to declare his incapacitation, as the context meant that it was important for him to undertake the flight and not reveal any weakness.

It was also difficult for the instructor to detect the pilot's incapacitation, because it was subtle, and because he was there to assess the trainee's piloting skills and decision-making capacity.

Fourth case

History of the Flight

During the cruise phase of a flight on December 31, the copilot felt abdominal pains and left the cockpit to go to the toilet. The Captain heard a dull thud and, looking at the CCTV monitor, saw the copilot flat out in the aisle. A cabin attendant saw the copilot fall and strike his head on the edge of a bulkhead,

without serious consequences. With the aid of the assistant, the copilot went to the toilet and returned to his seat.

The flight crew member incapacitation procedure was applied until the aircraft came to a halt on the apron: the copilot's seat was moved back, the harness was blocked, and a cabin crew member remained present in the cockpit.

Additional Information

Before undertaking the flight, the copilot had not noticed any particular symptoms, despite being all the more attentive after the Captain with whom he had flown the outbound leg was replaced for this flight, after feeling unwell with fatigue. The investigation established that the original Captain's fatigue had persisted for a day, but without any other symptoms. It may be that the copilot had caught something from the Captain and that, due perhaps to the altitude, the symptoms did actually develop in his case.

Conclusion

The original Captain had decided not to fly. Had he not made that decision, his symptoms might have worsened during the flight, just as the copilot was himself beginning to feel abdominal pain. Both pilots would then have been incapacitated, placing the safety of the flight at risk.

⁽¹⁾A partial, insidious incapacitation which may go undetected by the sufferer and those around him or her (from *Médecine aérospatiale*, 2nd edition, 1999)

Lessons Learned

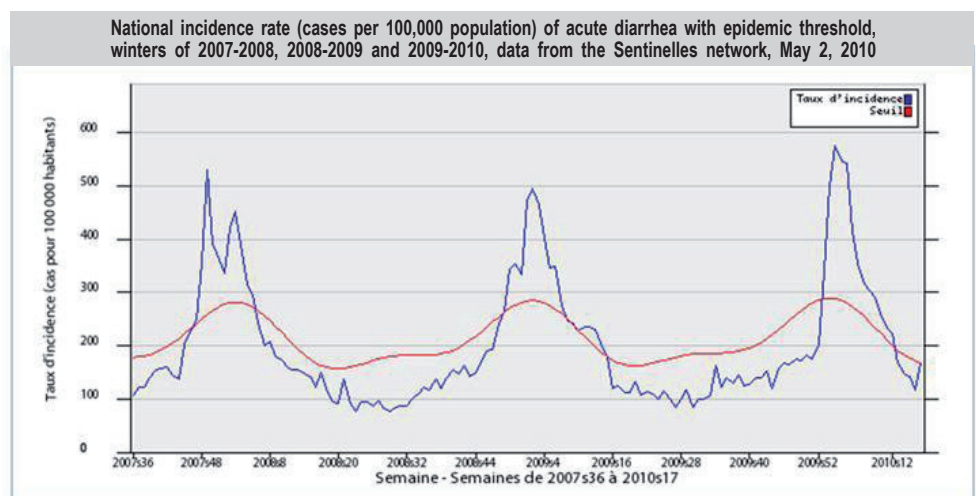
Gastroenteritis is seen as an almost routine cause of in-flight incapacitation. When the symptoms begin before undertaking the flight, the pilot has to assess the risk/benefit ratio prior to departure. Decision criteria such as commercial pressure or a supervised flight, as in the chosen examples, can incite the pilot to take the flight despite being aware of his symptoms. Even if the condition is medically benign, symptoms that begin before the flight generally get worse during it, due to altitude. The crew must bear in mind that, in flight, the risk of illness due to dehydration or vagal tone can lead to a lack of responsiveness during a critical flight phase, and even – as in the fourth case – to a sudden loss of consciousness.

Gastroenteritis can be due to food poisoning, especially during stopovers. This mode of infection is well known to crews, who adjust their eating habits accordingly.

The seasonal character of gastroenteritis epidemics, however, is generally less well known.

Its seasonality (see graph) might lead crews to be attentive, during the winter in France, to ill-defined disorders that could be early signs of gastroenteritis.

Proper hand washing remains the best way to prevent contamination between people.



Cardiac disorders

First case

History of the Flight

Due to a change of aircraft that reduced the cargo capacity by two tons, the cargo loading and passenger boarding operations for a flight from Paris Charles-de-Gaulle to Athens were disrupted: eighteen passengers, a quantity of freight, some luggage, and three gratis passenger (GP) ticketholders, whom the Captain had promised to carry, could not be embarked. The flight took off about an hour late, after lengthy negotiations between the Captain and the station manager, who refused to let the GP passengers embark. In flight, the company's operations department informed the crew that the delay had been officially attributed to the Captain.

In the vicinity of Zurich, after about an hour in the air, a feeling of fatigue suddenly came over the Captain, which developed, in the space of five minutes, into illness with chest pains. It became clear that he was unable to continue the flight. Concerned that it might be a heart attack, the copilot took over the controls, issued a distress call and diverted towards the aerodrome at Basel-Mulhouse. The ILS on runway 16 was out of service due to works, temporarily reducing the available runway length by 960m. The copilot performed a solo VOR/DME approach and landed without further incident.

Additional Information

Context of the flight

The investigation established that this was the second confrontation between the Captain and this particular station manager, himself a former pilot. On the first occasion, the Captain had also been obliged to yield to the station manager's arguments.

Medical information

The Captain was transferred to an ambulance and hospitalized in cardiac intensive care. After numerous tests, the final diagnosis was one of acute gastritis. It can, in fact, be difficult to distinguish between certain digestive symptoms and symptoms of cardiac origin.

The Captain had undergone repeated medical examinations in the months leading up to the occurrence, due to similar symptoms that had arisen during a stopover. The diagnosis of gastritis had already been evoked. However, a cardiologist had prescribed trinitrin for the Captain to take in the event of chest pain.

The diagnosis of acute gastritis is compatible with a residual effect of the confrontational professional experience described by the Captain.

The investigation therefore found that the Captain's in-flight illness was caused by the combination of his heated conflict with the station manager and his pre-existing medical condition.

Operational information

The station manager and the loading agent draw up the loading plan jointly. The company's procedures stipulate that the decision whether or not to embark passengers is a station responsibility.

Second case

History of the Flight

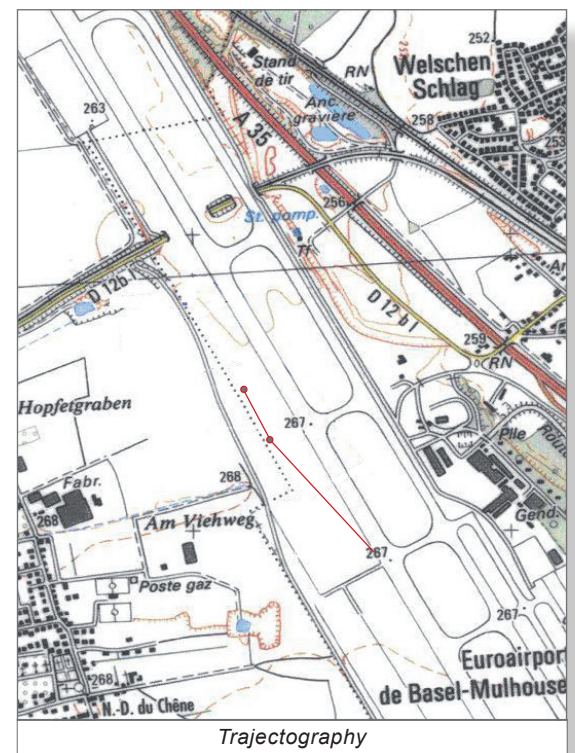
A public transport charter flight was due to take passengers from Basel-Mulhouse to Dresden, on a single-pilot twin-engine aircraft.

The passengers boarded twenty minutes behind schedule.

During startup, the pilot applied the engine start procedure incorrectly. Suspecting a technical problem, he sought assistance from a mechanic. The pilot lined up with taxiway H (TODA 2900m) on runway 16. While rolling to takeoff, he lost control of the aircraft's trajectory. The aircraft came off the edge of the runway, crossed taxiway G and came to a halt 700 meters further on, in a wheat field, 90 meters from the runway centreline.

The pilot and passengers were not injured. The aircraft was badly damaged.

Flight path

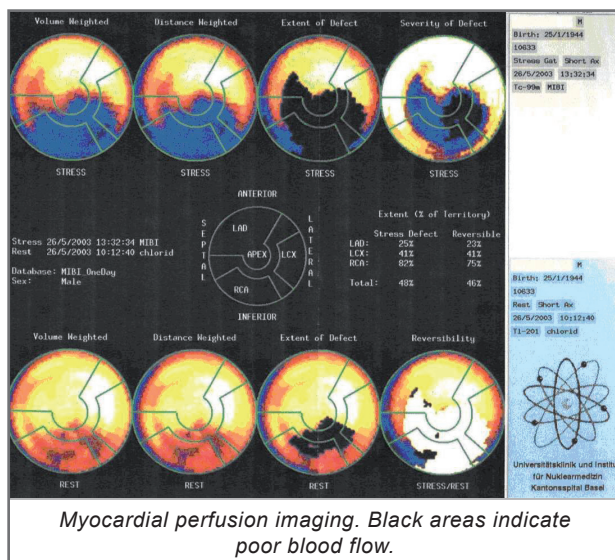


Additional Information

Medical information

The tests subsequently conducted revealed the existence of electrocardiographic anomalies indicative of a semi-recent cardiomyopathy of ischemic origin⁽²⁾. In this context, small hemodynamic changes⁽³⁾ may account for the emergence of pre-syncope symptoms such as those observed on the day of the accident. The final diagnosis was one of acute coronary syndrome.

⁽²⁾ Local anemia, usually linked to insufficient arterial blood flow.



⁽³⁾ Relating to blood flow or circulation

⁽⁴⁾ Modification of blood fat levels (based on Garnier and Delamarre, Dictionary of Technical Terms in Medicine)

Myocardial perfusion imaging. Black areas indicate poor blood flow.

A medical fitness test carried out less than six months earlier had noted that the cardiovascular parameters were within the normal limits specified by European regulations – when each criterion is taken in isolation. However, the age and gender of the pilot, the existence of excess weight, his blood pressure reading and the presence of dyslipidemia⁽⁴⁾ could be considered factors that placed the pilot in a very high cardiovascular risk group. One month before the accident, the pilot had, over several days,

experienced a general sense of fatigue with sudden onset, but with no particular pain or identified source. He had not sought medical attention, and the symptoms had disappeared spontaneously.

Regulatory provisions

Paragraph 2(b) Appendix 1 to Subpart B of the regulation of 27 January 2005 on the physical and mental fitness of civil aviation flight crew (FCL 3) states that:

“An accumulation of risk factors (smoking, family history, lipid abnormalities, hypertension, etc.) shall require cardiovascular evaluation by the AMC or AME in conjunction with the AMS.”

These provisions are also found in JAR-FCL 3 dated 1 December 2006.

However, the large and growing number of subjects at risk, both in the population at large and among flight crew, means that the regulation is hard to implement as it stands.

Lessons Learned

As this occurrence shows, a pilot can be passed as fit even though he presents a set of medical parameters, which – although each one individually is within the norm – collectively reflect a high level of cardiovascular risk that could lead to a serious incident. The risk here was even higher in that it was a single-pilot flight. It is therefore desirable that the regulations should require epidemiology to be taken into account when issuing a medical certificate, so that the risks incurred can be properly assessed.

In this case, treatments and preventive measures were available that could have delayed the emergence of the cardiac complications encountered and avoided the incident. Most of the public transport aircraft certified as single-pilot are actually flown by two pilots.

Estimate of the risk of cardiac accident, as a function of risk factors

	HTA Grade 1 (slight) PAS 140-159 and/ or PAD 90-99	HTA Grade 2 (moderate) PAS 160-179 and/or PAD 100-109	HTA Grade 2 (severe) PAS >180 and/or PAD >110
A FR=0	Low risk	Moderate risk	High risk
B 1 to 2 FR	Moderate risk	Moderate risk	High risk
C >3 FR Or visceral restriction or diabetes	High risk	High risk	High risk
If associated CV pathology, very high risk whatever the blood pressure level			

Source:
Management of adults with essential hypertension.
2005 update.
Rationale. July 2005, professional guideline service, Haute Autorité de Santé, France

Estimate of the risk of cardiac accident, as a function of risk factors

Third case

History of the Flight

While in cruise on a flight from Toulouse to Amsterdam, the Captain suddenly fell ill, with sweating, chest pain and pain in the left arm. The copilot diverted to Paris Charles-de-Gaulle. The Captain died shortly after admission to the airport emergency medical service.

Additional Information

The autopsy revealed that the Captain had died from acute pulmonary edema⁽⁵⁾.

The death was not ascribed to the flight, and was considered to be from natural causes. This occurrence was therefore not an accident as defined in the regulations; it was classed as a serious incident.

The investigation showed that the Captain had been taking an activated carbon medication

(Norit) indicated for the treatment of certain intestinal transit disorders. This medication does not necessarily require a medical prescription.

Lessons Learned

It can be difficult, and even impossible, to determine whether certain health problems are of digestive (generally gastro-esophageal) origin or of cardiac origin; firstly, because of the similarities between the symptoms, and secondly, because of the role played by stress in their modes of onset.

These data are not widely known among pilots and those around them, who tend to play down, sometimes wrongly, painful "stomach" problems. This can lead to self-medication, with over-the-counter medications being taken inappropriately to treat digestive disorders.

⁽⁵⁾In the present case, accumulation in the lung of liquids coming from the lung blood vessels, which results from a malfunction of the heart "pump". (based on "Principes de médecine interne", 15th edition, 2002)

Hypoglycaemia

Hypoglycaemia is revealed by the appearance of symptoms of very different kinds, reflecting a lack of glucose to the brain. The symptoms generally appear at blood glucose levels of less than 0.50 g/l. In the absence of a glucose metabolism disorder or strenuous physical effort, blood sugar levels diminish gradually.

It can be caused by poor compensation for insufficient food intake, or by a more serious organic pathology.

The symptoms of hypoglycaemia take many forms. Loss of consciousness generally reflects a significant glucose deficiency. The loss of consciousness may be preceded by insidious cognitive disorders, inducing a state of subtle incapacitation without any apparent consequence for the flight. Hypoglycaemia can also manifest as agitation, even aggression, making the subject dangerous to others.

First case

History of the Flight

At the end of the night, the crew had flown a repositioning flight lasting 35 minutes.

Before the following flight – the first commercial leg of the round trip – the length of the stopover was prolonged by a passenger boarding delay.

At the end of the morning, a cabin attendant brought meal trays for the crew, but the Captain passed out just as he was about to eat.

A doctor, responding to the cabin announcement, feared a cardiac problem. The copilot declared a distress situation to ATC and diverted the aircraft.

Additional Information

Medical tests on the Captain in hospital revealed hypoglycaemia. The positioning flight at the end of the night, and the absence

of food intake to meet the body's needs until the brunch was served, meant that the Captain was drawing on his reserves.

Lessons Learned

Hypoglycaemia is often evoked when people suddenly feel unwell, but it is rarely confirmed, because the body's blood sugar regulation mechanisms generally compensate for the temporary dip.

The question here is why did the glucose deficiency persist for so long as to cause a lasting malaise that was still observable several hours later, during medical examination at the hospital?

Second case

History of the Flight

While in cruise, the Captain, PNF, complained of abdominal pains. He began intermittently to

ignore radio communications, and questions from the copilot. His speech became increasingly incoherent. The copilot decided to divert the aircraft.

During the final approach, the Captain became increasingly agitated and started acting aggressively towards the copilot. The cabin attendant had to immobilize him on his seat and supervise him until the aircraft had landed.

Additional Information

Tests carried out at the hospital revealed a blood glucose level of 0.37 g/l, corresponding to severe hypoglycaemia.

Blood glucose level (g/l)	Physiological response to lower glucose plasma concentrations
1.00 – 1.20	"Normal" blood sugar
< 0.80 – 0.85	Reduced insulin secretion
< 0.65 – 0.70	Increased secretion of glucagon, adrenaline, and incidentally of cortisol and growth hormone
< 0.50 – 0.55	Symptoms => behavioural defence (intake of sugar)
< 0.50	<p>0.37 g/l: the blood glucose level of the pilot (2nd case)</p> <p>Cognitive symptoms => behavioural defence compromised</p>

The Captain had been pronounced fit by dispensation due to diabetes, which had been treated by oral glucose-lowering drugs from the biguanide class for some fifteen years. A similar crisis had occurred a year earlier. The Captain was put on insulin in the immediate aftermath of the incident.

Lessons Learned

Diabetic pilots must strive to maintain a regular and sufficient glucose intake despite the sometimes awkward working rhythms of short-to-medium haul flying. An excessive fall in blood glucose due to the action of medication is difficult for the body to compensate without an intake of sugar-rich food. This exposes the pilot to the risk of incapacitation, becoming unable – possibly in a subtle way – to perform piloting tasks. Sulfonylurea hypoglycaemic agents and insulin increase this risk. They are prohibited for the treatment of diabetes mellitus in flight crew.

Given the length of time for which the pilot had been treated for diabetes, his treatment may have been adjusted over time, perhaps involving the prescription of prohibited medications such as those mentioned above. In this context, the Captain may have omitted to report the change in treatment, notably so as not to lose his certification.

Common lessons

Irregular meals can have a significant impact on blood glucose balance, especially in diabetics – who may not be aware of their condition. In the first case, the effects of fasting may have been accentuated by shifting the work-rest cycle towards the morning. In the second case, the intensity and duration of the hypoglycaemia may be explained by the taking of regular medications without adequate food intake. In every case, the possibility of an unreported change in treatment should be considered.

The loss of consciousness described in the first case is the most well-known serious sign of hypoglycaemia. Aggressive agitation, though less well known, can be even more dangerous