Australian Government
Civil Aviation Safety Authority

GUIDELINES

Medical Assessment for Aviation

January 2024

Acknowledgement of country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and their continuing connection to land, water and community, and pays respect to elders past, present and emerging.

Inside front cover artwork: James Baban.

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Contents

Revision history

Amendments/revisions of these guidelines are recorded below in order of most recent first.

Version No.	Date	Parts/Sections	Details
1.0	January 2024	All	First issue

1. Introduction

1.1 Purpose

This document provides applicant pilots, air traffic controllers and medical practitioners with comprehensive guidance on the principles of aeromedical risk assessment and medical conditions that may inform decisions about medical fitness for aviation duties.

The medical guidelines in this document aim to assist:

- pilots and controllers in making an informed self-assessment of their state of fitness, in accordance with the medical requirements for their medical certificate or declaration.
- medical practitioners and other health care providers by clarifying the aeromedical considerations for medical conditions and assessment requirements for medical certificates or declarations.

Each medical certificate or declaration has requirements under the Civil Aviation Safety Regulations 1998 or other instruments that govern the obligations of the licence holder regarding the medical standard they must meet, the declarations and notifications they must make, and the processes that must be followed in managing their medical status. This document uses language around when a person must, should or is recommended to see or report to a medical practitioner, a DAME, or CASA about their medical issues or that of their patient. In all cases, the CASRs or the instrument that implements the certificate, exemption or declaration takes primacy.

1.2 Scope

Section 2 of this document begins with a comprehensive overview of the principles of aeromedical risk assessment and decision-making. This includes an overview of areas such as the flying task and human performance, the psychological stresses of flight and the physiological effects to body systems caused by the challenging flight environment.

From Section 3 onwards, the document then lists specific medical conditions that may inform the provision of a proposed Class 5 medical self-declaration. Each medical condition is set out and defined in its own section using the same heading structure and breakdown of diagnoses and supporting assessment guidelines.

Table 1. Example section and content for a medical condition

Example: Section 3	Description
3. Blackouts	Specific medical condition.
3.1 **Aeromedical considerations** 3.1.1 Effect of flight environment on cardiovascular conditions 3.1.2 Effect of transient loss of consciousness on flying safety	The effect of the: • flight environment on the medical condition • medical condition on the flying task and safety.
3.2 **Medical assessment for pilots**	When an applicant must be assessed by a medical practitioner or referred to a CASA DAME, before certification can occur.
3.3 **Medical assessment for doctors** 3.3.1 Diagnosis: Blackouts due to vasovagal syncope 3.3.2 Diagnosis: Blackouts due to diagnosed medical conditions	Diagnoses for the specific medical condition are listed with: • risk assessment considerations (e.g. clinical history) • unfavourable factors (e.g. recurrent episodes).

Example: Section 3	Description
3.3.3 Diagnosis: Blackouts of undetermined cause	• favourable factors (e.g. applicant is asymptomatic) • aeromedical decisions (e.g. when applicant is fit to fly) • when to refer (e.g. to a CASA DAME).

Note: These guidelines also outline specific medical conditions that are **not** eligible for a Class 5 medical self-declaration.

1.3 More information

Note: More information regarding additional resources and training will be made available following public consultation.

2. Principles of aeromedical assessment and decision-making

2.1 The flight environment

2.1.1 Atmosphere and altitude

Aviation activities, whether they be for commercial purposes, personal transport or recreation, are conducted within the Earth's atmosphere. For aviators, the atmosphere is either a workplace or a playground. The atmosphere's ability to provide a warming blanket of air, shield the planet from incoming radiation from space, and provide oxygen to support life, means that the Earth is maintained as a habitable environment for human life.

However, the physical characteristics of the atmosphere in which we fly and how they change with increasing altitude, can have significant physiological impacts on the human body while undertaking those aviation activities. The 3 important characteristics we need to consider are:

- gas composition
- pressure
- temperature.

The air we breathe contains 78% nitrogen, 21% oxygen and 1% other rare gases. Fortunately, this composition does not change at all with increasing altitudes. And of course, it is oxygen which is essential to support life. So why then does the body experience a deficit of oxygen when exposed to high altitude? This is explained by the way that pressure changes.

Standard pressure at sea level, as every aviator knows, is 1013.2 hPa (29.92 inHg). It is the pressure datum set on the altimeter subscale of the aircraft above 10,000 ft in Australia. With increasing altitude, however, comes decreasing atmospheric pressure, which means that the amount of pressure driving oxygen from the lungs into the blood is decreasing, and volumes of gas within body cavities will expand on ascent (and contract on descent).

The physiological significance of these physical changes is explained in more detail below. Unlike divers who experience a very predictable change in pressure of an extra 1 atmosphere for every 10 metres they descend below the surface, aviators experience a very different profile of pressure change, which is more like an exponential decrease with increasing altitude. This means that the greatest rate of pressure decrease occurs closest to sea level, and the rate of pressure change decreases rapidly the higher you go. At 18,000 ft the atmospheric pressure is already half its sea level value.

Temperature decreases at a rate of 1.98 °C (degrees Celsius) per 1000 ft as you ascend through the troposphere, the lowest layer of the atmosphere. This means that in a standard atmosphere the outside air temperature would be -56.5 °C at 36,000 ft. The human body would not be able to tolerate exposure to these temperatures at altitude without protection provided by aircraft systems. Even a simple heating system in the cabin for flight below 10,000 ft is a necessity.

2.1.2 Physiology and psychological stresses of flight

Aside from the impacts from the changing atmospheric characteristics, are the impacts from the flight itself. The physiological effects caused by the challenging flight environment impact multiple body systems, including:

- the respiratory system
- vision
- balance
- the ears
- hearing

- the cardiovascular system
- the gut
- the brain.

Impacts to body systems

Barotrauma

One of the most common physiological problems experienced in flight is barotrauma, which is the injury caused to gas containing body cavities when gas volumes either increase of decrease under the influence of changing ambient or cabin atmospheric pressure. Regions of the body commonly affected include the ears, the sinuses, the gut, and much less commonly, teeth and lungs. Typically, ear or sinus pain can be experienced on descent through the lowest levels of the atmosphere, and this pain can be so severe that it impairs a pilot's ability to land the aircraft effectively and safely. In some cases, changing pressure inside the middle ear cavity can induce severe dizziness, a highly dangerous symptom to experience while piloting an aircraft.

Hypoxia

At sea level, the partial pressure of oxygen in the air is 21% of the total pressure (1013.2 hPa). This is an important pressure because the body relies upon it as the driving force that pushes oxygen from the air sacs of the lungs into the blood and onto the red blood cells that transport it through the circulation. With decreasing atmospheric pressure, this partial pressure decreases because although the concentration of oxygen always remains 21%, the total pressure of the atmosphere is reducing. For example, at 18,000 ft where atmospheric pressure if halved, the partial pressure of oxygen is also halved. This means the driving force for oxygen into the body has been substantially reduced. As a result, oxygen supply to the cells, tissues, organs and especially the brain, will fall below what is required to maintain adequate function. This is a condition known as hypoxia.

Healthy human physiology can normally cope and tolerate this decreasing partial oxygen pressure up to an altitude of 10,000 ft, after which oxygen is generally required for the crew. Those with less than healthy physiology or medical conditions may not fare so well and suffer the effects of hypoxia below 10,000 ft. It can make underlying medical problems much worse. This demonstrates the critical importance of being medically and physiologically fit to fly any aircraft.

Decompression Illness (DCI)

Decompression illness, also known widely as 'the bends', is a concern for aviators as well as SCUBA divers. DCI occurs when a reduced atmospheric pressure at altitude, with decreased partial pressure of nitrogen, can cause the formation of microscopic bubbles of nitrogen within body tissues and the bloodstream. It can affect multiple body organ systems, but most commonly results in joint pains, neurological symptoms, rashes, and rarely breathing difficulty.

It is most likely to occur with long exposures to altitudes and ambient pressures well above 18,000 ft but can occur at any altitude if certain predisposing conditions exist, such as recent scuba diving. Any symptoms occurring in flight that might be DCI would prompt an immediate descent to higher pressures, use of oxygen if available and on landing, urgent assessment by medical personnel experienced in diving and aerospace medicine.

G-forces

Aerobatic flight, high speed manoeuvring and steep turns are examples of flight operations that can subject the body of the pilot to high levels of acceleration and therefore high G-loads. Acceleration in the head-to-foot direction (known as +Gz) has profound effects on the human cardiovascular system and puts it under considerable stress. Human reflexes are designed to maintain blood pressure and flow to the brain and eyes under normal conditions of +1 Gz (normal gravity).

As this G-force increases during flight, blood is pushed downwards in the body, reducing the blood flow and oxygen supply to the brain. The heart is put under stress as it tries to compensate, but eventually vision becomes impaired, the blood starved brain will switch off and consciousness will be lost at +4-5 Gz and above.

Noise

Light aircraft can be extremely noisy. This results in 2 potential problems:

1. It can impair effective communications between aircraft occupants, or between the crew and air traffic control or other aircraft.
2. Prolonged exposure to loud noise can result in long-term damage to the ears and loss of hearing.

The standard for safe noise exposure in Australia allows for an average exposure of up to 85 dB over an 8-hour period. Most aircraft are much noisier than this, so the use of hearing protection is essential to preserve the hearing of pilots. Having healthy ears and normal hearing is an important step towards ensuring safe and effective communication in these noisy environments. In particular, normal hearing is important for radio communications between aircraft in the air, and between the aircraft and the ground. This is especially important for flight in and around controlled airspace. Normal hearing is also important for audible warnings and alerts, and for awareness of the normal operation of the aircraft systems such as engine sounds.

Vision

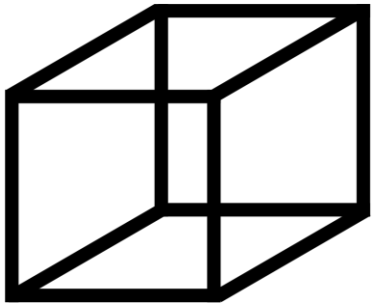
The human visual system is an amazingly complex sensory system that allows us to see the fine detail of objects we need to identify, plays a role in posture and balance, provides discrimination of distance and depth, and allows us to see the world in colour. Although they normally need a lot of light to work well, eyes can still adapt to darkness and allow some degraded vision in darkness. The eyes provide us with 80% of the information we need for the brain to correctly orient us within our surroundings.

As amazing as this system is, there are still inherent limitations, even in normal eyes, that can reduce visual performance in flight. Some examples of these normal limitations include:

- blind spots, especially a night blind spot in your central vision
- the poor acuity and colour perception of peripheral vision
- the (sometimes) confusing cues of depth perception.

Additionally, the brain can misinterpret visual information even when it is easily visible. Perception has a lot to do with how the brain interprets this information. How often do you hear people say, ‘my eyes are playing tricks on me!’? An example is shown at Figure 1 below[i]:

Figure 1. How many different ways can you see this cube?



In clear visual meteorological conditions, good visual function is essential to maintain separation from other aircraft and terrain (see and avoid), to read instruments, charts and documents. It is therefore important to ensure that there are no medical conditions or treatments that impair the normal function of the visual system, which might predispose to spatial disorientation.

Balance and motion: the Human ‘sixth sense’

There are sensory systems that are rarely mentioned, most likely because they act constantly and subconsciously to keep you oriented in the world. The 2 systems involved are called the:

[i] (Image credit: https://openclipart.org/detail/5523/necker-cube)

- vestibular system
- proprioceptive system.

The sensory organs of the vestibular system are located deep inside the inner ear and are constantly detecting accelerations acting on the body whenever you move forward or back, up or down, or rotate. This is also important to help the eyes track the world around you accurately.

The proprioceptive system includes multiple sense organs in the skin, joints, muscles, and tendons, feeding information to the brain about limb position, external pressures and vibrations, and muscle stretch. Pressure on certain parts of the body, for example, lets you know subconsciously which way gravity is acting. These systems together provide the brain with about 20% of the information it requires to provide orientation, balance, and postural stability.

Spatial disorientation

The human sensory systems that provide the brain with the necessary information for orientation relative to world around you, the vestibular, visual and proprioceptive systems, are designed to maintain balance and postural control in a straight and level, normal gravity two-dimensional environment. Flying exposes those sensory systems to a highly dynamic motion environment with varying accelerations in 3 dimensions, for which they are poorly adapted. When spatial disorientation occurs, it often involves all 3 of these systems in some way and is caused by multiple different factors.

In flight, the visual information which provides the most reliable picture of your position in space can be limited, confusing, or indeed absent altogether. When this happens, there is the possibility of visual illusions occurring, where the brain does not have enough information to perceive the world accurately, so spatial disorientation can result. An example at night is the tendency to confuse ground lights with stars and vice versa. Even normal visual functions can cause problems when flying. The brain’s skill at perceiving the horizon as a horizontal reference can work against you if a sloping bank of cloud or a coastline suddenly looks like the horizon. The eyes’ ability to sense movement and provide balance can lead to false perceptions of motion, like when you are in a stationary car and the car next to you starts rolling forward.

Spatial disorientation that arises from the balance (vestibular) system because of aircraft manoeuvring and accelerations can result in a number of different illusions. A common example of this is called ‘the leans’, which is an illusion experienced by pilots in situations with limited visual references. It occurs when the aircraft is in a coordinated turn and then levels off or returns to straight and level flight. During the turn, the vestibular system in the inner ear senses the acceleration and movement, providing the pilot with a sense of orientation. However, when the aircraft levels off, the fluid in the inner ear continues to move for a short period, creating a mismatch between the vestibular system and the visual cues. As a result, the pilot may feel a false sensation of banking or turning in the opposite direction. For example, after completing a coordinated turn to the left and levelling off, the pilot may experience a sensation of the aircraft banking to the right, leading them to lean to the left to correct the perceived imbalance.

Another example is called the ‘dark night take-off’ or somatogravic illusion. This is a vestibular illusion that can occur during aircraft acceleration or deceleration, particularly in situations where visual cues are limited during take-off or landing. The somatogravic illusion is based on the sensory input received by the vestibular system, which includes the otolith organs that sense linear accelerations, such as changes in speed or direction. When an aircraft accelerates forward, the otolith organs sense this linear acceleration as a tilt backward. As a result, the pilot may experience a false sensation of the nose pitching upward. This can lead the pilot to perceive that the aircraft is in a more nose-high attitude than it is. During landing or when the aircraft decelerates, the somatogravic illusion can create a false sensation of the nose pitching downward. This can lead the pilot to perceive that the aircraft is in a more nose-low attitude than it actually is.

To prevent spatial disorientation, it is important that you ensure that you do not have medical conditions or take medications that can impair the normal functioning of your balance and orientation system.

Motion sickness

Motion sickness is a common condition in aviators, especially for inexperienced student pilots. It can occur when there is a disconnect between the visual input received by the eyes and the vestibular (balance) system's perception of movement. It typically arises when a person is exposed to certain types of motion or motion-related environments, such as turbulent flights or sea voyages. An example of this disconnect is reading a map in a moving aircraft, where the eyes perceive a stationary environment while the vestibular system detects the aircraft’s motion, leading to sensory conflict.

The most common symptom of motion sickness is nausea, which may be accompanied by vomiting in severe cases. The sensation of queasiness arises due to the body's response to conflicting sensory signals. Prolonged motion sickness can result in fatigue, general discomfort, and a sense of overall unease. Individuals experiencing motion sickness may exhibit symptoms such as cold sweats, and paleness of the skin. Some people may develop headaches or migraines because of motion sickness. Motion sickness can impair cognitive functions, concentration, and overall performance, making it challenging to engage in activities such as flying.

The severity of motion sickness symptoms can vary from person to person. While some individuals may only experience mild discomfort, others may suffer from more severe symptoms that significantly impact their activities. Various preventive measures and treatments, such as medication, acupressure bands, and controlled breathing techniques, can help alleviate or manage motion sickness. It is important to note that many of the medications used to treat motion sickness can cause drowsiness or blurred vision, and other side effects that are not acceptable for aviation. If treatments are being considered, it is a good idea to speak with your medical practitioner about the best options.

Thermal stress

Thermal stress refers to the challenges posed by extreme temperatures in aviation.

Heat stress can be caused by:

- high ambient temperatures (operating in hot climates)
- intense sunlight, which can elevate temperatures within the aircraft
- enclosed spaces, of aircraft cabins and cockpits, which lead to heat build-up, especially during ground operations
- engine heat.

Cold stress can be caused by:

- low ambient temperatures in cold climates
- wind chill (the combination of low temperatures and wind)
- cold aircraft cabins with poor insulation
- inadequate heating systems, and at high altitude because temperature decreases by approximately 2 °C per thousand feet.

Thermal stress can affect pilot performance in several ways:

- Physical discomfort**:** High temperatures can cause physical discomfort, leading to sweating, dehydration, and fatigue. The body's natural cooling mechanisms may struggle to cope with excessive heat, resulting in discomfort and reduced physical performance.
- Dehydration**:** Heat can accelerate the process of dehydration, as the body loses water through perspiration. Dehydration can impair cognitive function, decrease alertness, and lead to fatigue, which can affect a pilot's decision-making abilities and reaction times.
- Heat exhaustion and heatstroke: Prolonged exposure to high temperatures without adequate measures to cool down can lead to heat-related illnesses such as heat exhaustion and heatstroke. These conditions can cause dizziness, confusion, weakness, and even loss of consciousness, severely compromising a pilot's ability to operate an aircraft safely.
- Reduced cognitive performance: Thermal stress can impair cognitive performance, including attention, concentration, memory, and decision-making. High temperatures can increase mental fatigue, reduce vigilance, and slow down cognitive processing, which can impact a pilot's ability to effectively monitor the aircraft, respond to critical situations, and make accurate judgments. Cold stress can slow down the body's overall response time. Pilots may experience delayed reactions to critical situations, such as changes in weather conditions or unexpected events, which can affect their ability to make quick decisions and take appropriate actions.
- Decreased dexterity: Cold temperatures can impair manual dexterity and fine motor skills. Pilots may experience reduced sensitivity and coordination in their hands and fingers, making tasks that require

precise movements, such as operating controls and instruments, more challenging.

- Fatigue and discomfort: Cold temperatures can cause physical discomfort and lead to fatigue. Pilots who are uncomfortable and fatigued may experience decreased alertness and mental performance, increasing the risk of errors or lapses in judgment.
- Frostbite and hypothermia: In extreme cases of cold stress, pilots may be at risk of developing frostbite or hypothermia. Frostbite can result in numbness, pain, and tissue damage, while hypothermia can lead to confusion, shivering, and impaired cognitive function, posing a severe threat to pilot performance and safety.

To mitigate the effects of thermal stress, it is important to ensure your physical health is appropriate for the task and you take precautions. These precautions include:

- wearing appropriate protective clothing and gear
- staying well-hydrated
- utilising heating or cooling systems in the cockpit
- scheduling flights during cooler times of the day
- implementing rest and recovery periods in extreme temperature conditions.

2.2 The flying task and human performance

2.2.1 Priorities of the flying task: Aviate, navigate and communicate

As soon as flight training commences, most pilots are trained to prioritise their focus and actions in the cockpit in a way that will remain relevant throughout their career in any aircraft, be it in a Cessna 152 or a Boeing 787: that is, to ‘aviate, navigate, and communicate’.

- Aviate: The first priority of any pilot is to aviate effectively, which refers to safely flying the aeroplane by manipulation of the flight controls, as well as via the flight instruments that allow them to safely direct the aeroplane’s attitude, airspeed, and altitude.
- Navigate: Once this top priority has been established and implemented, a pilot can then turn their attention to establishing where they are and where they’re going (navigate).
- Communicate: As appropriate, talking to air traffic control (ATC), other crew members or pilots of other aircraft can then be given some of the pilot’s attention and concentration (communicate).

What is critical, however, is not losing track of the number one priority at any stage, no matter how well a pilot can navigate and communicate—it means nothing if they fail to fly the aircraft safely. Such a simple set of priorities may seem straightforward and easy to follow, but it’s easy to forget when you get busy or distracted in the cockpit.

2.2.2 The importance of human factors to performance

Being able to apply effective human performance concepts is of critical importance to achieving safety across all aspects of aviation. Results from accident investigations from authorities around the world make it clear that the majority of aviation incidents and accidents can be attributed to human error—that is, the cause of the incident lies with those people working within the aviation system itself. Studying and understanding human factors relevant to aviation is part of any pilot training program, and models have been developed to help unpack all the factors that may have contributed to an incident or accident. One such system is known as HFACS.

HFACS (Human Factors Analysis and Classification System)

HFACS is a model used by the United States Air Force (USAF) to analyse and understand the underlying factors contributing to aviation accidents and incidents. It focuses on human factors as a key element in accident causation and provides a framework for identifying and classifying these factors. HFACS consists of 4 levels of analysis, each representing a different category of human error.

Unsafe Acts: This level encompasses the active failures or actions that directly contribute to accidents, such as errors in decision-making, skill-based errors, violations of procedures, or lack of situational awareness.

Preconditions for Unsafe Acts: These are the individual and environmental factors that influence human performance and contribute to the occurrence of unsafe acts. They include factors such as fatigue, stress, inadequate training, organisational culture, and communication issues.

Unsafe Supervision: This level focuses on supervisory factors that can influence safety. It includes inadequate supervision, insufficient resources, ineffective leadership, and poor communication within the organisation.

Organisational Influences: This level encompasses the broader organisational factors that shape safety culture and influence individual and supervisory behaviour. It includes organisational policies, resource allocation, training programs, and the overall safety culture.

By systematically categorising factors at each level, HFACS helps identify root causes of accidents and incidents and provides insights for implementing preventive measures. HFACS emphasises the importance of addressing not only individual errors but also the organisational and systemic factors that contribute to them, fostering a proactive approach to aviation safety.

2.2.3 Judgement and decision-making

The importance of open and honest medical self-declaration by individual pilots cannot be understated. The goal here is not to enforce unattainable levels of medical certification but to simply encourage an honest declaration, as discussed above, that will allow for a level of cognition and performance in flight that will minimise errors, as well as the consequences of those errors that do occur.

Being able to competently make sound decisions, exercise judgement and react to the complex, dynamic environment that is the cockpit of an aircraft, requires not only adequate vision and hearing, but also unimpaired cognition. As discussed further in section 2.2.5 on stress, factors to which a pilot might be subjected, can occasionally lead to unintended errors in judgement and task management. However, the performance expectation is not of perfection, but of a reasonable level that can be applied during every flight to maintain safety.

Decision-making is a skill that goes beyond technical expertise. While some individuals may have a natural inclination for it, it is often a skill that needs to be learned. Numerous factors can influence decision-making, including stress, time constraints, knowledge, perception, and experience. We have all likely experienced instances where we made poor decisions, often due to overlooking available options or misdiagnosing the problem initially. In aviation, hasty and poorly considered decisions can lead to severe consequences, which is why some aviators undergo specific training in the decision-making process.

To prevent making rushed or inappropriate decisions, pilots can utilise decision-making tools. These tools provide structure and discipline to the process. Various forms of decision-making tools exist, but a useful one that can be applied to recreational aviation is PIOSEE.

The PIOSEE decision-making tool

The mnemonic PIOSEE is used as a decision-making tool and memory aid in aviation. It is an abbreviation for:

Problem: Identify the problem or issue that needs to be addressed. This could be a situation that requires a decision or action.

Information: Gather all relevant information related to the problem. This includes any available data, reports, observations, or inputs from others.

Options: Generate a range of potential options or solutions to the problem. Consider different courses of action and evaluate their feasibility and potential outcomes.

Select: Evaluate and choose the best option among the alternatives based on the available information and the desired outcome.

Execute: Implement the chosen option effectively and efficiently. Take the necessary actions to execute the selected course of action.

Evaluate: Continuously monitor and assess the results and effectiveness of the executed option. Evaluate if the problem has been resolved, and if not, consider adjusting the approach or selecting a new option.

PIOSEE provides a structured framework for decision-making, helping individuals systematically address problems and make informed choices. It is particularly useful in dynamic and time-sensitive situations, such as aviation, where quick and accurate decision-making is crucial for safety and operational efficiency.

2.2.4 Situational awareness and information processing

Situational awareness is formally defined as the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future[91]. It involves being aware of the current situation, anticipating potential changes, and comprehending the implications of those changes.

Five key elements of situational awareness

Situational awareness encompasses 5 key elements:

1. Perception: Gathering information through instruments, visual cues, radio communications, and other sources to understand the current state of the aircraft and its surroundings.
2. Comprehension: Processing and understanding the collected information to determine the aircraft's position, trajectory, and potential risks or hazards.
3. Projection: Anticipating how the situation might evolve based on the available information, weather conditions, air traffic, and other factors.
4. Decision-making: Making informed decisions based on the perceived situation and projected developments to maintain flight safety and efficiency.
5. Action: Implementing appropriate actions to mitigate risks, adjust the flight path, or communicate with air traffic control or other aircraft, as necessary.

Situational awareness is a crucial skill for pilots to ensure safe and effective decision-making during all phases of flight. It helps pilots identify and respond to potential hazards, maintain proper navigation, manage aircraft systems, and remain aware of other air traffic in the vicinity.

To effectively implement priorities, a pilot must be able to not only concentrate on the task at hand but also maintain enough awareness of their environment to take note of and prioritise incoming information from the variety of sources around them. For example, these sources could include radiotelephony, aircraft systems, weather and turbulence, and visual scanning. This is where human factors become an important concept, as it is not enough to simply fly the aeroplane (important as that may be, as discussed above) and have adequate vision and hearing, but to also be able to effectively multi-task, maintain adequate situational awareness, and prioritise what they should be doing and when.

Five stages of human information processing

How we process information is crucial to establishing and maintaining situational awareness. Human information processing refers to the cognitive processes involved in perceiving, interpreting, and understanding information from the environment. It involves 5 stages: sensation, perception, attention, memory, and decision-making.

1. Sensation: During sensation, sensory organs receive stimuli from the environment, such as visual or auditory cues, and transmit them to the brain for further processing (bottom-up processing).
2. Perception: Perception involves the interpretation and organisation of sensory information to form meaningful representations of the world (top-down processing).
3. Attention: Attention plays a crucial role in selecting relevant information for further processing while filtering out distractions.
4. Memory: Memory processes encode, store, and retrieve information, allowing for the retention and recall of past experiences.
5. Decision-making: Finally, decision-making involves evaluating and integrating available information to make choices or take action.

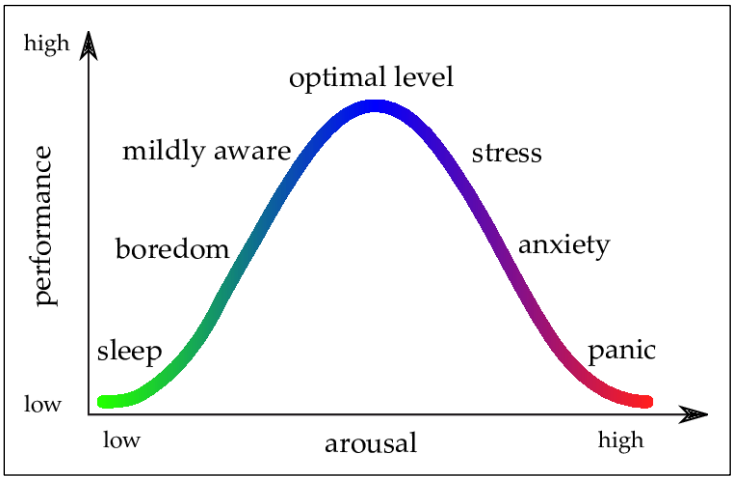
Human information processing is therefore a complex and dynamic system that allows individuals to interact with their surroundings, make sense of the world, and respond effectively to various situations. It involves the interplay of cognitive processes to perceive, process, and utilise information, ultimately influencing our thoughts, behaviours, and decision-making abilities.

2.2.5 Stress and dealing with emergencies

Relationship between stress levels and performance

There is a relationship between arousal or stress levels and performance or task execution. It suggests that there is an optimal level of arousal or stress that leads to peak performance, while both low and high levels of arousal can result in diminished performance. Performance tends to improve as arousal increases up to a certain point. As arousal levels rise, there is an optimal point where individuals become more alert, focussed, and motivated, which can enhance their performance. However, beyond the optimal point, further increases in arousal can lead to negative effects on performance.

Figure 1. The Performance-Arousal curve[ii]



Emergency situations and the associated distractions in the cockpit can cause extreme stress and be deadly. With so much activity often occurring within a short space of time, it is easy to understand how our focus on more critical items or tasks can become degraded. Pilots are trained to do everything they can to minimise distractions as best they are able and focus on what is most important in an emergency or any high-stress situation.

From a human factors perspective, one can break down an emergency scenario into 2 components:

1. Stress: Unfamiliar events may be occurring with more of our attention and focus being required.
2. Workload: An increase in items to action in a shorter period.

Differences in communication can become exacerbated, and a tendency to rush due to an often-inaccurate perception of time can occur. The reason we discuss emergency scenarios independently within a medical guidelines document such as this is because years of research and accident investigation have shown that people are particularly likely to react differently and unexpectedly compared to their usual routine behaviour when exposed to such situations. This is understandable and explained by the physiology of the human fight-or-flight response.

The acute stress response

The fight-flight-freeze response, also known as the acute stress response, is a physiological reaction triggered by a perceived threat or stressful situation. It is an innate mechanism that prepares the body to either confront the threat (fight) or escape from it (flight); or take time to analyse and prepare for response

[ii] Haberkorn T. *Aircraft separation in uncontrolled airspace including human factors* 2016.

(freeze). When a person encounters a threat or perceives danger, the release of stress hormones, initiate a cascade of physiological changes throughout the body, preparing it for immediate action. In the:

- fight response, the body prepares for aggression and physical confrontation. The heart rate and blood pressure increase, the muscles tense, and the senses become heightened.
- flight response**,** the body prepares for rapid escape or avoidance of the threat. The heart rate and breathing rate increase further to supply oxygen to the muscles. Blood flow is redirected from non-essential areas to the muscles, resulting in increased alertness and readiness for quick movements.
- Freeze response, the body is making time for the situation to evolve, and for the body and brain systems to be able to understand the threat and to formulate the best response. Heart rate and breathing can change (often lower) and body movements and reactions can be slowed.

All of these reactions can help with survival in the face of threats and stress, but when they are not working normally (over or under-active) the person can end up suffering more harm. This can be seen with diseases like severe anxiety and post-traumatic stress disorder.

In modern-day life, the fight-or-flight response can also be triggered by non-physical stressors, such as work pressure or emotional stress. These physiological responses can lead to physical symptoms such as those of hyperventilation, shaking, and palpitations.

Tips for dealing with emergencies

There are simple things a pilot can do to increase the chances of a good outcome should an emergency occur during the flight. Putting in the time and effort to plan ahead and brief any passengers you may have on board before the flight could prove to be a lifesaver. Set expectations as best you can, slowly and carefully describe your role in the flight as well as theirs.

Remember that many passengers might be nervous about flying, and taking in new information can be difficult in a stressful situation. Ensuring that all on board are aware of the concept of a sterile cockpit and how to apply it—that is, no conversation or unnecessary distractions that are not directly related to flight safety during those critical periods of flight (namely, take-off and landing).

2.2.6 Threat and error management

Threat and error management (TEM) is a systematic approach used in aviation to identify, assess, and mitigate potential threats and errors that can lead to incidents or accidents. It focuses on proactive strategies to enhance safety by recognising and managing risks within the operational environment.

- Threats: Threats in aviation refer to external factors or events that have the potential to adversely affect flight safety. These can include adverse weather conditions, air traffic congestion, equipment malfunctions, or human factors like fatigue or distractions. TEM emphasises the importance of anticipating and mitigating these threats through effective risk assessment, situational awareness, and decision-making.
- Errors: Errors, on the other hand, encompass unintentional actions, mistakes, or failures in the execution of tasks. They can arise from factors such as miscommunication, inadequate training, or cognitive limitations. TEM recognises that errors are a normal part of human performance and aims to minimise their impact by promoting error detection, error recovery, and the use of error reduction techniques like checklists or automation.

TEM involves various strategies and practices, such as crew resource management (CRM), threat and error analysis (TEA), and operational procedures that promote open communication, teamwork, and the continuous improvement of safety processes. By adopting TEM principles, pilots can better understand and manage the complex and dynamic nature of threats and errors, enhancing safety and reducing the likelihood of incidents or accidents.

2.3 General principles of aeromedical assessment

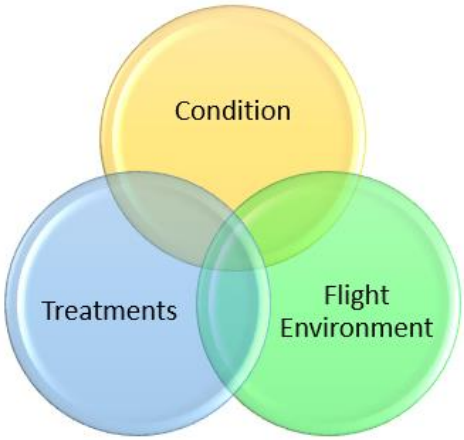
The aim of determining fitness to fly is to achieve a balance between:

1. minimising any risk of aviation accidents for the individual and the community posed by the pilot's injury or illness.
2. maintaining the pilot's freedom to exercise the privileges of their pilot licence.

In any assessment of aeromedical risk, it is important to consider the three-way interaction between:

- the flight environment and task
- the condition itself
- any medications or treatments.

Figure 2. Interaction between the flight environment, condition and treatments



The key question to address in assessing the risk of any medical condition is this:

> What is the likelihood that the person will be unable to control the aircraft and/or be unable to act or react to the flight environment in both normal and emergency circumstances in a safe, consistent, and timely manner?

Acute incapacitation and subtle impairment are 2 terms used to describe different levels or types of medical conditions that can affect a person's ability to perform their duties or tasks, especially in high-risk environments such as aviation. Both acute and subtle incapacitation pose risks in safety-critical environments, such as aviation. Using medical screening tools such as the Class 5 medical self-declaration process and the ongoing and appropriate management of significant health conditions in recreational pilots are crucial to mitigating the risks associated with incapacitation.

2.3.1 Acute incapacitation

Acute incapacitation refers to a sudden and severe impairment of physical or mental functions that renders an individual incapable of performing their duties effectively or safely. This could result from a medical emergency, such as a heart attack, stroke, seizure, or loss of consciousness. Acute incapacitation is often readily apparent and can have immediate and profound consequences on a person's ability to function in their role. These guidelines focus mainly on medical conditions that have the potential to cause significant impairment and/or sudden incapacity.

2.3.2 Subtle impairment

Subtle impairment , sometimes referred to interchangeably as subtle incapacitation, refers to a more gradual or subtle impairment of physical or mental functions that may not be immediately obvious or noticeable. It may arise from conditions such as fatigue, stress, medication side effects, dehydration, or certain medical conditions that cause cognitive or physical limitations. Subtle impairment can affect an individual's performance, decision-making, reaction times, or situational awareness, compromising their ability to carry out tasks effectively without being immediately apparent to others.

The following should be considered when assessing the possibility of subtle incapacitation/impairment:

- Impairments can either persist or occur episodically (e.g. seizures). Pilots with persistent impairments can be assessed based on their observable abilities and functional capacity. However, those with episodic impairments need to undergo a risk analysis that considers the likelihood and impact of the episode, as well as any triggering factors and the potential for avoidance.

- Some impairments may fluctuate, such as the cognitive abilities of individuals living with dementia, which can vary from day-to-day or within a 24-hour period. It is crucial to consider the potential for fluctuating capacity and its effect on flying safety.
- Impairments can be progressive or static, which refers to permanent disabilities. The distinction between progressive and static conditions has implications for ongoing monitoring.
- Impairments can also arise due to the use of medications that affect sensory function, motor function and cognitive abilities. Medications can also impact reaction time, thus affecting the risk of sudden incapacity and loss of control of an aircraft.
- Impairments can resolve with treatment, which has implications for reassessing and reinstating medical certification.

2.3.3 Undifferentiated conditions

A pilot may exhibit symptoms that could have implications for their fitness to fly, but where the diagnosis is uncertain. Conducting investigations to determine the cause of the symptoms will result in a period of uncertainty before a definitive diagnosis can be made and the appropriate certification requirements can be applied with confidence.

Each situation involving a pilot will require individual assessment, considering the likelihood of a serious medical condition or a long-term injury or illness that may affect their ability to fly, as well as the specific circumstances in which flying is required. However, if a pilot presents with symptoms of a severe nature, such as chest pains, dizziness, blackouts, or delusional states, they should be advised not to fly until their condition can be thoroughly evaluated. Once a diagnosis is definitively established and the applicable relevant section of these guidelines can be applied.

2.3.4 Preventing incapacitation

The IMSAFE checklist is a widely used tool in aviation for self-assessing a pilot's fitness for flight. It is an acronym that stands for the following elements:

1. Illness: Pilots assess themselves for any illness or symptoms that may affect their ability to safely operate an aircraft. This includes conditions such as fever, severe cold or flu, dizziness, nausea, or any other illness that may impair cognitive or physical functioning.
2. Medication: Pilots evaluate the medications they are taking to determine if any of them have side effects that could impact their performance. Certain medications can cause drowsiness, dizziness, or other impairments that may affect a pilot's ability to fly safely.
3. Stress: Pilots consider their stress levels and determine if they are under excessive stress that could affect their focus, decision-making, or situational awareness. High levels of stress can impair cognitive abilities and increase the risk of errors during flight.
4. Alcohol and other drugs: Pilots ensure they are free from the effects of alcohol and other drugs. It is crucial to adhere to the regulations under Part 99 of the *Civil Aviation Safety Regulations 1998* (CASR) regarding alcohol consumption before operating an aircraft. Generally, a specific time frame must elapse between consuming alcohol and flying, and you must not have a blood alcohol higher than 0.02%. Pilots must also be free from the effects of illicit substances, and not suffering from problematic use, dependence or disorders relating to substances.
5. Fatigue: Pilots assess their level of fatigue and determine if they have had enough rest and sleep before a flight. Fatigue can significantly impair performance, reaction times, and decision-making abilities, posing a risk to flight safety.
6. Eating and hydration: Pilots consider their nutritional status and fluid intake. Adequate nutrition is essential for maintaining energy levels and cognitive function, while dehydration can impact blood pressure, concentration and decision-making abilities.

The first checklist of each flight should be done on you, the pilot. By going through the IMSAFE checklist before every flight, pilots can self-assess their physical and mental condition to ensure they are fit to fly. It promotes self-awareness and helps identify potential issues that could compromise flight safety by causing acute incapacitation or impairment. If any element of the checklist raises concerns, pilots should take appropriate actions, such as seeking medical advice, resting, or delaying the flight until they are fit to fly.

2.4 Australian aviation regulations

2.4.1 Part 67 of CASR

The *Civil Aviation Safety Regulations 1998* (CASR) is the principal legal instrument that provides direction on how the *Civil Aviation Act 1988* is implemented in Australia. It includes the requirements and obligations for aviation operations and licensing for individuals. Part 67 of CASRs governs the system for aviation medical certification.

The Class 5 medical self-declaration does not fall under Part 67 of the CASRs in terms of requirements for medical examinations, issuance of medical certificates and medical standards. However, the pilots who are flying with a Class 5 medical self-declaration continue to be subject to the requirements and obligations under the CASRs and other Australian laws. This includes the obligation for making true and honest declarations, and notification to CASA of any situation where their ability to exercise the privileges of their pilot's licence may be in question. It also includes CASA's authority to issue, suspend or cancel certificates and licences.

2.4.2 Medical examiners and examinations

Aerospace medicine professionals, called designated aviation medical examiners (DAMEs), examine pilots, air traffic controllers and other aviation industry personnel who require medical certification. Medical examinations are conducted to ensure aviation personnel meet the provisions of the:

- *Civil Aviation Act 1988*
- *Civil Aviation Regulations 1988 (CAR)*
- *Civil Aviation Safety Regulations 1998 (CASR)*.

DAMEs are accountable to the CASA principal medical officer (PMO). The PMO oversees the administration of the aviation medicine system. In addition to DAMEs, there are also designated aviation ophthalmologists (DAOs) and credentialed optometrists (COs).

DAMEs conduct medical examinations and issue certificates for fitness to return to flying under Part 67 of CASR. They are delegated to:

- personally conduct the applicant medical examination
- discuss the applicant's medical history and medical record with the applicant
- refer applicants for follow-up testing when required
- respond to questions from applicants about illness or medical conditions.

DAMEs are required to send relevant information to CASA within a reasonable period of time—usually not more than 14 days after seeing the patient.

Not all medical encounters for pilots and air traffic controllers need to be with a DAME. For example, a mild medical condition that is not safety-relevant for that pilot (such as a sprained ankle or mild head cold) does not need a DAME to be involved in the management. Class 5 medical self-declarations also do not need to have oversight or management by a DAME. There is always value, however, wherever there is a question from a pilot, controller or their health care provider, in checking with a DAME or with CASA Avmed about whether a health state, disease or treatment might be an issue for aviation safety and for their medical certificate or declaration.

2.4.3 Responsibilities of pilots and doctors

Class 1, 2 and 3 aviation medical certificate-holders have specific responsibilities under the CASRs regarding their medical examinations, medical certificates and reporting obligations. Class 1, 2 and 3 medical certificate-holders and their DAMEs, DAOs and/or COs are encouraged to refer to the Guidelines to inform their assessment of the aviation safety-relevance of health states, diseases or treatments, but the content of

the Guidelines does not override the regulatory obligations including those in the Clinical Practice Guidelines, DAME handbook or individual directions or decisions on a person's aviation medical certificate.

Class 5 medical self-declarations require a person to make a self-assessment of their health status, disease or treatment regarding its safety-relevance. The Guidelines are designed to assist that self-assessment, so that the declaration can be made in a way that is reliable, valid and safe. Many sections of the Guidelines state that in a certain situation a pilot is strongly advised to see a medical practitioner or DAME for assessment of their eligibility to make a Class 5 medical self-declaration. These are circumstances where a self-assessment of diagnosis, severity or degree of impairment cannot be reasonably made without the input from a medical practitioner, or where results of tests must be interpreted by a medical practitioner in order to properly understand the aviation safety implications of a medical condition. A person may not have made a lawful Class 5 medical self-declaration if they haven't sought or relied on the medical advice recommended in the Guidelines.

If a pilot consults with a health care provider regarding their fitness to make a Class 5 self-declaration and the provider does not refer to the Guidelines and follow the recommendations, that medical practitioner may be considered not to have acted in accordance with the principles of Good medical practice: a code of conduct for doctors in Australia.

2.4.4 Part 99 of CASR

Part 99 of the *Civil Aviation Safety Regulations 1998 (CASR)* sets out a framework for the development of drug and alcohol management plans (DAMPs) for people involved in safety-sensitive aviation activities (SSAAs) and a regime for random drug and alcohol tests conducted by, or on behalf of CASA.

All pilots, no matter what licence or medical certificate, are included in the Part 99 alcohol and other drug testing processes. In most cases, medications that may return a positive result on a DAMP drug test are also not compatible with holding a Class 1, 2 or 3 medical certificates. Pilots who are flying with a Class 5 medical self-declaration or other non-DAME or non-CASA medical system (such as RAMPC, Basic Class 2 exemption or ASAO-managed system) should consider whether their medications may return an initial positive result for DAMP test and consult with their health care provider or a Medical Review Officer to understand how to manage this safely while they are performing SSAAs, and what to do if they return a positive DAMP test result.

3. Class 5 medical self-declaration excluded conditions

3.1 Aeromedical considerations

This list of excluded conditions in the Class 5 medical self-declaration has been formulated based on the following principles:

- the ability to reflect on personal health and wellbeing (How do I feel? Does the way I feel present a hazard to safe flying?)
- the ability to understand the details of symptoms, diagnosis and treatment (How bad is my disease? How much does it affect me? How do these medications make me feel? How much do they affect me?)
- the predictability or reliability of that assessment for the flight (Can the way I feel or the status of my disease change while I'm flying in a way that is unsafe and can't be predicted?).

Applying these principles, a self-assessment cannot be reliably made by:

- a person who has been diagnosed with a disease or condition that reduces their capacity to self-assess and/or to make a declaration (for example, dementia or psychosis)

- a person who is currently regularly* taking a medication or using substances that may reduce their capacity to self-assess and/or to make a declaration.
  - (*) regularly means taking the medication most days, and/or the disease or symptoms will become significantly worse if the medication is not taken on most days.
  - These include:
    - » benzodiazepines and other sedatives
      (1) for example, diazepam, alprazolam,
    - » antipsychotics
      (1) for example, olanzapine, quetiapine, aripiprazole
    - » tricyclic antidepressants
      (1) for example, amitriptyline
    - » mood stabilising medications
      (1) for example, lithium, sodium valproate
    - » narcotic analgesics
      (1) for example, hydromorphone, codeine, morphine, oxycodone
    - » pain-modifying medications
      (1) for example, gabapentin, pregabalin
    - » alcohol and other drugs whether illicit or prescribed - anything that would lead to a non-negative initial result on a DAMP test
      (1) for example, dexamphetamine, THC
    - » Any medication that causes the pilot to have an alteration in sensory function, motor function or cognition.

- A person who has been diagnosed with a disease or a condition that can become suddenly and unpredictably safety-relevant in the flying environment:
  - Epilepsy and other seizure disorders, or diseases that could cause seizures
  - Blackouts or other sudden alterations of consciousness, or diseases that could cause these
  - Insulin-treated diabetes
  - High-risk pregnancy
  - Lung disease that requires oxygen therapy
  - Intracranial malignancies.
- A person who has a medical condition that makes them unable to perform all required aspects of the flying task safely:
  - Visual field or visual acuity that does not meet the private driver's licence standards
  - Hearing loss that means they are unable to understand conversational voice at a distance of 2 metres
  - Physical impairment that causes them not to be able to operate the flight controls safely in all circumstances.

If a pilot is unsure if they have a certain diagnosis, or they are unsure if their disease is severe enough to be safety-relevant, or they are unsure if their medication is of concern, they will be expected to seek advice from their GP or an aviation medical examiner before making a self-declaration.

Where any of the excluded medical conditions is present, the pilot is not eligible for a Class 5 medical self-declaration, however they may be eligible for another Class of medical certificate. They should discuss their

symptoms, diagnosis and management with their GP or an aviation medical examiner to discuss whether and how their condition might be compatible with flying.

3.2 Excluded medical conditions

With consideration of the above matters, the Class 5 medical self-declaration includes a declaration that the person does not have any of the following health issues:

- Taking any medications for treating mental illness
    - This does not include non-sedating antidepressants.
- Taking any medications for treating severe pain
- Dementia or other memory disorder
- Psychotic disorders or disorders with psychotic features
- Degenerative neurological diseases
- Epilepsy and other seizure disorders, or diseases that could cause seizures
- Blackouts or other sudden alterations of consciousness, or diseases that could cause these
- Insulin-treated diabetes
- High-risk pregnancy
- Lung disease that requires oxygen therapy
- Intracranial malignancies
- Visual field or visual acuity that does not meet the private drivers licence standards
- Hearing loss that means they are unable to understand conversational voice at a distance of 2 metres
- Physical impairment that causes you not to be able to operate the flight controls safely in all circumstances.

4. Blackouts

4.1 Aeromedical considerations

A blackout, for the purposes of these guidelines, can be defined as a transient loss of consciousness (TLOC) with occurs suddenly and recovers spontaneously. Causes may be entirely benign and provoked by identifiable factors, due to serious cardiovascular or neurological causes, or from causes unknown.

Cardiovascular causes include:

- heart problems
- low blood pressure
- fainting from pain or fear
- blood flow blockages in the brain.

Neurological causes include[1]:

- epileptic seizures
- non-epileptic conditions
- low blood sugar
- psychiatric conditions
- sleep disorders such as narcolepsy, or
- drug and alcohol related problems.

4.1.1 The effect of transient loss of consciousness on flying safety

The occurrence of TLOC during flight, regardless of the cause, obviously has major safety implications, as sudden and total incapacitation, even transiently, can result in loss of aircraft control that may not be recoverable, resulting in an accident. If the cause of TLOC is epileptic seizure, then the violent spasms associated with the seizure can prevent even another pilot from assisting or taking control (See section 8 - Neurological).

4.1.2 The effect of the flight environment on cardiovascular conditions

There are numerous environmental and flying task-related factors that may predispose to TLOC. By themselves, those that may lead to a provoked TLOC (e.g. hypoxia) or may increase the likelihood of TLOC occurring in individuals with underlying conditions that put them at risk. Relevant aviation factors include:

- mild hypoxia
- pressure change (e.g. causing pain in ears or sinuses while descending)
- inadequate nutrition or hydration
- G-forces
- stress or fear in emergencies
- heat stress among others.

4.2 Medical assessment for pilots

If you declare that you have a recent or past history of any transient loss of consciousness, then you should be assessed by a medical practitioner.

If you suffer from a transient loss of consciousness, blackout, or fainting episode, you should not fly until you are assessed by a medical practitioner to determine the cause.

If your doctor determines that the cause is clearly identifiable, for example, a vasovagal syncope (simple faint) caused by things such as prolonged standing in the heat, having an injection or blood taken, which are not likely to occur while flying, then this is unlikely to restrict your ability to fly.

A blackout may be caused by more serious conditions, however. If there is no well-defined cause for TLOC, then your doctor will need to investigate further to find the cause, which may be cardiovascular or neurological in nature. If a condition is identified, this will be addressed under the relevant sections of these guidelines, and referral to a CASA DAME may be needed.

If no cause can be found, then further assessment should be performed before any aviation medical certification or declaration can occur.

As blackouts are an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed.

4.3 Medical assessment for doctors

4.3.1 Diagnosis: Blackouts due to vasovagal syncope

Risk assessment

Syncope is incapacitating and unpredictable, and it is relatively common in the general population. In recreational pilots, the early detection of any underlying pathology, as well as the management of what might be considered a ‘benign event’ in many cases in the general population, is crucial for flight safety[2]. Importantly, syncope has a relatively high recurrence rate, with 21% of those who have had one event reporting further events, and just under 1% reporting 3 or more recurrences[3].

Risk assessment considerations

Assessment of risk is based on the:

- clinical history
- eyewitness accounts
- identification of provocative factors that are clearly defined
- history of any recurrence.

Favourable factors

Favourable factors include:

- clearly defined provocative factors can be identified that are unlikely to occur during flight.
- applicant is asymptomatic.

Aeromedical decision

Asymptomatic applicants who:

- present shortly after a vasovagal syncope with a clearly defined provocative cause, can be considered fit for flight 24 hours after the event.
- have a past history of vasovagal syncope with a clearly defined provocative cause and no other relevant underlying health conditions, can be considered fit for certification.

When to refer

The applicant should be referred to for further assessment, before certification or resumption of flying activities can occur, if episodes of vasovagal syncope have:

- been frequently recurrent, or
- occurred during flight.

4.3.2 Diagnosis: Blackouts due to diagnosed medical conditions

Risk assessment

A blackout is a transient loss of consciousness (TLOC) most commonly due to syncope reflex syncope (neurally mediated, a ‘faint’) due to a benign cause with an identifiable trigger (see Diagnosis: Blackouts due to vasovagal syncope). However, underlying medical reasons can be a diverse range of usually cardiovascular or neurological conditions such as arrhythmia, structural heart disease, orthostatic hypotension, epileptic seizures, and cerebrovascular disorders[4]. Convulsive syncope can occur in 12% of syncopal episodes without representing epilepsy. However, this distinction can make risk assessment difficult[5].

Risk assessment considerations

Assessment of risk is based on the:

- clinical history
- eyewitness accounts
- identification of provocative factors
- history of any recurrence.

Risk will also be determined by investigations and referrals to identify the nature of any underlying medical condition and its associated treatments.

Unfavourable factors

Unfavourable factors include:

- no clearly defined provocative factors
- symptoms and signs of underlying cardiovascular or neurological disease
- history of associated convulsions
- recurrent episodes
- prolonged alteration of consciousness.

Aeromedical decision

Applicants who:

- present with TLOC should be investigated and referred as required to establish a diagnosis and institute appropriate treatment before certification can be considered.
- have a past history of vasovagal syncope with a clearly defined provocative cause and no other relevant underlying health conditions can be considered fit for certification.

If syncope has been the result of a diagnosed medical condition, it should be managed according to the relevant section in these guidelines.

When to refer

Depending on the nature of the underlying cardiovascular or neurological condition, or in the case of any uncertainty on the part of the examining doctor, the applicant may be referred to a CASA DAME for further assessment before certification or resumption of flying activities can occur, according to the guidelines relevant to the specific condition.

4.3.3 Diagnosis: Blackouts of undetermined cause

Risk assessment

Risk assessment considerations

Assessment of risk is based on the:

- clinical history
- eyewitness accounts
- identification of provocative factors
- history of any recurrence.

Investigations should be performed to identify the nature of any underlying medical condition and its associated treatments.

In 50% of cases, the cause of a TLOC cannot be determined with certainty[5]. Where a clear provocative stimulus cannot be identified and a medical cause not found, it becomes impossible to accurately assess risk and the probability of recurrence. In this case, the only option is to adopt a ‘wait and see’ approach.

Unfavourable factors

Unfavourable factors include:

- no clearly defined provocative factors.
- no identified medical cause that can be treated.
- recurrent episodes
- history of associated convulsions

- prolonged alteration of consciousness.

Aeromedical decision

Applicants who present with a:

- single episode of TLOC, where an underlying medical condition is suspected, should be fully investigated. If no cause is found, they should be advised not to fly for 12 months after the episode, after which they can be considered fit for certification if no recurrence has occurred.
- past history of a single episode of TLOC, who have been fully investigated with no cause found but who have had no recurrences within the last 12 months, can be considered fit for certification.

When to refer

If TLOC recurs and the cause remains undetermined, then the applicant should be referred for further assessment before any aviation medical certification or declaration can occur.

5. Cardiovascular conditions

5.1 Aeromedical considerations

The recreational flight environment has the potential to put the cardiovascular system under increased stress and workload and therefore can precipitate severe illness, even in asymptomatic pilots with unrecognised disease processes.

5.1.1 The effect of cardiovascular conditions on flying safety

The occurrence of symptoms of cardiovascular disease, such as shortness of breath, heart palpitations and chest pains, can be very concerning and can distract a pilot from the task of flying safely. Decreased blood supply to the brain can impair cognitive abilities leading to subtle incapacitation. In the worst case, low blood pressure or sudden arrhythmia can lead to complete loss of consciousness or sudden cardiac arrest, resulting in total incapacitation.

5.1.2 The effect of the flight environment on cardiovascular conditions

In situations of high workload or stress while flying, for example, handling unexpected emergencies, the:

- heart rate and blood pressure can increase.
- heart's demand for oxygen will increase.
- heart muscle will be put under extra load.

This can also occur at altitudes where oxygen partial pressure in the atmosphere is reduced, posing a risk of hypoxia. Sudden changes in barometric pressure can lead to nitrogen bubbles in the circulation. Acceleration (g) forces put the cardiovascular system and its reflexes under increased stress to maintain blood pressure[6].

In conditions such as ischaemic heart disease, where the coronary circulation is comprised, these stressful conditions may precipitate:

- myocardial ischaemia
- chest pain
- myocardial infarction, or
- arrhythmias.

5.2 Medical assessment for pilots

If you declare that you have a past or current history of any of the following cardiovascular conditions, you should be assessed by a medical practitioner:

- ischaemic heart disease conditions such as:*****
  - acute myocardial infarction
  - angina
  - coronary artery bypass grafting (CABG)
  - percutaneous coronary intervention (stenting).
- disorders of rate rhythm and conduction, such as:
  - atrial fibrillation or other cardiac arrhythmias
  - cardiac arrest
  - cardiac pacemaker
  - implantable cardioverter defibrillator
  - ECG changes.
- diseases of the cardiovascular system, such as:
  - aneurysms
  - deep vein thrombosis
  - pulmonary embolism
  - valvular heart disease.
- myocardial diseases, such as:
  - any type of cardiomyopathy.
- congenital heart disorders
- heart failure and ventricular assist devices
- hypertension
- heart transplant.

*Ischaemic heart disease (IHD) is the most common cardiovascular condition of all and is the leading single cause of disease burden and death in Australia. It occurs when there is a narrowing or blockage in the blood vessels that supply blood to the heart muscle. In 2020–21, more than half a million Australians (2.9% of the adult population) were living with IHD, and the prevalence of IHD increases rapidly with age. In 2020, an estimated 56,700 people had an acute coronary event in the form of a heart attack or unstable angina—around 155 events every day. Of these, 6,900 (12%) were fatal[iii].

There are 2 major clinical forms: heart attack (also known as acute myocardial infarction) and angina, but in many cases, the diseased arteries cause no symptoms at all initially. IHD is largely preventable, as many of its risk factors are modifiable. These include:

- tobacco smoking
- risk factors such as high blood pressure and high blood cholesterol
- insufficient physical activity
- poor diet and nutrition
- overweight and obesity.

[iii] https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts/contents/summary-of-coronary-heart-disease-and-stroke/coronary-heart-disease

Note: If you have these risk factors, it is recommended that you speak with your doctor. It is good practice to estimate risk of a coronary event using risk calculators. Examples of these calculators can be found on the Australian Heart Foundation website (https://www.heartfoundation.org.au/bundles/for-professionals/cvd-risk-calculator) and PREDICT ().

As some cardiac conditions can lead to alterations of consciousness, which is an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed for applicants with cardiac disease.

5.3 Medical assessment for doctors

5.3.1 Diagnosis: Angina

Risk assessment

A self-declared history of angina requires assessment by a medical practitioner.

Varying degrees of mild hypoxia, stress and workload may all precipitate an episode of angina in-flight.

Anginal chest pain occurring in-flight is at best distracting, or at worst myocardial ischaemia can result in acute incapacitation due to sudden arrhythmia, for example.

Treatments such as nitrates may themselves lead to incapacitation due to sudden hypotension.

Risk assessment considerations

Assessment of risk is based on the:

- history
- active symptoms
- response to medical management
- investigations.

A previous diagnosis of angina, if well-managed and asymptomatic, is not necessarily a bar to certification.

Unfavourable risks

Unfavourable risks include:

- unstable angina
- history of chest pain on minimal exertion
- ECG ST segment depression
- an equivocal or positive exercise ECG (Bruce protocol)
- a stress echocardiogram or myocardial perfusion scan demonstrating reversible ischaemia.
- investigations must be current within 12 months of the application.

Aeromedical decision

Applicants can be considered fit for certification if:

- they are asymptomatic with non-flow limiting coronary lesions.
- there is no current evidence of active reversible myocardial ischaemia.
- they have responded well to medical therapy.

When to refer

The applicant should be referred for further assessment before any aviation medical certification or declaration can occur, if:

- symptoms of angina occur on exertion or at rest despite medical treatment, and/or
- investigations show evidence of reversible myocardial ischaemia.

5.3.2 Diagnosis: Myocardial infarction

Risk assessment

A self-declared history of myocardial infarction requires assessment by a medical practitioner.

Varying degrees of mild hypoxia, stress, and workload affecting a compromised coronary circulation may all precipitate an acute myocardial infarction in flight.

The symptoms of an acute myocardial infarction may severely incapacitate a pilot, as they are distressing and distracting, or they may lead to complete incapacitation due to sudden arrhythmia or sudden death.

Complications following myocardial infarction are common. There is a risk of heart failure in the first 12 months[7]. Mechanical complications such as left ventricular free-wall rupture, ventricular septal rupture, papillary muscle rupture, pseudoaneurysm, and true aneurysm have high mortality rates but are uncommon and usually occur in the first 3-5 days[8].

Risk assessment considerations

Assessment of risk is based on the:

- history
- recency of the myocardial infarction
- degree of recovery
- residual symptoms
- response to medical management
- evidence of any persistent reversible ischaemia.

Unfavourable risks

Unfavourable risks include:

- evidence of persisting reversible myocardial ischaemia on a stress echocardiogram
- an ejection fraction <40%
- ongoing symptoms of chest pain
- shortness of breath
- poor exercise tolerance.

Aeromedical decision

Applicants can be considered fit for certification if:

- it is at least 4 weeks since the myocardial infarction.
- they are asymptomatic.
- they have had a satisfactory response to medical treatment.
- there is no evidence of reversible myocardial ischaemia.
- there is good exercise tolerance on exercise stress echocardiogram.
- the ejection fraction is >40% with no clinical evidence of heart failure.

When to refer

The applicant must be referred for further assessment before any aviation medical certification or declaration can occur, if:

- should symptoms of chest pain or impaired cardiac function are persistent after 4 weeks.
- there is evidence of ongoing reversible ischaemia or a history of arrhythmia, heart failure or other complication.

5.3.3 Diagnosis: Coronary revascularisation

Risk assessment

A self-declared history of coronary artery bypass surgery, percutaneous coronary catheterisation/stenting or other revascularisation procedure requires assessment by a medical practitioner.

Risk assessment considerations

Assessment of risk is based on the:

- type of revascularisation
- expected reoccurrence rates in the areas of revascularisation.
- residual disease burden (including assessment of left ventricular ejection fraction and regional wall motion, scar burden, and viability)[9].

For coronary artery bypass graft surgery (CABG)

In a population with similar characteristics to pilots, the probability of a major adverse cardiac event (MACE) over 5 years was found to be 1.6% per year. Historic data on CABG outcomes from within the civilian aeromedical community demonstrate death or MI rates of <2% per year, with repeat revascularisation rates of 3–4%per year[9]. For assessment of cognitive function, post-operative cognitive impairment is common, with an incidence 20.8% after 3 months[10].

For percutaneous coronary intervention (PCI)

Stenting procedures may fail for several reasons, including restenosis, stent thrombosis, or disease progression in the target lesion, or lesions remote from it. PCI trials report annual MACE rates of 1–2% per year for successful and uncomplicated single or two-vessel disease, although importantly most stent failure occurs in the first 6 months[9]. Reinfarction rate after PCI for myocardial infarction is 1.8% in the first month, and 4% in the first 12 months[11] (see also acute myocardial infarction).

Aeromedical decision

Applicants can be considered fit for certification if:

- it is at least 4 weeks since PCI or 3 months since CABG.
- they are asymptomatic.
- there is no evidence of reversible myocardial ischaemia
- there is complete healing of all surgical wounds.
- there are no ongoing symptoms of pain.
- there is recovery of all physical functioning
- there is a return to normal daily activities
- they have good exercise tolerance.

When to refer

If there is a history of any post-revascularisation complications or ongoing reversible ischaemia, then the applicant should be referred for further assessment before any aviation medical certification or declaration can occur.

5.3.4 Diagnosis: Atrial fibrillation

Risk assessment

People with recurrent arrhythmias causing syncope or pre-syncope are usually not fit to fly. A self-declared history of atrial fibrillation requires assessment by a medical practitioner.

Hypoxia, stress, workload and fatigue caused by the aviation environment may precipitate atrial fibrillation (AF).

The symptoms of AF in-flight may cause subtle incapacitation or distraction (hypotension, palpitations, dyspnoea, chest pain) or total incapacitation (syncope, thromboembolic stroke).

Risk assessment considerations

Assessment of risk is based on the:

- frequency of episodes or history of recurrence
- severity of symptoms
- rate and rhythm control
- response to medical treatment
- any untreated underlying causes (e.g. hyperthyroidism).

Unfavourable risks

Unfavourable risks include:

- history of syncope
- haemodynamic compromise
- untreated risk of thromboembolism (CHA2DS2VASc).

Aeromedical decision

Applicants can be considered fit for certification if:

- satisfactory rhythm control has been achieved by ablation or medication.
- satisfactory rate control has been achieved with medication.
- any risk of thromboembolism has been satisfactorily treated.
- there is no history of incapacitating symptoms.
- there is satisfactory exercise tolerance.

When to refer

If there is a history of any AF causing haemodynamic compromise, syncope or thromboembolic stroke, then the applicant should be referred to for further assessment before any aviation medical certification can occur.

5.3.5 Diagnosis: Other tachyarrhythmias

Risk assessment

People with recurrent arrhythmias such as SVT (supraventricular tachycardia), sustained VT (ventricular tachycardia), and atrial flutter, causing syncope or pre-syncope are usually not fit to fly. A self-declared history of paroxysmal tachyarrhythmias requires assessment by a medical practitioner.

Hypoxia, high G-forces, stress, workload and fatigue caused by the aviation environment may precipitate a number of cardiac tachyarrhythmias.

The symptoms of tachyarrhythmia in-flight may cause subtle incapacitation or distraction (hypotension, palpitations, dyspnoea, chest pain) or total incapacitation (syncope, cardiac arrest).

Risk assessment considerations

Assessment of risk is based on the:

- frequency of episodes/recurrence
- severity of symptoms
- response to medical treatment
- any untreated underlying causes (e.g. hyperthyroidism).

Unfavourable risks

Unfavourable risks include:

- history of syncope
- haemodynamic compromise.

Aeromedical decision

Applicants can be considered fit for certification if:

- cure has been achieved by ablation, or rhythm controlled satisfactorily by medication.
- there is no history of incapacitating symptoms or syncope accompanying episodes.
- there is satisfactory exercise tolerance.

When to refer

If there is a history of any haemodynamic compromise or syncope, then the applicant should be referred for further assessment before any aviation medical certification can occur.

5.3.6 Diagnosis: Cardiac arrest

Risk assessment

A self-declared history of previous cardiac arrest requires assessment by a medical practitioner.

The recurrence of sudden cardiac arrest in survivors of non-traumatic cardiac arrest is common. 15.24% of sudden cardiac arrest survivors experience a recurrence, and of these, 35.03% experience a second recurrence. At 1 year, the incidence of recurrence is 10.62%[12]. Survivors are generally considered to be at heightened risk for developing subsequent life-threatening ventricular arrhythmias because of myocardial scar tissue formation, heart failure, or untreated hereditary arrhythmogenic conditions.

Risk assessment considerations

Assessment of risk is based on the underlying cause of the cardiac arrest, which may be:

- correctable (e.g. trauma, hypovolaemia, electrolyte disturbances), or

- the result of an ongoing underlying disease process (e.g. ischaemic heart disease, cardiomyopathy) with risk of recurrence.

Psychological impact of the cardiac arrest should be considered.

Unfavourable risks

Unfavourable risks include:

- uncontrolled underlying medical cause of cardiac arrest with risk of further cardiac arrest, or
- need for implantable cardioverter-defibrillator.

Aeromedical decision

Applicants can be considered fit for certification 6 months following cardiac arrest if:

- an identifiable and reversible cause has been identified and treated.
- there has been a satisfactory recovery and response to treatment.
- there are no symptoms persisting that could interfere with the flying task.

When to refer

The applicant should be referred for further assessment before any aviation medical certification can occur, if:

- there is a risk of recurrence, or
- underlying medical conditions persist that might lead to another cardiac arrest.

5.3.7 Diagnosis: Cardiac pacemaker

Risk assessment

A self-declared history of a cardiac pacemaker requires assessment by a medical practitioner.

For patients with accelerometer-based rate-responsive pacemakers, there do not appear to be any potentially dangerous or adverse effects from motional or vibrational influences in single-engine fixed-wing general aviation aircraft with normal activity sensor settings[13], nor does there appear to be any electrical interference[14]. However, the possibility of this, as well as the possibility of device failure, must be considered as part of any risk assesmement[15].

Risk assessment considerations

Assessment of risk is based on the:

- ongoing symptoms
- age and reliability of the device
- satisfactory response to pacing.

An assessment of any ongoing symptoms should include:

- heart failure
- dyspnoea
- palpitations
- bradycardia
- syncope.

Sufficient time must be allowed for satisfactory recovery from the insertion procedure and healing of any surgical wounds.

Unfavourable risks

Unfavourable risks include:

- poor response to pacing
- symptoms of conduction abnormalities or arrhythmia
- poor exercise tolerance.

Aeromedical decision

Applicants can be considered fit for certification:

- 4 weeks after the insertion of a pacemaker if the risk assessment is satisfactory.
- if they have existing pacemakers that are functioning satisfactorily
- if there are no symptoms relevant to the flying task.

When to refer

The applicant should be referred for further assessment before any aviation medical certification can occur, if there:

- is any uncertainty about pacemaker function.
- are symptoms of haemodynamic instability.
- are symptoms of rhythm or conduction disorders.

5.3.8 Diagnosis: Implantable cardioverter defibrillator (ICD)

Risk assessment

A self-declared history of an implantable cardioverter defibrillator (ICD) requires assessment by a medical practitioner.

Risk assessment considerations

An assessment of the underlying medical cause for requiring an ICD should be accounted for and addressed separately (for example, symptomatic ischaemic heart disease or heart failure). The psychological impact of the ICD should be considered.

An ICD may be implanted as secondary prevention after an episode of cardiac arrest, or as primary prevention in patients with specific risk factors. The device monitors cardiac electrical activity with high sensitivity and will deliver an electrical shock to treat potentially lethal arrhythmias.

Recovery from the surgical procedure must be assessed as ‘satisfactory’ based on ongoing symptoms and functional abilities.

The delivery of a shock to reverse an arrythmia in the confines of a small cockpit has serious consequences: complete incapacitation, followed by partial incapacitation, startle, stress response, loss of situational awareness, and inappropriate aircraft handling. The impact post-shock can persist for up to 90 days[16].

The possibility of aircraft systems and electromagnetic radiation from transponders or other aircraft avionics must be considered but is unlikely to be a risk[17]. The device must be reliable and be functioning normally; device-related complications of battery and leads are not uncommon[18].

Unfavourable risks

Unfavourable risks include:

- uncontrolled underlying medical cause of cardiac arrest
- symptoms related to heart failure, arrhythmia or reversible ischaemia
- ICD implanted within 6 months of a cardiac arrest.

- shock delivered within the last 3 months.

Aeromedical decision

Applicants can be considered fit for certification:

- if they are asymptomatic for 6 months following cardiac arrest that results in implantation of an ICD.
- 2 weeks after implantation of an ICD prophylactically, if recovery from the procedure is satisfactory and there are no symptoms of a cardiac nature that could interfere with the flying task.

When to refer

The applicant should be referred for further assessment before any aviation medical certification can occur if there:

- is any uncertainty about ICD function.
- are ongoing symptoms of haemodynamic instability, or symptoms of rhythm or conduction disorders.

5.3.9 Diagnosis: Electrocardiogram (ECG) abnormalities

Risk assessment

Applicants with a self-declared history of electrocardiogram (ECG) abnormalities, such as left or right bundle branch block, various degrees of heart block, frequent ventricular ectopics, or other conduction disturbances require assessment by a medical practitioner.

Hypoxia, high G-forces, stress, workload and fatigue caused by the aviation environment may precipitate a number of cardiac rhythm and conduction disturbances[19]. This must be considered especially in applicants with known cardiac disease.

The symptoms of conduction disturbances in-flight may cause subtle incapacitation or distraction (hypotension, palpitations, dyspnoea, chest pain) or total incapacitation from profound bradycardia or asystoles (syncope, cardiac arrest). Some abnormalities may be benign (such as partial RBBB). However, the presence of certain asymptomatic ECG abnormalities may be indicative of underlying aviation-relevant cardiac disease (e.g. valvular disease, cardiomyopathy or ischaemic heart disease).

Risk assessment considerations

Assessment of risk is based on the:

- nature of the abnormality
- frequency of episodes/recurrence of symptoms
- severity of symptoms
- response to medical treatment
- any untreated underlying causes (e.g. reversible myocardial ischaemia).

Unfavourable risks

Unfavourable risks include:

- history of syncope
- haemodynamic compromise
- active symptoms
- structural heart disease
- poorly controlled heart conditions.

Aeromedical decision

Applicants can be considered fit for certification if there:

- is no significant underlying cardiac condition or a condition that is managed satisfactorily with medical treatment.
- have been no symptoms in the last 3 months (e.g. palpitations, dyspnoea, chest pain)
- is no history of incapacitating symptoms or syncope.
- is satisfactory exercise tolerance.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if there is a history of any:

- haemodynamic compromise
- syncope, or
- inadequately managed underlying cardiac condition.

5.3.10 Diagnosis: Aortic aneurysm

Risk assessment

Applicants with a self-declared history of aneurysmal dilatation of the thoracic or abdominal aorta, treated or untreated, require assessment by a medical practitioner.

High G-forces, stress, hypoxia, and workload caused by the aviation environment can place heavy demands on the cardiovascular system, increasing heart rate and blood pressure above resting values. This may theoretically put extra stress on aneurysms of the aorta, thereby increasing the risk of dilatation, dissection, and rupture[20].

The effect of an aneurysm on flight safety may be profound in the event of an unheralded rupture, leading to sudden and complete incapacitation and is rapidly lethal. Rapid dilatation that leads to significant chest or back pain will result in distraction, loss of situational awareness and subtle incapacitation.

Aneurysm of the ascending aorta most commonly occurs in the aortic root. The growth is generally slow, but there is a drastic increase in a risk if the diameter is > 6 cm[21]. An aneurysm of the descending thoracic aorta has a significant risk of rupture with a diameter >7 cm. The 5-year survival of untreated thoracic aortic aneurysm is 54%, but elective surgery achieves a survival curve approaching that of the healthy, age-matched population[22].

An aneurysm of the abdominal aorta (AAA) is any dilatation >3.0 cm. Rupture risk increases beyond 5.5 cm diameter, and surgery is then usually indicated. The size of the aneurysm and its rate of growth is therefore important in risk assessment.

Surgical treatment of aortic aneurysms is a major procedure carrying with it a significant mortality rate and risk of peri- and post-operative complications that can interfere with the flying task or suddenly incapacitate. The major adverse event rate following AAA repair is 15-30%[23]. A thorough assessment of post-operative recovery and risk of complications must be guided by the vascular surgeon’s opinion of outcome and prognosis.

Risk assessment considerations

Assessment of risk is based on the:

- location of the aneurysm
- the aneurysm’s size and pattern of growth
- presence of symptoms
- any other untreated vascular disorders (e.g. coronary artery disease, cerebrovascular disease, hypertension).

Unfavourable risks

Unfavourable risks include:

- thoracic aortic aneurysm >6.0cm diameter
- AAA > 5.5 cm
- haemodynamic compromise
- active symptoms
- structural heart disease
- poorly controlled heart conditions
- poor operative recovery or post-operative complications.

Aeromedical decision

Applicants can be considered fit for certification if:

- the risk of imminent rupture of the aneurysm is assessed as low.
- there are no symptoms.

Applicants can be considered fit for certification 3 months after surgical repair if they have:

- had a satisfactory response to surgery.
- recovered fully with no post-operative complications.
- a favourable report from their vascular surgeon.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if there:

- is an untreated aneurysm that is assessed as being at risk of rupture (>5.5-6.0cm)
- are symptoms of pain or vascular compromise.
- are cardiac symptoms caused by aortic root dilatation, or post-operative complications from surgical repair.

5.3.11 Diagnosis: Venous thrombosis

Risk assessment

Applicants with a self-declared history of deep vein thrombosis (DVT) or pulmonary embolism (PE) require assessment by a medical practitioner.

Prolonged sitting in an aircraft cockpit may compound other thrombotic risk factors and contribute to the formation of lower limb DVT. Pulmonary embolism, whether silent or symptomatic, causing ventilation-perfusion mismatching within the lungs can lead to hypoxia, which is made worse as oxygen partial pressure falls at altitude.

Deep vein thrombosis is often silent. If symptoms of a lower limb DVT are present, then swelling or pain may interfere with lower limb function and effective aircraft control inputs. Respiratory symptoms may occur from pulmonary embolism, resulting in chest pain, dyspnoea, cough, or acute incapacitation while flying or even sudden death.

Risk assessment considerations

Assessment of risk is based on the:

- location of the DVT
- presence of symptoms

- any respiratory compromise
- response to anticoagulation treatment
- recovery from symptoms.

Unfavourable risks

Unfavourable risks include:

- respiratory symptoms or hypoxaemia at sea level
- pain, swelling or impaired function as a result of DVT.

Aeromedical decision

Applicants can be considered fit for certification if:

- there has been a full recovery from DVT or PE
- there is a satisfactory response to anticoagulation treatment.
- they are asymptomatic.
- they have good exercise tolerance at sea level.

When to refer

Before certification can occur, the applicant must be referred for further assessment before any aviation medical certification can occur if there is:

- a history of ongoing symptoms of DVT that may impair function or mobility, or
- impaired respiratory function causing hypoxaemia at sea level following a PE.

5.3.12 Diagnosis: Valvular heart disease

Risk assessment

Applicants with a self-declared history of valvular heart disease or surgery to repair heart valves require assessment by a medical practitioner.

The flight environment can put considerable stress on the cardiovascular system in general and the heart in particular. The sympathetic nervous system response to stressful flight situations, acceleration forces or emergencies will increase heart rate, contractility and blood pressure, increasing blood flow across damaged or diseased heart valves.

Disruption of blood flow across valves, either through stenotic restriction or regurgitation, can result in a variety of potentially incapacitating symptoms relevant to aviation. Structural heart disease can lead to arrhythmia, conduction disorders, thrombosis and embolism, heart failure, infective endocarditis, hypotension, and syncope. The occurrence of these symptoms can lead to subtle incapacitation and distraction, or sudden total incapacitation while flying[24].

Risk assessment considerations

Assessment of risk is based on the:

- diagnosis
- presence of symptoms
- response to treatment
- recovery from surgical repair.

Unfavourable risks

Unfavourable risks include:

- ECG abnormalities
- ongoing cardiac symptoms of palpitations
- chest pain
- heart failure
- dyspnoea
- thromboembolism
- poor exercise tolerance
- incomplete post-operative recovery.

Aeromedical decision

Applicants can be considered fit for certification if:

- there are no symptoms or evidence of any haemodynamic compromise from the valve disease
- it has been at least 3 months following surgical repair, and
- recovery from the procedure is satisfactory, with no ongoing pain or functional limitations.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if:

- there is a history of symptomatic valvular disease which is causing haemodynamic compromise, or
- the condition has caused complications such as arrhythmia, syncope or thromboembolism.

5.3.13 Diagnosis: Myocardial disease, cardiomyopathies

Risk assessment

Cardiomyopathies represent a heterogeneous group of conditions affecting the heart muscle, with a variety of morphological and physiological characteristics, and highly variable natural history. Applicants with a self-declared history of diseases of the heart muscle, such as various forms of cardiomyopathy, require assessment by a medical practitioner.

The physiological demands of the aviation environment, with the potential for exposure to hypoxia, hypobaria, and acceleration forces, represent a unique challenge to the cardiovascular system. The sympathetic nervous system's response to stressful flight situations, acceleration forces, or emergencies will increase heart rate, contractility and blood pressure, placing extra demand on a compromised or failing heart muscle.

The primary aeromedical concerns associated with cardiomyopathies are arrhythmias and left ventricular dysfunction[25]. The occurrence of these symptoms can lead to subtle incapacitation and distraction, or sudden total incapacitation while flying. Medical treatments used for cardiomyopathies may also cause side effects that can impact the safety of flying.

Risk assessment considerations

Assessment of risk is based on the:

- type of cardiomyopathy
- presence of symptoms
- occurrence of rhythm or conduction disturbances
- history of syncope and exercise tolerance, which is best assessed by a functional exercise test (e.g. Bruce protocol).

Left ventricular function assessed by ejection fraction should be >40% below which heart failure with reduced ejection fraction (HFrEF) carries a significantly worse prognosis[26].

Unfavourable risks

Unfavourable risks include:

- ECG abnormalities
- rhythm disturbances
- cardiac symptoms of palpitations
- chest pain
- heart failure
- dyspnoea
- syncope
- poor exercise tolerance
- family history of sudden cardiac death.

Aeromedical decision

Applicants can be considered fit for certification if:

- there are no symptoms or evidence of any significant left ventricular dysfunction.
- ejection fraction >40%
- there is no history of ventricular arrhythmias or family history of sudden death.
- there is a satisfactory response to medical treatment with no adverse effects.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if the:

- applicant has signs or symptoms of heart failure.
- left ventricular dysfunction ejection fraction <40%, or
- condition has caused complications such as arrhythmia, or syncope.

5.3.14 Diagnosis: Congenital heart disorders

Risk assessment

Congenital heart disease (CHD) ranges from simple abnormalities, such as isolated bicuspid aortic valve disease, to complex cyanotic heart disease. Applicants with a self-declared history of congenital heart disease require assessment by a medical practitioner.

It is estimated that 0.3–0.5% of the adult population live with CHD. Applications for aviation medical certifications can include individuals who have an almost normal quality of life despite their underlying CHD[27].

It is known that individuals with CHD have higher rates of arrhythmia, chest pain, hospitalisation, and emergency department attendance than the general population. They require long-term follow-up due to the risk of long-term sequelae and the need for intervention and surgery.

The aviation environment may expose even recreational pilots to additional physiological stressors (such as hypoxia, atmospheric pressure changes and potentially sustained acceleration) that may increase these risks further. Valvular stenosis, regurgitation, shunts, and coronary anomalies of modest concern clinically may be aggravated by the stressors of flight with an accompanying increase in aeromedical risk. Therefore, appropriate risk assessment is paramount to ensure flight safety[27].

Risk assessment considerations

Assessment of risk is based on the:

- type of CHD
- potential physiological consequences
- presence of symptoms
- occurrence of rhythm or conduction disturbances
- history of syncope and exercise tolerance.

Some mild asymptomatic forms of CHD are of no concern to recreational flying. For example, patent foramen ovale (PFO) is present in 25–33% of the population and is often an incidental finding, which should be regarded as a normal variant unless previously associated with an embolic event[27].

Unfavourable risks

Unfavourable risks include:

- ECG abnormalities
- rhythm disturbances
- cardiac symptoms of palpitations
- chest pain
- heart failure
- dyspnoea
- syncope
- poor exercise tolerance
- history of infective endocarditis.

Aeromedical decision

Applicants can be considered fit for certification if there has been:

- surgical correction (either open or percutaneous) of CHD
- a full recovery from the procedure with no residual symptoms and minimal haemodynamic consequences.

It must be 4 weeks since a percutaneous procedure and 3 months since an open surgical procedure.

Applicants can be considered fit for certification with mild untreated forms of CHD which cause no haemodynamic consequences, and no symptoms of a cardiac nature such as palpitations, dyspnoea, chest pain, or syncope. The LV ejection fraction must be >40%.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if the:

- applicant has complicated CHD with signs or symptoms of heart failure, left ventricular dysfunction, LVEF <40%, or
- CHD has caused complications such as arrhythmia, infective endocarditis, or syncope.

5.3.15 Diagnosis: Heart failure and ventricular assist devices

Risk assessment

Heart failure may be caused by a heterogeneous group of conditions such as ischaemic heart disease, valvular disease, cardiomyopathies, and pulmonary hypertension. Therefore, risk management of applicants with heart failure very much depends on the underlying condition that causes it and how that is managed. Applicants with a self-declared history of diseases of the heart muscle, such as various forms of cardiomyopathy, require assessment by a medical practitioner.

Characteristics of the aviation environment and the flying task have the potential to impact on the pathophysiology of heart failure. These include decrease of atmospheric pressure, prolonged immobility in a cockpit, decrease in humidity at altitude, and both physical and emotional stress[28]. The sympathetic nervous system's response to stressful flight situations, acceleration forces, or emergencies will increase heart rate, contractility, and blood pressure, placing extra demand on a compromised or failing heart muscle. Even for the recreational pilot, arterial oxygen saturation can fall to 93% at altitudes less than 10,000 ft. Applicants with HF are especially vulnerable to increasing hypoxemia, which can lead to increase in systemic blood pressure, heart rate, myocardial contractility, and increase in pulmonary artery pressure due to pulmonary vasoconstriction[28].

The primary aeromedical concerns associated with heart failure are the symptoms of insufficient cardiac output such as hypotension and syncope, dyspnoea, thrombosis which may be worsened by the flight environment. The occurrence of these symptoms can lead to subtle incapacitation and distraction, or sudden total incapacitation while flying. Medical treatments used for heart failure may also cause side effects that can impact the safety of flying.

Risk assessment considerations

Assessment of risk is based on the:

- grade of severity of heart failure
- presence of symptoms
- occurrence of rhythm or conduction disturbances
- history of syncope
- exercise tolerance, which is best assessed by a functional exercise test (e.g. Bruce protocol).

Left ventricular function assessed by ejection fraction should be >40% below which heart failure with reduced ejection fraction (HFrEF) carries a significantly worse prognosis[26]. Patients with stable and mild to moderate HF have been demonstrated to tolerate mild hypoxia for periods up to 7 hours[28].

Due to the scarcity of donor organs and the increasing number of patients with heart failure, ventricular assist devices (VADs) have become a common surgical procedure and an attractive alternative to support failing circulation in patients with end-stage heart failure. They can be used as a 'bridge to transplant (BTT) therapy' or as 'destination therapy (DT)' for those who are ineligible for transplantation in order to improve survival and quality of life[29]. These devices, however, carry a significant morbidly and mortality risk, with complications including right ventricular failure, pump thrombosis, bleeding risk (23% incidence due to anticoagulation), device-related infections (incidence 13-80%), neurological complications (CVA risk constant out to 4 years), and device failure (50% rate in the first 12 months)[29].

Unfavourable risks

Unfavourable risks include:

- uncontrolled underlying disease or risk factors
- ECG abnormalities
- rhythm disturbances
- cardiac symptoms of palpitations
- chest pain
- dyspnoea

- syncope
- oedema
- fluid overload
- poor exercise tolerance
- history of hospitalisation for acute pulmonary oedema
- implantation of a ventricular assist device.

Aeromedical decision

Applicants can be considered fit for certification if:

- there are minimal or no symptoms of heart failure.
- LV ejection fraction >40%
- there is no history of ventricular arrhythmias or family history of sudden death.
- there is a satisfactory response to medical treatment with no adverse effects.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if:

- the applicant has signs or symptoms of heart failure caused by poorly controlled underlying disease.
- there is left ventricular dysfunction LVEF <40%, or
- the condition has caused complications such as arrhythmia or syncope.
- the applicant has end-stage heart failure, and they require the support of a ventricular assist device.

5.3.16 Diagnosis: Hypertension

Risk assessment

Hypertension is the most common chronic medical disorder affecting the cardiovascular system. Dangerously high blood pressure (known as hypertensive crisis) has been defined as the elevation of systolic blood pressure (SBP) >179 mmHg or diastolic blood pressure (DBP) >109 mmHg[30]. Applicants with a self-declared history of blood pressure that has exceeded 180 mmHg systolic and/or 110 mmHg diastolic require assessment by a medical practitioner.

The physiological demands of the aviation environment and the flying task with the potential for exposure to hypoxia, hypobaria, acceleration forces, and emotional stress, represent a unique challenge to the cardiovascular system[6]. The sympathetic nervous system response to stressful flight situations, acceleration forces or emergencies will increase heart rate, contractility and blood pressure, worsening dangerously high blood pressure and risking acute end-organ damage and incapacitation.

Hypertension is most often a silent disease. The primary aeromedical concerns associated with hypertension are acute hypertensive crisis causing sudden organ failure (e.g. acute coronary syndrome or CVA) and target organ damage that has longer-term risk to flying safety. Target organ complications to be considered in the risk assessment of the hypertensive applicant include:

- Eyes – hypertensive retinopathy, haemorrhages, exudates, or papilloedema.
- Brain – hypertensive encephalopathy, CVA, TIA.
- Heart – pulmonary oedema, left ventricular hypertrophy, heart failure, coronary artery disease.
- Kidneys – renal failure.

Medical treatments used for hypertension may also cause side effects that lower blood pressure or impair baroreflexes such that the cardiovascular system is unable to respond normally to G-forces while flying.

Risk assessment considerations

Assessment of risk is based on the:

- blood pressure readings measured
- presence or absence of target organ damage.

Unfavourable risks

Unfavourable risks include:

- ECG abnormalities
- heart failure
- history of acute coronary syndrome or CVA
- hypertensive retinopathy impairing vision
- blood pressure higher than 180 systolic and 110 diastolic.

Aeromedical decision

Applicants can be considered fit for certification if:

- blood pressure is consistently less than 180 mmHg systolic and 110 mmHg diastolic.
- their hypertension is satisfactorily treated.
- their treatment causes no adverse side effects such as orthostatic hypotension.
- there is no evidence of target organ damage that might cause acute incapacitation.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if the applicant has:

- blood pressure consistently >180 mmHg systolic and/or > 110 mmHg diastolic, or
- symptoms of target organ damage that might cause incapacitation in flight.

5.3.17 Diagnosis: Cardiac transplantation

Risk assessment

Applicants with a self-declared history of cardiac transplantation require assessment by a medical practitioner.

Cardiac transplantation is associated with a high rate of morbidity and mortality (highest in the first 6 months), with complications including neurological (CVA), respiratory, graft failure or dysfunction, cardiac allograft vasculopathy (CAV), renal failure, diabetes, graft rejection, sudden cardiac death, infections and malignancies[31]. The 1-year survival rate is 82%, but after the first year, mortality rate decreases to 3.4% per year.

The physiological demands of the aviation environment and the flying task with the potential for exposure to hypoxia, hypobaria, acceleration forces, and emotional stress represent a unique challenge to the cardiovascular system[6]. The sympathetic nervous system response to stressful flight situations, acceleration forces or emergencies may be diminished because of a denervated heart.

The primary aeromedical concerns associated with cardiac transplantation are cardiac allograft vasculopathy and the risk of sudden cardiac death. Symptoms associated with any of the complications listed above may lead to subtle or acute incapacitation while flying. Medical treatments used for immunosuppression may also cause side effects that can impact the safety of flying.

It is possible to safely return to flying after cardiac transplantation as long as risk assessment is done, and certain criteria are met[32].

Risk assessment considerations

Assessment of risk is based on the:

- time since surgery
- surgical recovery
- presence of symptoms
- occurrence of any complications
- exercise tolerance assessed by the Bruce protocol.

Unfavourable risks

Unfavourable risks include:

- poor post-operative recovery
- signs or symptoms of heart failure, graft rejection, CAV, infections, malignancy, diabetes.

Aeromedical decision

Applicants can be considered fit for certification if:

- it is more than 6 months since the surgery.
- post-operative recovery is satisfactory with no pain or functional impairments.
- exercise 90% of predicted on Bruce protocol.
- there is no CAV.
- normal left ventricular systolic function
- no history of hemodynamically compromising rejection (at any time since transplant) or treated rejection in the previous 2 years.
- no life-threatening infection in the previous 6 months
- no visceral malignancy
- no insulin dependent diabetes[32].

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if:

- the applicant has signs or symptoms of heart failure.
- left ventricular dysfunction LVEF <40%, or
- the transplant has caused complications such as arrhythmia, or syncope.

6. Diabetes

6.1 Aeromedical considerations

Diabetes is a chronic disease characterised by increased levels of blood sugar (glucose) which can, over time, lead to the development of heart disease, as well as cause damage to the eyes, kidneys, nervous system and blood vessels. A diagnosis of diabetes does not automatically mean that a pilot cannot obtain a medical certificate in the future; however, there are many considerations to be made to ensure an adequately safe flying environment is maintained.

6.1.1 The effect of diabetes on flying safety

Diabetes in any form may impact upon a pilot's ability to fly safely in many ways. The most prominent of these possible events occurs in those diabetics requiring medication such as insulin to lower their blood sugar levels. Suffering from a low blood sugar event in flight, which can result in impaired or lost consciousness, could obviously have catastrophic consequences, particularly in single-pilot operations which represent the majority of recreational flying activities.

Other considerations are those resulting from the end-organ effects of diabetes. These include damage to the eyes and reduced vision, which is an obvious problem in the context of flying. The heart and cardiovascular system can also be damaged (refer to the Cardiovascular conditions in section 4 of this guidelines document), and the health of our nerves and small blood vessels, reducing sensation coming from our extremities, particularly the feet. It is also important to note that people with type 2 diabetes more commonly have sleep apnoea than those who do not have diabetes, which can lead to, among many other problems, poor sleep and increased levels of fatigue (refer to the Sleep conditions in section 10 of these guidelines).

6.1.2 The effect of the flight environment on diabetes

The nature of the flight environment leads to other challenges we must consider beyond those broader issues identified above. The need to urinate frequently, common in diabetics, is uncomfortable and distracting, resulting in obvious problems in a confined cockpit, which add unnecessary pressure on a pilot to land. A serious complication of diabetes is a condition called ketoacidosis, where the body reacts to a lack of insulin. Besides frequent urination, other symptoms include thirst, confusion, nausea and abdominal pain, all of which create a flight safety risk. Coupled with reduced fluid intake and possible dehydration that is common when you fly, ketoacidosis can be much more serious, potentially resulting in coma or death if left untreated.

We must also consider those pilots who may be embarking on longer flights. This is a situation which is no longer the sole realm of commercial operations and is becoming increasingly more common in recreational operations given the long distances involved with travel around Australia, and increasing technological advances allowing for more efficient, longer-range recreational aircraft. The resulting disruption to the daily routine of a pilot embarking on a long-range / long-duration flight may result in irregular or less frequent food intake which can make management of diabetes particularly challenging.

6.2 Medical assessment for pilots

6.2.1 Risk assessment for self-declaration

Note: If you have been diagnosed with any form of diabetes in the past, it is strongly recommended that you go see a doctor prior to making a Class 5 self-declaration. If you have not previously been diagnosed, it is very important that you understand your risk and when you should be screened for diabetes.

The Australian Government has provided resources for the public to allow individuals to assess whether they may require a screening test for diabetes. For pilots of any age and gender, the following is **important to note**[iv]:

- You can have diabetes even without experiencing any symptoms. You could have high blood sugar levels slowly causing damage to various body systems without you being aware of it.
- High blood sugar levels can cause health problems over time.
- Your doctor may ask you to get tested if you are at higher-than-average risk of having diabetes.
- Risk factors for developing type 2 diabetes include being older than 55 years, living with overweight or obesity, having high blood pressure or having a family history of type 2 diabetes.

Diabetes Australia has developed a free Risk Calculator[v] which allows individuals to assess their risk of developing diabetes within 5 years. Anyone with a result that does not encompass the Low risk category should be screened.

6.2.2 Advice to pilots with diabetes

Note: Any diabetic or at-risk individual needs to speak with their doctor before they can be considered safe to fly.

Pilots with diabetes and medical practitioners involved in their medical certification are encouraged to familiarise themselves with the Diabetes fact sheet[33]. While the information provided applies predominantly to Class 1 and 2 medical certificate applicants, the information it contains, together with the references and resources provided, are relevant and can be used to guide your self-assessment and decision-making.

6.3 Medical assessment for doctors

6.3.1 Diagnosis: Diabetes mellitus—diet controlled

Risk assessment

A medical history or clinical diagnosis of diet-controlled diabetes mellitus means the patient is not eligible for a self-declared medical declaration without review by a medical practitioner.

Risk assessment considerations

Assessment of risk is based on the:

- symptoms of hyperglycaemia (polyuria, polydipsia, blurred vision, fatigue which will distract from the flying task).
- likelihood of ketoacidosis.
- target organ damage – risk of a coronary event (based on risk index calculations), evidence of cardiovascular disease, retinal disease, renal disease, microvascular damage, peripheral neuropathy. (refer to the relevant sections in these guidelines).

When an applicant with a history of diabetes presents to a doctor and is examined for the first time, the doctor should explain what they should be monitoring with regards to flying (and if they are the usual treating

[iv] Health Direct, www.healthdirect.gov.au/diabetes-screening-tests

[v] https://www.diabetesaustralia.com.au/risk-calculator/

doctor or have made the diagnosis, the usual primary care interventions would apply as per the relevant guidelines, irrespective of their suitability to fly).

Aeromedical decision

Applicants with a diagnosis of diabetes mellitus that is controlled by diet alone are generally considered eligible for a Class 5 medical self-declaration, provided there is no evidence in their history or upon examination of disqualifying ophthalmological, renal, cardiovascular, or neurological diseases (refer to the relevant sections in these guidelines).

When to refer

For those individuals who do not meet the above criteria at the time of their examination, a medical certificate may be considered in future following review by an endocrinologist outlining a management plan (including regular follow-up) and documented evidence that the above criteria have been met.

6.3.2 Diagnosis: Diabetes mellitus—with glucose-lowering medication other than insulin

Risk assessment

A medical history or clinical diagnosis of medication-controlled diabetes mellitus means the patient is not eligible for a Class 5 medical self-declaration, without review by a medical practitioner.

In addition to consideration of the risk of symptoms in flight, and target organ damage, use of certain medications introduces the additional risk of hypoglycaemic episodes.

Studies have demonstrated that drivers with diabetes are at a slightly higher risk overall of having a vehicle accident than those drivers without diabetes[34,35,36,37,38]. While recreational flying has many differences to driving a car, there are enough meaningful similarities that would allow for the use of driving data, particularly given how frequently and in-depth drivers have been studied compared to pilots. Statistics from driving studies that relate to diabetics on medications that lower blood glucose levels and cause incapacitation from a ‘hypo’ (hypoglycaemia) are particularly relevant and applicable to the recreational aviator too. This includes those individuals who have measurably ‘tighter control’ of their diabetes.

For the purposes of this document, a ‘severe hypoglycaemic event’ is defined by Austroads guidelines as:

> ‘An event of hypoglycaemia of sufficient severity such that the person is unable to treat the hypoglycaemia themselves and so requires someone else to administer treatment’[39].

This means that a pilot is unable to function in any useful manner which is clearly a critical safety problem when flying. This definition includes things such as a loss of consciousness or seizure. It does not matter where or when such an event may have occurred. It may not have been behind the wheel of a car or while flying. It is still considered critically relevant and important because it affects how we think and concentrate and may impair our perception, coordination and motor skills, as well as our level of consciousness. It is easy to see why this is a situation to avoid for any pilot, and why steps must be taken to mitigate the risks involved prior to flying an aeroplane. Austroads guidelines also define ‘mild hypoglycaemic events’, which while less severe, are still of critical importance because they can progress from a mild to severe event if ignored. Mild ‘hypos’ can present with symptoms such as tingling around the mouth, tremors or shakes in the hands, hunger and sweating.

Recreational pilots should consider appropriate precautionary steps such as the examples listed below by Austroads to reduce the risk of a severe ‘hypo’ occurring while driving[39], because although they are very general, they are applicable with some slight modifications to recreational flying:

- Complying with general medical review requirements as requested by their general practitioner or specialist.
- Not flying, if either blood glucose is at or less than 5 mmol/L or if, while wearing a continuous or flash glucose monitor, the predicted glucose level is showing downward trends into the hypoglycaemia range.
- Wearing a continuous or flash glucose monitor, preferably with an active hypoglycaemia alert or alarm.
- Not flying for more than one hour without considering having a snack.

- Not delaying or missing a main meal.
- Self-monitoring blood glucose levels before flying and every 2 hours during a journey, as reasonably practical.
- Carrying adequate glucose in the aircraft for self-treatment.
- Treating mild hypoglycaemia if symptoms occur while flying as able, including:
  - safely diverting and landing immediately
  - self-treating the low blood glucose
  - checking the blood glucose levels 15 minutes or more after the hypoglycaemia has been treated and ensuring it is above 5 mmol/L
  - not recommencing any flying until reviewed by a medical practitioner.

Aeromedical decision

An applicant is not fit to hold a Class 5 medical self-declaration if they have end-organ complications that may affect flying by not meeting the standards outlined in the relevant sections of these guidelines.

A Class 5 medical self-declaration may be considered subject to periodic (annual) review, taking into consideration the nature of the flying task, information available from relevant laboratory tests for monitoring, and information from the treating doctor if different to the doctor assessing the patient for the Class 5 medical self-declaration.

All the following criteria would need to be met to be eligible for medical self-declaration :

- Any end-organ effects are satisfactorily treated, with reference to the standards in this publication
- The person is following a treatment plan that minimises the risk of hypoglycaemia
- The person experiences early warning symptoms (awareness) of hypoglycaemia or has a documented management plan for lack of early warning symptoms
- Any recent severe hypoglycaemic event has been adequately treated, with reference to the 'Advice for pilots with diabetes' section (5.2.2) above.

When to refer

For those individuals who do not meet the above criteria at the time of their examination, medical certification may be considered in future, following review by an endocrinologist outlining a management plan (including regular follow-up) and documented evidence that the above criteria have been met.

Pilots should not fly if they have had a severe hypoglycaemic event until they have been appropriately cleared to do so by a registered medical practitioner. The medical practitioner may need to seek further advice from an endocrinologist or aviation medicine specialists if they are unsure of when to certify a pilot as being fit to fly following such an event.

6.3.3 Diagnosis: Diabetes mellitus—treated with insulin

Risk assessment

Until relatively recently, it was considered an unacceptable risk to allow insulin-treated pilots to fly aircraft. With the advent of new monitoring systems, modern insulin analogues and insulin delivery systems, it has been shown that the risks are now acceptable[40]. Many countries are now allowing Class 1 and Class 2 pilots to fly while taking insulin, so long as certain conditions are met[41,42]. This is reliant upon good patient compliance with treatment, rigorous monitoring of blood glucose, tight glucose control, regular medial review, and strategies to manage any problems in flight. These protocols are only manageable by using a more stringent medical certification system.

In addition to consideration of the risk of symptoms in flight, and target organ damage, use of certain medications introduces the additional risk of hypoglycaemic episodes.

Studies have demonstrated that drivers with diabetes are at a slightly higher risk overall of having a vehicle accident than those drivers without diabetes[34-38]. While recreational flying has many differences to driving a

car, there are enough meaningful similarities that would allow for the use of driving data, particularly given how frequently and in-depth drivers have been studied compared to pilots. Statistics from driving studies that relate to diabetics on medications that lower blood glucose levels and cause incapacitation from a 'hypo' (hypoglycaemia), are particularly relevant and applicable to the recreational aviator too. This includes those individuals who have measurably 'tighter control' of their diabetes.

For the purposes of this document, a 'severe hypoglycaemic event' is defined by Austroads guidelines as 'an event of hypoglycaemia of sufficient severity such that the person is unable to treat the hypoglycaemia themselves and so requires someone else to administer treatment'[39]. This means that a pilot is unable to function in any useful manner, which is clearly a critical safety problem when flying. This definition includes things such as a loss of consciousness or seizure. It does not matter where or when such an event may have occurred. It may not have been behind the wheel of a car of while flying. It is still considered critically relevant and important because it affects how we think and concentrate and may impair our perception, coordination and motor skills, as well as our level of consciousness.

It is easy to see why this is a situation to avoid for any pilot, and why steps must be taken to mitigate the risks involved prior to flying an aeroplane. Austroads guidelines also define 'mild hypoglycaemic events', which while less severe, are still of critical importance because they can progress from a mild to a severe event if ignored. Mild 'hypos' can present with symptoms such as tingling around the mouth, tremors or shakes in the hands, hunger and sweating.

Aeromedical decision

An applicant is not fit to hold a Class 5 medical certificate if they have diabetes treated with insulin due to the risk of hypoglycaemia occurring in flight.

When to refer

If the applicant has diabetes treated with insulin, then they should be referred for further assessment before any aviation medical certification can occur. As insulin-treated diabetes is an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed.

A CASA Class 2 medical certificate may be considered by the applicant in conjunction with the CASA DAME should certain conditions be met. However, the applicant should be advised of the following requirements:

- CASA involvement and the requirement to undergo review by a DAME, to include an annual review.
- There is no recent history of a 'severe hypoglycaemic event', and
  - the person is following a treatment regimen that minimises the risk of hypoglycaemia, and
  - the person experiences early warning symptoms (awareness) of hypoglycaemia (refer to section 3.2.1) or has a documented management plan for lack of early warning symptoms, and
  - there are no end-organ effects that may affect driving as per this publication.
- Referral to an endocrinologist or consultant physician specialising in diabetes, and subject to regular specialist review.
- There are further specific requirements outlined by CASA (8) for Class 2 applicants with insulin-dependent diabetes[vi].

[vi] CASA Clinical Practice Guidelines: Type I Diabetes – Insulin dependent – High-risk of hypoglycaemia

7. Hearing

While the Austroads standards[vii] for private vehicles upon which these guidelines are based do not require individuals to meet a hearing standard, the same is not true for pilots wishing to receive a Class 5 medical self-declaration. Should a pilot declare any history of hearing loss, assessment by a medical practitioner is required in the form of a conversational voice test prior to the issue of a Class 5 medical self-declaration.

7.1 Aeromedical considerations

Effective communication and application of coherent radiotelephony is a requirement for any pilot, as is the ability to comprehend auditory inputs that allow pilots to monitor and accurately assess the status of their aircraft. All pilots will know precisely what their aircraft engine should sound like when it is functioning normally. Subsequently, any unexpected sounds (or lack thereof) may alert the pilot to possible hazards, malfunctions, and even failures, of their engine or other aircraft components[viii].

Using hearing aids or a Cochlear implant does not preclude certification, and in fact are quite commonly used in recreational, general and commercial aviation to varying degrees. The applicant must, however, be able to demonstrate if asked that such devices will work effectively with their chosen in-flight headset.

Further information in this regard can be sought from a flight instructor, who can assess the applicant's hearing in the dual-training flight environment and advise upon any concerns noted. The Civil Aviation Authority of New Zealand have In-Flight Hearing Assessment protocols which can be used as a guide[ix].

7.2 Medical assessments for pilots

7.2.1 Risk assessment for self-declaration

An applicant should declare if they:

- suffer from (or think they may suffer from) hearing loss.
- have ever been advised by a medical practitioner or audiologist that they suffer from any level of hearing loss.
- use/require hearing aids (regardless of how often they are actually used).

A review by a medical practitioner is required should any of the above apply, prior to a Class 5 medical self-declaration being issued.

As inability to hear conversational voice at a distance of 2m is an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed in that case.

7.2.2 Medical assessment for doctors

Standards

The Austroads standards do not apply for this section, as there are no Austroads standards for hearing for private drivers. The hearing standards required for a CASA Class 2 medical certificate have instead been used and identify the need for conversational voice test 'according to a recognised protocol' (for which the FAA protocol has been used)[x].

[vii] Austroads. Assessing Fitness to Drive. Section 4 – Hearing loss and deafness. 22nd June, 2022.

[viii] FAA Safety Brochure – Hearing and Noise in Aviation

[ix] https://www.aviation.govt.nz/assets/forms/24067-204.pdf

[x] CASA Designated Aviation Medical Examiner Handbook – Medical Tests – 6.3 Hearing Tests

Risk assessment

Any declaration of hearing loss will require the applicant to present to a medical practitioner for assessment in the form of a conversational voice test. No formal testing or referral is required at this stage, however, should the applicant fail to pass the test outlined below to the satisfaction of the examiner, referral for further assessment and possible pure-tone audiometry testing is required.

A conversational voice test is required should evidence of hearing loss exist, or declaration of the same made by the applicant. Any hearing aids or Cochlear implants compatible with the applicant's chosen headset must be worn for the test if the applicant intends to use the hearing device in conjunction with their headset in flight. If not, then the test should be conducted without the aid.

The FAA recommends the following[xi]:

- The applicant must demonstrate hearing of an average conversational voice in a quiet room.
- Using both ears at 2 metres, with the back turned to the examiner.
- The examiner should not use only sibilants (S-sounding test materials).
- If the applicant can correctly repeat words, numbers and phrases spoken by the examiner, then they should be considered to have passed the hearing test.

Aeromedical decision

Should the conversational voice test be passed at the discretion of the examiner, the applicant should be considered to have met the hearing requirement of the Class 5 medical self-declaration.

When to refer

Failure of a conversational voice test, or any other concerns raised by the medical practitioner conducting the assessment should result in a referral for assessment and possible pure-tone audiometry testing.

[xi] FAA Guide for Medical Examiners Item 49 - Hearing

8. Musculoskeletal conditions

8.1 Aeromedical considerations

To safely operate an aircraft, pilots must be able to perform and coordinate numerous complex muscular movements that require sufficient range of motion, sensation, coordination, and strength in both the upper and lower limbs.

8.1.1 The effect of musculoskeletal conditions on flying safety

- The upper limbs are necessary for controlling the flight controls and operating secondary aircraft controls.
- The lower limbs are required for operating the foot controls, such as the rudder pedals, which may require considerable force in non-normal events such as asymmetric flight.
- The ability to turn the head is vital for scanning the surrounding airspace, especially during manoeuvres and for visual navigation to maintain situational awareness.
- Getting in and out of the aircraft also demands a certain level of strength and flexibility and may need to be achieved quickly in an emergency on the ground.
- Acute and chronic pain associated with musculoskeletal conditions may also impact the cognitive aspects of flying, as may the pain medications used to treat pain. These factors can affect attention and concentration.

The specific requirements may vary depending on the type of aircraft and the nature of the flying task.

8.1.2 The effect of the flying environment on musculoskeletal conditions

Different aircraft have varying cockpit layouts, control systems, and ergonomics, and certain types of flying tasks can be physically demanding in terms of both the operation of the aircraft and the duration of flight. Prolonged sitting, awkward postures, heavy flight control movements and exposure to vibration are some of the environmental conditions that could exacerbate musculoskeletal problems.

8.2 Medical assessment for pilots

If you have a current acute musculoskeletal condition that causes significant pain requiring the regular use of pain medications, or limitation of function, such that it is likely to interfere with your ability to operate the controls of an aircraft, then you should be assessed by a medical practitioner. For example:

- bone fracture
- lumbar disc protrusion
- anterior cruciate ligament tear.

If you have a chronic or permanent musculoskeletal condition that results in a permanent reduction in your ability to function, then you should be assessed by a medical practitioner. For example:

- loss of a limb
- prosthetic devices
- ankylosing spondylitis
- severe osteoarthritis.

As physical impairments that causes a person not to be able to operate the flight controls safely in all circumstances is an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed in that case.

8.3 Medical assessment for doctors

8.3.1 Diagnosis: Acute and chronic musculoskeletal conditions

Risk assessment

The risk assessment aims to identify if the applicant has sufficient functional ability to undertake the task of flying a light aircraft safely.

Risk assessment considerations

Assessment of risk is based on:

- whether the condition acute or chronic, permanent and static, or progressive
- the functional capacity in the cockpit, based on:
  - muscle strength
  - flexibility
  - endurance
  - somatosensory abilities (sensation, proprioception, kinaesthesia).
- the presence of pain that may cause distraction and subtle incapacitation by impairing concentration, attention, or movement.
- the potential impairment from prescription medications, such as narcotics.
- the likelihood that the condition will progress/worsen.
- whether aircraft control modifications are required to accommodate permanent or chronic conditions.

Applicants with acute musculoskeletal pain and/or reduced mobility from short-term conditions such as injury or surgery should be advised not to fly for the duration of their treatment. Return to flying should be determined by the treating doctor but the impact of any ongoing pharmacological treatments should be considered as well as non-pharmacological treatments such as soft collars or braces.

The overall risk assessment may be informed by a functional assessment in the aircraft type flown by a qualified flying instructor, to ensure that the applicant is able to undertake all routine and emergency flying tasks effectively and safely. This is particularly important where the applicant has a requirement for a prothesis that interacts with aircraft controls. If assessed and managed correctly, limb prostheses are potentially compatible with safe recreational flying[43,44].

Unfavourable risks

Unfavourable risks include:

- chronic pain
- weakness
- mobility limitation
- medications that impair the central nervous system.
- aircraft modification would be required.

Aeromedical decision

The applicants can be considered fit for certification:

- if the risk assessment determines that the musculoskeletal condition will not interfere with flying the aircraft safely
- the condition is stable
- any treatments are effective

- if performed, a functional assessment is satisfactory.

When to refer

Before certification or resumption of flying activities can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if:

- functional impairment is assessed to be of a severity that will interfere with the effective and safe use of aircraft controls, or
- the use of regular medication that impairs cognition or causes drowsiness is required to control pain.
- it is determined that an applicant's permanent disability will require the installation of aircraft control modifications.

9. Neurological conditions

9.1 Aeromedical considerations

Cognitive performance is particularly important in safety-critical activities such as aviation, especially when dealing with unfamiliar or in-flight emergency scenarios. The ability to perform complex tasks safely and effectively in aviation requires strong executive functioning and spatial working memory. While those older pilots with experience will generally exhibit preserved spatial working memory, even mild cognitive impairment can have a negative impact on their ability to manage the demanding and high-level tasks involved in safely operating an aircraft—even for a pilot with significant experience.

9.1.1 The effect of neurological conditions on flying safety

Flying an aeroplane is a complex and demanding task that requires a pilot to constantly maintain and apply many critical neurological functions, which may be impaired by various neurological disorders[94]. These functions include:

- visuospatial perception
- insight
- judgement
- attention and concentration
- comprehension
- reaction time
- memory
- sensation
- muscle power
- coordination
- vision.

Loss of these functions may result in subtle incapacitation, in the same way that acute or chronic pain can cause incapacitation or impairment. Neurological disorders can also result in sudden and complete incapacitation in the event of a seizure or loss of consciousness.

9.1.2 The effect of the flight environment of neurological conditions

Various aspects of the aviation environment can be distracting, discomforting and even dangerous. It is easy to see how certain exposures might make existing medical conditions experienced by a pilot even worse. Hypobaric hypoxia can occur even at low altitudes sufficient to affect a pilot in many different ways, depending on age and general health.

Hypoxia is a condition that occurs when there is a decrease in the amount of oxygen available as altitude increases (see section 2.1 The flight environment for more detailed information). It happens because the air pressure is lower, making it harder for our bodies to get enough oxygen. This can lead to problems with brain function and the performance of important tasks. Hypoxia poses a significant physiological danger during higher-altitude flights, which may be deliberate, forced due to unforeseen circumstances such as bad weather, or from climbing inadvertently. While fatalities related to hypoxia are uncommon in general and recreational aviation, incidents are likely more frequent than suggested due to under-reporting.

Hypoxia can affect susceptible individuals below 10,000 ft (3,048 m) in non-pressurised aircraft and (more specific to military and commercial operations) higher altitudes in pressurised environments when life support systems malfunction or due to improper equipment use. While a recreational pilot with a Class 5 medical self-declaration would be restricted to operations up to 8000 ft, the aircraft being flown would almost universally be capable of operations at far higher altitudes. Between 10,000 ft and 15,000 ft (4,572 m), brain function is mildly impaired, and symptoms of hypoxia are common, although accurately quantifying them is

often challenging. Above 15,000 ft, brain function rapidly declines with increasing altitude, until loss of consciousness occurs[95].

The period during which operational tasks can be effectively and safely performed after exposure to hypoxia is referred to as the time of useful consciousness (TUC). However, this is generally considered of more relevance at higher altitudes than those frequently flown by recreational pilots. An awareness by any pilot of the risk posed by hypoxia and the potential to significantly worsen an existing neurological condition, is important. It is highly likely that a pilot with any symptoms or impairments listed in section 8.1.1 above would experience worsening symptoms in a hypoxic state.

9.2 Medical assessment for pilots

This section provides guidance and medical criteria for the following conditions:

- Headaches and migraines
- Neurocognitive impairment, dementia and the ageing pilot
- Seizures and epilepsy
- Aneurysms
- Cerebral palsy and neuromuscular conditions
- Traumatic brain injury (TBI)
- Parkinson's disease
- Multiple sclerosis (MS)
- Ménière's disease
- Stroke
- Transient ischaemic attacks
- Space-occupying lesions including brain tumours.

Note: If you have a history of any of the above conditions, you should be reviewed by a medical practitioner. Certification may be possible after review by a medical practitioner, should the risk to flight safety be considered low enough, as per the criteria listed below.

As many neurological conditions are excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed in the presence of these diseases.

9.3 Medical assessment for doctors

9.3.1 Diagnosis: Headaches and migraines

Migraines are a type of recurring headache and a relatively common condition that affects about 12% of the population. Research suggests that around 18% of women and 6% of men experience at least one migraine attack per year. Migraines can occur at any age and are identified as one of the top 10 most disabling diseases in aviation[xii] and can range from distracting to debilitating. While most people have experienced headaches, mild episodes without serious symptoms aren't typically considered a cause for concern. Even more severe headaches related to temporary, harmless illnesses are often not of aeromedical significance[xiii]. However, if symptoms are severe and debilitating, migraines could impair a pilot's ability to fly, causing a

[xii] FAA Safety Briefing – January/February 2019

[xiii] New Zealand Civil Aviation Authority (NZ CAA) Medical Manual Part 3.10 - Central Nervous System

serious safety risk due to rapid onset and potentially incapacitating symptoms.

In brief, migraines can be divided into 2 major types:

1. Migraines with aura are associated with visual, auditory, sensory, or motor symptoms that begin 10 to 60 minutes before the headache but can occur coincidentally.
2. Migraines without aura are more common and can occur without warning, typically on one side of the head, and are associated with symptoms that could seriously interfere with flying safety, such as nausea, confusion, blurred vision, mood changes, fatigue, and increased sensitivity to light, sound, or noise.

Migraines can be triggered by various factors such as:

- stress
- bright flashing lights
- loud noises
- medicines
- sudden changes in weather or environment
- over-exertion
- tobacco
- caffeine (or caffeine withdrawal)
- certain foods.

Identifying a trigger that can be avoided is beneficial to the individual and a favourable factor for medical certification. There is no cure for migraines, and treatment focuses on symptom relief for the occasional migraine and preventive treatment for the more severe and/or frequent migraine. Different types of medicines are used to treat migraines, including over-the-counter pain relievers and prescription medications.

While a diagnosis of migraines or recurring headaches would pose a challenge to medical certification for those seeking higher-level professional pilot licences, certification for recreational flying is possible should certain criteria be met, as per the information provided below.

Risk assessment

Risk assessment considerations

A diagnosis of migraine should be confirmed based on a patient's medical history. Notes from a general practitioner and/or emergency department assessment should identify any triggers, and the frequency and severity of migraine episodes.

Headaches and migraines become a concern for pilots if they:

- cause distraction.
- affect sensory, motor or visual functions.
- impair concentration due to symptoms like:
  - pain
  - nausea
  - vomiting
  - photophobia
  - poor motor function.

Features that suggest aeromedical significance include:

- the rapid onset of symptoms
- frequent episodes
- long episodes

- the need for strong pain medication
- the cessation of activities due to migraines.

The potential consequences of a migraine episode during a flight will depend on the type of operation being undertaken. For instance, a pilot operating alone at night under instrument flight rules may struggle to cope with even a mild migraine episode, given the significant workload and concentration required to fly accurately and safely in these conditions. However, the same pilot experiencing a similar episode might be able to land safely if flying during the day under visual flight rules. As such, operational restrictions may provide adequate mitigating circumstances at times.

Favourable risks

Favourable risks include migraines that:

- occur predictably and infrequently.
- have an aura or warning that has a slower, more predictable onset (as such, would allow the pilot to delay the flight or land immediately)
- do not interfere with the pilot's function (physically or mentally)
- are not accompanied by painful headaches or associated common symptoms such as vomiting or neurological impairment (such as visual changes, dizziness etc.).

Aeromedical decision

Medical certification under the Class 5 system is possible following a review by a medical practitioner who can ascertain the following[xiv]:

- No symptoms such as nausea, vomiting, photophobia, phonophobia, aura, or sensory or motor features are present when the headache/migraine occurs.
- There is a known and avoidable trigger for the episode (that is, the pilot can safely determine that they have not been and will not be exposed to a known trigger leading up to and during the flight).
- No medication other than simple pain relief, such as paracetamol or a non-steroidal anti-inflammatory drug (NSAID) is needed during an episode.
- There is no requirement for immediate medical treatment or admission to a hospital when the episodes occur.
- The episode does not interfere with the ability to perform tasks.
- The frequency of the headaches/migraines is less than twice a year, or they have not occurred in the past 5 years.
- The headache/migraine was a one-time occurrence related to a temporary and non-serious illness.

While applicants with migraines would encounter some difficulty in applying for medical certificates associated with higher level, professional pilot licences, consideration for a Class 5 medical self-declaration would be given to an applicant who meets the criteria listed above.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if the applicant has frequent and debilitating headaches that:

- interfere with normal daily activities.
- do not respond readily to medical therapies.
- are determined by a medical practitioner to pose a risk to flight safety.

[xiv] New Zealand Civil Aviation Authority (NZ CAA) Medical Manual Part 3.10 - Central Nervous System

9.3.2 Diagnosis: Neurocognitive impairment, dementia and the ageing pilot[xv]

A self-declared history of neurocognitive impairment or dementia requires assessment by a medical practitioner.

Impaired cognitive performance is likely to have an adverse impact on safety-critical activities such as flying recreational aircraft, particularly when facing unfamiliar or in-flight emergency situations. The ability to perform complex tasks safely and effectively in aviation relies on well-developed executive functioning and spatial working memory. Certification cannot be granted to individuals with a diagnosis of dementia, which refers to severe cognitive and behavioural problems that significantly impair normal functioning.

> **Note:** It is important to note that cognitive impairment may go unnoticed by the pilot.

Risk assessment

Risk assessment considerations

The biggest risk for this condition is that the applicant may be unaware of their impairment or not have the insight to declare it. These pilots may never present for review and thus go undetected. Maintaining a cautious approach is crucial when evaluating older pilots. Mild cognitive impairment may not interfere with their daily activities, but it poses a considerable risk to flight safety.

The reviewing medical practitioner should inquire about the applicant's flying experience since their last application and/or medical review and discuss with them:

- their ability to manage different situations.
- difficulties encountered with different aircraft types.
- flight planning.
- procedural activities (such as cockpit or air traffic control communications).

Discuss and review any recent incidents or near misses related to flying or driving that are brought to the attention of the medical practitioner.

It is acknowledged that such discussion may require specialist aviation knowledge beyond the usual day-to-day practice of a specialist general practitioner (for example). Specialist aviation medical examiners in Australia and abroad use a variety of office-based tests as initial screening tools, such as the:

- Montreal Cognitive Assessment (MOCA)[xvi]
- CAA (New Zealand) Ageing Pilot Report[xvii]

> **Note:** Many of the simple cognitive tests available to medical practitioners are unlikely to detect mild cognitive impairment that may have significant aeromedical implications.

Aeromedical decision

Any evidence or concerns noted by the medical practitioner regarding cognitive impairment renders the applicant ineligible for a Class 5 medical self-declaration.

[xv] See ‘Diagnosis: The ageing pilot’ in section 17 (Other medical conditions and symptoms not otherwise specified) in these guidelines.

[xvi] Montreal Cognitive Assessment (MoCA) Test

[xvii] New Zealand Civil Aviation Authority (NZ CAA) Ageing Pilot Report

When to refer

In certain cases, formal neurocognitive testing may be necessary, but this would be beyond the requirement of the initial assessing medical practitioner for a medical self-declaration or certification applicant, as any evidence or concern about cognitive impairment renders the applicant ineligible for the certification.

Before certification can occur, the medical practitioner should refer the applicant for further assessment. Decisions about any aviation medical certificate will include review in the context of the aviation environment and consider:

- multiple factors, including the type of flying to be conducted and the aircraft being operated.
- requesting the most recent aeroplane flight review (AFR) or competency flight check report to include for review.

A CASA flight examiner assessment may be required to specifically evaluate decision-making skills, flight planning abilities, and procedural tasks. A higher-level of restricted medical certification may be considered in these circumstances.

9.3.3 Diagnosis: Seizures and epilepsy

A self-declared history of epilepsy or seizures requires assessment by a medical practitioner.

A seizure is an uncontrolled burst of electrical activity in the brain that can cause changes in behaviour, movements, feelings, and consciousness levels. If a person experiences 2 or more seizures without a known cause, they may be diagnosed with epilepsy. Seizures vary in type, symptoms, and severity, depending on where they begin in the brain and how far they spread.

Most seizures last between 30 seconds and 2 minutes, but a seizure that lasts longer than 5 minutes is possible and, while rare, would be considered a medical emergency. Seizures can be caused by a wide variety of factors such as stroke, head injury, infection, or other illnesses, but sometimes the cause is simply unknown despite investigations and review by a medical practitioner[96].

Risk assessment

Risk assessment considerations

A history of seizures poses a significant risk to aviation safety, since they can occur suddenly and without warning, resulting in total incapacitation of the pilot. Seizures can cause pilots to make erratic aircraft control inputs, potentially stressing the aircraft structure beyond its limits and leading to a rapid loss of control or destruction of the aircraft.

Convulsive incapacitation is considered a higher risk than other forms of incapacitation, and a careful evaluation is necessary when dealing with any history of convulsions, including febrile convulsions. When dealing with a history of loss of consciousness, it is important to confirm that the cause was not a seizure. A thorough history, supported by witness accounts and medical records, should be obtained, and a neurologist's opinion may be necessary if there is no clear cardiovascular cause for the episode.

Risk assessment hinges on establishing the underlying cause of the seizures to determine if they are secondary to another medical condition, or the result of idiopathic epilepsy. To assist in their assessment of an applicant with a history of seizures, the examining medical practitioner should attempt to obtain and consider the following information:

- A copy of:
  - GP notes for at least the past 5 years, as well as those relevant to the period during which seizures occurred.
  - records pertaining to any episode of seizure, as well as the results of any investigations that were undertaken as a result.
- Specialist neurologist reports.

Febrile convulsions are a common cause of early childhood seizures and warrant specific mention. According to the National Health Service (UK), a febrile seizure is an event that occurs in early childhood, typically between the ages of 3 months and 5 years, associated with fever and without any apparent cause

for the seizure[97]. Approximately 2–5% of children in this age group will experience at least one febrile seizure, with the peak occurrence being between 18 to 22 months of age.

Febrile seizures are classified as:

- simple, if they last less than 15 minutes and do not recur within 24 hours.
- complex or complicated, if they are focal, last longer than 15 minutes, or occur in clusters of 2 or more convulsions within 24 hours[xviii].

Children with 3 or more febrile seizures, abnormal neurological or developmental status before their first seizure, a family history of afebrile seizures, or a complex febrile seizure are at increased risk for epilepsy later in life. A large study of over 2 million children found that the cumulative risk for epilepsy was 2.2%, and for those with a history of febrile seizures, the risk increased to 6.4%, 10.8%, and 15.8% after the first, second, and third febrile seizure, respectively. The risk of epilepsy did not decrease over time, even after long periods without seizures. The cumulative risk after even one seizure remained higher than that of the reference population up to 25 to 30 years later.

Aeromedical decision

An applicant may be considered for a Class 5 medical self-declaration on a case-by-case basis if the applicant:

- has established adult epilepsy or post-traumatic epilepsy and has been seizure-free for over 10 years without medication.
- presents with a history of childhood epilepsy, or atypical or complex febrile seizures.

An applicant aged 20 years and over, with a well-documented history of a single episode of non-complex febrile convulsion before the age of 5, would generally be considered for a Class 5 medical self-declaration.

If in any doubt, the examining medical practitioner should refer the applicant to CASA DAME for review and consideration of a different class of medical certificate.

An applicant with a history of seizures related to alcohol or drug withdrawal is similarly generally considered to have a medical condition that is relevant to aviation safety. However, once again, they may be considered for a Class 5 medical self-declaration on a case-by-case basis, should they satisfy criteria identified within this section and those contained in section 11 (Substance misuse) of these guidelines.

When to refer

If an applicant has a confirmed history of adult epilepsy or post-traumatic epilepsy, it is considered a medical condition that would likely have a significant impact on aviation safety. Such an applicant is not eligible for a Class 5 medical self-declaration, and they should be before any certification can occur.

9.3.4 Diagnosis: Cerebral artery aneurysms

A self-declared history of a current or previous ruptured or unruptured cerebral artery aneurysm requires assessment by a medical practitioner.

An aneurysm is an abnormal bulging or ballooning of a blood vessel that occurs when a weakened area of a blood vessel wall becomes stretched and bulges out. When an aneurysm ruptures or tears (known as a dissection) it can lead to life-threatening bleeding or blockage of blood flow to vital organs. Such abnormalities can occur in any blood vessel, including the brain, resulting in a condition known as a haemorrhagic stroke should they rupture. They often do not cause noticeable symptoms until a catastrophic event occurs, such as rupture or dissection. These events can happen suddenly and have severe consequences, even leading to death. The possible consequences of such an event occurring in flight could be sudden and total incapacitation.

Intracranial aneurysms have a prevalence of 3.6–6.5% of the population over 30 years of age[98]. Subarachnoid haemorrhage (SAH) only affects a small proportion of these individuals, but the consequences of this are potentially devastating and the fatality rate is high. The reported annual incidence of SAH varies

[xviii] New Zealand Civil Aviation Authority (NZ CAA) Medical Manual Part 3.10 - Central Nervous System

from 2 to 22.5 cases per 100,000 people (0.002–0.023% per year). The aviation implications of acute aneurysmal SAH have been well described as:

- sudden incapacitation affecting command and control of the aircraft.
- remoteness from definitive medical care.
- the impact such an event has on crew resources and performance[99].

Evidence and information pertaining to intracerebral aneurysms in pilots and their associated risk is scarce, apart from occasional case studies. The natural course of unruptured cerebral aneurysms varies according to the size, location, and shape of the aneurysm[100].

Risk assessment

Risk assessment considerations

Assessment of risk is based on[101]:

- site of the aneurysm
- size of aneurysm
- any history of rupture or dissection
- risk of:
  - recurrence
  - rebleeding
  - seizure.

Aeromedical decision

A previous diagnosis of an unruptured or untreated intracerebral aneurysm renders the applicant ineligible for automatic issuance of a Class 5 medical self-declaration. Referral to a DAME is required should the applicant wish to pursue aeromedical certification as outlined below.

The presence of an aneurysm is not necessarily a disqualifying condition for medical certification, with cases of even military aviators returning to flying after rupture and surgical repair[101]. The aim is to ensure that pilots with aneurysms are closely monitored, receive appropriate treatment if necessary, and are certified to fly only if their condition does not pose an undue risk during flight. As with any medical condition in this context, the safety of both the pilot and the passengers remain the primary concern. In most cases, formal neurological review and imaging will be necessary, but this would be beyond the requirement of the initial assessing medical practitioner for a Class 5 medical self-declaration applicant.

For aneurysms that have been surgically repaired, the *Austroads Fitness to Drive* document outlines requirements for private drivers, which have been modified below to apply to a Class 5 medical self-declaration applicant:

- The pilot should not fly for:
  - at least 3 months following an aneurysmal subarachnoid haemorrhage.
  - 6 months following any intracranial surgery, but based on a seizure risk assessment.
- If any seizures occur, then the relevant section of these guidelines will apply.

When to refer

Before certification can occur, the applicant should be referred for further assessment before any aviation medical certification can occur if the applicant has a declared history of unruptured cerebral artery aneurysm. Any medical certification decision should include review of the applicant in the context of the aviation environment and consider multiple factors, including the:

- likelihood of rupture.
- monitoring required.

- overall suitability for any aeromedical certification.

CASA may request information like that outlined by the Federal Aviation Administration (FAA) for applicants presenting with an unruptured intracranial aneurysm[xix]. The following information is provided below for guidance to the assessing medical practitioner in the first instance, to assist in arranging the likely required investigations (though they are advised to discuss the case with CASA and/or a DAME prior to requesting any invasive imaging or investigations).

CASA may request the following information:

- A current, detailed neurological evaluation from a neurologist no more than 90 days before the DAME examination.
- CTA (preferred) or MRA head performed no more than 12 months before the DAME examination.
- Previous imaging (CT, MRI, CTA, MRA or cerebral catheter angiography/cath angio of the head) performed at any time after the symptoms occurred.

The applicant should be referred for further assessment before any aviation medical certification can occur if:

- complications have occurred from previous rupture or surgical repair, or
- the risk of seizure, recurrence or rebleeding is considered significant.

9.3.5 Diagnosis: Cerebral palsy and neuromuscular conditions

Cerebral palsy is a neurological condition caused by brain injury or abnormal development, while neuromuscular conditions primarily affect the muscles, nerves, or neuromuscular junction.

Risk assessment

Risk assessment considerations

Any applicant with cerebral palsy (CP), as well as certain neuromuscular conditions such as muscular dystrophy, myasthenia gravis,, motor neurone disease or peripheral neuropathies, is not eligible for a Class 5 medical self-declaration without review by a medical practitioner.

Both cerebral palsy and certain neuromuscular conditions can lead to challenges with movement, coordination, posture, and muscle control. These difficulties can potentially interfere with a pilot's ability to safely operate an aircraft’s controls. Precise manipulation of controls such as the yoke, rudder pedals, and various other cockpit instruments, requires coordinated movement, fine motor skills, and adequate muscle strength.

For a pilot, motor skills and functionality are vital for maintaining control and responding to changing flight conditions. Whether it is due to impaired muscle control, muscle weakness, neuromuscular fatigue, or coordination issues, limitations in these areas can pose significant challenges in fulfilling the requirements for a recreational pilot medical certificate.

While CP is a condition that is unlikely to progress over time, this is not the case for other neuromuscular conditions. Any such diagnosis necessitates careful assessment upon initial application, particularly pertaining to the effects on flight safety. Such assessment would generally not be considered a requirement by the initial treating medical practitioner when assessing an applicant for a Class 5 medical self-declaration, as a CP diagnosis (or concerns thereof for CP or any neuromuscular condition) does not allow for a Class 5 medical self-declaration to be issued (see When to refer below).

The efficacy of pharmaceuticals used to treat a neuromuscular condition continues to progress and can, in some cases, reduce the severity of symptoms and the frequency of their occurrence. Generally, however, this group of diseases is not considered curable, and treatments prescribed often come with side effects that are unsafe for flying.

Aeromedical decision

[xix] Federal Aviation Administration – Guide for Aviation Medical Examiners (Brain Aneurysms)

A diagnosis of CP or any neuromuscular condition, or evidence that might suggest such a diagnosis as noted by the medical practitioner, renders the applicant ineligible for a Class 5 medical self-declaration.

Individual cases may vary widely depending on the specific nature and severity of the condition. While some individuals with mild forms of cerebral palsy or certain neuromuscular conditions, such as muscular dystrophy, myasthenia gravis, or peripheral neuropathies, may be able to meet the necessary standards and obtain medical certification, others with more significant impairments may face limitations or restrictions.

Ultimately, the decision regarding medical certification is made on a case-by-case basis, taking into consideration the specific circumstances, capabilities, and limitations of the pilot applicant. Aviation medical experts conduct comprehensive evaluations to assess the individual's ability to safely operate an aircraft and may require additional documentation, assessments, or adaptations to ensure aviation safety.

When to refer

Any diagnosis of CP (or concern that such a diagnosis of CP or any neuromuscular condition might be possible) noted by the medical practitioner renders the applicant ineligible for a Class 5 medical self-declaration and the medical practitioner should refer the applicant for assessment before certification can be considered. Aviation authorities, such as CASA, have established guidelines and standards to assess the medical fitness of pilots. These guidelines prioritise safety and ensure that pilots possess the physical capabilities necessary for safe aircraft operation.

Since some conditions in this category can fluctuate, the medical practitioner should discuss with the applicant the reason for the refusal and subsequent referral to a DAME, emphasising that any current examination status may not accurately represent the intermittent, yet more severe, impairments that may arise in the future. In certain cases, formal neurological testing may be necessary. The CASA DAME is trained to further review the applicant in the context of the aviation environment and consider multiple factors, including the type of flying to be conducted and the aircraft being operated. They will likely consider requesting the most recent AFR (aeroplane flight review) or competency flight check report to include for review.

A CASA flight examiner assessment may be required to specifically evaluate:

- fine and gross motor skills
- decision-making skills
- flight planning abilities
- the mechanical performance of certain procedural tasks.

9.3.6 Diagnosis: Traumatic brain injury

A traumatic brain injury (TBI) is defined as an alteration in brain function or evidence of other brain pathology caused by an accident (the resulting injury being from an external force/impact to the head). Traumatic brain injuries can range from mild concussion to severe, with temporary or permanent effects.

A TBI can cause neurological and neurocognitive problems, as well as psychological and mood changes, and may increase the risk of post-traumatic epilepsy (PTE). Therefore, a history of TBI can potentially affect the safe operation of an aircraft due to the increased risk of seizures in the pilot.

Risk assessment

Risk assessment considerations

Risk assessment should include a detailed history of the accident, along with medical records from the ambulance service, emergency department, and hospital to determine the severity of the head injury. Risk is determined by the duration of any neurological impairments, and any persistent effects of the head injury. There is some evidence that there is a persistent risk of aviation mishaps even after mild TBI[102].

The following reports and information are important in the assessment of TBI risk and should be obtained:

- Emergency department (ED) records
- Fitness for work certificates
- Concussion services reports

- Neurology and neuropsychological reports
- Imaging - If a recent head injury is known to have occurred, the practitioner should attempt to obtain a CT head scan evaluation within the first 3 days following the injury, as this is when the presence of intracranial bleeding and new cerebral contusions can be detected.
- Evaluate if alcohol use was a factor at the time of the accident.

Post-traumatic epilepsy (PTE) risk

The risk of PTE has now been shown to depend mainly on the presence of intracranial blood, which is readily detectable with early CT brain imaging and may be intracerebral, extracerebral, or both. Subdural bleeding may be acute or chronic, and if acute, it is generally accompanied by intracerebral bleeding. A contusion is a form of superficially located intracerebral bleeding and bruising[xx]. The risk for epileptic seizures is substantially increased after TBI, especially during the first 6 months after the injury and in patients with a combination of intracranial bleeding and brain contusion[56].

A concussive convulsion is a seizure at the moment the head injury occurs, which is not usually epileptic and does not increase the risk of post-traumatic epilepsy. However, it should also be determined that an epileptic seizure was not the cause of the head injury in the first place. An early post-traumatic seizure occurs within one week of a head injury, whereas PTE is the occurrence of one or more epileptic seizures one week or more after the head injury.

The severity of head injuries can be classified as mild, moderate, or severe:

- Mild TBI results in loss of consciousness or post-traumatic amnesia for no more than 30 minutes in the absence of a skull fracture or any persistent neurological symptoms or signs. CT scan shows no evidence of intracranial bleeding.
- Moderate TBI results in loss of consciousness or post-traumatic amnesia for more than 30 minutes but less than 24 hours, and there may be other symptoms and/or a non-depressed skull fracture. There are no persistent central nervous system symptoms or signs, and CT scan shows no evidence of intracranial bleeding.
- Severe TBI results in loss of consciousness or post-traumatic amnesia of more than 24 hours, structural brain injury as demonstrated by CT scan or surgical exploration, any persistent focal neurological deficits or symptoms indicative of cerebral hemisphere damage, an epileptic seizure occurring one week later or more following the TBI, or a depressed fracture[xx].

Assessment of clinical risk factors that increased the likelihood of PTE include:

- any focal neurological signs.
- loss of consciousness at the time the injury occurred.
- early seizures.
- any need for admission to an ICU and the associated requirement for mechanical ventilation.
- a history of alcohol abuse also increases PTE risk.
- findings on imaging, including any midline shift, skull fracture, cerebral contusion and subdural haemorrhage.
- skull fracture - should be considered to have a TBI associated with it. A depressed fracture occurs when the inner table of the skull is depressed more than the thickness of the skull and is a significant risk.

Most aviation regulators around the world will assess risk and subsequent aeromedical certification based on the likelihood of seizures occurring. The Civil Aviation Authority of New Zealand (NZ CAA) has adopted the following table (Table 2) denoting the risk of PTE based on the literature available[104].

[xx] New Zealand Civil Aviation Authority (NZ CAA) Medical Manual Part 3.10 - Central Nervous System

Table 2. The severity of TBI and PTE risk

TBI severity	Estimated initial risk of PTE	Estimated time to near the risk of the general population
Severe Combined extra and intracerebral bleeding	Up to 40%	Well over 10 years
Severe Intracerebral bleeding only	25 %	10 years and over
Severe No intracerebral bleeding, but may have extracerebral haematoma, early epilepsy, depressed skull fracture or more than 24 hours of post-traumatic amnesia.	3–4%	• 2 years if only one risk factor • 3 years if the risk factors occur in combination.
Moderate Post-traumatic amnesia or loss of consciousness for greater than 30 minutes but less than 24 hours, may have linear fracture with or without other signs or symptoms, no persistent signs or symptoms, CT scan shows no intracranial bleeding.	Close to that of the normal population	N/A
Mild Post-traumatic amnesia or loss of consciousness for greater than 30 minutes, no skull fracture, no persistent signs or symptoms, CT scan shows no intracranial bleeding.	Same as normal population	N/A

Aeromedical decision

Mild TBI

An applicant with a history of mild head injury (simple concussion) may be considered as meeting the standards for a Class 5 medical self-declaration if:

- after at least 3 months since the injury, the history obtained by the assessing medical practitioner, as well as a review of the relevant medical records pertaining to the head injury (including details such as LoC and PTA) support a diagnosis of a mild head injury, as per the criteria noted above, and
- the neurological examination is normal, the patient remains asymptomatic and there are no mood changes or cognitive findings relevant to the head injury, and
- any related imaging such CT of the brain shows no abnormality.

When to refer

Any applicant should be referred for further assessment before any aviation medical certification can occur if they:

- do not meet the criteria outlined above (under Mild TBI), or
- have a history of moderate or severe TBI.

Should there be any concerns by the medical practitioner regarding the applicant's ability to safely operate an aircraft, they should not sign off on a Class 5 medical self-declaration and instead, advise the applicant to seek review by a CASA DAME.

9.3.7 Diagnosis: Parkinson’s disease

Parkinson's disease (PD) is a progressive degenerative disorder affecting the central nervous system. PD is a disease which progresses over time and necessitates careful assessment, not only regarding its immediate effects on flight safety during certification, but also its anticipated development throughout the certification period.

Risk assessment

Risk assessment considerations

The symptoms associated with PD that are relevant to flight safety and must be considered include:

- The motor (movement) symptoms associated with Parkinson's disease are many and varied, but most often include a combination of:
  - tremors
  - stiffness
  - slowed movement
  - difficulties with walking and coordination[105].

  Unfortunately, these symptoms are not always immediately apparent to the individual or those close to them.
- Cognitive and behavioural issues may arise, with dementia commonly occurring in the later stages of the disease and depression being particularly prevalent with regards to mental health disorders that are commonly associated with PD.
- Relevant and pervasive emotional problems can also be experienced.
- Symptoms that fluctuate.

Medication can alleviate the symptoms associated with PD, but they do not modify the course of the disease. Several treatments (including pharmacological) prescribed for PD come with side effects that are incompatible with flying safely[105], and these should be discussed with the applicant by the DAME should they choose to proceed with such a referral to seek an alternative CASA medical certificate.

Aeromedical decision

A PD diagnosis (or concerns thereof) does not allow for a Class 5 medical self-declaration to be issued. Certification is possible by a CASA DAME in certain circumstances. Since the impairment resulting from the disease fluctuates, the medical practitioner should discuss with the applicant the reason for the refusal and subsequent referral to a DAME, emphasising that any current examination status may not accurately represent the intermittent yet more severe impairments that may arise in the future.

PD can be managed, and medications and therapies to do so are improving all the time. In many cases (particularly with an early diagnosis), a good quality of life can be preserved for prolonged periods. A diagnosis of PD does not immediately exclude aviation medical certification in professional aviation personnel[59]. However, it does not allow for a self-declared medical such as the Class 5 medical self-declaration. A CASA DAME review for consideration of an alternative certificate is required.

When to refer

In certain cases, formal neurological testing may be necessary, but this would be beyond the requirement of the initial assessing medical practitioner for medical certification or self-declaration applicant. A diagnosis of PD (or concern that such a diagnosis might be possible) noted by the medical practitioner renders the applicant ineligible for Class 5 certification as per the above. It is recommended that the medical practitioner refer the applicant for further assessment before any aviation medical certification can occur.

CASA will review the applicant in the context of the aviation environment and consider multiple factors, including the type of flying to be conducted and the aircraft being operated. They will likely consider requesting the most recent AFR (aeroplane flight review) or competency flight check report to include for review.

A CASA flight examiner assessment may be required to specifically evaluate:

- fine and gross motor skills
- decision-making skills
- flight planning abilities
- the mechanical performance of certain procedural tasks.

9.3.8 Diagnosis: Multiple sclerosis

Multiple sclerosis (MS) is a common nervous system demyelinating disorder affecting the brain and nerves. A demyelinating disorder occurs when the protective covering around neurons, known as the myelin sheath, is compromised. This disruption can impair the transmission of signals within the affected nerves.

Risk assessment

Several of the manifestations of MS may cause performance impairment in a pilot. These include cognitive impairment, fatigue, and depression. Episodes of spasms, dysarthria, ataxia, paraesthesia, diplopia, and hemiplegia, as well as drug side effects, may also affect flight[60]. Seizures and episodes of vertigo may occur suddenly and result in in-flight incapacitation[61].

About 85% of patients appear with a relapsing-remitting onset, of which 90% will eventually convert to progressive MS. In 15% of patients, the initial presentation is progressive[60]. The nature and predictability of disease progression is difficult to ascertain, and often dependant on the sub-type of MS with which the applicant has been diagnosed.

Risk assessment considerations

In assessing risk, the following factors should be considered:

- Effects on flight safety – nature and severity of symptoms experienced.
- Anticipated development throughout the certification period – pattern of likely relapses and recurrences and progression
- Functional capacity – mobility, somatosensory function, vision, communication, cognition and mood.
- Pharmaceuticals used to treat MS reduce the severity of symptoms and the frequency of their occurrence. Generally, however, this group of diseases is not considered curable, and treatment prescribed for MS often comes with side effects that are unsafe for flying[60].

Aeromedical decision

A diagnosis of MS, or evidence that might suggest a diagnosis of any demyelinating condition, renders the applicant initially ineligible for a Class 5 medical self-declaration.

Certification is possible by CASA, however, in certain circumstances. Since the impairment resulting from the disease fluctuates, the medical practitioner should discuss with the applicant the reason for the refusal and subsequent referral to CASA, emphasising that any current examination status may not accurately represent the intermittent, yet more severe, impairments that may arise in the future.

When to refer

A diagnosis of MS or similar demyelinating condition noted by the medical practitioner renders the applicant ineligible for a Class 5 medical self-declaration. It is recommended that the medical practitioner refer the applicant for further assessment before any medical certification or declaration can occur.

Formal neurological testing may be necessary to ascertain whether other forms of medical certification may be possible, but this would be beyond the requirement of the initial assessing medical practitioner. CASA will further review the applicant in the context of the aviation environment and consider multiple factors, including the type of flying to be conducted and the aircraft being operated. They will likely consider requesting the most recent AFR (aeroplane flight review) or competency flight check report to include for review.

A CASA flight examiner assessment may be required to specifically evaluate:

- fine and gross motor skills
- decision-making skills
- flight planning abilities
- the mechanical performance of certain procedural tasks.

9.3.9 Diagnosis: Stroke

Stroke refers to a sudden interruption or reduction of blood flow to the brain, resulting in the loss of brain function. It occurs when the blood supply to a part of the brain is blocked (ischemic stroke) or when a blood vessel in the brain ruptures (haemorrhagic stroke).

Ischemic strokes are the most common type, accounting for approximately 85% of all strokes. They occur when a clot or plaque build-up, obstructs a blood vessel, cutting off the blood flow to an area of the brain. Haemorrhagic strokes, on the other hand, are caused by the rupture of a weakened blood vessel in the brain, leading to bleeding into the surrounding tissues.

The lack of blood flow during a stroke can deprive brain cells of oxygen and vital nutrients, causing them to start dying within minutes. The symptoms of a stroke can vary depending on the part of the brain affected but often include:

- sudden numbness or weakness on one side of the body
- trouble speaking or understanding speech
- severe headache
- dizziness
- loss of balance or coordination.

Strokes are medical emergencies and require immediate medical attention. Prompt treatment is crucial to minimise brain damage and improve the chances of recovery. Treatment options may include medications to dissolve blood clots, surgery to remove clots or repair blood vessels, and rehabilitation to regain lost functions and prevent complications.

Having a stroke does not necessarily mean you won’t be able to obtain a medical certificate, but a history of stroke requires assessment by a medical practitioner before medical certification can be considered. It is typical for individuals to feel tired and have difficulties focusing and paying attention after experiencing a stroke, even if they don't have any lasting neurological issues. These effects are usually temporary and may temporarily hinder the capacity to fly, but depending on several factors, recovery to meet the standards required for a Class 5 medical self-declaration is possible.

Risk assessment

Persistent symptoms or neurological deficits that have a significant impact on daily activities, including driving, can arise following a stroke. Subsequently, such a deficit could result in an impact on flying which could be significant. For applicants experiencing these deficits, their ability to fly safely will depend on the degree of impairment in the functions mentioned below.

Risk assessment considerations

Risk assessment of the Class 5 applicant with a history of stroke should consider the following:

- Ability to function in activities of daily living.
- Ongoing difficulties with language comprehension (aphasia) that could affect their suitability to fly safely.
- Standards related to musculoskeletal conditions and vision and eye disorders may also be relevant (please refer to the corresponding sections in these guidelines).
- If a person has experienced a seizure, the standards for seizures and epilepsy also apply (refer to section 8.3.3 Diagnosis: Seizures and epilepsy).
- The underlying cause of the stroke and likelihood of recurrence. A common cause of stroke in younger people is cryptogenic stroke due to a patent foramen ovale, which has been documented in young pilots previously[83].

- Presence of atrial fibrillation. Stroke recurrence rate of 17.7%. At 6 months, the recurrent event rate was 5.0%, at 1 year, 5.8%, and at 3 years 6.9%[109].
- If post-stroke rehabilitation is necessary, the individual's functional deficits may indicate potential impacts on their ability to fly. Upon discharge, documentation of the assessment should be provided, including confirmation that no permanent neurological deficits have been identified. Fitness to resume driving after the non-driving period may be a good indicator.

> **Note:** It is of critical importance that any medical practitioner reviewing the applicant considers their relevant cardiovascular risk factors, and that have been appropriately addressed and managed (by the assessing practitioner or the regular treating physician. Section 4 (Cardiovascular conditions) of these guidelines outlines what may be required prior to a medical certificate being issued.

Aeromedical decision

The applicant should be referred for further assessment before any aviation medical certification can occur, if the following conditions apply to the applicant:

- Significant impairments of any of the following:
  - Visuospatial perception
  - Insight
  - Judgement
  - Attention and concentration
  - Comprehension
  - Reaction time
  - Memory
  - Sensation
  - Muscle power
  - Coordination.
- Abnormalities of visual fields
- There have been one or more seizures.

Following a stroke there should be a minimum non-flying period of 4 weeks, and there should be a recovery of function with no evidence of the impairments listed above.

Applicants who do not exhibit relevant impairment in the functions listed above may be deemed eligible for a Class 5 medical self-declaration, provided they meet the other criteria listed in these guidelines for vision, hearing and seizure risk. It may be necessary to consult a CASA DAME for evaluation and consideration of an alternative medical certificate, which could involve a practical assessment with a flight instructor.

When to refer

An applicant who has suffered a stroke in the past provides a challenge for the assessing practitioner regarding establishing risk to flight safety. Any failure to satisfy the criteria above should prompt the assessing practitioner to refer the applicant to a CASA DAME for further assessment before certification can be considered. Furthermore, any concern by a practitioner regarding an applicant who satisfies the above criteria should still be referred, and the assessing practitioner should have a low threshold for such a referral.

9.3.10 Diagnosis: Transient ischaemic attack (TIA)

A transient ischaemic attack (TIA), also known as a mini stroke, occurs when there is a temporary disruption of blood flow to a part of the brain. It is similar to a stroke, but the symptoms usually last only for a short period, typically a few minutes to a few hours. During a TIA, a blood clot or a narrowed blood vessel

temporarily blocks the flow of blood to a specific area of the brain. This interruption can cause symptoms such as:

- sudden weakness or numbness in one side of the body
- difficulty speaking
- blurred vision
- dizziness
- loss of balance.

Risk assessment

A diagnosis of TIA can potentially impact a pilot's ability to safely operate an aircraft. TIAs are considered warning signs that the person may be at risk of a more severe stroke in the future. All regulatory authorities around the world responsible for pilot medical certification have strict guidelines to ensure the health and well-being of pilots, particularly when it comes to neurological disorders such as stroke and TIA. The risk of a TIA occurring during flight, which could impair the pilot's performance, is a significant factor that is taken into account during the medical certification process, as such an occurrence could have catastrophic consequences.

Ultimately, an aviation authority will prioritise the safety of the pilot, passengers, and those on the ground, which is similarly the aim of the Class 5 medical self-declaration and assessment process. If there are concerns about a pilot's medical condition, including a history of TIAs, then self-declaration and automatic issuance of a medical certificate is unavailable.

The applicant is not excluded from certification, but until a review by a medical practitioner has been conducted, the certificate cannot be issued. The medical practitioner conducting the assessment may require further evaluation, medical documentation, and possibly impose restrictions or limitations on the pilot's certification (predominantly in the case of professional licences, which includes the possibility of temporarily suspension until the situation is assessed and managed appropriately).

Risk assessment considerations

Much of the information provided in section 8.3.9 (Diagnosis: Stroke) is relevant to an applicant with a history of TIA, as is the cardiovascular disease section of these guidelines.

The following factors should be considered when assessing risk in an applicant with a history of TIA:

- Cardiovascular risk: It is well established that ischaemic strokes and TIAs are associated with an increased risk of cardiovascular problems, and hence, careful attention should be paid to the requirements outlined in the cardiovascular disease section of these guidelines.
- Any ongoing impairments or effects after the event.
- The underlying cause of the event: Some possible causes of these events include:
  - vascular stenosis or plaque build-up
  - small vessel disease
  - thrombo-embolism
  - blood hyperviscosity
  - migraines.

  In many cases, the exact cause of the event remains unclear even after conducting tests that show no abnormalities. In such situations, the final diagnosis is often labelled as probable occult vascular or cardiac disease. It is important to consider conditions like paroxysmal atrial fibrillation[109] or patent foramen ovale as potential underlying causes and encourage the applicant to have this investigated further.
- Recurrence risk: With modern medical therapy, the risk of a subsequent stroke is approximately 5 percent within the first year, and about half of that risk is concentrated in the first week.

Aeromedical decision

A TIA can occur as an isolated incident or repeatedly, and there is a possibility of them being followed by a stroke (refer to section 8.3.9 Diagnosis: Stroke). This definition includes patients who may show minor infarction on neuroimaging, but experience fully resolved symptoms and have a normal neurological examination within 24 hours.

If a TIA happens while flying an aircraft, it can significantly impair the pilot's ability to operate safely. However as per the *Austroads Fitness to Drive* document, upon which these guidelines are based, TIAs rarely cause loss of consciousness and are an extremely uncommon cause of (driving) accidents[94].

Considering the low risk of a TIA or stroke affecting driving, individuals flying aircraft should refrain from flying for 4 weeks following a TIA and undergo review by a DAME prior to returning to flying, as the DAME will ensure that the risk of recurrence and overall risk to aviation safety is low enough to allow for medical certification.

When to refer

Any evidence or suspicion by the assessing medical practitioner that the applicant has suffered, or is likely to suffer, a stroke or a TIA, renders the applicant ineligible for automatic issuance of a Class 5 medical self-declaration. Should such risks be present, or should such a diagnosis be newly made, then significant medical management and monitoring are likely required and referral to the appropriate specialist medical teams should be made prior to or in conjunction with, a referral a more comprehensive assessment of potential risk to aviation safety.

However, a previous diagnosis of a stroke or a TIA does not necessarily exclude the applicant from a Class 5 medical self-declaration, should their condition be well managed, and they meet all other requirements outlined within these guidelines (particularly those contained within section 4 Cardiovascular conditions and section 8 Neurological conditions).

9.3.11 Diagnosis: Space-occupying lesions including brain tumours

Brain tumours (also referred to as 'space-occupying lesions') can make pilot medical certification difficult due to several factors. For ease of discussion, these can be broken down into 3 main categories:

1. Effects of the lesion itself
2. Side effects of medication and treatment modalities
3. Potential consequences of therapy.

There is also a risk of the tumour growing back following a completed treatment regimen.

Risk assessment

Considering the potential effects of the lesion itself, the side effects of medication, and the consequences of therapy and recurrence, aviation medical certification may be difficult to obtain or maintain for individuals with a diagnosis of brain tumour, which includes the period following the necessary treatment. This is primarily due to the significant impact these factors can have on a pilot's cognitive abilities, physical health, and overall flight safety.

An applicant with a brain tumour diagnosis at the time of their application for a Class 5 medical self-declaration or at any period in the past should undergo a medical evaluation to ensure they meet the required standards for safe operation of an aircraft, and are thus ineligible for automatic issue of a medical certificate following a self-declaration.

Risk assessment considerations

The following factors must be considered in assessing risk:

- The effects on the individual caused by the lesion itself: Brain tumours can cause various symptoms depending on their size, location, and growth rate. These symptoms may include:
  - headaches
  - seizures

  - cognitive impairment
  - vision problems
  - motor coordination difficulties.

  These effects can significantly impact a pilot's ability to perform critical tasks required before (planning) and during a flight, such as maintaining situational awareness, making quick decisions, and operating aircraft controls safely.

- The effect of chemotherapy: This depends on factors such as the size of the tumour, location, type of tumour, patient age and general health to name a few. Subsequently it is easy to see why there might be many possible side effects of medication, a detailed description of which is beyond the scope of these guidelines.

  In short, brain tumours are often treated with medications such as corticosteroids, chemotherapy, and targeted therapies such as radiation. While these treatments aim to shrink or control tumour growth, they can have side effects that can readily affect pilot performance. For example, corticosteroids may cause mood swings, changes in cognition, and fluid retention, which can impair cognitive function and decision-making abilities. Chemotherapy drugs can lead to fatigue, nausea, and general weakness, making it difficult for pilots to stay alert and focused during flight operations.

- Surgery: Although an essential treatment, there can be long-lasting effects. Surgical interventions may cause post-operative complications, such as infections or impairments in neurological functions, and seizures.
- Radiation therapy: This can lead to fatigue, memory problems, and reduced cognitive function, affecting a pilot's ability to perform tasks effectively.
- Recurrence: The risk of tumour recurrence after treatment is a concern. If a brain tumour recurs, it may require further treatment, leading to additional side effects and potential long-term complications.

Aeromedical decision

In applicants with a previous history of a space-occupying lesion, certification may be possible subject to annual review, considering:

- the neurological examination is normal, the patient remains asymptomatic.
- any related imaging such a CTB notes the absence of any abnormality (considering surgical anatomy).
- information provided by an appropriate specialist gives a favourable prognosis.
- there are no significant impairments that might impact flying safety, including:
  - visuospatial perception
  - insight
  - judgement
  - attention
  - comprehension
  - reaction time
  - memory
  - sensation
  - muscle power
  - coordination or vision (including visual fields) that might impact flying safety.
- the result of a functional assessment or flight test with a qualified testing officer is satisfactory.
- if seizures occur, the standards for seizures and epilepsy in these guidelines apply.
- a person should not fly for 12 months following supratentorial surgery or retraction of the cerebral hemispheres.

When to refer

An applicant who has a current diagnosis of a space-occupying lesion of the brain should be referred for further assessment before any aviation medical certification can occur.

A patient with residual impairments that may significantly impact flying safety should be referred for further assessment before any aviation medical certification can occur.

10. Psychiatric conditions

10.1 Aeromedical considerations

Psychiatric disorders (mental illnesses, psychological disorders) are clinically significant disturbances of mental health, defined by the presence of certain symptom clusters (syndromes) and the duration and significance of these symptoms. These syndromes encompass a broad range of disorders with varying implications for flight safety, from the very minor to the potentially catastrophic[45]. All psychological disorders are characterised by significant distress and/or impairments in normal daily functions.

Broadly speaking, these disorders can be categorised as:

- adjustment disorders due to an acute emotional trauma
- disorders of mood, such as depression
- anxiety disorders
- specific phobias
- personality disorders
- post-traumatic stress disorder (PTSD)
- substance misuse disorders (see section 11 - Substance misuse)
- disorders that lead to psychotic and delusional symptoms, such as schizophrenia.

Some of these disorders may cause quite minor symptoms which might cause subtle incapacitation or impaired performance, while others might lead to acute incapacitation and cognitive impairment, such as panic disorder and acute psychosis. While treatments may be effective in controlling some of these conditions, they may also cause side effects that can interfere with the task of flying safely.

10.1.1 The effect of psychiatric disorders on flying safety

Psychiatric conditions can affect the body in many ways, not just in terms of brain function but also in terms of disturbing normal physiology. At a severe level, poor psychological health can be debilitating, significantly impairing performance. Even moderate symptoms may reduce wellbeing and lead to suboptimal attention, motivation, and performance when clear thinking and sound decision-making are fundamental to flying safely.

Psychiatric disorders can cause:

- impaired attention
- impaired judgement
- impulsive behaviours
- inappropriate risk taking
- risk of suicide
- acute cognitive incapacitation (due to panic, for example).

Psychiatric disorders can lead to poor sleep, fatigue, poor nutrition, weight loss or gain, and metabolic disturbances, which can lead to impaired performance in the air and increased risk of accidents. The side effects of medication, which may cloud cognition or lead to sleep disturbance and fatigue, or even drowsiness, may be a hazard to flight safety.

10.1.2 The effect of the flight environment on psychiatric disorders

Flying an aircraft recreationally may be an extremely pleasurable experience, but it may also be extremely stressful and fatiguing at times. Acute stress reactions and even panic may be induced by certain abnormal situations that may occur while flying. Flying itself may develop as a specific phobia in some people. The flying task can impose a taxing mental workload, which may not be handled effectively in the presence of a psychiatric condition.

10.2 Medical assessment for pilots

You should be assessed by a medical practitioner if you declare that you have a current or past diagnosis of any:

- psychiatric condition
- mental health condition or
- psychological disorder.

Conditions which you should self-declare and have assessed include:

- schizophrenia/episodes of psychosis from any cause
- bipolar disorder
- major depression
- attempted self-harm
- severe anxiety
- post-traumatic stress disorder
- personality disorders
- any treatments for a mental health condition.

As psychotic disorders and disorders with potential for psychotic features are excluded medical conditions for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed in the presence of these diseases.

10.3 Medical assessment for doctors

10.3.1 Diagnosis: Psychiatric disorder

Risk assessment

A fundamental problem in assessing risk for applicants with a mental health condition is declaration of the condition in the first place. Non-declaration of depression, or any mental health condition, may occur deliberately due to perceived stigma, for fear of its impact on certification, or unknowingly due to a lack of insight or failure to recognise the symptoms of an illness.

A diagnosis of a mental health condition is not necessarily a bar to certification, but it should be stable and well controlled on treatment.

Risk assessment considerations

Things to consider in assessing the risk of mental health conditions must include:

- Presence of symptoms that are incompatible with safe flying: For example, persistent depressed mood, fatigue, loss of energy, difficulty concentrating, psychomotor changes, suicidal ideation, psychotic features, and loss of insight, behavioural issues, physiological consequences, incoherent thought should be explored. To assess risk, a thorough mental state examination should be performed.
- Medications: The use of medications and psychotherapy, either alone or in combination, are effective treatments for many psychiatric disorders. Applicants who have attained remission, and in whom treatment is prescribed to prevent recurrence, can fly safely based on careful individual clinical assessment of efficacy and side effects. Non-declaration of medication use is common in pilots and must be considered. For example, an Australian study showed that only 1% of pilots in their periodical medical examination reported taking antidepressants, much less than what would be expected from population studies[46]. Important side effects to note include impaired cognition, drowsiness, and blurring of vision.
- Potential of recurrence: Many psychiatric conditions are known to recur, even on treatment. For example, 50% to 85% of people who have an episode of depression will suffer a recurrent episode during their lifetime. Of these, 50% will experience recurrence within 2 years of the initial episode. For those on

continuous treatment, 25% will experience a recurrence in the first 4-5 years[47]. Bipolar disorder is known to be a remittent and unpredictable disorder that commonly recurs even on treatment.

- Risk of harm to self or others: While suicide (or homicide) by aircraft is rare, it does happen in both commercial and general aviation, with mental health issues, personal crises and substance misuse being possible contributing factors[48]. An assessment of potential suicidality is vitally important in the event an aircraft might be used as an instrument to harm self or others.
- Comorbidities and organic causes: Consider comorbidities, such as substance misuse, and underlying medical causes, such as thyroid disease or neurological conditions, which may need to be treated and addressed under the other relevant sections of these guidelines.

Favourable factors

Favourable factors include:

- asymptomatic
- stable and in remission for the last 12 months with or without medication
- with normal mental state examination.
- no history of psychosis.
- no history of attempted self-harm.
- absence of significant medication side-effects.
- no comorbidities that need investigation or treatment.

Aeromedical decision

Asymptomatic applicants can be considered fit for certification if they:

- demonstrate stability of their psychiatric condition over 12 months
- understand the impact of their condition on aviation safety.
- have no aviation relevant side effects from treatment.
- have no comorbidities that need assessment.

When to refer

Before certification or resumption of flying activities can occur, the applicant should be referred for further assessment if:

- a chronic psychiatric condition is symptomatic, such that it is causing impairment to:
  - insight
  - cognition
  - behaviour
  - perception.
- there is concern about risk of self-harm or any psychotic features in the history.
- an asymptomatic chronic psychiatric condition has the potential to be:
  - commonly recurrent
  - resistant to treatment or
  - present with psychotic episodes.

11. Sleep disorders

11.1 Aeromedical considerations

Sleep is crucial for human beings for a variety of reasons. It plays a vital role in maintaining overall health and wellbeing. The following are some key reasons why sleep is important.

- Restoring and rejuvenating the body: Sleep provides an opportunity for the body to repair and restore itself. During sleep, various physiological processes occur, such as tissue repair, muscle growth, and the release of hormones necessary for growth and development.
- Cognitive function and memory consolidation: Sleep plays a critical role in cognitive processes such as learning, memory consolidation, and problem-solving. It helps solidify and organise memories, making it easier to recall information and improve overall cognitive performance.
- Emotional wellbeing: Sufficient sleep is essential for emotional regulation and mental health. Lack of sleep can lead to increased irritability, mood swings, and difficulty managing stress. Chronic sleep deprivation is also associated with an increased risk of developing mental health disorders such as depression and anxiety.
- Physical performance and energy levels: Quality sleep is essential for optimal physical performance. It improves coordination, reaction time, and enhances athletic abilities. Additionally, sleep helps replenish energy stores, promoting alertness and productivity during waking hours.
- Immune system function: Sleep plays a crucial role in supporting a healthy immune system. During sleep, the body produces and releases cytokines, which are necessary for fighting infections, inflammation, and stress. Insufficient sleep can weaken the immune system, making individuals more susceptible to illnesses.
- Hormonal regulation: Sleep is closely linked to hormonal regulation in the body. It helps maintain a balance of various hormones, including those involved in appetite regulation (leptin and ghrelin), metabolism, growth, and stress response (cortisol). Lack of sleep can disrupt these hormonal patterns, leading to increased appetite, weight gain, and hormonal imbalances.
- Cardiovascular health**:** Sufficient sleep is essential for maintaining a healthy cardiovascular system. Chronic sleep deprivation has been associated with an increased risk of developing conditions like hypertension (high blood pressure) heart disease, and stroke.

Overall, sleep is a fundamental biological process that supports physical health, cognitive function, emotional wellbeing, and various other aspects of human physiology. It is important to prioritise regular and adequate sleep to maintain optimal health and functioning.

11.1.1 The effect of sleep disorders on flying safety

Any sleep disorder that results in insufficient or poor-quality sleep will primarily result in fatigue and excessive daytime sleepiness that can then lead to poor physical and mental functioning, such as impaired decision making, memory and reaction times. Sleep disorders can even result in a complete loss of consciousness and loss of aircraft control if an individual falls asleep at inappropriate times when intending to stay awake.

11.1.2 The effect of the flight environment on sleep disorders

The recreational flight environment can be very stimulating and exciting, but at other times on long cross-country sectors, may be quite boring and promote sleepiness. The background engine drone, movements of the aircraft, warm temperatures in the cockpit, together with mild hypoxia at altitude, may precipitate sleep just like being rocked by the motion of a car as a passenger on a long journey. Flying at night can be a provocative environment with darkness, low cockpit lighting, absence of outside visual cues, and the monotony of monitoring instruments on long sectors promoting the onset of sleep. Somnolence is also known to be a symptom of motion sickness due to aircraft motion in some people.

11.2 Medical assessment for pilots

You should be assessed by a medical practitioner if you declare that you have:

- a current or past diagnosis of any sleep disorder, in particular obstructive sleep apnoea or narcolepsy, or
- any other disorder that results in excessive daytime sleepiness.

Conditions which you are strongly recommended to have assessed include:

- obstructive sleep apnoea
- narcolepsy and hypersomnolence disorders

A diagnosis of sleep apnoea generally involves the following:

- a formal sleep study (polysomnography) or home sleep apnoea test demonstrating:
  - ≥5 obstructive respiratory events per hour of sleep
  - presence of one or more of the following:
    - » feelings of drowsiness, non-restorative sleep, fatigue, or insomnia symptoms
    - » waking up with breath holding, gasping, or choking.
    - » a partner or other observer reports habitual snoring, breathing interruption, or both during your sleep.
    - » concurrent hypertension, mood disorder, cognitive dysfunction, coronary artery disease, stroke, congestive heart failure, atrial fibrillation, or type 2 diabetes mellitus.

11.3 Medical assessment for doctors

11.3.1 Diagnosis: Obstructive sleep apnoea

Risk assessment

Obstructive sleep apnoea (OSA) is a common disorder in the Australian community. Prevalence in adults ranges from 9% to 38% when OSA is defined as disordered breathing present on a sleep study, although prevalence is in the range of 4% to 6% when OSA on sleep study is combined with symptoms of excessive daytime sleepiness(EDS)[49].

OSA is a risk to flight safety for 3 main reasons[50]:

- It can be responsible for cognitive and psychological disorders: impaired memory and concentration, longer reaction time, irritability, mood disorders, etc.
- It can generate excessive daytime sleepiness, which can lead to an increased risk of accidents.
- OSA is considered a cardiovascular risk factor.

Excessive daytime sleepiness assessment

Excessive daytime sleepiness (EDS) has been documented even in professional and military aviators[51]. Any applicant declaring excessive daytime sleepiness is likely to have obstructive sleep apnoea or other sleep disorder. A thorough risk assessment should aim to establish the diagnosis and mitigate the risk to flying through the appropriate implementation of treatment. A basic risk assessment could include some or all the following:

- Administration of the Epworth Sleepiness Scale (ESS)
- Assessment of clinical risk factor using tools such as the STOP-BANG questionnaire
- Clinical symptoms and signs consistent with the diagnosis such as poor memory and concentration, morning headaches, sore throat, insomnia, always tired, falling asleep at inappropriate times, hypertension, type 2 diabetes mellitus, thick neck (>42 cm in men, >41 cm in women) and a narrow oedematous (crowded) oropharynx.

- Sleepiness-related crash or accident, off-road deviation, and history of falling asleep while driving. Sleep deficiency due to either sleep apnoea or insufficient sleep duration is strongly associated with motor vehicle crashes in the general population, independent of self-reported excessive sleepiness[52]. This well documented risk can be extrapolated to aviation.
- Maintenance of Wakefulness Test (MWT), and Multiple Seep Latency Test (MSLT)[53].
- Formal polysomnography.

Established OSA assessment

An established diagnosis of OSA is relatively low-risk if treatment is effective.

Effectiveness of treatment and treatment compliance can be assessed by subjective measures such as the ESS, or more reliably by obtaining a report from the applicant's sleep physician and a data download from the CPAP device, if one is used. Residual sleepiness, even on treatment, is possible and must be assessed[50].

Favourable factors

Favourable factors include:

- asymptomatic
- normal ESS
- satisfactory response to treatment
- good compliance with treatment
- no residual sleepiness on treatment
- absence of other significant comorbidities.

Aeromedical decision

Applicants with excessive daytime sleepiness or suspected OSA, especially those who have had driving-related accidents due to sleepiness, should be investigated and established on treatment before considering certification.

Asymptomatic applicants who demonstrate a satisfactory response and good compliance with treatment can be considered fit for certification.

When to refer

The applicant should be referred for further assessment before any aviation medical certification can occur if:

- the applicant has established and symptomatic sleep apnoea and declines treatment, or
- where treatment is ineffective and they suffer ongoing daytime sleepiness.

11.3.2 Diagnosis: Narcolepsy

Risk assessment

Investigation of excessive daytime sleepiness (EDS) may reveal the diagnosis of narcolepsy, although it is a rare disorder. EDS is often the first symptom to appear, which occurs daily, typically during inactivity, but also at work, at school, and while driving. Sleep episodes are irresistible, of short duration, come on with no warning, and often associated with dreaming. Narcoleptic patients usually feel refreshed after a short nap, but sleepiness returns soon later. They do not have an excessive amount of sleep over the 24-hr period, but rather fragmented wakefulness and sleep periods (sleep and wake bouts) being unable to stay awake or asleep for a long time.

In the most severe cases, episodes of irresistible sleep attacks, or unconscious lapses occur while talking to someone, or even when eating, driving, or in this case flying. There are 2 types based on the neurochemistry involved: narcolepsy type 1 (NT-1) and narcolepsy type 2 (NT-2). NT-1 is the most concerning, as it includes

cataplexy, a sudden and involuntary loss of muscle tone while awake, with a sparing of the muscles associated with breathing, which is provoked by strong emotions[54].

Excessive sleepiness, sudden onset of sleep episodes, which can last minutes, and the possibility of cataplexy, make the diagnosis a significant risk to recreational aviation from sudden and complete incapacitation, with a catastrophic outcome.

Risk assessment considerations

Narcolepsy risk assessment should include:

- administration of the Epworth Sleepiness Scale (ESS)
- clinical symptoms and signs consistent with the diagnosis.
- sleepiness-related crash or accident, off-road deviation, and history of falling asleep while driving.
- Maintenance of Wakefulness Test (MWT) and Multiple Seep Latency Test (MSLT).
- formal polysomnography
- referral to a sleep physician.

Treatment of risk assessment should include consideration of:

- symptom control
- chance of recurrence/breakthrough symptoms
- side effects of medications.

The treatment of narcolepsy is symptomatic only and lifelong. Currently, used drugs treat EDS alone (modafinil/armodafinil, methylphenidate, and amphetamine) cataplexy alone (‘off-label’ use of antidepressants) or both EDS and cataplexy (sodium oxybate)[55]. These drugs have abuse, tolerability, and adherence issues, and more than half of patients report problems with the treatment[56]. Narcolepsy is a chronic condition, and symptoms can still recur while on treatment.

The frequency and intensity of symptom recurrence can depend on several factors, including:

- the individual's specific subtype of narcolepsy (type 1 or type 2)
- the chosen treatment regimen
- adherence to medication
- lifestyle factors
- overall health.

More than half of people on treatment experience multiple episodes of sleepiness and fatigue daily, with a third of patients with cataplexy having episodes up to twice daily ,and some having three or more episodes[56].

Favourable factors

Favourable factors include:

- asymptomatic
- Satisfactory response to treatment
- good compliance with treatment
- no residual sleepiness on treatment
- absence of treatment side effects.

Aeromedical decision

Asymptomatic applicants can be considered fit for certification if they:

- demonstrate a satisfactory response and good compliance with treatment.
- have had minimal symptoms in the last 6 months.

- have had, normal sleep studies including MSLT.
- have minimal side effects from medications.

When to refer

The applicant should be referred for further assessment before any aviation medical certification can occur established narcolepsy which remains symptomatic despite treatment.

- frequent episodes of EDS.
- abnormal sleep studies, or
- ever had an episode of cataplexy.

12. Substance misuse

12.1 Aeromedical considerations

This section addresses the heavy use of, and dependence on, alcohol and other drugs (AOD) whether they be prescribed or used illicitly. Guidelines for certification do not address acute intoxication, which is subject to management according to Part 99 of the *Civil Aviation Safety Regulations 1998 (CASR).* This regulation deals with the no-notice and targeted testing protocols used for all persons involved with safety-sensitive aviation roles, including recreational pilots. Even without acute intoxication, a long-term dependent person may be impaired due to both chronic use and recent consumption.

12.1.1 The effect of alcohol and other drugs on flying safety

Research by the Australian Transport Safety Bureau (ATSB) examined all occurrences in which drugs or alcohol were recorded between 1 January 1975 and 31 March 2006. There were 36 drug and alcohol-related events (31 accidents and 5 incidents). Most of these occurrences were related to alcohol (22 occurrences). The drugs identified included prescription drugs, over-the-counter medications and illegal drugs (including heroin and cannabis)[57]. It is important to note that these statistics pre-date the introduction of AOD testing in the Australian aviation sector.

The central nervous system effects of alcohol and other drugs affecting cognition and behaviour are very dangerous while flying. These effects can cause deficits in short-term memory and learning, impaired perceptual-motor speed, impaired visual search and scanning, deficits in executive functions such as:

- mental flexibility and problem-solving skills
- planning, organising and prioritising tasks
- focusing attention
- shifting focus from one task to another
- filtering out distractions
- impulsivity.

Some substance may also have sedative or euphoric effects, or may involve risk taking, aggression, feelings of invulnerability, narrowed attention, altered arousal states and poor judgement.

12.1.2 The effect of the flight environment on alcohol and other drugs

The physiological changes that occur at altitude can interact with the central nervous system and cardiovascular effects of various substances. Mild hypoxia may exacerbate the effects of alcohol or other substances, and the vasodilatory effect of alcohol can reduce the body's tolerance to acceleration, for example.

12.2 Medical assessment for pilots

The chronic misuse of alcohol and other substances in not compatible with Class 5 medical certification. It can result in a condition of dependence, characterised by several indicators, including:

- increased tolerance, where higher quantities of the substance are required to achieve the desired effect, or the substance has a diminished effect even with continued use of the same amount.
- experiencing withdrawal symptoms when the substance is stopped, either the specific withdrawal syndrome associated with that substance or using a similar substance to alleviate or prevent withdrawal symptoms.
- consistently consuming larger amounts of the substance or using it for a longer duration than originally intended.
- having a persistent desire to reduce or control substance use but being unsuccessful in doing so.
- devoting a significant amount of time to acquiring the substance, using it, or recovering from its effects.

- significant social, work-related, or recreational activities are abandoned or diminished due to substance use.
- the individual continues to use the substance despite being aware of a persistent or recurring physical or psychological issue that is likely to have been caused or worsened by the substance.

12.3 Medical assessment for doctors

12.3.1 Alcohol

Risk assessment

There are very few studies that document the effect that alcohol has on flying safety and performance. From the limited simulator and in-flight studies that do exist, the following acute effects are apparent:

- increased procedural errors.
- narrowed task focus, neglecting other important tasks.
- inability to handle increased workload.
- increasing performance impairment with increasing applied acceleration.
- error rate increases in line with increasing blood alcohol.
- long-lasting visual impairments after drinking.

Table 2 lists the specific flying tasks shown to be impaired with increasing blood alcohol concentrations[58]. It is also recognised that environmental factors during flight, such as acceleration and mild hypoxia, may exacerbate the impairment caused by alcohol.

Table 3. Adverse effects on performance of piloting tasks attributable to alcohol

Terrain separation	Aircraft descent
Performance during angular acceleration ± dim lighting	Management of heavy workload conditions
Tracking radio signals	Target tracking
Airport traffic control vectoring	Flight coordination and configuration
Traffic observation and avoidance	Stimulus response tasks involving use of hand sticks and foot pedals
Complex coordination	Short-term memory
Reaction time	Performance during linear acceleration
Progressively larger and more consistent	Oculovestibular function

Persistent excessive alcohol consumption also poses a genuine threat of neurocognitive deficiencies that can impact on the ability to fly including:

- difficulties in short-term memory and learning, particularly noticeable when tasks become more challenging.
- impaired speed of perceptual-motor responses.
- impaired ability to visually search and employ effective scanning strategies.
- deficiencies in executive functions, such as:
  - mental adaptability and problem-solving skills.

- planning
- organising and prioritising tasks
- maintaining and shifting attention between tasks
- filtering out distractions
- monitoring and controlling one's actions.
- impulsive behaviour.

Prolonged and excessive alcohol consumption is also linked to various organ-related conditions that can impact flying ability. For instance, conditions like Wernicke-Korsakoff syndrome or peripheral neuropathies, which manifest as numbness or tingling in the hands or feet, may affect flying capability.

If these organ-related effects have an impact on flying, appropriate measures should be followed as outlined in other sections of these guidelines. Individuals dependent on alcohol may experience a withdrawal syndrome when they stop or significantly reduce their alcohol intake. This withdrawal syndrome carries a certain risk of generalised seizures, confusional states, and hallucinations, which put flying safety at significant risk.

Risk assessment should include data gathered from questionnaires such as AUDIT, history of DUI convictions, biomarkers of chronic alcohol use, and clinical evidence of end-organ damage.

Aeromedical decision

Applicants can be considered fit for certification if they:

- demonstrate abstinence and remission for at least 3 months from a substance use disorder that is confirmed by biological testing
- have no evidence of end-organ damage or cognitive impairment.

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment:

- if they have an established and symptomatic substance use disorder involving alcohol that could impact on safe flying, or
- where treatment is ineffective, or
- they are non-compliant.

12.3.2 Other substances

Risk assessment

There is a wide variety of other substances that can be misused and lead to significant impairment of flying ability, including:

- opiates
- benzodiazepines
- THC
- cocaine
- hallucinogens
- psychostimulants.

Of primary importance is the degree to which these substances can cause impairment of cognition and sedation. A 5-year study of 1169 pilots fatally injured in aircraft accidents, the majority of whom were general aviation, demonstrated that 48% had drugs detected on post-mortem analysis, and the most common illicit substances found were opioids, benzodiazepines and THC[92]. Cannabis use in pilots is associated with a general deterioration in flying skills and performance, while the pilot may be unaware of their level of

impairment[93]. A common finding is that the more difficult the task, the more likely that pilot performance will be impaired[59].

In Australia, amphetamine-type stimulants have been found in 7.1% of all fatal road crashes, the presence of cannabis (THC) in 11.1% of all drivers injured in a road accident and 13.1% of road fatalities, and benzodiazepines were found in 8.2% of fatalities and 12% of injured drivers. While illicit substances are usually only found in a smaller percentage of aviation accidents, the road accident data is relevant and highlights the crash risk and the prevalence of potential use in a recreational aviation setting.

It is possible that chronic utilisation of stimulants, opioids, and benzodiazepines may be connected to cognitive decline. Chronic THC use is associated with cognitive impairment. Brain injury may also be caused by hypoxia during overdose, physical injury, or chronic illnesses. Injectable drug use may also be associated with damage to vital organs such as the heart, brain, and liver. The misuse of cocaine and other stimulants has been associated with cardiovascular issues.

Risk assessment should therefore include:

- determining if use is current
- which substance or substances are being misused
- the neurocognitive, sedative and behavioural impact of that use
- the presence of any end-organ damage.

When conducting the risk assessment, applicants may downplay their substance use due to concerns about certification. Additionally, the immediate and long-term cognitive impacts of certain substances make it challenging to obtain an accurate substance use history and identify the specific substances used.

Therefore, assessments should encompass various markers of substance use beyond self-reporting, including objective measures. Objective evidence of recent drug use can be obtained through urine drug screens, oral fluid testing, and blood testing. However, these methods may only provide limited information about past drug use. Hair testing, on the other hand, allows for a longer detection period spanning several months, making it useful for evaluating remission progress.

Aeromedical decision

Chronic misuse of drugs is incompatible with safe flying.

Applicants can be considered fit for certification if they:

- demonstrate abstinence and remission for at least 3 months from a substance use disorder that is confirmed by biological testing
- have no evidence of end-organ damage or cognitive impairment.

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment if:

- they have an established and symptomatic substance use disorder that could impact on safe flying, or
- treatment is ineffective, or
- they are non-compliant.

13. Vision and eyes

13.1 Aeromedical considerations

13.1.1 The effect of vision on flying safety

Good vision is of critical importance to effectively flying an aircraft, for obvious reasons. Vision includes visual acuity and visual fields in this regard, and deterioration beyond a certain level in either area will impact upon the pilot's ability to fly safely. Flight safety, with respect to vision, encompasses a wide variety of relevant factors, including a pilot's ability to detect other aircraft (potentially with increased reaction time), visual cues for orientation, and weather phenomenon, to name a few.

A pilot's peripheral vision helps increase awareness of the aviation environment both in the air and on the ground. It is important in all aspects of flying, not only for visual cues and traffic avoidance, but also for critical phase-of-flight tasks such as landing, particularly in poorer light conditions or night flying. It is also important to note that deterioration in visual acuity and visual fields can occur slowly, often unrecognised by the individual. Hence, there is a requirement to meet certain visual standards depending on the medical category to which the applicant is applying, and the type of flying involved.

13.1.2 The effect of the flight environment on vision

The flight environment itself also provides a unique challenge to the visual system, in that it is particularly demanding, since humans are not adapted to the high speeds and movements inherently associated with flying an aeroplane. As both a significant asset and yet one of our many limitations in the air, vision can make us susceptible to several forms of illusions, which can be exacerbated by poor ambient lighting (such as flying at night) or any situation where there are reduced visual cues with which to orientate ourselves. Exposure to moderate altitudes, such as those commonly flown by recreational aircraft below 10,000 ft, has been shown to detrimentally affect colour vision[59]. Combined with other common aspects of flight known to be distracting factors, such as glare and vibration, it is easy to see why maintaining a high standard of visual acuity is of the utmost importance.

Identifying the cut-off for visual acuity is challenging, however, and the research conducted into drivers for the same reason has not resulted in clear-cut results[60]. Similarly, research into colour-deficient drivers suggests there is no association between increased crash risk and colour vision. Colour vision assessment is mandatory for holders of CASA-issued Class 1, 2 and 3 aviation medical certificates. For the issue of a Class 5 medical self-declaration, the standards in Austroads for the issue of a private vehicle driver licence must be met.

13.2 Medical assessments for pilots

You should confirm that your vision and eye health meets the Austroads standards for the issue of a private driver licence[61] prior to making a Class 5 medical self-declaration. This means that you must have had your eye health, visual acuity and, if necessary, visual fields formally assessed by a medical practitioner, optometrist or ophthalmologist. Confirmation by these health professionals is required because it is not possible for a person to effectively self-assess their visual acuity or visual fields.

Note: Wearing corrective lenses (spectacles or contact lenses) is acceptable for f flying with a Class 5 medical self-declaration if the pilot meets the Austroads standard for a private driver licence and the pilot's vision or prescription has not changed since their last medical review.

13.3 Medical assessments for doctors

13.3.1 Diagnosis: Refractive errors

Standards

The Austroads standards for vision (Section 10 – Vision and eye disorders) are the standard used for vision for applicants applying for a Class 5 medical self-declaration[61]. CASR Part 67 specifies the visual standards for all other Classes of Aviation Medical Certificate.

Risk assessment – Class 5 medical self-declaration.

Distance visual acuity must be sufficient to see and avoid other air traffic and identify ground features for navigation. Near vision must be sufficient to accurately read documents, navigational charts and cockpit instruments. An applicant is not fit to hold a Class 5 medical self-declaration if the applicant's visual acuity in the better eye or with both eyes together is worse than 6/12.

If this standard is met with corrective lenses, a Class 5 medical self-declaration can be made, provided that the following requirements are met for each flight:

Distance vision correction

The applicant must wear distance vision correction while exercising the privileges of the pilot's licence.

The applicant must carry 2 pairs of corrections. For example, they could wear:

- contact lenses and carry one spare pair of glasses, or
- one pair of glasses and carry one spare pair of glasses.

Reading correction

Reading correction to be available while exercising the privileges of the pilot's licence.

The pilot must carry 2 pairs of correction lenses. For example, they could:

- wear contact lenses and carry a spare pair of glasses, or
- carry 2 pairs of glasses.

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13.3.2 Diagnosis: Visual field defects

Risk assessment

Defects of the visual fields if large enough can prevent pilots from safely seeing and avoiding other aircraft, navigating with reference to ground targets, or using visual cues to safely land an aircraft, especially if they are located centrally around the macula.

Aeromedical decision

An applicant is eligible for a Class 5 medical self-declaration if:

- The applicant has no significant eye disease or reason to suspect a visual field defect, and assessment of visual fields by a medical practitioner, optometrist or ophthalmologist using the confrontation method does not identify a visual field defect.

If the Class 5 medical self-declaration applicant has a significant eye disease or there is reason to suspect a visual field defect, the applicant must demonstrate, using formal perimetry-based assessment, that:

- the binocular visual field has a horizontal extent of at least 110 degrees within 10 degrees above and below the horizontal midline, or

- there is no significant visual field loss (scotoma) within a central radius of 20 degrees of the foveal fixation or other scotoma likely to impede flying performance, or
- there is no significant visual field loss (scotoma) with no greater than 4 contiguous spots within a 20-degree radius from fixation.

When to refer

If the standards listed above cannot be met, then the applicant should be referred for further assessment before any aviation medical certification can occur.

13.3.3 Diagnosis: Monocular vision

Risk assessment

Monocular vision results in a significant loss of one side of the visual field, which requires the use of head movement to allow effective visual scanning for targets such as other aircraft. The loss of binocular vision also results in a loss of accurate distance and depth perception, which is so important on landing.

Nonetheless, some early studies have shown that monocular pilots can fly and land an aircraft safely if well adapted, although the way they fly the approach can be a bit different[62,63]. However, after loss of binocular vision, such adaptation takes time, depending on whether the loss is sudden or gradual. One study reports this time to be from 3.6 to 8.8 months, with patients reporting driving difficulties with parking, reversing, and night driving, and judging proximity of other vehicles[64].

It is important to assess the function of the remaining eye to ensure adequate visual acuity and absence of other significant visual field defects.

Aeromedical decision

An applicant:

- is not eligible for a Class 5 medical self-declaration within 3 months of losing binocular vision.
- may be considered fit for Class 5 medical self-declaration, taking into account the information provided by the treating optometrist or ophthalmologist, if:
  - the visual acuity in the remaining eye is 6/9 or better, with or without correction
  - the visual field in the remaining eye has a horizontal extent of at least 140 degrees within 10 degrees above and below the horizontal midline
  - there is no other significant visual field loss that is likely to impede driving performance.
  - they attend 2-yearly medical review.

When to refer

If the applicant does not meet the standards outlined above, then they should be referred for further assessment before any aviation medical certification can occur.

13.3.4 Diagnosis: Diplopia

Risk assessment

An applicant is not fit to hold a Class 5 medical self-declaration without medical assessment if the person has any form of diplopia.

Anything but very minor diplopia is dangerous in both driving and recreational flying tasks. It is especially concerning if it occurs within 20 degrees of central visual fixation.

Risk assessment considerations

Assessment of risk must include:

- the degree of diplopia
- visual acuity
- visual fields
- any potential underlying medical cause for the diplopia which might itself pose a risk (for example, central nervous system neoplasms).

Aeromedical decision

An applicant may be issued a Class 5 medical self-declaration if they do not experience any diplopia (other than physiological diplopia) within 20 degrees from central fixation.

For diplopia within 20 degrees of central fixation, the following apply:

- The condition is managed satisfactorily with corrective lenses or an occluder.
- It has been at least 3 months using an occluder.
- The applicant meets other visual criteria as per this section, including visual fields.
- Corrective lenses or an occluder do not pose a risk to aviation safety as deemed by CASA.
- They attend for annual review.

When to refer

If the applicant does not meet the standards outlined above, then they should be referred for further assessment before any aviation medical certification can occur.

14. Neurodevelopmental

14.1 Aeromedical considerations

14.1.1 The effect of attention-deficit hyperactivity disorder (ADHD) on flying safety

ADHD is an abbreviation for attention-deficit hyperactivity disorder. It is a condition that affects the brain and can make it difficult for people to pay attention, control their impulses, and stay still. Imagine you have a TV in your brain that plays different channels. People with ADHD have trouble focusing on one channel for a long time. Their brain keeps switching to different channels, making it hard to concentrate on one thing, like listening to an instructor or completing a task. This can make it challenging to follow instructions, stay organised, and complete coursework or training tasks.

ADHD also makes it difficult to control impulses. People with ADHD may act before thinking, blurt out answers, or have trouble waiting their turn. They might fidget, squirm, or feel restless, finding it tough to stay seated or stay still. ADHD can affect both children and adults, and it can make daily life a bit more challenging. But with the right support (such as therapy or medication) people with ADHD can learn strategies to manage their symptoms and succeed in their everyday tasks.

ADHD can pose challenges for a pilot because flying requires a high level of focus, attention to detail, and the ability to stay organised and follow procedures. Consider the following:

- Inattentiveness: People with ADHD may have difficulty maintaining attention for extended periods, which is crucial for a pilot who needs to stay focused on their instruments, navigation, and communication with air traffic control, other crew members and other aircraft. Inattentiveness can lead to missing important information or making errors in judgment, which can compromise safety.
- Impulsivity: ADHD can make it harder to control impulses and act without thinking. In aviation, quick decision-making and following established protocols are vital. Impulsive behaviour, such as deviating from the flight plan without proper reason, could have serious consequences and compromise the safety of the flight.
- Hyperactivity and restlessness: The restlessness associated with ADHD can make it challenging to sit still and maintain a stable position in the cockpit. This may affect a pilot's ability to operate controls smoothly or remain physically comfortable during long flights.
- Organisational difficulties: Pilots need to be highly organised to manage complex flight plans, communicate effectively, and keep track of critical information. ADHD can make it harder to stay organised, leading to potential issues with time management, paperwork, or following proper procedures.

> **Note:** ADHD affects individuals differently, and not all people with ADHD would necessarily encounter significant challenges in obtaining medical certification to fly. However, due to the nature of the profession and the importance of safety, aviation authorities typically have specific guidelines and assessments in place to ensure pilots meet the necessary standards, including evaluating potential ADHD-related difficulties.

14.1.2 The effect of dyslexia on flying safety

Dyslexia is a learning difference that makes it harder for some people to read, write, and spell. It's like having a special way of processing words and letters in the brain. People with dyslexia might mix up letters or have trouble understanding the sounds that go with them.

Imagine trying to read a puzzle where the letters keep switching places or seem jumbled up. That's how it can feel for someone with dyslexia when they try to read. It can make reading and writing more challenging, but it doesn't mean they are less smart or capable than others. With the right support, like special reading programs and extra help from educators and instructors, people with dyslexia can learn to read and write just like everyone else.

Dyslexia may cause challenges for a pilot due to the nature of the tasks involved in flying and the specific difficulties associated with the condition. Consider the following:

- Reading and comprehension: Dyslexia affects reading and word recognition skills, which can be critical for pilots when interpreting flight instruments, charts, weather reports, and navigation information. Misreading numbers or letters could lead to errors in navigation or decision-making.
- Processing speed: Dyslexia can slow down information processing, making it harder for pilots to quickly assess and respond to changing situations during flights. In time-sensitive situations or emergencies, delayed processing could have serious consequences.
- Memory challenges: Dyslexia can affect short-term memory and working memory, which is crucial for remembering important instructions, checklists, or procedures during a flight.
- Attention and focus: Maintaining focus during long flights is essential for a pilot. Dyslexia can make it harder to sustain attention, leading to potential distractions and decreased situational awareness.
- Communication: Dyslexia can affect verbal and written communication. Clear and precise communication is crucial for pilots, especially during interactions with air traffic control and flight crew of other aircraft.
- Time management: Dyslexia may impact time management and organisation skills, making it challenging to plan and execute flights efficiently.

Note: While these challenges might not be insurmountable for all individuals with dyslexia, the aviation industry has strict safety standards to ensure pilots can handle the demanding responsibilities of flying. Therefore, applicants with dyslexia who wish to become pilots must undergo thorough assessments to determine their ability to safely perform the required tasks and fulfill their duties without compromising safety.

14.1.3 The effect of autism spectrum disorder (ASD) on flying safety

Autism spectrum disorder (ASD) is a developmental condition that affects how a person communicates, interacts with others, and perceives the world around them. The term ‘spectrum’ is used because the symptoms and characteristics of ASD can vary greatly from person to person. People with ASD may experience a wide range of challenges and strengths, making each individual unique.

Some common features of ASD include:

- Social difficulties: People with ASD may find it challenging to understand social cues, such as facial expressions or body language. They might have difficulty making eye contact, initiating conversations, or understanding social norms.
- Communication differences: Communication can be affected in various ways. Some individuals may have delayed speech or struggle with verbal language, while others might have a rich vocabulary but struggle with the social aspects of communication, like engaging in reciprocal conversations.
- Repetitive behaviours and interests: Many people with ASD engage in repetitive actions or have intense interests in specific topics. They may become fixated on certain activities or objects and prefer routines and sameness.
- Sensory sensitivities: People with ASD can be sensitive to sensory stimuli, such as bright lights, loud noises, or certain textures. These sensitivities may lead to either overreacting or underreacting to sensory input.

ASD is a lifelong condition, and its symptoms typically appear early in childhood. However, the severity and specific challenges can vary widely among individuals. Some people with ASD might require significant support and assistance in daily life, while others can lead independent lives with no or minimal assistance.

It's essential to remember that individuals with ASD also have unique strengths, such as excellent attention to detail, deep focus on specific interests, and strong problem-solving abilities. Early intervention, supportive therapies, and specialised educational programs can help individuals with ASD reach their full potential and lead fulfilling lives.

According to the DSM-5 criteria, there can also be significant impairment in social or work-related functioning. However, language skills and cognitive development are not affected, which means someone with ASD may have the potential to learn the necessary skills to work as a pilot or air traffic controller safely.

Still, challenges in interpersonal interactions may arise, particularly in the collaborative environment of a modern airline cockpit.

Note: It is crucial that individuals with ASD seeking a career in aviation, undergo assessment by a psychologist with expertise in the condition before pursuing such a path.

14.1.4 The effect of intellectual disabilities on flying safety

Intellectual disability, also known as intellectual developmental disorder (IDD), is a condition characterised by limitations in cognitive functioning and adaptive behaviour. It is a lifelong condition that begins before the age of 18. Intellectual disability affects a person's ability to learn, reason, solve problems, and adapt to everyday life tasks. The specific characteristics of intellectual disability can vary widely among individuals, but some common features include:

- Intellectual functioning: People with intellectual disability have below-average intellectual functioning, usually measured through intelligence quotient (IQ) tests. The IQ score typically falls below a certain cutoff, often around 70–75, but this may vary depending on the assessment tool used.
- Adaptive behaviour: Adaptive behaviour refers to a person's practical skills and ability to handle daily activities required for independent living, such as communication, self-care, social skills, and functional academics. Individuals with intellectual disability often have difficulties in these areas, which can impact their ability to live independently.

Intellectual disability is classified into 4 different levels based on the severity of the limitations:

1. Mild intellectual disability: IQ scores typically range from 50–70, and individuals may develop adequate self-care skills and social abilities. They often benefit from educational and vocational support.
2. Moderate intellectual disability: IQ scores range from 35–49. Individuals may learn basic communication and self-help skills but may require significant support in academics and daily life tasks.
3. Severe intellectual disability: IQ scores range from 20–34. Individuals have limited communication and self-care skills and require constant supervision and support.
4. Profound intellectual disability: IQ scores are below 20. Individuals have significant intellectual and adaptive limitations, requiring extensive support for daily living.

It is important to note that each person with intellectual disability is unique, and their capabilities and potential for improvement can vary. Early intervention, individualised educational plans, and appropriate support and accommodations can significantly improve the quality of life for individuals with intellectual disability and help them lead fulfilling and meaningful lives.

Note: An intellectual disability could make the medical certification process challenging for a pilot due to the specific cognitive and adaptive limitations associated with the condition. The aviation industry prioritises safety above all else, and a pilot's ability to perform critical tasks effectively is crucial for safe flying. Deficiencies in domains such as cognitive functioning, adaptive skills, learning and retention and stress management are all of relevance to a pilot.

14.2 Medical assessment for pilots

14.2.1 Attention-deficit hyperactivity disorder (ADHD)

Assessment for consideration of any aviation medical certificate will likely require assessment by a neuropsychologist. Neuropsychologists receive specialised training in understanding how the brain works, its structure, and how it affects behaviour. When evaluating for ADHD, a neuropsychologist may employ

different standardised tests and questionnaires to gather information. The assessment can be focused solely on ADHD or include a broader examination to rule out or confirm other related issues.

The cognitive domains tested cover:

- intelligence
- memory
- learning
- attention
- problem-solving
- organisational skills
- emotional control.

After analysing the data, the clinician will compile a concise report with treatment suggestions to enhance everyday functioning, as well as providing the report (with consent) to the doctor assessing your aviation medical certificate application (most likely a DAME, if a diagnosis of ADHD is confirmed).

Some studies have been conducted looking at ADHD from an aviation perspective, the potential contribution the diagnosis may have had on accidents, as well as the medical assessment process for applicants with ADHD[70]). The primary focus of an ADHD assessment for pilots should look at performance and symptoms occurring during their childhood and school years, as usually by then, signs of ADHD have become apparent (and have almost certainly been noticed before entering flight school). In some cases, ADHD that went undetected earlier may become evident during pilot training due to the substantial cognitive, social, perceptive, and motor demands placed on trainee pilots. As a result, special attention should be given to initial training. As a natural course, ADHD-related concerns may arise when a student pilot seeks their first medical certificate or when the flight school raises questions about a student pilot with the Aeromedical Examiner (AME).

As with many medical conditions, a significant source of valuable information in the assessment process is the pilot's self-reporting. This can include the pilot's own reflections or descriptions of their challenges and any disclosure regarding past or current prescriptions for ADHD medication. In some cases, urine drug screening is employed as part of the assessment, although its sensitivity is limited compared to quantitative laboratory testing[70].

14.2.2 Dyslexia

Dyslexia qualifies as a disability in Australia because it is a long-term impairment that can negatively impact a person's ability to carry out normal daily activities. From an aviation perspective however, safety cannot be compromised and adjustments that could jeopardise safety are not considered reasonable.

While it may be reasonable for students in many fields to receive help from a scribe for tasks like essay writing and exams, this is not feasible for pilots when it comes to reading checklists, weather reports, instrument displays, charts, etc. during a flight. The use of an additional person as an aid for word recognition and help with tasks (including the general overarching concept of a multi-crew environment, all of whom involved having their own, often high workload roles) would obviously be difficult and impractical for a pilot.

> **Note:** Pilots need to demonstrate sufficient reading and writing skills to complete their training successfully. If an applicant for pilot licensing requires assistance with reading and writing, there are currently no reasonable adjustments available with existing technology to ensure safe solo flying or pursue a career in aviation.

14.2.3 Autism spectrum disorder (ASD)

If someone with autism spectrum disorder (ASD) is considering becoming a pilot, it's essential to understand that obtaining a medical certification for flying might be challenging. This is because the aviation industry prioritises safety, and certain characteristics associated with ASD can potentially interfere with a pilot's ability

to perform the critical tasks required for safe flying. However, it's crucial to note that each case is unique, and the outcome may vary depending on individual strengths, challenges, and the severity of ASD symptoms.

Some reasons why a diagnosis of ASD might make medical certification difficult include:

- Social and communication challenges: Pilots must effectively communicate with air traffic control and others. ASD may impact social interactions and communication skills, making it harder to maintain clear and efficient communication.
- Sensory sensitivities: Individuals with ASD may have sensory sensitivities to stimuli like noise, lights, or vibrations. In a cockpit environment with various sensory inputs, these sensitivities could be problematic and affect performance.
- Flexibility and adaptability: Pilots need to handle unexpected situations and adapt to changing conditions swiftly. ASD may make it harder to handle unpredictability or adjust plans accordingly.
- Attention to detail: While attention to detail can be an advantage, extreme focus on specific elements might cause pilots to overlook broader aspects of the flight.
- Emotional regulation: Stressful situations are common in aviation, and emotional regulation is essential for making sound decisions. ASD-related emotional challenges may impact decision-making under pressure.

Regarding the medical evaluation, applicants with ASD may need to undergo additional assessments to determine their suitability for a pilot's role. The specific tests may vary based on the aviation authority and the individual's circumstances but may include:

- Neuropsychological assessment: This evaluation assesses cognitive abilities, attention, memory, and other relevant aspects related to flying.
- Psychological evaluation: A psychologist with expertise in aviation and neurodevelopmental disorders may assess social and communication skills, emotional regulation, and coping strategies.
- Flight simulator assessment: Some authorities may require individuals to demonstrate their flying abilities in a flight simulator to assess their practical skills.
- Occupational functioning evaluation: This examination evaluates the candidate's ability to handle the demands and responsibilities of a pilot's role effectively.

Note: It's crucial for individuals with ASD who aspire to become pilots to consult with aviation medical experts and professionals who have experience in evaluating individuals with neurodevelopmental conditions. These assessments aim to ensure the safety of both the pilot and passengers and determine if the individual can meet the essential requirements for piloting an aircraft successfully.

14.2.4 Intellectual disabilities

Ultimately, the medical certification process for pilots is designed to assess an individual's physical and mental fitness to handle the responsibilities and challenges of flying safely. Aviation authorities take into account the safety of everyone on board, and the presence of an intellectual disability may raise concerns about a pilot's ability to meet these standards.

However, it is important to note that each case is evaluated individually, and the outcome may vary depending on the specific circumstances and the severity of the intellectual disability. A Class 5 medical self-declaration applicant considering pursuing a career as a pilot or plans to fly recreationally, with an intellectual disability, will need to consult with aviation medical experts who can provide guidance on the certification process and potential accommodations that may be available.

14.3 Medical assessment for doctors

14.3.1 Diagnosis: Attention-deficit hyperactivity disorder (ADHD)

Risk assessment

Impairment differs at various phases of the illness and may vary markedly between individuals. Impairments associated with ADHD, which are common to both driving (as outlined in the Austroads Fitness to Drive Guidelines) and flying, include:

- being prone to angry aggressive and risky driving behaviour
- difficulty:
  - planning, organising and prioritising tasks
  - sustaining or shifting focus
  - managing frustration, modulating emotions and self-regulation.

Risk assessment considerations

Many aviation regulatory authorities do not provide fixed guidelines on ADHD and assess each case on an individual basis. According to the UK Civil Aviation Authority (CAA)[xxi], the DSM-5 guidelines note that this condition is diagnosed when a person shows signs of inattention, hyperactivity, or impulsiveness to a degree that significantly affects their social, school, or work functioning. The symptoms should have been present before the age of 7 and might improve as the person grows older. As a result, individuals seeking pilot licensing with a diagnosis of this condition, must undergo a neuropsychological assessment to determine if they can safely perform pilot duties. Those with persistent ADHD symptoms will not be eligible for pilot training. Additionally, using medication for this disorder usually disqualifies individuals from obtaining a pilot's licence.

As mentioned, neuropsychological tests can be used to assess executive function, but it is essential to exercise caution when drawing conclusions without a detailed clinical history and risk information. It is also necessary to assess non-executive tasks, involving multiple neuropsychological domains. Certain subtests may measure aspects like visual information processing and reaction time. Online neuropsychological test batteries such as CogScreen[xxii] and CANTAB[xxiii] are commonly used by some aviation regulatory authorities around the world. Although IQ test batteries may be used, they might not be sensitive enough to identify specific deficits. Individuals with ADHD might generally perform poorer on IQ tests, especially timed subtests, due to impulsivity and distractibility[70].

The FAA core test battery used for evaluating ADHD cases is comprehensive, covering at least 11 domains that require familiarity with numerous general psychometric and specialist neuropsychological measures. These domains include:

- executive function
- processing speed
- working memory
- visual memory
- continuous attention
- language
- psychomotor performance

[xxi] Civil Aviation Authority (UK) – Dyslexia, Asperger Syndrome and ADHD

[xxii] CogScreen www.cogscreen.com

[xxiii] Cambridge Cognition CANTAB https://cambridgecognition.com/

- personality
- mathematical ability.

However, it's worth noting that this battery may be challenging to administer for some clinicians in certain jurisdictions, due to resource and expertise limitations.

Aeromedical decision

A person with a diagnosis of ADHD must be assessed by a medical practitioner with experience in assessment of neurodiversity and capacity to determine whether the applicant's ADHD is sufficiently severe as to render them unable to safely fly an aircraft. If the medical practitioner is unable to make this determination, referral for formal neuropsychological assessment is recommended to inform the medical practitioner's advice to the applicant.

When to refer

If an applicant with ADHD has ongoing symptoms despite treatment, and those symptoms are sufficiently severe as to impair the applicant's ability to perform the normal activities of adult life independently, they are not eligible for a Class 5 medical self-declaration. These applicants should be referred for formal neuropsychological assessment and for review by a CASA DAME to identify opportunities for other forms of aviation medical certification.

14.3.2 Diagnosis: Dyslexia and other learning disorders

Risk assessment

Should an applicant with a known diagnosis of dyslexia present for medical assessment as part of a Class 5 medical self-declaration, then the assessing medical practitioner should consider whether the applicant has ongoing symptoms that affect their ability to access and understand written information, such as during school or at work. If an applicant proceeds with their pilot training and achieves the necessary standards, then this would be considered an acceptable assessment of their capabilities in the aviation context. That is, given a chronic condition unlikely to progress or become incapacitating, if their licence has been issued, then they have proven that they meet the necessary requirements and hence by definition, their dyslexia does not unduly compromise aviation safety.

Aeromedical decision

If an applicant is able to perform at school or work without impairment, without any modification of tasks and without assistance, they are eligible for a Class 5 medical self-declaration. If there is any indication of impairment or requirement for task modification or assistance, they are not eligible and should be referred to CASA for consideration of an alternative form of medical certification.

When to refer

The medical practitioner may choose to refer the applicant to a DAME for consideration of the Class 5 medical self-declaration or other classes of certificate for which they may otherwise be eligible. The medical practitioner and the applicant may choose to pursue further investigations in the case of an unclear diagnosis, or to clarify any concerns the practitioner may have regarding suitability for certification and overall risk to aviation safety.

14.3.3 Diagnosis: Autism spectrum disorder (ASD)

Risk assessment

The *Austroads Fitness to Drive Standards*[xxiv] states the following about ASD:

> 'Applicants with autism spectrum disorder (ASD) and developmental and intellectual disability should be assessed individually. A practical in-flight assessment could be useful to assess functional ability'.

Risk assessment considerations

In assessing risks relevant to the task of flying, the following should be considered:

- People with ASD can have differences in social communication and interaction, with restricted and repetitive patterns of behaviour, interest and activities.
- Similar to results of very limited studies of drivers[xvi], pilots with ASD may fly differently from people without ASD.
- Shortcomings in tactical flying skills may be observed, while rule-following aspects of flying may be improved.
- There is considerable difference in the range and severity of ASD symptoms, so assessment should focus on these and the significance of likely functional effects, such as:
  - managing attention and distraction
  - understanding non-verbal communication from other drivers
  - planning and organisation of the driving task and adapting to unexpected change
  - sensory sensitivities (e.g. glare and sound)
  - emotional regulation and input overload
  - repetitive behaviours such as rocking or hand flapping.

If an applicant commences and continues with their pilot training and achieves the necessary standards, then this would be considered an acceptable assessment of their capabilities in the aviation context. That is, given a chronic condition unlikely to progress or become incapacitating, if their licence has been issued, then they have proven that they meet the necessary requirements and hence by definition, their ASD does not unduly compromise aviation safety.

Aeromedical decision

If an applicant is able to perform at school or work without impairment, without any modification of tasks and without assistance, they are eligible for a Class 5 medical self-declaration. If there is any indication of impairment or requirement for task modification or assistance, they are not eligible and should be referred to CASA for consideration of an alternative form of medical certification.

When to refer

The medical practitioner and the applicant may choose to pursue further investigations in the case of an unclear diagnosis, or to clarify any concerns the practitioner may have regarding suitability for certification and overall risk to aviation safety.

The medical practitioner may also choose to refer the applicant to CASA for consideration of other classes of certificate for which they may otherwise be eligible.

[xxiv] Austroads Fitness to Drive. Section 7: Psychiatric Conditions

14.3.4 Diagnosis: Other neuropsychological and intellectual disabilities

The range of diagnoses and the variations in severity and functional impact of these conditions make it impossible to provide details on assessment, decisions and referral indications. Applicants and doctors are recommended consider the guidance provided above for other neurodiverse conditions. Seeking advice from a CASA DAME, an Aerospace Medicine Specialist or from CASA Avmed will assist in these cases.

15. Respiratory conditions

15.1 Aeromedical considerations

The respiratory system, which encompasses all the upper and lower airways and the lungs, is arguably the most important and most vulnerable system when it comes to aviation. It is the central system that allows the body to absorb oxygen from the air, but also helps maintain normal physiology in many other ways including:

- exchanging heat with the environment
- maintaining normal blood chemistry
- protecting the body from infections
- assisting in some hormonal functions.

The changes in atmospheric pressure and oxygen that occur at altitude and are described in section 2.1 (The flight environment) decrease the respiratory system's ability to absorb oxygen even in health, and this situation is made worse by respiratory disorders. The unpressurised recreational flight environment has the potential to expose pilots to oxygen levels low enough to cause potentially life-threatening hypoxia even at modest altitudes. The flight environment may also precipitate severe respiratory illness even in asymptomatic pilots or those with unrecognised disease processes.

15.1.1 The effect of respiratory conditions on flying safety

The occurrence of symptoms of respiratory disease, such as shortness of breath, chest pains, coughing, airway irritation, poor exertional tolerance, and wheezing, are concerning and can distract a pilot from the task of flying safely. Decreased oxygen supply to the brain can impair cognitive abilities leading to subtle incapacitation from even mild hypoxia. Hypoxia can impair cognition and decision-making to the point that deteriorating function cannot be recognised and corrective actions not taken. Complete incapacitation may happen suddenly, such as when oxygen levels fall low enough to result in loss of consciousness, or when sudden pain and breathing difficulty occurs when a lung collapses, for example.

15.1.2 The effect of the flight environment on respiratory conditions

Respiratory conditions can be made worse in a number of ways by the recreational flight environment. In an unpressurised light aircraft cockpit at altitude, the reduced barometric pressure results in a reduced driving pressure of oxygen to enter the body. The diffusion of oxygen may be further impaired by diseases that affect the airways or lungs. Changing pressure also affects the size of a volume of gas, as pressure decreases, volume increases proportionally.

Regions of air trapped in diseased lungs that cannot escape can expand and cause sudden and severe lung damage, such as a collapsed lung. Gas can even escape the lungs into the bloodstream as bubbles making its way to the brain, causing a stroke. G-forces can place extra stress on the circulation of blood and flow of air through the lungs, leading to impaired absorption of oxygen. Finally, any smoke or fumes that enter a light aircraft cockpit can irritate the lungs and airways, which can precipitate an asthma attack or simply incapacitate from the symptoms of airway irritation, such as burning airways and coughing.

15.2 Medical assessment for pilots

If you declare that you have a past or current history of any of the following respiratory conditions, you should be assessed by a medical practitioner:

- Asthma
- Cysts in the lung
- Chronic obstructive pulmonary disease
- Spontaneous pneumothorax
- Pulmonary hypertension
- Pulmonary thromboembolism - (refer to Diagnosis: venous thrombosis)

As lung diseases requiring oxygen therapy are an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed in these cases.

15.3 Medical assessment for doctors

15.3.1 Diagnosis: Asthma

Risk assessment

A self-declared history of asthma requires assessment by a medical practitioner to establish the severity, level of control and likelihood of exacerbation.

Varying degrees of mild hypoxia, gas trapping, stress and workload, cold air at altitude, and smoke and fumes may all precipitate an episode of asthma in-flight or make asthma worse[65].

Asthma occurring in-flight is at best distracting and concerning, or at worst extreme difficulty breathing can result in acute incapacitation because of severe airway obstruction that can stop a person from breathing (status asthmaticus). Trying to treat asthma with inhalers and spacers while flying is also very distracting, even if readily accessible, as attention will be taken off the critical task of controlling the aircraft.

Treatments such as inhaled bronchodilators (and spacers) must be carried and readily available should an asthma attack occur in flight.

Risk assessment considerations

Assessment of risk is based on:

- history
- active symptoms
- response to medical management
- precipitants
- frequency of asthma attacks.

Consideration should be given to history of hospital admissions, use of oral corticosteroids, and regular high doses of inhaled corticosteroids. Spirometry pre- and post-bronchodilator is helpful in the assessment of reversible bronchoconstriction.

A previous diagnosis of asthma, if mild, well managed and asymptomatic, is not necessarily a bar to certification. Asthma that is managed well with inhaled corticosteroids can be safe in the aviation environment with few occurrences in-flight[65].

A history of childhood asthma which has never recurred, is not a concern for certification.

Unfavourable risks

Unfavourable risks include:

- unstable asthma
- frequent episodes
- frequent hospital admissions
- oral corticosteroids
- abnormal spirometry, precipitated by cold air, mild exertion, or inhalation of irritants.

Aeromedical decision

Asymptomatic applicants can be considered fit for certification if they have:

- well-controlled and stable asthma.

- responded well to medical therapy
- a history of childhood asthma which has not recurred.

> **Note:** Rescue treatments and devices, such as inhaled bronchodilators and spacers, must be carried and accessible in the cockpit at all times.

When to refer

The applicant should be referred for further assessment before any aviation medical certification can occur if:

- symptoms of asthma are unstable, severe or frequent and poorly controlled despite medical treatment and/or
- investigations show evidence of reversible bronchoconstriction that has not been stabilised.

15.3.2 Diagnosis: Bullous lung diseases and cysts

Risk assessment

The term “bulla” refers to a pocket or cyst of air inside the lung that is more than 1cm in diameter. Chronic bullae, chronic pneumatoceles or cysts are associated with emphysema, inflammatory or infectious process or genetic diseases. A self-declared history of bullous or cystic lung disease requires assessment by a medical practitioner.

Varying atmospheric pressures during flight, as altitude changes, raises the possibility that gas trapped within cystic spaces may expand and rupture, possibly causing a pneumothorax. The acute pain, breathing difficulty and hypoxaemia from ventilation-perfusion mismatching that would occur in these circumstances would cause acute incapacitation of a pilot.

Rupture of pulmonary cysts resulting in cerebral arterial gas embolism has previously been documented during very rapid decompressions[66]. However, data from studies of routine air travel where pressure change is more moderate suggest that this concern is unwarranted and patients with bullous disease do not show any increased risk of pneumothorax[67].

Risk assessment considerations

Assessment of risk is based on:

- history
- active symptoms
- exercise tolerance at sea-level
- sea-level oxygenation on pulse oximetry (see section below - Methods for risk-assessing respiratory function before flight)
- results of imaging and lung function tests that might inform the likelihood of underlying lung disease being the cause.

This would then need to be assessed for risk according to the relevant section of these guidelines. There must be full recovery from any previous surgical excision.

Isolated bullae in otherwise normal lungs in young applicants, are usually stable and unlikely to progress. The presence of underlying lung disease suggests the likelihood of progression[68].

Unfavourable risks

Unfavourable risks include:

- underlying lung disease
- hypoxaemia at sea level
- shortness of breath on mild exertion at sea level

- previous spontaneous pneumothorax.

Aeromedical decision

Asymptomatic applicants can be considered fit for certification if they have:

- isolated single bullae that have been stable over a substantial period.
- normal respiratory function and exertional tolerance,

If pneumothorax has previously occurred, refer to section 14.3.6 (Diagnosis: spontaneous pneumothorax).

When to refer

Before certification can occur, the applicant should undergo further assessment if there:

- are symptoms of hypoxaemia, or pulse oximetry is <92% at sea level.
- is poor exertional tolerance.
- is chest pain.

Underlying diseases that are identified may also require referral for further assessment before certification can occur.

15.3.3 Diagnosis: Chronic obstructive pulmonary disease (COPD)

Risk assessment

Chronic obstructive pulmonary disease (COPD) is one of the most common chronic respiratory conditions, characterised by:

- chronic airflow obstruction
- reduced carbon monoxide transfer capacity (DLCO)
- impaired pulmonary gas-exchange
- hypoxemia.

Exposure to a hypobaric altitude environment can cause an aggravation of gas exchange limitations requiring careful assessment[67]. In the 2017–18 ABS National Health Survey (NHS), the prevalence of COPD (captured here as self-reported emphysema and/or bronchitis) in Australians aged 45 and over was 4.8%, or an estimated 464,000 people[69]. It tends to be irreversible and progressive, and by the time symptoms occur, lung damage is usually significant.

A self-declared history of COPD requires assessment by a medical practitioner.

At altitudes of 8000 ft, COPD has been shown to cause severe and clinically significant hypoxaemia[70]. COPD will rarely cause acute incapacitation, however the subtle incapacitation caused by arterial oxygen desaturation will lead to decreased cognitive function, poor decision making, and possible clouding of consciousness. Symptoms such as dyspnoea, air hunger, and reduced exertional tolerance have been found to increase at altitude[71] and if present, may also cause distraction and subtle impairment and may worsen at altitude.

In advanced stages of COPD, the lower partial pressures of oxygen described in section 2.1 (The flight environment) can lead to a significant reduction in arterial oxygen saturation, even below 10,000 ft where the majority of recreational pilots fly, and in pressurised cabins[72].

Decreasing atmospheric pressure during flight raises the concern that air trapping within emphysematous lungs leads to discomfort and impaired respiratory function. If bullae are present, they may expand and rupture, possibly causing a pneumothorax[68].

Recurrent respiratory infections are common, and response to treatment is often poor.

Risk assessment considerations

Risk assessment for pilots with COPD should include:

- history
- frequency of respiratory infections
- presence of active symptoms
- response to treatments
- treatment side effects (e.g. high dose corticosteroids)
- physical examination
- initial screening with pulse oximetry.

In patients with COPD with resting saturations between 92% and 95%, HAST is a good screening tool for sea level exertional tolerance and inflight hypoxemia[73]. Alternative methods of assessment are listed in Table 3.

Unfavourable risks

Unfavourable risks include:

- sea level oxygen saturation <92%
- symptomatic at rest
- frequent respiratory infections
- poor response to treatments
- requirement for high dose corticosteroids
- Requirement for supplementary oxygen.

Aeromedical decision

Asymptomatic applicants can be considered fit for certification if they:

- are well controlled on treatment.
- have satisfactory oximetry and exertional tolerance on room air at sea level.

Treatments should cause minimal side effects that are relevant to aviation.

> **Note:** Rescue treatments such as inhaled bronchodilators must be carried and accessible in the cockpit at all times.

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment if:

- there are frequent and persistent symptoms of COPD.
- hypoxaemia or pulse oximetry is <92% at sea level.
- it is determined that supplemental oxygen will be required in-flight.
- there is poor exertional tolerance, or
- there are recurrent complications, such as frequent chest infections.

15.3.4 Diagnosis: Spontaneous pneumothorax

Risk assessment

Spontaneous pneumothorax can either be:

- primary, arising from pre-existing subpleural blebs that rupture in otherwise well young adults, or
- secondary to COPD, which is a second peak of incidence in the elderly.

A self-declared history of primary (PSP) or secondary spontaneous pneumothorax (SSP) requires assessment by a medical practitioner.

Varying atmospheric pressures during flight, as altitude changes, raises the possibility that gas trapped within blebs, bullae or cysts may expand and rupture, causing a pneumothorax. The acute pain, breathing difficulty and hypoxaemia from ventilation-perfusion mismatching that would occur in these circumstances would cause acute incapacitation of a pilot. With a pneumothorax present, any further increase in altitude will cause further gas expansion inside the pleural cavity leading to further respiratory compromise and possible tension pneumothorax.

Recurrence of PSP is common. There is a 32% recurrence rate after a first PSP, and almost all that occurs in the first year[74]. After a first recurrence, there is a much higher likelihood of further recurrences. Recurrence rates after various surgical treatments range from 1.2% – 7%[75].

Risk assessment considerations

Assessment of risk is based on assessing if the pneumothorax is primary or secondary. Any recurrences must be noted, and presence of blebs, bullae, cysts. If treated, post-operative recovery must be assessed. If secondary, see guidelines for COPD, bullae and cysts.

Unfavourable risks

Unfavourable risks include:

- underlying lung disease
- presence of gas in the thorax
- recurrences of previous PSP
- poor post-operative recovery after treatment
- coincident cerebral arterial gas embolism (CAGE).

Aeromedical decision

Recreational pilots must not fly with an untreated pneumothorax. The British Thoracic Society recommends waiting 2 weeks after pneumothorax resolution on a chest radiograph to fly, regardless of how it was treated[73].

The underlying pulmonary condition resulting in secondary pneumothorax must be assessed on its merits referring to the relevant section of these guidelines. Any complications arising from a coincident gas embolism should be assessed with reference to the relevant section in these guidelines (e.g. Neurology – stroke)

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment if there:

- has been more than one recurrence of PSP, or
- are untreated blebs or bullae that may result in a further pneumothorax.

Underlying lung diseases that are identified, may also require referral for further assessment before any

aviation medical certification can occur.

15.3.5 Diagnosis: Pulmonary hypertension

Risk assessment

A self-declared history of pulmonary hypertension requires assessment by a medical practitioner.

Relatively mild hypoxia, as experienced in a commercial aircraft cabin and below altitudes of 10,000 ft, can precipitate pulmonary vasoconstriction and hypoxaemia, even in asymptomatic individuals, particularly those with medical conditions that predispose to pulmonary hypertiension[76]. In those with diagnosed pulmonary hypertension, altitude exposure will cause further vasoconstriction, increases in pulmonary artery pressures, worsening hypoxaemia and risking right heart failure. Altitudes above 2000 m (6,500 ft) should be avoided in those with mean pulmonary artery pressures >35mmHg without the use of supplemental oxygen[77].

Symptoms of pulmonary hypertension are mainly related to worsening hypoxaemia and right heart failure. Dyspnoea, fatigue, chest pain, presyncope or syncope, lower extremity oedema and palpitations are common[78] and if they occur in-flight are at best distracting and concerning, or at worst can result in acute incapacitation. The clouding of cognition that hypoxaemia causes, poses a significant threat to the safety of the flight.

Risk assessment considerations

Assessment of risk is based on:

- history
- active symptoms
- exertional tolerance at sea level
- response to medical management.

Pulmonary hypertension is caused by a large and diverse group of medical conditions. Identifying the underlying cause for pulmonary hypertension is essential for risk assessment.

Consideration should be given to arranging a hypoxia altitude simulation test combined with simultaneous echocardiography (HAST-echo)[76].

Unfavourable risks

Unfavourable risks include:

- pulmonary artery pressure > 35 mmHg
- symptomatic at sea level
- poorly controlled on treatments
- need for supplemental oxygen
- significant underlying medical conditions.

Aeromedical decision

Asymptomatic applicants with mild pulmonary hypertension, who have responded well to medical therapy, and in whom the underlying medical cause is treated and stable, can be considered fit for certification. Underlying medical conditions should be considered with reference to the relevant section of these guidelines.

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment if:

- symptoms are present at sea level and poorly controlled despite medical treatment.
- there is poor exertional tolerance at sea level.

- supplemental oxygen is required.
- pulmonary artery pressures are >35 mmHg.

15.3.6 Methods for risk-assessing respiratory function before flight

Applicants with risk factors for inflight hypoxemia should undergo:

- medical history review
- physical examination
- pulse oximetry.

Any applicant with a resting oxygen saturation level determined by pulse oximetry of <92% should be referred for further assessment before certification can occur. Applicants with baseline oxygen saturation level determined by pulse oximetry of 92%-95% and applicants with underlying lung disease regardless of oximetry should undergo predictive testing for hypoxaemia at altitude.

Different methods are described in Table 3. Ideally, this should be the High-Altitude Simulation Test (HAST) which involves breathing a mixture of gases with an inspired oxygen fraction of 15.1% via a tightly fitting mask or mouthpiece for a period of 20 minutes, during which continuous ECG and pulse oximetry readings are obtained[73]. However, this may not be readily available in most centres.

Table 4. Methods of predicting hypoxaemia in flight for general air travellers[73].

Method	Pros	Cons
Resting oxygen assessment		
Pulse oximetry	Non-invasive, inexpensive, accessible	Single point value may miss significant hypoxemia with exertion
Arterial blood gas	Inexpensive	Uncomfortable
Exercise testing		
6-minute walk	Minimal equipment required, widely used measurement in other pulmonary disease	Poor ability to predict inflight hypoxemia
50-metre walk	Assesses patient during exercise, not just at rest	Poor ability to predict inflight hypoxemia
Cardiopulmonary exercise test	Provides thorough evaluation of cardiopulmonary system	Time consuming, limited availability, expensive
Pulmonary functioning testing		
Spirometry, lung volumes, and diffusion capacity	Widely available, gives additional information on pulmonary disease	Poor ability to predict inflight hypoxemia
Predictive equations		
Calculation from point oxygen saturation determined by pulse oximetry or oxygen saturation	Inexpensive, quick, simple to use	Lack of agreement between equations, poor predictive ability
Altitude simulation		

Method	Pros	Cons
Hypoxic challenge test	Good ability to predict inflight hypoxemia	Time consuming, may not be readily available at all centres
Hypobaric chamber	Most closely mimics inflight environment	Very limited clinical availability, primarily used for research, expensive, time consuming.

The one-minute sit-to-stand test is a valuable alternative to the 6-Minute Walk Test to estimate functional exercise performance, especially in COPD patients. The cardiorespiratory demand is different between both tests, although the variation of dyspnoea is similar[79].

16. Renal and urological conditions

16.1 Aeromedical considerations

16.1.1 The effect of renal and urological conditions on flying safety

Renal and urological conditions can cause partial or complete incapacitation because of severe pain. The condition of greatest concern and of most relevance to this section, is urinary tract calculi. The sudden severe pain that occurs during an episode of renal colic can render a pilot incapable of safely flying and landing an aircraft[80].

16.1.2 The effect of the flight environment on renal/urological conditions

Environmental conditions associated with flying that may predispose to the formation of urinary tract calculi, include:

- hot weather
- dehydration
- inability to take fluids in flight.
- intentional fluid restriction to minimise the need for urination in-flight.

16.2 Medical assessment for pilots

If you declare that you have a past or current history of kidney stones or episodes of renal colic, you should be assessed by a medical practitioner.

As kidney stones can cause sudden and unpredictable incapacitation, which is an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed in this case.

16.3 Medical assessment for doctors

16.3.1 Diagnosis: Urinary tract calculi

Risk assessment

A self-declared history of urinary tract calculi or renal colic requires assessment by a medical practitioner.

Due to the severity of pain that occurs with symptomatic renal colic, and the incapacitation that results, urinary tract calculus is one of the few urological conditions of significance for the recreational pilot. The presence of a calculus is strongly associated with future episodes of renal colic. There is a 2-10% annual risk of symptomatic renal colic after incidental detection of a calculus[80]. A previous history of renal colic is also strongly predictive of future episodes.

Risk assessment considerations

Assessment of risk is based on:

- if there are renal calculi currently present
- the location of the calculi – collecting system or parenchymal.
- previous history of renal colic is a risk factor for further episodes.
- frequency and severity of any recurrences.
- metabolic risks for stone formation, and any treatments.
- underlying kidney conditions (e.g. medullary sponge kidney disease).
- the opinion of the applicant's treating urologist.

Favourable risks

Favourable risks include:

- renal tract currently free of stones
- metabolic disorders satisfactorily controlled
- no other renal conditions
- parenchymal (not collecting system) calculi.
- isolated or infrequent episodes of renal colic with well-managed risk factors.

Aeromedical decision

Applicants who have a history of renal colic, which is infrequent, but whose renal collecting system is currently clear of stones, can be considered fit for certification.

Applicants who have parenchymal calcifications which, in the opinion of a urologist, are unlikely to move into the collecting system or cause symptomatic renal colic, can be considered fit for certification.

When to refer

Before any aviation medical certification can occur, applicants should be referred for further assessment if they have:

- calculi within the collecting system
- frequent and severe episodes of renal colic, or
- underlying kidney disorders which predispose to stone formation.

17. Ear, nose and throat (ENT) conditions

17.1 Aeromedical considerations

The ears, nose and throat (ENT) comprise anatomical structures which function as part of the upper respiratory tract and contribute to hearing and balance. Respiratory disorders and hearing problems are covered elsewhere in this guidelines document. However, the balance system of the inner ear is subjected to frequent and unaccustomed accelerations while flying, which can lead to serious spatial disorientation, as described in the section 2.1 (The flight environment).

Although common and not likely to be considered a condition worthy of self-declaration, awareness of the impact of upper respiratory tract congestion because of viral infection (common colds) and allergy must be borne in mind. Inability to equalise pressure in the middle ears and sinuses as the aircraft descends is a consequence of this congestion, which can result in significant pain, distraction, sometimes dizziness, and possibly perforation of an eardrum. This is a hazard to safe recreational aviation and pilots should take the decision not to fly until these conditions resolve fully.

17.1.1 The effect of ear, nose and throat (ENT) conditions on flying safety

The occurrence of symptoms from disorders of the ears, nose and throat can lead to distraction, incapacitation and aircraft accidents. Pain or fullness in the ears, can distract from the flying task, and any hearing loss that occurs can impair effective communication (see section 2.2 on the flying task).

The occurrence of dizziness or vertigo is most concerning, as it can lead to significant spatial disorientation as a result of perceived rotational movement and impairment of vision, which can rapidly lead to loss of aircraft control. Episodes of vertigo may also be associated with nausea and vomiting.

17.1.2 The effect of the flight environment on ear, nose and throat (ENT) conditions

Barometric pressure changes in a climb or descent have an impact on the ENT system because of potential gas trapping in the middle ear cavity or sinuses which cannot be equalised. Symptoms of pain in the ears or face, nose bleeds, fullness in the ears, dizziness or deafness can result. Aircraft manoeuvring and accelerations, or rapid head movements in the cockpit necessary to maintain situational awareness around the aircraft, can precipitate certain types of vertigo (dizziness) that are sensitive to head position or rotation.

17.2 Medical assessment for pilots

If you declare that you have a past or current history of any of the following conditions, you should be assessed by a medical practitioner:

- Any disorder resulting in frequent or recurrent vertigo or dizziness.
- Frequent difficulty clearing your ears or sinuses while diving or flying.

17.3 Medical assessment for doctors

17.3.1 Diagnosis: Vertigo

Risk assessment

A self-declared history of recurrent vertigo requires assessment by a medical practitioner.

The recreational flight environment exposes pilots to barometric pressure change, G-forces, vibration, and rapid head movements, all of which my precipitate vertiginous episodes. Benign paroxysmal positional vertigo can be provoked by head movements, and exposure to vibration and acceleration[81], while unequal

ventilation of the middle ears when pressure changes can result in alternobaric vertigo[82]. The occurrence of vertigo in-flight can be extremely disorienting and dangerous.

It is important to establish if the symptoms experienced are true vertigo or dizziness and light-headedness from other causes such as orthostasis.

Many conditions can cause vertigo, which may:

- occur once (for example, viral labyrinthitis) or
- be recurrent (for example, benign positional vertigo)
- be unpredictable (for example, Meniere's disease) which is the more concerning situation.

A prodrome heralding an attack may not give sufficient time to land the aircraft. Vertigo may occur as a result of other underlying disorders of the central nervous system, such as cerebellar infarction[83], which should be assessed on their merits under the relevant section of these guidelines (see Neurological).

Risk assessment considerations

Assessment of risk is based on:

- establishing the diagnosis
- identifying precipitating factors
- identifying the pattern of recurrence.

Unfavourable risks

Unfavourable risks include:

- undetermined diagnosis
- frequent or unpredictable recurrences
- underlying neurological conditions.

Aeromedical decision

Asymptomatic applicants can be considered fit for certification if:

- they are fully recovered from a self-limiting disorder that has caused vertigo in the past.
- have an established cause for vertigo, which recurs infrequently and/or is controlled satisfactorily on treatment.

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment if:

- symptoms
  - are frequently recurrent.
  - occur unpredictably.
  - are poorly controlled despite medical treatment, and/or
- the underlying cause for vertigo cannot be established.

17.3.2 Diagnosis: Recurrent barotrauma

Risk assessment

A self-declared history of recurrent ear or sinus pain, when subjected to pressure change, such as when SCUBA diving or flying as a passenger, requires assessment by a medical practitioner.

The recreational flight environment exposes pilots to barometric pressure change that requires equalisation of pressure within the ears and sinuses during climb and descent. Inability to do so, can result in significant

pain in the ears, face, deafness, nose bleeds and ear drum perforation[84]. Unequal ventilation of the middle ears when pressure changes, can result in alternobaric vertigo[82]. It is important to note that on rare occasions, the presence of a unilateral grommet can result in this problem. Perilymphatic fistula leading to severe vertigo has also been connected to flying activities and pressure change[85].The occurrence of vertigo in-flight can be extremely disorienting and dangerous.

It is important to establish if recurrent symptoms are caused by an underlying medical condition such as:

- eustachian tube dysfunction
- deviated nasal septum.
- chronic sinusitis
- chronic allergic rhinitis, or
- other ear and sinus pathology.

Risk assessment considerations

Risk assessment includes consideration of previous history of symptoms occurring with pressure change, including:

- frequency and severity
- assessment of ability to perform a valsalva manoeuvre.
- previous sinus surgery or grommets.

Unfavourable risks

Unfavourable risks include:

- undetermined cause
- frequent or unpredictable recurrences
- inability to equalise pressures at sea level.
- persistence despite previous corrective surgery
- occurrence of alternobaric vertigo.

Aeromedical decision

Asymptomatic applicants can be considered fit for certification if they:

- only experience symptoms during self-limiting viral upper respiratory tract infections or allergic rhinitis.
- have had a satisfactory response to surgical treatments, such as endoscopic sinus surgery or ventilation tubes.

Applicants may fly with grommets in situ.

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment, and possible ENT specialist, if:

- symptoms
  - are frequently recurrent.
  - occur unpredictably.
  - are poorly controlled, despite treatment, and/or
- the underlying cause for barotrauma cannot be established.

18. Other medical conditions and symptoms not otherwise specified

18.1 Aeromedical considerations

These guidelines cannot cover every clinical scenario that may affect a recreational pilot's ability to fly safely. It is acknowledged that other medical conditions or combinations of conditions may also be relevant, which may affect a pilot's overall functioning and compromise flight safety. Thus, a certain level of professional judgment is necessary on the part of the assessing medical practitioner when evaluating fitness to fly. The medical practitioner conducting the assessment should adhere to general principles when evaluating recreational pilots, considering factors such as:

- the flying environment in which they wish to operate.
- how the condition may impact sensory, motor, and cognitive abilities.

Similarly, these guidelines cannot cover every condition or situation that may temporarily impact the ability to fly safely. There is a wide range of conditions that can temporarily affect fitness to fly, such as post-operative recovery, various minor injuries and other self-limiting conditions which are of a limited duration and do not have an impact on fitness to fly in the longer-term. It is the responsibility of the healthcare provider managing the pilot's treatment to offer appropriate advice on their fitness to fly safely, including recommended periods of refraining from flying. This advice should consider the potential impact of the condition and their individual circumstances on the flying task. This section provides guidance on some common conditions that may temporarily impact on ability to fly safely.

18.1.1 Diagnosis: Pregnancy

Medical assessment for pilots

Flying is physiologically demanding and can have significant safety implications in the aviation environment. Some medical conditions associated with pregnancy can also cause incapacitation or impairment in flight. A female recreational pilot should:

- ground herself as soon as she becomes aware she is pregnant.
- seek advice of her medical practitioner before resuming flying.

Risk assessment

Under normal circumstances, pregnancy is not considered a barrier to driving, however flying while pregnant can pose certain unique risks to flying safely. These risks primarily revolve around the potential impact on the health and wellbeing of the pregnant pilot, which in turn can affect her ability to perform the flying task safely. There may also be associated risks to the developing fetus to be considered.

Risk assessment considerations

Here are some considerations regarding the risks associated with a female pilot flying while pregnant:

- Physical and cognitive changes: Pregnancy involves numerous physical and hormonal changes that can affect a pilot's physical abilities and cognitive functions. These changes may include:
  - Fatigue
  - Reduced exercise tolerance
  - Changes in breathing
  - Changes in blood pressure
  - Changes in body shape
  - Reduced bladder capacity

This can interfere with physical mobility in and out of the aircraft and the use of restraint systems, as well as full deflection of aircraft controls.

Medical complications: Pregnancy can bring about certain medical changes and complications, and some pregnancies are at high risk of complications. These include:

- gestational diabetes
- hyperemesis gravidarum
- hypertension
- preeclampsia
- changes in visual acuity
- dilutional anaemia
- placental complications
- fetal growth complications
- multiple gestations (twins, triplets etc)

These conditions can impact a pilot's overall health and may require medical treatment, potentially affecting her fitness to fly. They can also cause unpredictable early labour, or fetal emergencies.

- Decreased tolerance to hypoxia: During pregnancy, a woman's oxygen requirements increase, and her tolerance to hypoxia may decrease, for example because of anaemia. This could potentially impact her performance at high altitudes, where oxygen levels are lower.
- Risk of preterm labour: If a pilot experiences preterm labour or premature rupture of membranes while in-flight, it can pose a significant emergency due to pain and distraction, and potentially compromise the safety of both the pilot and passengers.

The stage of the pregnancy should be considered, as risks relevant to flying differ according to trimester,

Every pregnancy should be assessed by the health care provider who is providing antenatal care, and if anything is other than normal they should be further assessed by a consultant Obstetrician.

Aeromedical decision

The decision to fly while pregnant should be made based on an individual assessment of:

- the pilot's health (maternal factors)
- the status of the pregnancy (pregnancy factors)
- The status of the developing baby (fetal health).

Pregnancy under normal circumstances can be compatible with flying a recreational aircraft. However, the pilot’s obstetrician should be made aware of the relevant considerations of recreational flying to properly advise of the safety of flying when pregnant.

Applicants or certificate holders can be considered fit for certification if they:

- have absence of significant symptoms that might impact on the task of flying:
- are clinically stable with no complications of pregnancy.
- have acceptable biochemical and haematology results.
- have stable visual acuity.

Consideration should be given to advising that flying be restricted after 30 weeks of gestation (for example with a multicrew limitation), or more frequent and detailed pregnancy health assessments are done if the pilot continues to fly as the pregnancy progresses. A return to unrestricted flying can be considered once the pilot has fully recovered after the end of the pregnancy.

When to refer

Before any aviation medical certification can occur, the applicant should be referred for further assessment if:

- the applicant or pilot has a complicated or high-risk pregnancy
- the applicant has any symptoms of pregnancy that are more than mild
- there is unstable visual acuity.

As high-risk pregnancy is an excluded medical condition for Class 5 self-declaration, it is strongly recommended that advice from a medical practitioner is sought and followed in this case.

18.1.2 Diagnosis: Gastrointestinal conditions

Risk assessment

Medical conditions affecting the gastrointestinal (GI) tract have the potential to cause:

- sudden incapacitation
- subtle decline in performance
- distractions for recreational pilots.

For example, acute or chronic GI haemorrhage can lead to low blood pressure, reduced oxygen-carrying capacity, and distractions that can render a pilot unable to control an aircraft effectively. Chronic and progressive anaemia caused by slow GI blood loss can result in reduced tolerance to low oxygen levels, decreased ability to engage in physical activity, and subtle decline in performance that can negatively impact a pilot's effectiveness. Distractions arising from painful abdominal distention due to trapped gas at high altitudes, or the untimely release of stool, can significantly impair the performance of even the most focused pilot[86] when toilet facilities are inaccessible.

Risk assessment considerations

Assessment of risk is based on:

- establishing the diagnosis
- assessing any active symptoms that may interfere with the flying task.
- establishing the risk of sudden or subtle incapacitation
- assessing the effectiveness of treatments
- determining if significant symptoms are likely to progress or recur.

Aeromedical decision

In a pilot with a condition of the GI tract, certification may be considered if the following criteria are met:

- The condition:
  - does not pose a risk of sudden incapacitation.
  - poses minimal potential for subtle performance decrement, particularly with regard to cognition.
  - can be resolved or is stable and expected to remain so, even under stress while flying.
- If the possibility of progression or recurrence exists, the first symptoms or signs must be easily detectable and not pose a risk to the individuals or the safety of others.
- Must be compatible with the intended flying task.

When to refer

Applicants who have a chronic GI condition with active symptoms that may significantly affect the flying task should be referred for further assessment before any medical certification can occur.

18.1.3 Diagnosis: Endocrine disorders

Risk assessment

The human endocrine system is a complex network of glands that secrete hormones into the bloodstream. These hormones act as chemical messengers and regulate various bodily functions, maintaining homeostasis and coordinating the activities of different organs and systems. The primary functions of the human endocrine system include:

- regulation of metabolism
- growth and development
- reproduction and sexual development
- maintenance of fluid balance and electrolyte levels
- modulating stress response
- regulation of blood sugar levels (see Diabetes section of these guidelines)
- control of body temperature
- mood regulation and emotional well-being.

The endocrine conditions of primary concern to aviation are:

- disorders of pituitary function (such as hypopituitarism and hyperpituitarism)
- disorders of the thyroid
- Addison's disease
- Cushing's syndrome
- disorders of calcium metabolism (hyper and hypocalcaemia) and Conn's syndrome.

Symptoms arising from endocrine disorders can cause sudden or subtle incapacitation in flight.

Risk assessment considerations

Assessment of risk is based on:

- establishing the diagnosis
- assessing the presence and severity of symptoms relevant to the flying task
- determining the effectiveness of treatment if treatment is successful.

If surgery has been required (for example, assessing the stability of the condition thyroidectomy, or pituitary adenoma excision) then post-operative recovery must be considered.

If the endocrine disorder is secondary to other diseases (for example, small cell lung cancer and some pancreatic tumours) then the underlying disease must be addressed according to the relevant section of these guidelines.

Unfavourable risks

Unfavourable risks include:

- active symptoms
- elevated or unpredictable incapacitation risk
- untreated condition
- inadequate or ineffective treatment.

Aeromedical decision

Most endocrine disorders can be managed effectively or indeed cured by surgery.

Applicants can be considered fit for certification if they have:

- minimal or no symptoms
- had a satisfactory response to treatment
- a well-controlled and stable condition
- recovered satisfactorily from any surgical procedures.

When to refer

Before any aviation medical certification can occur, the applicant should either be referred for further assessment if:

- they have an active unstable condition, with poorly controlled symptoms, or
- underlying primary disease process.

18.1.4 Diagnosis: The ageing pilot

Risk assessment

Operating an aircraft necessitates excellent vision, cognitive abilities, and coordinated coordination between the eyes, hands, and feet. Therefore, pilots must first interpret external visual cues and information presented on the instrument panel. Subsequently, they need to provide the appropriate inputs to the flight control surfaces by executing coordinated movements with their hands (ailerons and elevator) and feet (rudder).

However, as individuals age, they typically experience a deterioration in vision, motor skills, hand-foot-eye coordination, and perceptual-motor adaptability[87]. Pilots over 65 years of age showed a nearly threefold elevated risk for a general aviation accident (fatal and non-fatal combined) compared with younger (18–24 years of age) pilots. Studies have found that male pilots, those older than 60 years of age, and with more experience, are more likely to be involved in a fatal accident[88].

It is more likely that medical factors may contribute to fatal accidents among elderly pilots. In addition, medication use, and polypharmacy use should be taken into consideration[89].

Vision

Various aspects of vision can deteriorate with age, including visual acuity, visual fields, and contrast sensitivity. Older individuals are also more susceptible to eye conditions like cataracts, glaucoma, and macular degeneration. Pilots may experience these age-related changes and eye conditions without necessarily noticing them.

Undergoing regular eye health check-ups can aid in the early detection and management of any vision changes. Difficulties with night flying and issues with glare may serve as initial indicators of age-related visual decline and should be discussed with a health professional. Implementing flying restrictions such as avoiding night flights, can help ensure safe flying. Additionally, the removal of cataracts can effectively restore vision for flying purposes (see section 12 - Vision and eyes in these guidelines).

Cognitive function

Different aspects of cognitive processing necessary for safe recreational flying can decline as individuals age, including:

- memory
- working memory
- visual processing
- visuospatial skills
- attention functioning.
- executive functioning

- insight.

These cognitive impairments can have an impact on a pilot's ability to effectively process and respond to the complexities of the aviation environment. It is important to note that these impairments may fluctuate from day-to-day, making it challenging to definitively assess their impact on flying. Of particular concern, is dementia, as older pilots with dementia often lack awareness of their cognitive deficits and may be more inclined to fly when it is unsafe to do so. Cognitive assessment using a tool such as the MOCA should be considered.

Motor and sensory functions

As individuals age, there is typically a decrease in the following which can impact their ability to fly an aircraft:

- muscle strength
- endurance
- flexibility
- range of motion
- joint stability.

Older pilots may also be more susceptible to musculoskeletal conditions such as arthritis. These age-related health conditions can lead to chronic pain and fatigue. Additionally, proprioception, which refers to the awareness of one's body position and movement, may be affected. These impairments can pose challenges for older pilots when it comes to tasks such as:

- entering and exiting the aircraft
- adjusting seats and controls
- using flight controls.

Cardiovascular risk

Cardiovascular and cerebrovascular disease risk becomes an important consideration as pilots age. Ageing is associated with changes in the cardiovascular system, including:

- reduced cardiovascular reserve.
- increased arterial stiffness.
- a higher likelihood of developing cardiovascular conditions.

Age-related factors such as hypertension, atherosclerosis, and coronary artery disease can increase the risk of cardiovascular events or stroke during flight. Cardiovascular diseases are covered in the Cardiovascular conditions section in this guidelines document. The use of a cardiovascular risk calculator such as PREDICT can help to understand and mitigate these risks.

Aeromedical decision

If applicants continue to meet to age-based requirements to hold a driver licence under the Austroads guidelines, then they may be considered fit for certification.

If any concerns arise regarding any of the common age-related conditions described above, refer to the relevant section of these guidelines. If uncertain, referral to a CASA DAME is advised.

Many age-related conditions will be detected via the increased frequency of medical declarations and screening with advancing age.

Appendices

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Appendix B – Medical glossary

Term	Definition
Accelerometer-based rate-responsive pacemakers	Pacemakers that use an accelerometer to adjust the heart rate in response to physical activity.
Acute musculoskeletal condition	Temporary or short-term condition affecting the musculoskeletal system.
Adjustment disorder	A psychiatric disorder resulting from an acute emotional trauma.
Aeromedical decision	A decision made by aviation medical authorities regarding the fitness of an individual to operate an aircraft.
Aircraft control modifications	Changes made to aircraft controls to accommodate specific conditions.
Airways	The passages that allow air to flow in and out of the lungs, including the nose, throat, trachea, and bronchial tubes.
Alternobaric vertigo	Vertigo caused by unequal ventilation of the middle ears during pressure changes.
Aneurysms	Abnormal bulging of blood vessels.
Angina	Chest pain or discomfort caused by reduced blood flow to the heart.
Anxiety disorders	Mental health conditions characterised by excessive and persistent anxiety and fear.
Arrhythmia	A heart rhythm disorder that causes the heart to beat too fast, too slow, or irregularly.
Asthma	A chronic respiratory condition characterised by inflammation and narrowing of the airways, leading to breathing difficulties.
Asymptomatic	Not experiencing any symptoms of a disease or condition.
Atrial fibrillation	A type of arrhythmia where the heart beats irregularly.
Austroads	Refers to the Austroads standards used for private driver licence issuance.
Benign paroxysmal positional vertigo	A type of vertigo triggered by specific head movements.
Benign	Not harmful or life-threatening.
Blood pressure	The force exerted by circulating blood on the walls of blood vessels.
Blood sugar	Glucose present in the bloodstream that provides energy to the body's cells.
Blood vessels	Tubular structures that transport blood throughout the body, including arteries, veins, and capillaries.
Bradycardia	A slow heart rate.
Bronchodilators	Medications that relax and widen the airways, making it easier to breathe.

Term	Definition
Cardiac arrest	A sudden loss of heart function, leading to loss of consciousness and death if not treated immediately.
Cardiac pacemaker	A device that uses electrical impulses to regulate the heartbeat.
Cardiomyopathy	A group of diseases that affect the heart muscle.
Cardiovascular disease	A group of conditions that affect the heart and blood vessels.
Cardiovascular system	The network of blood vessels, including the heart, responsible for transporting oxygen and nutrients throughout the body.
CASA Designated Aviation Medical Examiner (DAME)	A medical examiner authorised by the Civil Aviation Safety Authority (CASA) to conduct aviation medical assessments.
Cataplexy	Sudden loss of muscle tone triggered by strong emotions.
Central nervous system neoplasms	Abnormal growths or tumours in the central nervous system (brain or spinal cord).
Central nervous system	The complex of the brain and spinal cord.
Cerebral palsy	A neurological condition caused by brain injury or abnormal development, while neuromuscular conditions primarily affect the muscles, nerves, or neuromuscular junction.
Cerebrovascular disorders	A group of medical conditions that affect blood vessels in the brain, such as stroke or aneurysm.
Chronic allergic rhinitis	Long-term allergic inflammation of the nasal passages.
Chronic musculoskeletal condition	Long-term or persistent condition affecting the musculoskeletal system.
Chronic sinusitis	Persistent inflammation of the sinuses.
Chronic	Persisting for a long period or recurring frequently.
Co-morbidities	The presence of 2 or more medical conditions or disorders in the same individual.
Cochlear implant	A surgically implanted electronic device that provides a sense of sound to individuals with severe hearing loss or deafness.
Cognitive dysfunction	Impairment in cognitive processes such as thinking, memory, and problem-solving.
Cognitive function	Mental processes related to acquiring knowledge, perception, memory, and problem-solving.
Collecting system	Structures in the kidney that collect and transport urine.
Colour vision	The ability to perceive and distinguish different colours.
Coma	A state of prolonged unconsciousness.
Compliance	Adherence to prescribed treatments or protocols.

Term	Definition
Conduction disturbances	Abnormalities in the way that electrical signals are conducted through the heart.
Congenital heart disorders	Heart defects that are present at birth.
Congestion	The state of being congested or blocked, often referring to the upper respiratory tract.
Consciousness	The state of being aware and responsive to one's surroundings.
Conversational voice test	A test conducted to assess a person's ability to hear and understand spoken words in a conversation.
Coronary artery bypass graft surgery (CABG)	A procedure used to treat coronary artery disease.
Coronary artery disease	A condition characterised by the narrowing or blockage of blood vessels supplying the heart.
Coronary event	An event related to the coronary arteries, such as a heart attack.
Corrected visual acuity	Visual acuity achieved with the use of corrective lenses.
Corrective lenses	Eyeglasses or contact lenses used to correct refractive errors.
CPAP device	Continuous Positive Airway Pressure device, a treatment for sleep apnoea.
DAME	Designated Aviation Medical Examiner, a medical practitioner authorised to conduct aviation medical examinations.
Deep vein thrombosis	A blood clot that forms in a vein deep in the body, usually in the legs.
Dehydration	A condition caused by inadequate fluid intake or excessive fluid loss.
Depth perception	The ability to perceive the relative distances of objects in three-dimensional space.
Deviated nasal septum	A condition where the nasal septum, the wall dividing the nasal passages, is off-centre or crooked.
Diabetes mellitus	A chronic metabolic disorder characterised by high blood sugar levels due to insufficient insulin production or ineffective insulin utilisation.
Diffusion	The movement of molecules from an area of higher concentration to an area of lower concentration.
Diplopia	Double vision, seeing 2 images of a single object.
Distraction	Diversion of attention from the task at hand.
Dizziness	A sensation of unsteadiness or lightheadedness.
Dyspnoea	Difficulty breathing or shortness of breath.
Ears, Nose, and Throat (ENT)	Anatomical structures that contribute to hearing, balance, and the upper respiratory tract.

Term	Definition
ECG abnormalities	Abnormalities in the electrical activity of the heart, as measured by an electrocardiogram.
Emotional regulation	The ability to manage and control emotions.
End-organ complications	Complications affecting specific organs due to a medical condition.
Endocrinologist	A medical specialist dealing with endocrine disorders, including diabetes.
Epileptic seizures	A sudden, abnormal, and excessive electrical activity in the brain that results in seizures.
Epworth Sleepiness Scale (ESS)	A questionnaire used to assess an individual's daytime sleepiness.
Ergonomics	The study of designing equipment and systems for maximum efficiency and safety.
Eustachian tube dysfunction	Impairment in the function of the eustachian tube, which connects the middle ear to the back of the nose and helps equalise pressure.
Excessive daytime sleepiness (EDS)	Excessive sleepiness during waking hours, leading to a strong urge to sleep.
Family history	The medical history of an individual's biological relatives.
Fatigue	A feeling of tiredness or exhaustion.
Favourable risks	Factors indicating a lower risk or better prognosis.
Foveal fixation	The point of focus on the retina for detailed vision.
Fragmented wakefulness	Sleep patterns characterised by disrupted and fragmented periods of wakefulness and sleep.
G-forces	The forces experienced during acceleration, deceleration, or manoeuvres that affect the flow of blood and air through the body.
Gas exchange	The process of exchanging oxygen and carbon dioxide between the lungs and the bloodstream.
Gas trapping	The retention of gases in specific body areas, such as the middle ear or sinuses.
Glare	Excessive brightness or harsh light that can cause visual discomfort or impairment.
Glucose control	Management of blood sugar levels.
Glucose monitor	Device used to measure blood glucose levels.
Hearing aids	Partial or complete inability to hear sounds.
Heart block	A condition in which the electrical signals in the heart are delayed or blocked.

Term	Definition
Heart disease	A range of conditions that affect the heart's structure and function, including coronary artery disease, heart failure, and arrhythmias.
Heart failure	A condition in which the heart is unable to pump blood effectively.
Heart palpitations	A sensation of rapid, fluttering or pounding heartbeats.
Hormonal regulation	The process of maintaining a balance of hormones in the body.
Hyperglycemia	High blood sugar levels.
Hypertension	High blood pressure.
Hypoglycemic episodes	Episodes of low blood sugar levels.
Hypoxaemia	A condition characterised by low levels of oxygen in the blood.
Hypoxia	A condition resulting from a deficiency of oxygen reaching body tissues, potentially leading to impaired cognitive function and other health issues.
Illusions	Perceptual distortions or misinterpretations of visual stimuli.
Immune system	The body's defence system against infections and diseases.
Implantable cardioverter defibrillator (ICD)	A device that can detect and correct potentially life-threatening arrhythmias.
Incapacitation	The state of being unable to perform normal physical or mental activities.
Incidental detection	Discovery of a condition by chance or during unrelated medical examinations.
Inhaled corticosteroids	Medications used to reduce airway inflammation in conditions like asthma.
Insight	Awareness and understanding of one's own condition or situation.
Insulin analogues	Synthetic versions of insulin with modified properties.
Insulin	A hormone produced by the pancreas that regulates blood sugar levels by facilitating the uptake of glucose into cells.
Irritants	Substances that can cause inflammation or irritation of the airways, triggering respiratory symptoms.
Ischemic heart disease	A condition where the blood supply to the heart is reduced, leading to chest pain or heart attack.
Ketoacidosis	A potentially life-threatening complication of diabetes characterised by high levels of ketones in the blood.
Kidneys	Organs responsible for filtering waste products from the blood and producing urine.
Left or right bundle branch block	A delay or blockage of electrical signals in the heart's conduction system.
Loss of consciousness	A state of being unconscious or unaware of one's surroundings.

Term	Definition
Low blood pressure	A condition where blood pressure is abnormally low.
Low blood sugar	A condition that occurs when the level of glucose in the blood is lower than normal.
Lower limbs	Refers to the legs and feet.
Lungs	The primary organs of the respiratory system where gas exchange occurs, allowing oxygen to enter the bloodstream and carbon dioxide to be removed.
Medications	Substances used for the treatment of psychiatric disorders.
Medullary sponge kidney disease	A congenital disorder affecting the kidney's ability to absorb urine, leading to the formation of kidney stones.
Meniere's disease	A disorder of the inner ear characterised by recurrent episodes of vertigo, hearing loss, and ringing in the ears.
Mental health disorders	Conditions that affect an individual's emotional wellbeing and behaviour.
Metabolic risks	Factors related to the body's metabolic processes that contribute to stone formation.
Microvascular damage	Damage to small blood vessels.
Middle ears	The part of the ear between the eardrum and the inner ear.
Monocular vision	Vision with only one functional eye.
Mood disorders	Disorders characterised by disturbances in mood, such as depression.
Motor skills	Abilities related to movement and physical actions.
MSLT (Multiple Sleep Latency Test)	A diagnostic test that measures how quickly an individual falls asleep in a quiet environment.
Musculoskeletal conditions	Conditions affecting the muscles, bones, joints, and associated tissues.
Myocardial infarction	A medical emergency caused by blockage of blood flow to the heart, leading to heart muscle damage.
Myocardial ischemia	A condition where the heart muscle doesn't receive enough blood flow and oxygen.
Narcolepsy	A neurological disorder characterized by excessive daytime sleepiness and sudden loss of muscle tone (cataplexy).
Nerves	Bundles of fibres that transmit signals between the brain, spinal cord, and other parts of the body.
Nervous system	The complex network of nerves and cells that transmit signals between different parts of the body.
Neurological	Relating to the nervous system, including the brain and spinal cord.

Term	Definition
Non-epileptic conditions	Medical conditions that can cause symptoms similar to seizures but are not caused by abnormal brain activity.
Obesity	Excessive accumulation of body fat.
Obstructive sleep apnoea	A sleep disorder characterised by interrupted breathing during sleep.
Occluder	An optical device used to cover or block one eye to manage diplopia.
Ophthalmological	Relating to the study and treatment of eye diseases.
Ophthalmologist	A medical doctor specialising in eye and vision care.
Optometrist	A healthcare professional who examines eyes for vision and eye health problems.
Organic causes	Underlying medical conditions that may contribute to or influence the development of psychiatric symptoms.
Orthostasis	A condition where a person feels lightheaded or dizzy upon standing up.
Orthostatic hypotension	A type of low blood pressure that occurs when a person stands up from a sitting or lying position.
Overweight	Having a body weight above the recommended or healthy range for a given height.
Pacemaker	A small device implanted under the skin that helps regulate heart rhythm.
Palpitations	Abnormal or irregular heartbeats.
Parenchymal	Relating to the functional tissues of an organ, in this case, the kidney.
Parkinson's disease (PD)	A progressive degenerative disorder affecting the central nervous system.
Percutaneous coronary intervention (PCI)	A family of minimally invasive procedures used to open clogged coronary arteries (those that deliver blood to the heart).
Perforation	A hole or rupture, in this context, referring to the eardrum.
Perilymphatic fistula	An abnormal connection or rupture between the inner ear and the middle ear, leading to leakage of inner ear fluid.
Peripheral neuropathy	Nerve damage affecting the extremities, such as hands and feet.
Peripheral vision	The ability to see objects and movement outside the direct line of sight.
Permanent disability	A long-term or permanent impairment affecting the ability to function.
Personality disorders	Chronic patterns of thoughts, feelings, and behaviours that significantly deviate from societal expectations.
Pharmacological treatments	Treatments involving medications.
Physiology	The normal functioning of the body and its systems.
Polydipsia	Excessive thirst.

Term	Definition
Polysomnography	A sleep study that monitors various physiological parameters during sleep.
Polyuria	Excessive urination.
Post-traumatic stress disorder (PTSD)	A disorder that can develop after experiencing or witnessing a traumatic event.
Postural stability	The ability to maintain a stable body posture.
Prescription	The specific details and instructions for corrective lenses provided by an eye care professional.
Prevalence	The proportion of individuals in a population who have a specific condition or disease.
Primary prevention	The use of interventions to prevent the development of a disease or condition.
Prodrome	Early symptoms or signs that precede the onset of a condition or episode.
Prostheses	Artificial devices used to replace missing body parts.
Psychiatric disorders	Also referred to as mental illnesses or psychological disorders, these are clinically significant disturbances of mental health.
Psychotic symptoms	Symptoms involving a loss of contact with reality, such as hallucinations or delusions.
Pulmonary embolism	A blood clot that travels to the lungs.
Pure-tone audiometry testing	A hearing test that measures an individual's hearing sensitivity at different frequencies using pure tones.
Reaction time	The time it takes to respond to a stimulus or situation.
Recurrence	The reappearance of symptoms or episodes after a period of improvement or remission.
Refractive errors	Abnormalities in the shape of the eye that cause blurred or distorted vision.
Remission	A period of absence or reduction of symptoms of a psychiatric condition.
Renal colic	Severe pain caused by the passage of kidney stones.
Renal disease	Diseases affecting the kidneys.
Renal	Relating to the kidneys.
Respiratory system	The anatomical system that includes the upper and lower airways and the lungs, responsible for the exchange of oxygen and carbon dioxide in the body.
Retinal disease	Diseases affecting the retina of the eye.
Reversible bronchoconstriction	A narrowing of the airways that can be reversed with appropriate treatment.

Term	Definition
Risk calculator	A tool used to assess an individual's risk of developing a particular condition within a specified time frame.
Risk factors	Factors that increase the likelihood of developing a particular disease or condition.
Schizophrenia	A chronic mental disorder characterised by psychosis, disturbed thinking, and social withdrawal.
Scotoma	An area of partial or complete loss of vision within the visual field.
Screening test	A test or examination conducted to identify the presence of a particular disease or condition.
Secondary prevention	The use of interventions to prevent recurrence of a disease or condition.
Shortness of breath	Difficulty breathing or a feeling of suffocation.
Sibilants	Sounds characterized by a hissing or hushing effect, such as the ‘s’ sound.
Side effects	Unintended and potentially adverse effects of a medication or treatment.
Seizure	An uncontrolled burst of electrical activity in the brain that can cause changes in behaviour, movements, feelings, and consciousness levels.
Sinuses	Air-filled cavities in the skull connected to the nasal passages.
Situational awareness	Awareness of the current flight situation and environment.
Sleep apnoea	A sleep disorder characterised by interrupted breathing during sleep.
Sleep disorder	A condition that affects the quality, duration, or timing of sleep.
Sleep study	A comprehensive evaluation of sleep patterns and disorders.
Snellen chart	A standardised eye chart used to measure visual acuity.
Somatogravic illusion	A vestibular illusion that can occur during aircraft acceleration or deceleration, particularly in situations where visual cues are limited during take-off or landing.
Somatosensory abilities	Sensory abilities related to body perception, including sensation, proprioception (awareness of body position), and kinaesthesia (awareness of movement).
Spatial disorientation	A condition where the perception of one's position or motion in space is inaccurate or misleading.
Specific phobias	Intense, irrational fears of specific objects or situations.
Spirometry	A lung function test that measures the amount and speed of air that can be inhaled and exhaled.
Status asthmaticus	A severe and life-threatening asthma attack that does not respond to usual treatments.

Term	Definition
Stress	Physical or emotional strain or tension.
Stroke	A sudden disruption of blood flow to the brain, often resulting in neurological impairment.
Structural heart disease	A condition that affects the heart's structure, such as a heart valve problem or congenital heart defect.
Substance misuse disorders	Disorders related to the problematic use of substances, including alcohol and drugs.
Subtle incapacitation	Affecting performance without obvious signs or symptoms.
Supraventricular tachycardia (SVT)	A heart condition featuring episodes of an abnormally fast heart rate.
Suicidality	The presence of thoughts, plans, or behaviours related to self-harm or suicide.
Symptom clusters	Groups of symptoms that occur together and help define specific psychiatric disorders.
Symptomatic	Exhibiting symptoms or signs of a condition.
Syncope	A temporary loss of consciousness due to a lack of oxygen to the brain, also known as fainting.
Syndromes	In the context of psychiatric disorders, these refer to clusters of symptoms that define specific mental health conditions.
Target organ damage	Harm or injury to specific organs or systems in the body.
Time of useful consciousness (TUC)	The period during which operational tasks can be effectively and safely performed after exposure to hypoxia.
Tolerability	The ability to tolerate or endure a treatment or medication.
Transient ischaemic attack (TIA)	Also known as a mini stroke, occurs when there is a temporary disruption of blood flow to a part of the brain. Similar to a stroke, but the symptoms usually last only for a short period, typically a few minutes to a few hours.
Transient loss of consciousness (TLOC)	A sudden and temporary loss of consciousness, which recovers spontaneously.
Traumatic brain injury (TBI)	An alteration in brain function or evidence of other brain pathology caused by an accident (the resulting injury being from an external force/impact to the head).
Type 2 diabetes	A form of diabetes characterised by insulin resistance and high blood sugar levels.
Unequal ventilation	Imbalance in the distribution of air or pressure in the middle ears.
Upper limbs	Refers to the arms and hands.
Upper respiratory tract	The part of the respiratory system that includes the nose, nasal passages, pharynx, and larynx.

Term	Definition
Urinary tract calculi	Kidney stones or calculi that form in the urinary tract.
Urological	Relating to the urinary system.
Urologist	Medical specialist who deals with diseases and conditions of the urinary system.
Valsalva manoeuvre	A technique that involves attempting to exhale while occluding the nose to force air into the eustachian tubes and middle ear cavity.
Valvular heart disease	A condition where the heart valves don't function properly.
Vasovagal syncope	A fainting episode caused by a sudden drop in heart rate and blood pressure.
Ventricular assist devices	Medical devices that help support the function of the heart.
Ventricular ectopics	Extra heartbeats that originate in the lower chambers of the heart.
Ventricular tachycardia	A type of abnormal fast heart rhythm, or arrhythmia.
Vertigo	A form of dizziness characterised by a spinning or rotational sensation.
Vibration	Shaking or oscillating movement.
Visual acuity standards	Established criteria or requirements for visual acuity based on the medical category and type of flying involved.
Visual acuity	The sharpness or clarity of vision, typically measured using a Snellen chart.
Visual cues	Visual information or signals used to guide and orient oneself in the environment.
Visual fields	The entire area that can be seen when the eyes are focused on a central point, including the peripheral vision.
Visual fixation	The act of focusing the eyes on a specific point.
Visual system	The anatomical and physiological structures involved in vision.