

Age Limitations

Commercial Air Transport Pilots



Conclusions and Recommendations

Ries Simons, Alwin van Drongelen, Alfred Roelen, René Maire, Pierre Valk

Disclosure Information

Ries Simons, M.D.

I have no financial relationships to disclose.

Age-dependent causes of sudden incapacitation:

- Sudden Death
 - Acute Coronary Syndrome
 - Cardiac Arrhythmias
 - Pulmonary Embolism
 - TIA and Stroke
 - Syncope
 - Late onset Seizure(s)
 - Acute Psychosis
- Cardiovascular Risk Assessment
-
- The diagram shows a list of eight causes of sudden incapacitation. A large right-facing curly bracket groups the first five items: Sudden Death, Acute Coronary Syndrome, Cardiac Arrhythmias, Pulmonary Embolism, and TIA and Stroke. To the right of this bracket, the text 'Cardiovascular Risk Assessment' is written in a dark blue font.

Syncope

Significant increase >70 yrs

Most frequent cause:

1. vasovagal / neuro-cardiogenic
2. cardiogenic
3. orthostatic
4. neurologic
5. psychologic/psychiatric

Late onset Seizures

Older adults: acute stroke cause of seizures in 50% of cases

[Brodie et al., 2009]

Epileptic seizures: regarded as marker of subclinical cerebrovascular disease [Brigo et al., 2014]

Other cause: brain tumor/metastase(s)

- Brain MRI not recommended for screening of asymptomatic individuals [Komotar et al., 2008; Kagami et al., 2009]

Acute Psychosis

No significant evidence for increasing risk of depressive disorder or suicide risk with increasing age [WHO, 2017; ISD Scotland, 2012; Scowcroft, 2017]

Non-affective psychoses of the elderly: rare but an increase appears in non-affective psychoses and degenerative brain processes in people >60 years [Van Os et al., 1995; Brugha et al., 2005]

Evidence for connection between degenerative brain processes and onset of non-affective psychosis in the elderly [van Os et al., 1995]

Medical History and Psychiatric Consultation

Age-related causes of impaired functioning:

- Sensory Impairments (Vision, Hearing)
- Cognitive Impairment
- Limitation of Coping capacity:
 - Long and/or irregular working hours, overtime work
 - Fatigue

Vision – Increasing Age

- Presbyopia
- Cataract
- Decline in contrast sensitivity (medium & high spatial freq.)
- Impaired visual performance as light levels decrease
- Impaired adaptation to darkness
- Generalized reduction in colour vision
(significant \geq age 70 yrs [Wuerger, 2013])



Vision - Age

Recommendation CAT pilots ≥ 60 years :

- ✓ Periodical Ophthalmological Examination by specialist
- ✓ + Contrast Sensitivity testing
- ✓ + Dynamic visual acuity tests using different levels of luminance

Hearing - Age

Prevalence of hearing loss by age [US; Yamasoba et al., 2013] :

40-49 yrs: 3%

50-59 yrs: 9%

60-69 yrs: 22%

70-79 yrs: 50%



Gradual decline in ability to hear high tones (12 kHz) at first, and later lower tones (1, 2 and 4 kHz)

Hearing - Age

Recommendation CAT pilots ≥ 60 years :

- ✓ Periodical Audiometry
- ✓ In borderline cases: test dynamic function of hearing in the performance of a range of flight tasks

Cognitive Decline: Neuropsychological tests?

Have diagnostic value in patients with mental health symptoms or suspected history (to be identified by the AME).

Have never been developed as a 'pass' / 'fail' instrument for screening individuals for highly skilled jobs.

Meaningful interpretation of results in asymptomatic individuals is difficult due to lack of validated cut-off points that predict safe (flying) performance.

Cognitive Decline and Flight Performance

Low predictive validity of laboratory cognitive measures to flight performance [e.g., Damos, 1996]

Standard cognitive tests are insufficient to capture the complexity and dynamism of the cognitive skills involved in flying an aircraft [Hardy & Parasuraman, 1997].

Evaluation of pilot's cognitive functioning

Use information about pilot's occupational history, functioning in the event of incidents/accidents and functioning during simulator sessions, proficiency checks and training courses.

When there is evidence for structural deterioration of functioning, the AME should refer the pilot for neurological or neuropsychological examination.

Screening on Cognitive Decline - Recommendations

Currently: use simulator checks, line checks, and peer review to detect below standard performance.

+ Consider recent flight hours [Li et al. 2001 and 2003]

Initiate research aimed at incorporating assessment of essential cognitive factors of flight performance in the regular proficiency checks (LPC/OPC). Focus on abilities to function under highly stressful demands, such as high time pressure.

Long and/or irregular working hours, overtime work

Long working hours (≥ 55 hours per week) or frequent overtime work (3-4 hours overtime) is associated with increased risks of fatal and non-fatal coronary heart disease, stroke, and atrial fibrillation

[Virtanen et al., 2010; Kivimäki et al., 2015; Kivimäki et al., 2017]

Irregular working hours (shift work) is associated with myocardial infarction (RR 1.23), all coronary events (RR 1.24), and ischaemic stroke (RR 1.05). [Vyas et al. 2012]

Fatigue - Age

Older employees tend to need more time to recover from long and irregular working hours [Saksvik et al., 2011].

Commercial pilots: risk of chronic fatigue increases with age [van Drongelen et al., 2016].

Should operation time of 60+ CAT pilots be limited to 40 hrs/week and duty time to 10 hrs/24 hrs ?

[Virtanen et al., 2018].



Task 1: Age-dependent causes of sudden incapacitation:

- Sudden Death
- Acute Coronary Syndrome
- Cardiac Arrhythmias
- Pulmonary Embolism
- TIA and Stroke
- Syncope
- Late-onset Seizure(s)
- Acute Psychosis

Task 2: Risk Assessment Based on Operations Considerations

Single pilot: risk of the 55-64 age group is at the margin of the acceptability limit for catastrophic system failures for single piloted CS23 aircraft with a single reciprocating engine and a seating capacity for 0-6 pax.

Multi-pilot: pilots older than 65 years in multi pilot CAT operations would require additional risk-mitigation measures

Task 3: Screening of Cardiovascular Risks in Asymptomatic Pilots

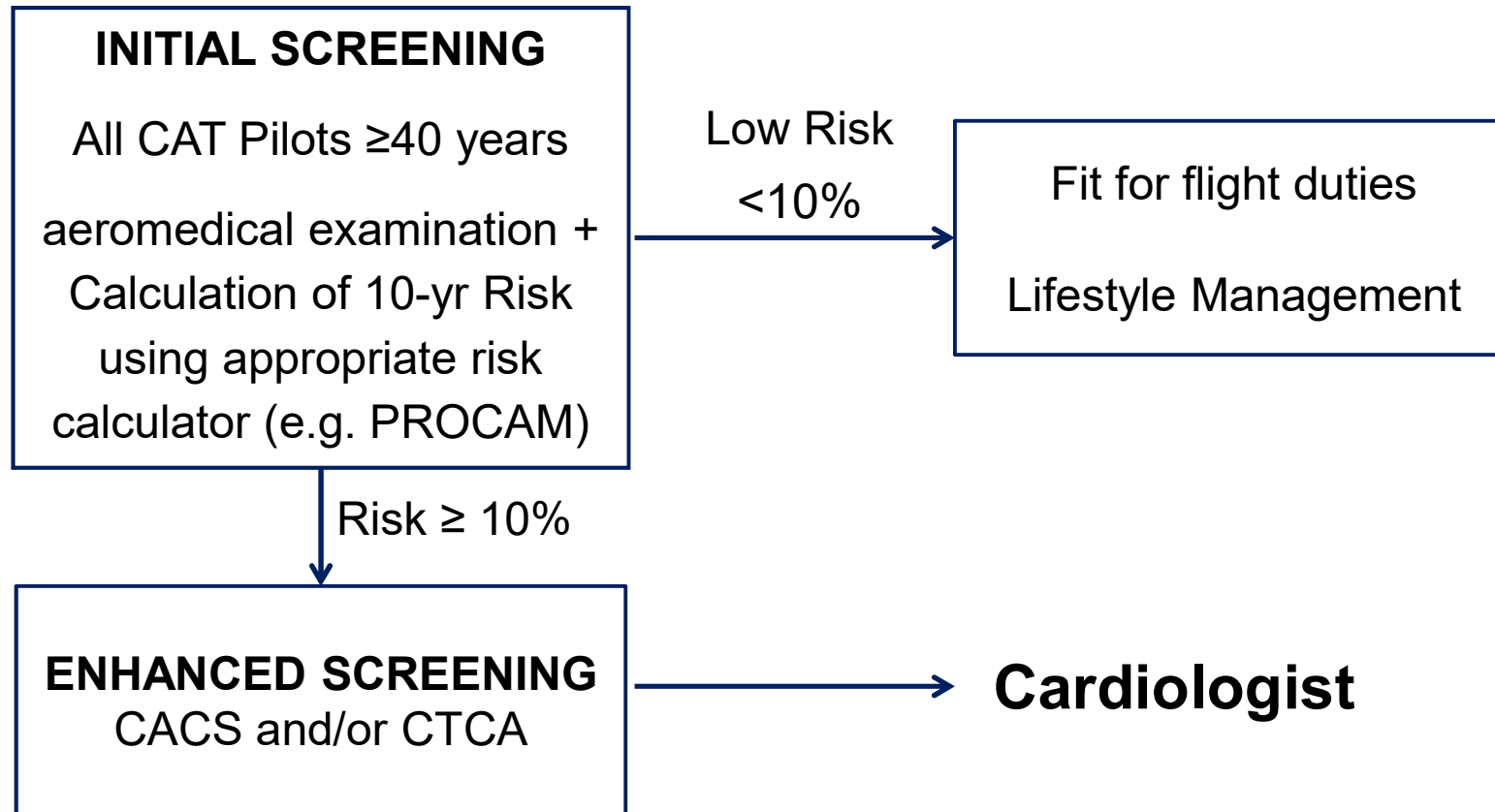
Screen all aircrew over the age of 40 years on cardiovascular risk using a resting ECG and a risk estimator providing a 10-yr risk of non-fatal and fatal cardiovascular events.

Risk level $\geq 10\%$: further cardiological risk assessment using enhanced methods, such as Coronary Calcium Scanning (CACS) and/or CTCA. Refer to Cardiologist.

Aircrew with a CACS > 100 , CTCA-single stenosis $> 50\%$, CTCA-aggregate stenoses $> 120\%$, or Left Main (LM) $> 30\%$ stenosis should be grounded pending further investigations.

Conclusions - Prevention

- Periodically screen all aircrew ≥ 40 years on cardiovascular risk using resting ECG, risk estimators ('calculators'), and enhanced screening methods.



Cardiologist

ENHANCED SCREENING CACS and/or CTCA

LOW RISK:

CACS <100 or CTCA-single
or aggregate stenoses <50%
good functional capacity

HIGH RISK:

CACS >100 or CTCA-single
stenosis >50% or CTCA-
aggregate stenoses >120% or Left
Main (LM) >30% stenosis

Fit for flight duties
Aggressive risk
factor modification
for all those with
CACS>0

Cardiological
+ aeromedical
advice:
Fit or Unfit +
preventive
treatment

SECOND LINE INVESTIGATIONS:

Anatomic Imaging: CTCA or ICA;
Functional Imaging: SPECT, PET,
CMR, Stress -Echocardiography

Conclusions – Single Pilot OPS

Recommendation: extend age limit of CAT pilots flying single pilot operations from 60 years to the pilot's 65th birthday.

Extension of the age limit for single pilot operations should be accompanied by additional measures to reduce the likelihood of pilot incapacitation to meet current operational accident acceptability values.

Timing of routine examination	Complete general aeromedical examination	12-lead ECG	Blood lipids & blood sugar	Cardiovascular risk estimation	Specialist ophthalmological examination	Audiometry	Spirometry	LPC or OPC
Age								
60	✓	✓	✓	✓	✓	✓	✓	✓
60.5	✓							✓
61	✓	✓	✓	✓				✓
61.5	✓							✓
62	✓	✓	✓	✓	✓	✓		✓
62.5	✓							✓
63	✓	✓	✓	✓				✓
63.5	✓							✓
64	✓	✓	✓	✓	✓	✓		✓
64.5	✓							✓
65	Class 1 medical certificate expires							

Recommendation – Single & Multi Pilot CAT OPS

The recommended systematic cardiovascular risk assessment should be evaluated on efficacy and cost-effectiveness.

NAAAs should collect the data of all individual scores of the initial cardiovascular risk estimation and the consequences of the score as well as the outcome of enhanced screening.

Evaluation Data – Single & Multi Pilot CAT OPS



1. how many individuals have risk score $\geq 10\%$?
2. how many of those are diagnosed with coronary artery disease?
3. how many with risk score $< 10\%$ turned out to have CAD?

Conclusions – Multi Pilot OPS

Recommendation: keep the age limit at 65 years as it is currently set by EASA (FCL.065; EASA, 2016).

Use the same additional measures as for single pilots to reduce the likelihood of pilot incapacitation.

Keep age limit multi crew OPS: 65 years – WHY?

1. It is prudent to start with the new cardiovascular risk assessment procedure and consider further extension of the age limit after having collected sufficient data that confirm the efficacy and cost-effectiveness of the assessment procedure in pilots up to 65 years of age.

WHY?

2. Increase of individual variation in physical fitness and cognitive functioning is assumed to become significant after 65-70th year [Hänninen et al., 2002; EURODEM].
- Above 65 yrs: More pilots at risk for physical (cardiovascular) and mental ailments while medical examination will only detect a proportion of serious conditions.
 - Likelihood of missing a high risk case is considered to increase above 65 years of age. [Evans, 2011]

WHY?

3. There are currently no relevant and sensitive tests available to identify subtle impairments in cognitive functioning of asymptomatic pilots that are associated with flight safety.

WHY?

4. The age of 65 is socially accepted retirement age, which provides a pilot an acceptable reason to stop when he/she is still proficient.

It may become a personal tragedy for a pilot to be forced to stop because of impaired cognitive performance or failure(s).

Fixed retirement age: opportunity to anticipate concerning pension scheme and new life design

Scarcity of NAA data of medical evaluations of CAT pilots:

- inaccessible databases
- data extraction too laborious



Proper accessibility of the NAA databases is a pre-requisite for evaluating the effectiveness of medical risk assessment procedures.



Evaluation is essential for future considerations concerning raising or abolishing age limits for CAT pilots

Future Directions - Recommendation

NAAAs should be enabled to register all data concerning medical evaluations of CAT pilots in an easily accessible format in order to assess trends in age-dependent medical conditions and to evaluate the effects of medical flight crew licensing requirements.

An inventory should be made of existing systems and/or methods, with special reference to accessibility and user-friendliness.



Lack of data concerning age, medical cause of incapacitation and level of incapacitation.

Conclusions – Accident and Incident Reporting System

ECCAIRS data: Currently unsuitable for estimation of in-flight incapacitation probabilities as a function of pilot age

Recommendation

Optimize registration of in-flight incapacitation occurrences

Future Directions - Recommendation

- The systematic cardiovascular risk assessment should be evaluated on efficacy and cost-effectiveness:
National Authorities should collect data of:
 - all individual cardiovascular risk scores
 - consequences of the score (actions taken)
 - outcome of enhanced screening

Future Directions – Follow-up system Pilot's Health ?

Very limited possibilities for medical follow-up of pilots who have stopped flying due to health problems or death.

- Follow-up hindered by national legislation.
- NAA / AeMC often not informed about medical reasons to stop flying or death and cause of death.

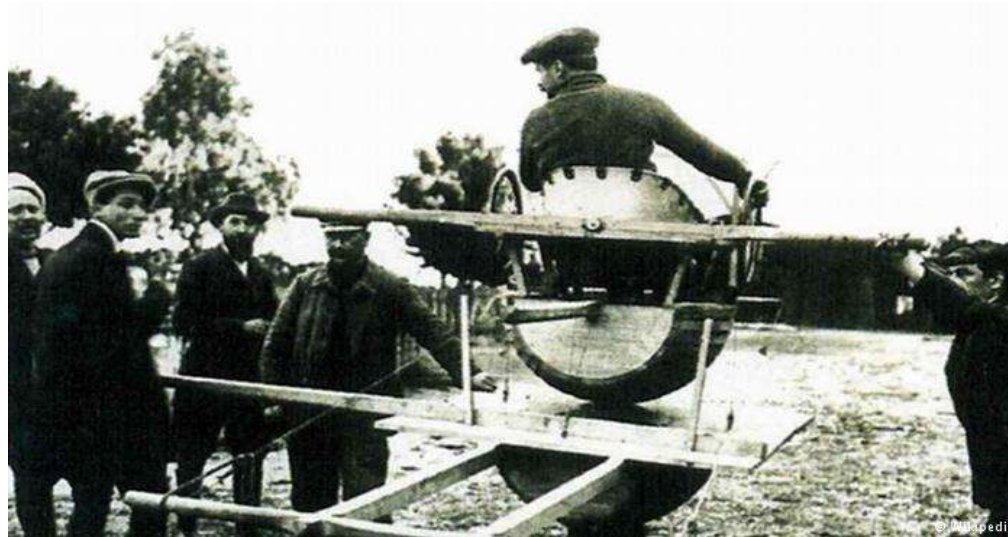
Make inventory of opportunities, limitations and methods to collect these data

Future Directions - Recommendations

Start already with a follow-up study aimed at assessing the risk factors and incidence of incapacitating events:

e.g. monitor pilots currently aged 63-65 during longer period, also covering a post-retirement period.

Future Directions - Recommendation



Recommendation: sensitive dedicated simulator checks and/or cognitive tests should be developed to enable proper evaluation of relevant individual cognitive and mental abilities

Future Directions – Simulator Checks

Research should be aimed at incorporating assessment of essential cognitive factors of flight performance in the mandatory License Proficiency Checks or Operator Proficiency Checks.

Focus on abilities to function under highly stressful demands, such as high time pressure.



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