



International Flight Considerations

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4.1 Introduction

In the last 20 years, the number of passengers traveling on planes has increased exponentially. The International Civil Aviation Organization (ICAO) along with other sources reports the number of persons traveling by air to be more than 2.5–3.2 billion worldwide every year, with an estimated 5% of travelers experiencing a chronic illness [1–4]. Although air travel is quite safe from a technical point of view, passengers are increasingly at risk during flight due to individual health problems [5]. Although air travel is growing safer and more comfortable, the increasing average age of passengers, heightened security, and stress surrounding flights and schedules, combined with the unique environment of airplanes with changes in cabin temperature, air pressure and humidity levels, narrow seats, and frequent flight delays, may result in adverse medical conditions during flights [6]. Combined with the rising number of passengers and increased capacity of larger aircraft with more long-distance domestic and international flights [2, 7], with long-haul aircrafts—such as the Airbus A380 and Boeing 777 LR now capable of extending flight times to 18–20 h—it is likely that the incidence of in-flight medical emergencies will continue to increase in the coming years [3]. International air travel in particular combines long-haul, extended flight times with unique exposures, and an even more austere, secluded environment for passengers with acute and/or chronic illnesses, and suggests unique medical challenges for recognition, stabilization, treatment, diagnosis, and disposition.

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4.2 Background

As the population ages, the number of travelers with health problems is also likely to increase, which may lead to an increase in the number of in-flight medical emergencies. Although they are uncommon, medical emergencies do happen on airplanes in flight [8]. Certain examples in the literature indicate that urgent medical conditions during flights have increased gradually [6].

Although the actual number of medical emergencies occurring in flight is unknown due to difficulties and lack of standardization in reporting, it is estimated that between 1 in 10,000 and 1 in 40,000 passengers per year will experience a medical emergency in flight [9]. In recent studies, urgent medical and surgical situations during air travel have been reported as 10–40 demands per 100,000 passengers [2, 5, 10–12]. Data from research studies conducted during the last few years have shown significant increases in in-flight medical emergencies (IMEs) worldwide, but data and knowledge on the incidences, causes, and consequences are still limited, nonuniform, and difficult to gather [3, 5, 7, 13, 14].

Although a majority of in-flight medical incidents are minor, as many as 7–13% of medical emergencies result in aircraft diversion or unscheduled emergency landing [11]. In-flight deaths are quite rare, with an estimated rate of only 0.3–1 death per million passengers per year [9]. The most common reason for a diversion is a cardiac event [15]. Diversions can be quite costly for an airline, with cost estimates ranging from \$30,000 to more than \$725,000, depending on the situation [15]. These figures do not include the additional costs to other passengers of missed connecting flights and other delays [8].

Qureshi and Porter, in their study of one major international air carrier, found that in 75% of medical emergencies either a doctor or a nurse responded to the air crew's request for help, and 11% of the time a paramedic responded with assistance [7]. A study by the Medlink group (a ground-based medical consulting service for airlines) found a similar rate of response, with medical professionals responding to in-flight medical emergencies about 70% of the time [8, 16]. However, in one study, in the year ending 31 March 1999, British Airways carried 36.8 million passengers and there were 3,386 reported in-flight medical incidents: about 1 per 11,000 passengers. Although 70% were managed by cabin crew without the assistance of an onboard health professional, in almost 1,000 incidents doctors and nurses were asked to help with the management of ill passengers [17].

4.3 Differences in Medical Emergencies on International Flights

Estimating the frequency of in-flight medical events is challenging because no mandatory reporting system exists [17]. Various prevalence data sources exist but most have been derived from individual airlines. In 1999, British Airways reported about one in-flight medical incident per 11,000 passengers [18]. A 2000 UK Government report indicated that the number can be as high as 1 in 1,400 passengers, and a study

of a ground-based communications center that provides medical consultative service to airlines estimated that medical emergencies occur in 1 of every 604 flights [4, 17]. Estimates of medical events requiring professional intervention were thought to be about 1 per 14,000 passengers [19].

These data are an average of short-haul and long-haul flights; given the reduced time on the plane with short-haul flights, and the decreased likelihood of passengers seeking help when they are closer to their destination, medical events are likely to be higher than this estimate on long-haul, international flights. In most cases, the incidence of IMEs is likely to increase with the continued growth in air travel, with the gradual aging of the traveling population, and with people with preexisting disease traveling by air, and as airlines continue to reduce prices by reducing seat sizes and increasing passenger numbers [20].

Providing medical care with limited resources, space, support personnel, and equipment creates a suboptimal environment for those physicians, nurses, and other medical professionals who often are asked to volunteer to provide care. Furthermore, some physicians may be reluctant to volunteer to assist in such emergencies given the current litigious environment [21]. The reliance of airlines on volunteer medical assistance combines with several other issues: inadequate space and seating for passengers, inadequate space to provide proper and adequate medical care, inadequate training of crew members, inadequate medical equipment, and inadequate or unclear laws pertaining to volunteer providers, crew members, airlines, and patients, especially on international flights crossing state and national borders and airline ownership; all these combine to increase difficulties of medical stabilization, treatment, diagnosis, and disposition, and even more so on long-haul, international flights [21].

4.4 General Medical Conditions Affected by Long-Haul International Flights

The unique environments associated with aviation, inside and outside the cabin, combined with passenger-specific preexisting medical conditions and risk factors, plus the suboptimal conditions for medical care, diagnosis, and treatment on long-haul flights, all result in increased medical risk for passengers, and likely increased in-flight emergencies on long-haul, international flights.

Exacerbation of preexisting medical problems such as respiratory or cardiovascular conditions can create medical emergencies in the air if passengers do not disclose pertinent information or their treating physicians do not fully understand the risks of flight. In addition, newly presenting medical conditions (e.g., syncope or dyspnea) may also manifest themselves at altitude. Such events may be presumed to be worst-case scenarios (e.g., syncope could be a manifestation of lethal arrhythmias, abdominal aortic aneurysm, or ruptured ectopic pregnancy) [22].

The special environments associated with aviation, reduced atmospheric pressure, reduced available oxygen, increased noise and vibration, and external sub-freezing temperatures, can place certain patients at increased risk for medical emergencies.

The cabin environment itself contributes to specific medical risks, which are only exacerbated with long-haul, international flights. With larger planes with greater numbers of passengers, and potentially hundreds of people in the aircraft cabin breathing and rebreathing the same air, ventilation becomes critical to eliminate possible contaminants and airborne infections and provide environmental comfort. In modern aircrafts, 50% of fresh air is introduced and added to 50% of recirculated air. While this is an improvement when compared to ventilation averages for public and commercial buildings, which combine 20% of fresh air with 80% of recirculated air, the population density is much higher in aircraft compared to most commercial buildings and public spaces [23].

On long-haul international flights, travelers spend longer periods in enclosed spaces, especially those which can facilitate the spread of infectious diseases. Several outbreaks of serious infectious diseases have been reported aboard commercial airlines since 1946, including influenza, measles, severe acute respiratory syndrome (SARS), tuberculosis, food poisoning, viral enteritis, and small pox [3].

Most commercial aircraft use high-efficiency particulate air filters to recirculate the cabin air. There appears to be little or no difference between types of air filters used: one study showed no significant difference in self-reported infection rates in aircraft that use high-efficiency particulate air filters compared with those in aircraft that use a single-pass cabin ventilation system [24].

The risk of onboard transmission of infection is mainly restricted to individuals either with close personal contact or seated within two rows of an index passenger [25, 26]. However, in one report of a single flight on Air China flight 112, 22 passengers and crew member developed probable onboard severe acute respiratory syndrome-associated coronavirus (SARS-CoV) infection [27].

According to the World Health Organization (WHO) and multiple other studies, the 2002–03 SARS epidemic indicated that commercial air travel has an effect on infectious-disease spread [28]. WHO estimates that “65 passengers per million who travelled aboard commercial flights originating from regions of active transmission during the outbreak were symptomatic with probable SARS” [28]. WHO estimates that during the SARS epidemic, 40 flights carried 37 probable SARS-CoV source cases during the outbreak, resulting in 29 probable onboard secondary cases [28].

It is likely, based upon data from these and other studies, as well as from the contained environment and prolonged exposure to rebreathed and recycled air, that these international flights pose a significant exposure risk to various infectious diseases.

4.5 Vector- and Insect-Borne Diseases on International Flights

As far back as 1933, it was recognized that air travel posed a risk for insect-borne diseases:

The first sanitary convention for aerial navigation was conducted in 1933 and recognized the importance of aviation to the worldwide community. One of the focused concerns was

control of the yellow fever mosquito vector. Following World War II, the WHO Committee on Hygiene and Sanitation in Aviation became activated and published the "Guides to Hygiene and Sanitation in Aviation." The most recent guide is dated 1977 [23].

In the last 50 years, insects and other vectors for malaria, dengue, and yellow fever have all been identified on aircraft. Further, a condition termed "airport malaria" refers to cases of malaria near international airports among people who have not recently traveled into endemic areas. In the past 30 years most European countries, the United States, Israel, and Australia have experienced confirmed or probable cases of airport malaria. In the last 30 years, the United States has reported four such cases [23].

Both the WHO and the Advisory Group for Aerospace Research and Development recommend "aircraft disinsection" given evidence that disease vectors, particularly mosquitoes, are being imported into countries on aircraft [29].

4.6 Risk of Deep Venous Thromboembolism in International Travelers

Some members of the traveling public have a genetic tendency for increased clotting that has been estimated to have a prevalence of as high as 20% in the general population. Other preexisting factors such as illness, smoking, and medication may represent preexisting risk factors leading to deep venous thrombosis (DVT) during or following traveling [23].

Until recently, reviews of the medical literature failed to find significant epidemiological studies that demonstrate a statistically significant increase in DVT as a result of traveling by any means in the absence of preexisting risk factors. In the absence of any good prospective published studies, the evidence linking DVT with flying is likely circumstantial [30].

However, according to Silverman 2008, the relationship between long-haul flights (>8 h) and increased risk of DVT has generated great interest in both medical publications and the media. Overall, studies show an association between venous thromboembolism and long-haul air travel, with risk up to fourfold, depending on study methods [31–37]. In their review article in *The Lancet* in 2008, Silverman et al. provided an overview of the mildly increased risk of DVT associated with air travel [3].

In 2001, the Air Transport Medicine Committee of the Aerospace Medical Association recommended that "passengers with no identifiable risk factors carry out frequent and regular stretching exercises particularly of the lower limbs during flight. Opportunities should be sought to change position in the seat as well as to walk about the cabin. For those with more identifiable risk factors it is recommended that the traveler seek advice from his or her personal physician" [30].

Silverman and colleagues describe risks of venous thromboembolism (VTE), consolidating various recommendations in the literature [3]. For example, for low-risk passengers on short-duration flights, passengers are encouraged to avoid

constrictive clothing and dehydration while also ambulating about the cabin when possible, whereas high-risk passengers on longer flights are potential candidates for low-molecular-weight heparin [3, 31–37]. Generally, there is high risk for VTE only in flights of more than 8 h [38] and the risk of VTE usually occurs only in flights of more than 4 h [6, 33].

4.7 Special Medical Equipment Needs for International Flights

Several resources are available to providers who respond to a medical emergency. The Federal Aviation administration (FAA) mandates that United States-based airlines carry first-aid kits that are stocked with basic supplies such as bandages and splints [39].

These supplies are not comprehensive (e.g., there are no pediatric or obstetrical supplies). An Aerospace Medical Association expert panel has recently recommended an expanded cache [40].

Because health professionals are not aboard every flight, most airlines contract with ground-based medical consultation services [41, 42]. The clinicians at these centers can provide treatment recommendations. Onboard volunteer providers can also consult these services during an emergency. In demanding situations that require more than one provider, a volunteer physician may ask whether other medical professionals can assist [38]. The FAA also mandates that flight attendants receive training every other year in cardiopulmonary resuscitation (CPR) and the use of AEDs [17, 42, 43].

4.8 Emergency Medical Kits on International Flights

The first emergency medical kit was mandated by the FAA in 1986 and was subsequently expanded in 2001 to include an inhaled bronchodilator, oral antihistamines, and nonnarcotic analgesics [44]. Beginning in 2004, the FAA required all commercial airlines with at least a 7,500-lb payload and one or more flight attendants to equip their planes with AEDs [44]. The emergency medical kit is intended for use by medically-trained professionals responding to an emergency onboard an aircraft and includes the items listed in Table 1.1. The medical kits that can be found on international airlines are different from those found on US carriers and usually represent an expanded version of the US kit.

According to Kahn et al. [44] and DeJohn et al. [45], several studies have been conducted, analyzing the usefulness of the FAA-mandated emergency medical kit:

A survey of health care professionals who had used the kit to manage emergencies aboard aircraft found that whereas 26% thought it was “very useful,” 55% found it only “somewhat useful,” and 18% believed that the kit was “not of any benefit.” [45]

A study by De John et al. [45] of 1,132 in-flight medical incidents on 5 US domestic airlines found that the emergency medical kit was opened 47% of the time overall and 65% of the time when a flight was diverted. In addition to the items included in the kit, healthcare professionals believed that the following were also very helpful a majority of the time when managing medical emergencies: supplemental oxygen, supportive care, and careful patient monitoring [44, 45].

4.9 Special Areas for Critical Patients on International Flights

Several airlines provide specialized sections and/or small rooms on board their international flights. Lufthansa has developed a patient-transport compartment (PTC) for intensive care on board Lufthansa commercial long-distance aircraft on intercontinental routes. The configuration consists of a small enclosed room placed in the middle row of wide-body international aircraft. Three rows of seats are removed to make room for the PTC. Backup devices are present for all vital medical equipment (for monitoring, artificial ventilation, infusions, etc.) in case of failure. Thirteen thousand liters of oxygen (gas volume) are carried on the flight. The patient is accompanied by one intensive care nurse and one physician [2]. Other airlines describe modifications of this concept, allowing a special, isolated space for critical patients requiring ongoing medical monitoring and care, rather than for providing space to treat in-flight medical emergencies; however, if present and unoccupied by other patients, these spaces could be used for in-flight emergency patients [2].

4.10 Legal Issues

Liability: An issue of concern to many healthcare professionals when deciding whether to volunteer assistance in a medical emergency onboard a plane is the legal liability issues involved. A physician who provides assistance creates a doctor–patient relationship, with its attendant obligations and liability risk. Most doctors are eager to help in an emergency but are concerned that doing so might put them at risk; however, there have been numerous “Good Samaritan” laws enacted to protect healthcare professionals who respond in emergency situations. In 1998, Congress enacted the US Aviation Medical Assistance Act, which outlines protection for physicians and airlines who provide emergency medical care for passengers on commercial airliners, provided that the physician acts in good faith, receive no monetary compensation, provide reasonable care, and does not “grossly neglect” the patient or commit “willful misconduct.” An example of such disregard would be an intoxicated physician treating a patient [46]. Furthermore, many airlines indemnify volunteering physicians, and the captain should provide written

confirmation on request [3, 11]. In addition, the insurance policies of many airlines cover healthcare professionals who provide emergency medical care to passengers or crew while on board their aircraft [46].

The situation is a bit more complicated for medical professionals traveling on an international flight, however, as he or she becomes subject to the laws of the country in which the airline is registered. These laws may differ significantly from those of the United States. New Zealand, for example, requires that medically qualified persons respond to a medical emergency, and failure to do so is grounds for legal action [46, 47].

According to British, Canadian, and US laws, medical professionals are not required to volunteer assistance during an in-flight medical event, unless they have a preexisting clinical relationship with the passenger. In contrast, physicians in Australia and many Asian, European, and Middle Eastern countries are required to provide assistance [41]. For international flights, the country where the aircraft is registered has jurisdiction, except when the aircraft is on the ground or in sovereign airspace [11, 41]. Medical assistance during an in-flight medical event is typically protected under Good Samaritan laws [3, 8, 48].

Documentation: According to the recommendations made by the International Air Transport Association (IATA), in-flight medical emergencies should be documented properly for a variety of reasons [42]. A recent study reported preliminary evidence that the documentation of in-flight medical emergencies is not as consistent as one would expect. Of the 32 European airlines that were asked to contribute data on in-flight medical emergencies, only 4 airlines were able to potentially provide the necessary data [14].

After the event, the provider should document the care that was provided and the treatment that was delivered and should use airline-specific documentation as required [42]. Providers should be mindful of the patient's privacy rights and should not discuss the patient's care with third parties (e.g., media) without appropriate authorization from the patient [49]. The captain of the aircraft and the flight crew should receive appropriate medical information to support correct medical management and allow for appropriate flight diversion. The airline itself is not obligated to follow federal regulations regarding healthcare privacy, because it is not considered to be a covered entity [17, 47].

In general, there is a large variation in the documentation of in-flight medical emergencies between airlines, and a higher degree of standardization is preferable for medical care, for research, and to meet the IATA recommendations [47].

4.11 Future Recommendations

Registries of in-flight emergencies: 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 exists. Presently, only company registers of specific airlines are available toward this end [10]. The lack of a central registry makes it difficult to conduct research as to the true incidence of in-flight events [10, 14]. The information gained from epidemiologic studies of in-flight medical emergencies is of benefit to the airlines, aerospace medical researchers, and the traveling public [5, 50, 51].

Training of airline personnel: In-flight medical emergencies occur frequently, and available evidence suggests that there is significant room to improve and standardize the care that is provided to patients during in-flight medical emergencies.

The US Federal Aviation Administration (FAA) mandates that flight attendants receive training “to include performance drills, in the proper use of AEDs and in CPR [cardiopulmonary resuscitation] at least once every 24 months” [52, 53]. However, the FAA “does not require a standard curriculum or standard testing” [52, 53].

Many airlines also contract with a commercial on-ground support company that can, in theory, offer radioed, real-time medical advice. To improve the chances that passengers who become ill during air travel will do well, airlines and their regulators could take steps similar to what they have done to ensure flight safety for all flights under FAA jurisdiction [52–54].

Other improvements for the future: The following suggestions are made from multiple studies examining long-haul in-flight emergencies:

1. A standardized recording system for all in-flight medical emergencies should be adopted, with mandatory reporting of each incident to the National Transportation Safety Board, the organization responsible for reviewing safety events and recommending changes to practice.
 - (a) A survey of European airlines identified 10,000 in-flight medical emergencies during a 5-year period [13]. The study noted that each airline had its own reporting system and protocol.
2. The optimal content of first aid kits on airplanes should be determined, with a mandate that a standard kit, with identical elements, in identical locations, be on every flight [13].
 - (a) Even though emergency medical kits are mandated to contain certain medications and equipment, the actual kits vary from airline to airline [52, 53].
3. The training of flight attendants in how to deal with medical emergencies should be enhanced and standardized.
 - (a) The US Federal Aviation Administration (FAA) mandates that flight attendants receive training “to include performance drills, in the proper use of AEDs] and in CPR [cardiopulmonary resuscitation] at least once every 24 months” [52, 53]. However, the FAA “does not require a standard curriculum or standard testing” [52, 53].
4. Access of flight crews to ground-to-air medical support should be standardized.
 - (a) Many airlines also contract with a commercial on-ground support company that can, in theory, offer radioed, real-time medical advice [54].

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