

THE PROCESS OF DETERMINING FITNESS TO FLY AEROPLANES IN NEW ZEALAND: A REVIEW OF CURRENT PRACTICE AND RECOMMENDED CHANGES.

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Summary.

Concern about the quality of the assessment of pilots' and pilot candidates' medical fitness to fly aeroplanes in New Zealand stimulated an independent review of the process. Further audit showed that the standard of practice was variable, that some medical practitioners undertaking such assessments did not meet the initial CAA criteria to do so, and that some of the medical practitioners involved had an unacceptably high clerical, procedural and clinical error rate. The process was also found to be at variance with international best practice, to largely ignore the assessment of those human factors usually responsible for aviation incidents, and to have been inadequately audited. To a large extent, the current system is the result of excessive de-centralisation with private funder capture of the process and inadequate Civil Aviation Authority medical resources.

A revised system is recommended that adopts best international practice and is as similar as feasible with that operated in Australia. This also incorporates the Transport Canada Aviation Medical Review Board system. Given that the mean age of pilots is increasing internationally (and which will cause a change in disease prevalence and competency issues) and that the science of pilot health surveillance is evolving rapidly, any new system must be able to accommodate reform, which is likely to be significant.

Executive Summary.

Introduction

1. This review concerns the medical fitness of pilots and pilot candidates (cited collectively henceforth as pilots) to fly aeroplanes in New Zealand. The Civil Aviation Authority (CAA) commissioned our review in the light of concerns raised in many quarters and because audits by the CAA of the medical examination of some pilots revealed clerical, procedural and clinical error rates at unacceptably high levels. The statutory purpose of the CAA is to protect public safety in aviation at reasonable cost; protecting the public by reducing the potential for air accidents caused by medically unfit personnel is the prime principle that has driven this review.

Defective System

2. The fundamental finding of our review is that the current system for the medical assessment of pilots is defective. Public safety and the international credibility of New Zealand's licensing procedures require urgent remedial action. There needs to be both legislative and administrative changes.

3. To a large extent, the problems with the current system are a result of excessive de-centralisation. The CAA has inadequate powers to exercise an effective regulatory function in respect to medical assessment of pilots. The CAA also suffers from inadequate medical resources.

4. The existing process for medical assessment is at marked variance with international best practice, as examined in this review. Further, the existing system has been inadequately audited in the past and this needs to be rectified.

5. The standard of medical certification practice is variable. Some medical practitioners who undertake medical assessments of pilots were originally admitted to the system despite not meeting the CAA's initial criteria. Some of the medical practitioners involved have an unacceptably high clerical, procedural and clinical error rate.

6. The legal regime established in New Zealand lacks adequate detail and procedures for proper clinical aviation principles to underpin the existing licensing system. There are legal gaps here that need to be filled.

7. The process of medical certification in New Zealand is almost completely decentralised. Private medical practitioners are appointed by the Director of Civil Aviation to examine and assess applicants and to issue medical certificates. There are two categories of certifying doctor in the system – Designated Medical Examiners (DMEs) and Aviation Medical Assessors (AMAs).

8. The AMAs are authorised to issue any class of CAA medical certificate within specific limits following a routine medical examination. They are also permitted to exercise some flexibility in the issue of a medical certificate where the applicant fails to meet the medical standards, but where flight safety will not be jeopardised

under the existing system. Too much authority has been delegated to AMAs. The CAA cannot exercise adequate independent regulatory control, which is required if public safety is to be assured.

No Findings on Individuals

9. Our review was in the nature of a preliminary general inquiry. We have made no findings in respect of the conduct of individual medical practitioners or their individual performance. There is no adverse finding here about any person. Instead, our findings relate to the licensing system, which we find to be dangerously defective.

10. We do recommend, however, when the Government has considered the policy contained in our report and decisions have been taken, that the CAA conduct a specific investigation of individual performance by a properly qualified panel in order to make decisions about the retention of those medical practitioners who are presently engaged in the system. The nature of our review did not allow any such findings to be made. Such an inquiry will need to be conscious of the need for procedural fairness, and establish a properly structured process to ensure that individuals' rights to natural justice are respected.

11. Despite the many claims to the contrary, we could find no evidence of generic current poor practice by the CAA in the context of our terms of reference, and in particular with respect to the performance of the CAA Principal Medical Officer (PMO). Indeed, the opposite is the case and we are happy to endorse her professional and personal conduct.

International Systems

12. The civil aviation regulatory system in New Zealand must take into account the system in Australia because of the Trans-Tasman Mutual Recognition Agreement (TTMRA) that allows pilots certified in one country to fly in the other.

13. In Australia, the process of certification is centralised in that the Director of Aviation Medicine issues medical certificates for all classes of pilot. All medical examination forms and questionnaires are forwarded to the Office of Aviation Medicine in the Authority. They are processed automatically in a captured electronic image of the assessment form and any related documents are stored as part of the applicant's medical history.

14. In North America, the Federal Air Surgeon provides medical certification services to pilots and air traffic controllers principally through the Aeromedical Certification Division of the Civil Aeromedical Institute. The Institute is assisted by 9 regional aviation medical divisions, each managed by a regional flight surgeon. The system is controlled by detailed legal requirements.

15. Transport Canada operates a similar system to the Federal Aviation Authority in the United States. Both North American systems are clearly experiential, categorical and hierarchical. The integrity of both systems is maintained by

selection of medical examiners, an enforced requirement for initial and ongoing training and by consistent auditing and counselling requirements, together with dismissal of examiners as required.

16. In Europe, all 33 member States of the Joint Aviation Authorities have their own regulatory systems, but the Authority was created to work towards common certification requirements. The United Kingdom system is similar to those operating in North America. The system is centralised and experienced aviation medical specialists at head office make decisions about certification. Like the North American system, it is experiential, categorical and hierarchical.

17. The International Civil Aviation Organisation and the international treaties underpinning it are also important, even setting the standards and recommended practices for personnel licensing in aviation.

18. In comparing the national and international systems of assessing pilots' fitness to fly, it is possible to identify international best practice.

Principles of Best Practice and the New Zealand System

19. International best practice is based on the following principles:

The process must be consistent with all relevant legislation and internationally mandated standards. In the New Zealand context, the TTMRA is particularly important.

Any assessment must be based on an understanding of the functional requirements of employment tasks, the identification of relevant and prevalent health conditions and of predictive survey tools. The latter is often best served by questionnaire. In many circumstances, medical examination of the otherwise well is expensive and poorly predictive. Functional factors that are critical in flight safety, such as physical, intellectual and psychological competency to fly aeroplanes should be addressed by functional capacity tests. These tests need to be objective and audited.

Where possible, the outcome should be discretionary on behalf of the primary risk acceptor – the pilot. This encourages veracity. But the New Zealand public and airline operators need to have clear guidelines about conditions that are categorised as acceptable and unacceptable. Thus, any process must be part discretionary and part prescribed. There is a need for medical practitioners involved in examinations to be trained and experienced in both aviation and occupational health surveillance.

The frequency and nature of ongoing surveillance should be dictated by attention to the type and frequency of work practice that is flying. It should also be dictated by the prevalence of the relevant health conditions for age and sex, and by the specific health history of the individual.

The process must be audited at every level, including the collection of data from the pilot.

20. The existing New Zealand system does not meet the principles of international best practice.

21. The strengths of the current CAA system include the following.

Many pilots have developed a relationship with a single medical practitioner and this has led to a trusting relationship and high levels of pilot-practitioner reporting veracity in many cases.

If the medical examiner is an AMA, then the certificate can often be issued immediately. If the examiner is not an AMA, but has a close relationship with an AMA, then a certificate can be issued reasonably quickly without the involvement of the central bureaucracy.

A relatively large number of DMEs is such that a medical examiner is probably available locally for a pilot to consult, and the role of the AMAs is such that a greater pool of community expertise is created than would exist under a centralised system.

22. The weaknesses of the current system include the following.

Many DMEs have neither appropriate training nor experience in aviation and/or occupational health surveillance. For this reason, and to obtain immediate certification, many pilots elect to be examined by an AMA.

Some AMAs were appointed despite failing to meet the initial criteria set for the CAA entry examination, and a small group of medical assessors have no formal training in aviation medicine.

There is no audit of the base clinical data, only the resulting paperwork. But it is important to note that comprehensive paper audits were not conducted in the first 6 years of the decentralised scheme.

The pilots fund the scheme. Thus their interests are often paramount and there has been a consequent discounting of the obligation of the system to other risk acceptors. The end result is such that the process tends to primary pilot advocacy.

A clerical assistant could perform about 75% of the assessments undertaken by the AMAs. In the context of the Australian system, the examination report could be machine-read.

The role and legal status of the CAA's medical certification appeals process is uncertain. This appears to result from excessive deregulation, accompanied by inadequate attention to both the formulation of statutes and the writing of the Rules.

The human factors that are responsible for between 75 and 80% of aviation incidents are generally not addressed by the New Zealand system.

23. In our opinion then, the New Zealand medical certification system is demonstrably and systematically flawed. It is largely inconsistent with international best practice. The poor performance seen in this context is easily predictable from a sociological perspective given the incentives that are set up by the existing system.

What is Required?

24. What is required is a simple hierarchy of designated aviation medical examiners (AMEs), a CAA medical division and a CAA aviation medical panel.

25. We strongly recommend that the system be partly publicly funded to re-establish the pre-eminence of public safety and the legitimacy of Government involvement.

26. We also recommend that the CAA be staffed with at least 3 full-time aviation medical specialists.

27. A key and valued feature of the successful regulatory systems in Europe and North America is their divorce from direct industry influence and this feature is strongly recommended in the New Zealand system.

28. The urgency of the issues flows from the concern for public safety and the health of pilots involved, and also from a forecast international pilot shortage.

The Recommended System

29. The Report describes in detail the system that is recommended to replace the existing system of medical certification.

30. Two systems are recommended – a set of interim changes followed by a permanent definitive format.

31. The recommendations we make can be well illustrated by flow diagrams that are now set out in Figures 1, 2, 3, and 4.

32. An AME would undertake the medical examination of Class 1 pilots every second year to the age of 40 and then annually from the age of 41 to a selected age of compulsory retirement. A retirement age of 65 years for Class 1 pilots is recommended. Class 2 pilots would be examined 5 yearly to age 60, and then annually from age 61. The CAA would be empowered to increase the frequency of examination for any pilot.

33. In all other years, both Class 1 and Class 2 pilots would be initially assessed by questionnaire alone and any physical examination would be determined by the answers given on the questionnaire.

34. An AME would be a registered medical practitioner who has post-graduate training in aviation medicine and in the specific context of fitness to fly health surveillance. AMEs must also satisfy the CAA's requirement for ongoing education. There would be a 3-yearly refresher course and an AME would also need to have access to the necessary equipment; for example, a multi-channel, self-calibrating and reporting ECG that has an output that would be suitable for online transmission to the CAA.

35. A visual examination would be conducted at the same time as the medical examination by a designated aviation optometrist or ophthalmologist or an AME who has successfully completed specific training.

36. There would be a Medical Manual, which would include medical standards, examination and assessment guidelines and administrative procedures. Consent should be obtained as part of the licensing process for access to general practitioner records.

37. There should be a move to machine-readable assessment forms that enable auditing to be much more accurate. Forms should be forwarded to the CAA for assessment and random selection for audit. Some pilots would be randomly selected and recalled for reassessment audit at public cost, that is, they would be interviewed and examined on behalf of the CAA medical division. If this clinical audit has a different categorical outcome such as uncertain fitness *versus* fitness to fly, then the 2 assessments would be forwarded to the CAA aviation medical panel for adjudication.

38. Health problems that are incompatible with flight safety should be defined by the Manual. The list, as it evolves from experience, should be available on the CAA website.

39. Any pilot denied medical certification and fitness to fly would be able to appeal for review to the CAA aviation medical panel.

40. The CAA aviation medical panel would be chaired by an appointee of the Director of the CAA. It would provide advice to both the Director, on specific certifications, and to the CAA's PMO for further clinical audits. The audits might reduce the need for further panels.

41. We recommend that risk thresholds be selected and applied. We do not consider it appropriate for us to recommend the actual level of risk. International best practice should be used to select levels for usage, taking local conditions into account and considering the arguments about differentiation between classes of certification. However, any threshold is a guideline and certification must be on a case-by-case basis. It is also important to recognise that any risk threshold refers to the upper level of tolerable risk and cannot be applied rigidly within the risk band. For example, some conditions for which the risk of incapacitation will not exceed these thresholds will nevertheless be considered incompatible with flight safety.

42. Online assessment systems are possible in New Zealand for FlightFit and are being developing in the United States, Canada and Australia. Once proven, we believe the CAA should purchase the respective system; in part, as this would enable an online, multi-national audit system.

Conclusion

43. We strongly believe that legislation is urgently needed to enable implementation of a revised centralised process of licensing pilots medically fit to fly. We also have made a series of specific recommendations about the implementation of our suggested process.

44. Our overall conclusion is that public safety demands urgent changes to the process of determining medical fitness to fly aeroplanes in New Zealand.

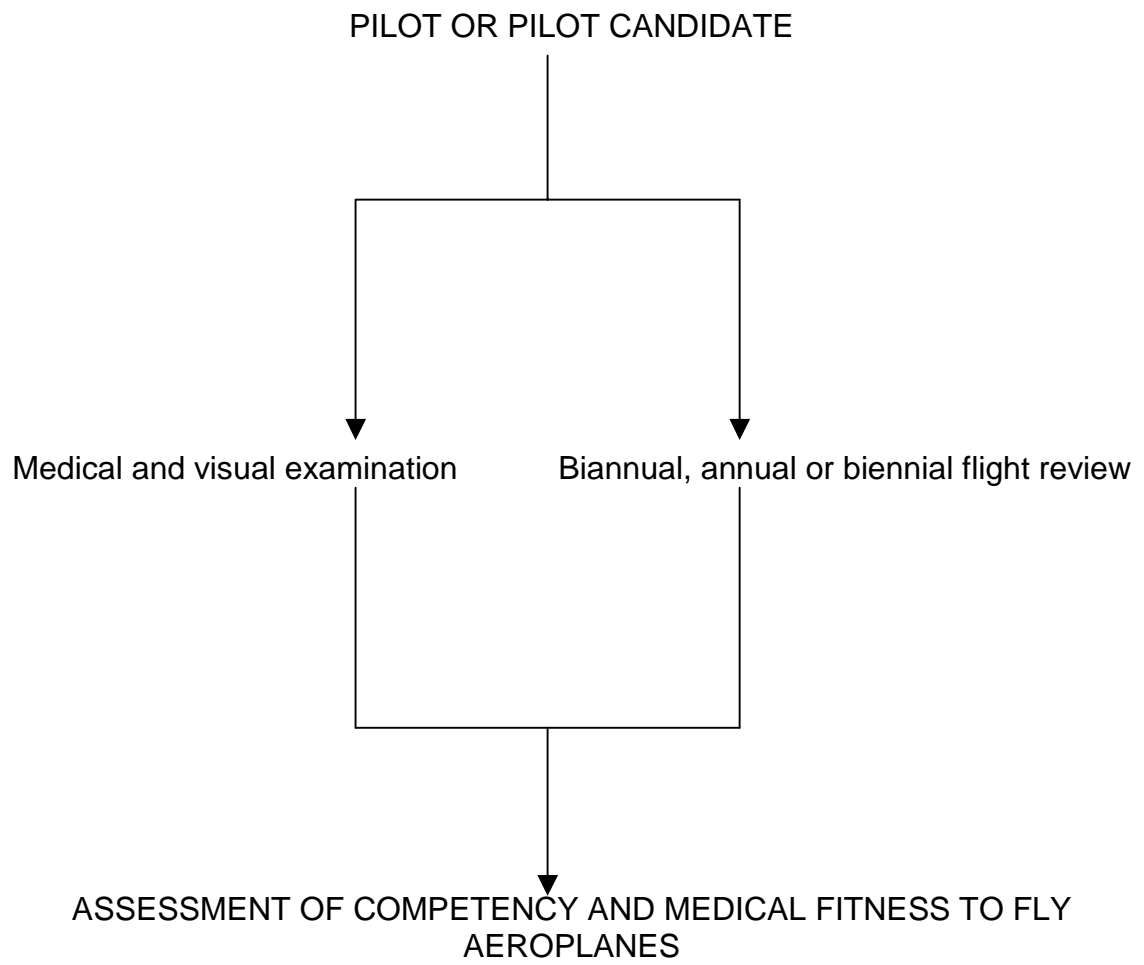


Figure 1

POSSIBLE INTERIM FORMAT

MEDICAL AND VISUAL EXAMINATION

Interview and examination by AME and AO.
Machine-readable CASA assessment form.
Interim certification.



Form forwarded to CAA for assessment and random selection for audit.



No anomalies → Issue definitive certificate.

Incomplete data or minor clerical anomaly → Request completion; reply forwarded to CAA for assessment.

Health problem that is incompatible with flight safety → Deny certificate.
Appeal to CAA Aviation Medical Panel available.

Health problem that is potentially compatible with flight safety



Refer to CAA Medical Division.
Medical Division fitness assessment.



Fitness established → Issue or deny certificate. Appeal to CAA Aviation Medical Panel available.

Fitness uncertain → Refer to CAA Aviation Medical Panel.

Figure 2: Possible Interim Format for Medical Certification System

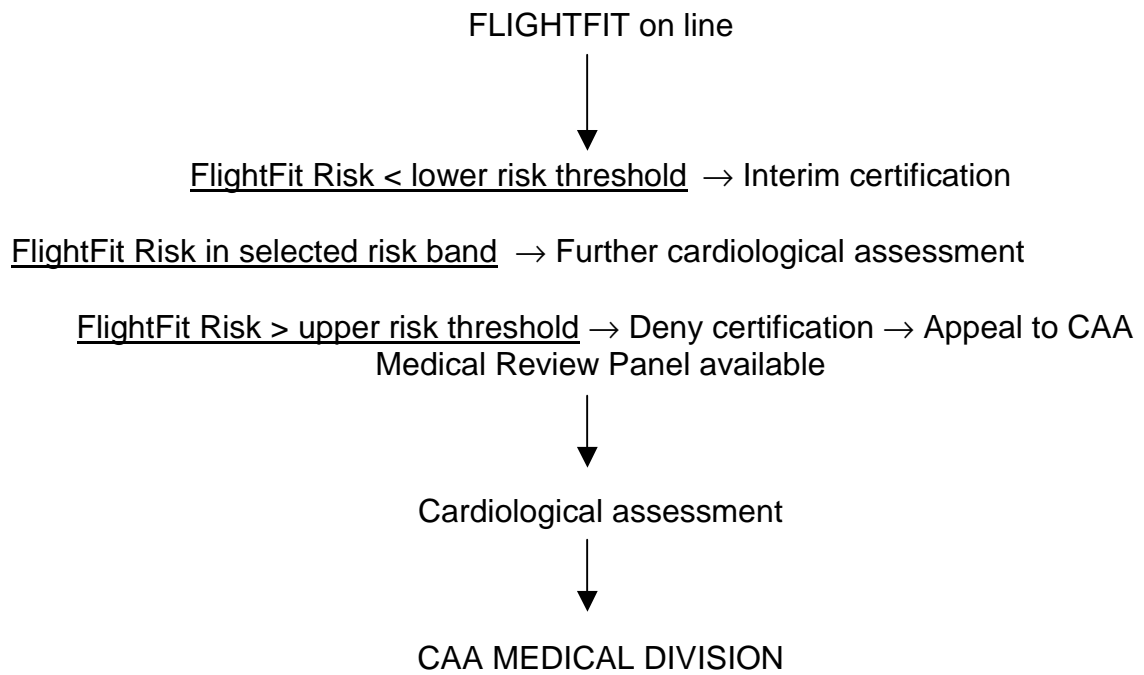


Figure 3

DEFINITIVE FORMAT

MEDICAL AND VISUAL EXAMINATION

Interview and examination by AME and AO.
On-line assessment.
Random selection for audit.



Input forwarded to CAA Computer System for assessment and reply downloaded.



No anomalies → Issue Certificate.

Incomplete data or minor clerical anomaly → Request completion; input forwarded to CAA Computer System for assessment and reply downloaded.

Health problem that is incompatible with flight safety → Deny certificate. Appeal to CAA Aviation Medical Panel available.

Health problem that is potentially compatible with flight safety



Refer to CAA Medical Division.
Medical Division fitness assessment.



Fitness established → Issue or deny definitive certificate. Appeal to CAA Aviation Medical Panel available.

Fitness uncertain → Refer to CAA Aviation Medical Panel.

Figure 4: Definitive format of proposed Medical Certification System

Chapter One. Introduction.

1.1 We undertook a review of the Civil Aviation Authority (CAA) process of determining the medical fitness of pilots and pilot candidates (collectively cited henceforth as pilots) to fly aeroplanes between 29 May 2000 and 02 February 2001. We did not specifically consider air traffic control officers, but much of our report is also relevant to this group. The terms of reference for this review are at Appendix 1. The review was conducted in the following 3 phases.

- a. Written submissions and presentations, which are listed at Appendix 3.
- b. Directed consultations.
- c. Consultations with other international authorities involved in certifying pilots medically fit to fly.

1.2 The second and third phases of the review were greatly facilitated by members of several international regulatory authorities. These members are tabulated at Table 1 (page 17) and we are very grateful for their assistance. We are most grateful to Dr Jeffrey Brock for his guidance in planning our visits to aviation authorities in the UK, Canada and the USA and his perspective on a number of historical and current aspects of problems being faced internationally. In addition, considerable assistance was given by many New Zealanders, especially Doctors Ross Ewing and John Faris.

1.3 The overall aim of the review was to identify a process that prioritised public safety, given the Trans-Tasman Mutual Recognition Agreement (TTMRA), was as similar as feasible with that operating in Australia and that conformed to best international practice in occupational health surveillance.

1.4 This review was “precipitated” by 4 reasonably concurrent events. First, after a delay of about 6 years, critical on-site and file audits of Designated Medical Examiners (DMEs) and Aviation Medical Assessors (AMAs) were conducted by the CAA auditors. The quality outcomes were variable and often poor. Second, a CAA audit of more than 100 selected high risk files originally assessed by the AMA responsible for about one-third of all pilot certifications in New Zealand, showed a clerical, procedural and clinical error rate of about 80%. This led to his public suspension by the CAA. The AMA in question has responded to the CAA’s concerns, and that response is under consideration by the CAA Director. Third, a fatal air accident near Taumaranui suggested deficiencies in the pilot’s behaviour, the CAA and the performance of the DME and AMA involved. Fourth, a district court judge found that the CAA’s “legal” authority with respect to critical aspects of medical certification was very limited.

1.5 Our review was undertaken in often-acrimonious circumstances; this included personal and occasionally very offensive criticism of and threats to CAA personnel and the review team. Despite the many claims to the contrary, we could find no evidence of generic current poor practice by the CAA in the context of our

terms of reference, and in particular with respect to the performance of the CAA Principal Medical Officer (PMO). Indeed, the opposite is the case and we are happy to endorse her professional and personal conduct. It is also noteworthy that CAA personnel were already aware of most of the shortcomings we have found and in many instances had already put corrective strategies in place, such as the revision of the Manual and informing the Ministry of Transport about the legal problems around pilot certification by the CAA.

1.6 Many submissions to us were focused on a perceived conflict between the CAA and pilots, showed little recognition of the importance of public safety in the debate and similarly showed little insight into the probability of random events. This was particularly true for submissions about the so-called “1% Rule”, many of which were apparently based on a misunderstanding of the difference between health surveillance and health promotion and which cited confidence interval data that do not exist. It was also noteworthy that the human factors that are responsible for between 75 and 80% of air transport crashes were seldom mentioned. Finally, a very common submission was that the current situation was “not broken” and consequently “did not need to be fixed”. This claim is inconsistent with the findings of this review.

1.7 Unfortunately, the behaviour described above is predictable from an sociological perspective and specifically from a model of guild behaviour (which is discussed in some detail below). Nowhere in medicine for example is the shift to external and transparent audit being welcomed, despite its inevitability. It also needs to be noted that while many pilot-medical practitioner interactions could be viewed as collusive and or even corrupt, this was not generic and most DMEs and AMAs practise soundly and ethically.

1.8 A model of guild behaviour in the context of the medical profession

The concepts of professions dates to the establishment of the late medieval guilds. Concepts of the rights, educational duties and civic responsibilities of professional bodies evolved rapidly in the later part of the 20th century. Sir John Marshall was head of a committee that considered the registration and discipline of teachers and produced the so-called “Marshall Report,” which was published by the Department of Education in 1978. That report states the following.

...in identifying a profession, three distinct standards emerge which differentiate professions from other occupations: first, the acquiring of specialised knowledge by study, training and practice, and the recognition of this qualification by degree, diploma or membership of a professional body; second, the maintaining of high standards of achievement and conduct from the practicing of the profession, enforced by disciplinary provision; and, third, accepting that, while a person practices a profession in order to earn a living, this consideration should take second place to serving the interest of the client, who needs and seeks the guidance, instruction or assistance which the professionally trained person is qualified to give.

In the present context, the client is composite; that is, the aspiring or practising pilot, the CAA, and both the public who seek to travel or indulge in recreation involving aircraft and those on the ground.

The evolution of the guild situation was reviewed in the Journal of the New Zealand Diabetic Association of October 1980 (Scott P.J. – address to the Norman Peryer Workshop, New Zealand Nurses' Association, Massey University, Palmerston North, November 1979). That lecture and consequent article drew attention to the developing deficiency in classical definitions of professions and warned about the problems ahead. It stated the following.

...the classical professions need not retreat into defensive positions as is their habit, in the face of external criticism, or in response to criticism from within their own ranks. Rather, the professions need to re-define and re-affirm those principles which remain valid for today's society.

Much of the material submitted to us by individual pilots, pilot organisations, and doctors, both collectively and individually, who were involved in the licensing process, was highly defensive and, in our opinion, took the form of an outmoded response to a public insistence upon surveillance from outside of the ranks of the professionals themselves. Such a reaction is not unusual and certainly is not limited to either pilots or medical practitioners. Indeed, when threatened with any form of outside surveillance, guilds in times past and professional groups over the last 150 years have practised militant patch protection and stoutly resisted those moves aimed at auditing their activities. Despite these reactions, a series of events in England, New Zealand and elsewhere, have hardened political, legal and public attitude against the traditional independence of professional groups. Part of the problem we are describing here has resulted from the speed of that attitudinal change.

Table 1

Civil Aviation Authority (United Kingdom)

Dr Simon Janvrin	Chief Medical Officer
Dr Anthony Evans	Deputy Chief Medical Officer

Civil Aviation Safety Authority (Australia)

Mr Richard Yates	Assistant Director, Aviation Safety Standards
Mr Bill McIntyre	Branch Head, Operational and Flight Crew Licensing
Mr John Gratton	Manager, International Relations
Dr Peter Wilkins	Director of Aviation Medicine
Dr Jeff Brock	Ex-Director of Aviation Medicine

Federal Aviation Administration (USA)

Dr Jon Jordan	Federal Air Surgeon
Dr Frederick Tilton	Deputy Federal Air Surgeon
Dr Robert Poole	Manager, Medical Specialities Division
Mr Dennis MacEachen	Manager, Aeromedical Standards

Transport Canada

Mr Art LaFlamme	Director General Civil Aviation
Dr Hugh O'Neil	Director, Civil Aviation Medicine Branch
Dr James Wallace	Senior Consultant, Operations, Policy & Standards, Civil Aviation Medicine Branch
Dr George Takahashi	Aviation Medicine Consultant, AMRB Member
Dr Guy Savoie	Senior Consultant, Clinical Assessment, Civil Aviation Medicine Branch

Chapter Two. The assessment of pilots' medical fitness to fly in New Zealand.

2.1 The history of the current system of medical certification of pilots in New Zealand

The current system of medical certification involving AMAs has been in place since February 1994, but the origins of this system predate by several years the Swedavia-MacGregor Report (April 1988), which led to the formation of the CAA. It is clear, however, that the "self regulatory" philosophy of the Report was highly influential in the subsequent reforms.

The system prior to 1994. Before February 1994, all medical assessments for pilot and air traffic control licensing were undertaken directly by the CAA (prior to 1 July 1992, this was a responsibility of the Civil Aviation Division (CAD) of the Ministry of Transport). The old process was as follows.

- Pilots were examined by a Designated Medical Examiner (DME), whose role was very similar to that in the current system. Prior to 1994, the CAA employed all medical assessors, so that DMEs forwarded all reports to the CAA Medical Unit.
- The CAA employed part-time medical assessors who assessed the "routine" medicals, plus a Senior Medical Officer who assessed the "special" medicals and consulted with the PMO as required. Other specialist medical input was obtained when required. In 1992, there were 3 routine assessors, each of whom worked 2 days per week.

Changes to pilot licensing and the structure of civil aviation impacted administratively on medical certification in the 1980s and 1990s, but these modifications did not immediately affect the basic process or the division of roles between the DMEs appointed by the CAA and the assessors who were directly employed by the Authority.

The most significant of these changes were as follows.

- The CAD regional offices were disestablished in late 1988, with the result that all medical assessments were then undertaken at head office, rather than in Auckland, Wellington and Christchurch.
- The CAA was established and lifetime licences were introduced, both in 1992.

The introduction of AMA's. The proposal to introduce AMAs (or super-DMEs as they were first referred to) appears to have arisen in the mid-1980s and was linked to the development of a post-graduate diploma in aviation medicine at the University of Otago, which was introduced in 1987. The then PMO resigned to direct the Otago program.

This linkage was described by the Swedavia-McGregor Report (1988) as follows.

Taking advantage of this development [the establishment of the Otago aviation medicine course], it has been proposed that designated medical examiners (DMEs) who complete the diploma (call them super DMEs) be awarded a higher status and be made responsible for checking professional pilots. Regional medical officers (RMOs) could then be dispensed with as an intermediate step between the DME and the principal medical officer (PMO).

However, the report did not recommend a system where there was either a compulsion for a pilot to be assessed by a super-DME or a complete decentralisation.

Well equipped, and with the requisite computer-screening aids, there is no reason why the PMO's office cannot deal with aspects of medical checks currently handled by RMOs.

In any event, RMOs were replaced with Central Medical Officers (CMOs) and regional offices were abolished later the same year; planning continued to introduce super-DMEs. Drafting of a new Civil Aviation Rule (Part 67) to establish a revised system began. A technical study group (TSG) was formed to undertake the drafting and the former PMO, now at the University of Otago, was engaged by the CAA to chair the group. Comment on the draft was sought from industry in October 1991 and Rule Part 67 was issued in October 1992.

With the Rule in place, it was intended to introduce the new system when graduates of the Otago course were available in sufficient numbers. Although it was hoped to introduce the new system in mid-1992, in part due to the Otago course being essentially pursued part time over 4 years, the first AMAs were not appointed until February 1994.

It was also envisaged that there would be two levels of AMAs: class 1, who would hold a diploma in aviation medicine from Otago or a British equivalent and who would issue medical certificates for all classes of licence; and, class 2, who would hold a lesser aviation qualification and only issue certificates for private (class 2) pilots. The latter was never introduced, apparently because the necessary "programmed-learning package" was not developed.

A letter from the Acting General Manager of the Air Transport Division of the Ministry of Transport to the Royal New Zealand Aero Club in October 1991 makes it clear that AMAs would be able to do examinations and assessments at the same time and issue medical certificates. This aspect, which did carry into the new system, was seen as a key benefit.

The result [of the changes] is a system that is considerably quicker and cheaper than the present licensing medical assessment system, and [the] cost of obtaining and renewing a licence medical validity certificate will be significantly lower.

During 1993, applications for appointment as an AMA-1 were invited from established DMEs who had completed the University of Otago Diploma of Aviation Medicine. The pre-requisites for appointment were as follows.

- Diploma of Aviation Medicine from Otago University, or similar overseas qualification.
- At least one year's experience as a DME.
- A pass in the procedural examination set by the PMO.
- Membership of the Aviation Medicine Society of Australia and New Zealand (AMSANZ). This requirement was set just prior to the appointment of the first AMAs in February 1994.

The AMA examination process. The AMA procedural examination process warrants particular attention because it suggests that the current system was largely compromised from the outset.

The procedural examination was a multi-choice open book exam completed over several weeks. Candidates were advised to use the Medical Manual to assist in answering the questions correctly. The examinations are not currently in use, but in the period from late 1993 to 1997, were essentially CAA examinations, superintended by the PMO. The initial exam was set late in 1993, but the examination paper was amended after the first 9 candidates had been marked because certain questions were thought to be “unnecessarily difficult.” Replacement questions were provided and the PMO wrote to candidates on 09 February 1994, as follows.

I am still awaiting the return of your exam paper, so thought I'd write with some updated information.

1. IMPORTANT, IF YOU ARE ABOUT TO COMPLETE THE EXAM; As a result of the initial replies, we have found certain questions were unnecessarily difficult. Although the pass rate has not been affected, this has caused an undue need to explain.

I therefore enclose some amendments for latecomers. This will simplify the process of marking and then appointing this batch. If by any chance you have already completed the earlier exam paper, do not despair. The pass rate from that version was 8 out of 9 candidates. But if there are any problems, we can discuss these after you are notified of your result.

A pass mark of 90% was contemplated, but this was reduced to 85% before the first examination. Nevertheless, some candidates were passed who did not reach 85% and some candidates only achieved passes after some wrong answers were “adjusted” and awarded full or half marks.

In subsequent examinations, the options under each multiple-choice question were reduced from 5 to 4 and the pass mark was reduced to 80% from February 1995. Some candidates still failed to pass at this lower standard however, and “adjustments” continued to be made by those marking the papers. From what we

can see, the “adjustments” were not consistent, with the same multiple-choice answer sometimes resulting in different marks, depending on the candidate.

In summary then, while many of the AMAs achieved the standards set, other “passes” were only achieved by a combination of “adjustments” (awarding marks for wrong answers) and or passing candidates whose results were below, but close to the pass mark.

The “1% Rule” in New Zealand. An annual risk of 1% for any sudden incapacitating event (such as heart attack, stroke or epileptic fit) is the boundary set by the CAA between acceptability and unacceptability in a pilot or air traffic controller. The origins and logic of the Rule are described below. The “1% Rule” was first formally discussed by the CAA and aviation medicine specialists in 1995, when the then CAA Medical Manual was being revised and updated. The Rule was finally adopted by CAA in the 1997 edition of the Medical Manual and initially operated with the support of aviation medicine specialists and largely without controversy.

In the past 18 months however, the Rule has become the source of significant controversy within the industry and many pilots have called for it to be abolished or relaxed in various ways. Opponents of the Rule attack it as discriminating against older pilots and dispute the validity of the underlying data and the way this is applied to the pilot population. The Rule is also incorrectly perceived to be a recent invention and is linked to the current PMO. From our investigations, it is clear that the “1% Rule” was introduced during the tenure of the previous PMO and that during his tenure the CAA essentially applied the Rule rigorously. However, and in contrast, the application of the Rule by the AMAs has been and is very inconsistent. It is also probable that the AMAs’ use of the Rule has been strongly influenced by market forces in the form of pilot selection of assessors.

FlightFit. FlightFit is a recently developed computer program, which is designed to help AMAs assess a pilot’s (or class 3 certificate holder’s) risk of sudden incapacitation due to heart attack, serious angina or stroke. Use of FlightFit is not compulsory, but unlike alternative methods (the National Heart Foundation tables and the Australian Civil Aviation Safety Authority – CASA - tables), only assesses risks that are thought to be directly related to flight safety. The CAA reasonably believes it is more accurate, as well as being easier to use; compared to the CASA tables, FlightFit is also less punitive occupationally.

In recent months, the use of FlightFit has also become very controversial, apparently because many see it as inextricably linked to the “1% Rule”. In fact, the 1% CAA threshold predates FlightFit and, as far as we can determine, applies regardless of the assessment tool used.

The suspension of an AMA. In May 2000, the CAA suspended an AMA following an audit of AMAs (see below). In the course of an audit, the CAA found errors in assessments undertaken by the AMA who, at the time, undertook about one third of the medical assessments in New Zealand. In the case of 9 pilots assessed by that AMA, the CAA judged the risk to flight safety to be sufficient to warrant “grounding” them pending reassessment.

The suspension was contentious within the aviation medicine community and the CAA was strongly criticised by the local committee of the AMSANZ. At the time of release of this report, the AMA is still suspended pending consideration of his submissions.

The Presland Case. In this recent case, the CAA prosecuted a pilot for flying without a valid medical certificate. The pilot defended the action, arguing (among other things) that the CAA could not legally require AMAs to refer applicants to the PMO for a special assessment because this requirement was in the Medical Manual and the Manual was not part of the Rules issued under the Civil Aviation Act.

The judge ruled in favour of the pilot on this point and dismissed the prosecution. CAA announced that it would appeal the decision, but in November 2000 the appeal was dropped; instead, the CAA instructed medical assessors and examiners to follow the medical certification process set out in the Civil Aviation Rule Part 67, in order to comply with the judge's ruling.

There are differing views on the extent and significance of the Presland ruling. Many in the aviation industry believe the ruling invalidated the "1% Rule" as it applies to medical certification. In contrast, the CAA view is that the impact of the judgement is limited to the assessment procedure, which needs to be strictly in accordance with that set out in Rule Part 67.

The Taumaranui Inquest. This inquest relates to the deaths of 3 people in a aeroplane crash near Taumaranui in May 1999. The aeroplane was flown by an 81 year-old pilot and a number of significant medical certification issues were raised at the inquest, including questions about the pilot's medication, medical problems declared by the pilot and the degree to which the certification process was appropriate and was followed. At the time of issue of this report, the Coroner has not yet issued his final report.

2.2 Current licensing system

The licensing system in use in New Zealand under the Civil Aviation Act 1990 is legislated by the Civil Aviation Rules; Part 61 (pilots), 63 (non-pilot flight crew) and 65 (ground crew, including Air Traffic Controllers) and in Part 67 (Medical Standards and Certification)[see Figure 5 p.28]. Used in conjunction with the CAA Medical Manual (Volumes 1 & 2) and the Advisory Circular 67, Part 67 summarises the detail needed by DMEs and AMAs regarding Parts 61 to 65. While Part 67 is the legal authority for the medical standards for CAA Medical Certificates, it does not have adequate detail of either the administrative procedures or clinical aviation principles, which underpin the licensing system. Part 67 of the Civil Aviation Rules prescribes the minimum clinical examinations and investigations, and the minimum standards of medical fitness. The process of medical certification in New Zealand is almost completely decentralised. Private medical practitioners are appointed by the Director of the CAA to examine and assess applicants and to issue medical certificates. Appointment as a DME is the entry level to this system. These DMEs are only permitted to examine an applicant for initial issue or renewal of any class of Medical Certificate, or to issue a notice of unfitness when appropriate. They are

not authorised to issue medical certificates. There are also appointments as DME – EYE and DME – ENT (for ophthalmologists, optometrists and otolaryngologists willing to receive referrals for special examinations). The AMAs are authorised to issue any class of CAA Medical Certificate within specific limits, following a routine or review medical examination. They are also permitted to exercise some flexibility in the issue of a medical certificate where the applicant fails to meet the medical standards, but where “flight safety will not be jeopardised”. Appointments are for 3 years at a time and are at the discretion of the Director of the CAA. The CAA Personnel Licensing Unit (Medical section) provides advice and information to industry clients on the medical certification process and the application of relevant civil aviation rules. The PMO provides specialist aviation medical advice to the Manager Personnel Licensing and to CAA clients. The PMO and other medical officers within the Personnel Licensing Unit also perform special medical assessments on request, where there is a possibility that a candidate may be eligible for a special issuance (exemption). Applicants who have no further recourse to the special issuance process may submit a request to the Aviation Medical Review Board. The Aviation Medical Review Board provides an impartial and independent forum for the resolution of a dispute. The Board has no statutory powers, acts in an advisory capacity to the Director and has been seldom convened.

2.3 The “1% Rule”

As cited above, the CAA has adopted the “1% Rule”. Given the recent local controversy about the application of this Rule, a brief review of the relevant history is warranted.

Dr Ian Anderson presented a paper to the 1973 meeting of the Aerospace Medical Association, which was based on his experience as a Senior Consultant to the Civil Aviation Medicine Service of Canada and which related engineering information concerning the air-worthiness requirements of aeroplanes to the assessment of pilot fitness to fly. At that time, the requirement for mechanical reliability was that a catastrophe (defined as an event involving the loss of an aeroplane and/or fatalities) should not occur for airworthiness reasons more often than one in 10^7 flying hours (one in 10 million flying hours). A risk or occurrence of this frequency could be regarded as “extremely remote”. It was apparent to Anderson that the risk of pilot “failure” could be assessed in a similar way and would provide, for the first time, an objective method of assessing medical fitness.

This idea was taken up by the UK Civil Aviation Authority (UK CAA), which, in 1982, convened the first of 4 cardiological workshops to refine the concept of risk assessment with respect to cardiovascular (CVS) disease in pilots. At that time, the fatal accident rate for large jet transport aeroplanes in the UK was somewhat greater than 0.2 per million (10^6) flying hours. This was the “all cause” rate including such factors as weather, engine failure, aeroplane system failure, and pilot failure. For the purpose of assessing medical risk, a target fatal accident rate was set at 0.1 fatal accidents per million flying hours (0.1 in 10^6 or one in 10^7 flying hours), which was just under half the rate at that time. It was further agreed that

the flight deck crew should be viewed in the same way as any other aeroplane “system” and that no system should constitute more than 10% of the total risk. “Crew failure” (pilot error plus incapacitation) should therefore result in a fatal accident no more often than one in 100 million (10^8) flying hours. Finally, it was decided that medical incapacitation should account for only a small proportion (10%) of the overall risk of crew failure, accepting that human error will comprise the majority of crew failures. Medical incapacitation should therefore cause a fatal accident no more often than one in 1,000 million (10^9) flying hours.

A CVS mortality risk of one in (10^9) hours (equivalent to an annual CVS mortality rate of 1 per 100,000) is, on average, not achievable at any age for a European male. Therefore, in order to achieve this very low level of risk, two-pilot operations are necessary to provide a fail-safe system in the event of one pilot’s incapacitation. Simulator studies indicated that, subsequent to pilot incapacitation, at a critical phase of the flight (take-off and initial climb, approach and landing), the second pilot would take over successfully on 399 occasions out of 400 such events. It was felt that this was probably optimistic for routine operations, where anticipation of a significant failure (aeroplane or pilot) is likely to be less than in the situation of a simulator check. Taking this into account, it was assumed that a trained pilot should be able to take over safely on 99 occasions out of 100. Therefore, a second pilot on the flight deck was considered to reduce the risk of any such incapacitation causing a fatal accident by a factor of 100. Further, if it is assumed that: the critical portions of flight represent only 10% of total flight time (assumed to be approximately one hour); incapacitations occur randomly during flight; and, that the second pilot safely takes over control on all incapacitations occurring outside the critical portions of flight, then the following conclusions can be made. First, only 10% of incapacitation events during flight have the potential to result in a fatal accident (those occurring at a critical phase of the flight) and, second, in only one in 100 such events will the second pilot fail to take over safely. As 10% of 1% is 0.1%, it can be assumed that, on average, only one in 1,000 pilot incapacitations, which occur during flight will cause a fatal accident.

As previously stated, the target fatal accident rate from medical causes is one in 10^9 flying hours. This would be the “acceptable” rate of pilot incapacitation were aeroplanes flown by one pilot, and it is not achievable by an adult European male. Because at least two pilots are invariably required to operate large aeroplanes, an incapacitation rate target 1,000 times greater than this (1 in 10^6) is acceptable for an individual pilot operating such (two-pilot) aeroplanes. As there are 8,760 hours in one year, approximating to 10,000 (10^4) hours, an incapacitation rate of one in 10^6 (one in 1,000,000) hours is equivalent to a rate of 1% per annum. This is known as the “1% Rule” and forms the formal and or informal basis of aeromedical decision making in several countries. However, in order to ensure that no individual with an incapacitation risk of over 1% per annum operates as a pilot, it is essential that the risk of incapacitation for various medical conditions and at different ages be known. For some common diseases, reasonably good data are available. Cardiovascular mortality rates are well documented and increase exponentially with age, reaching about 1% *per annum* (equivalent to a CVS mortality rate of 100 per 100,000) between 60 and 64 years of age for a British

male. There are marked differences in mortality rates between different nationalities, but common to all in the developed countries is an increase in CVS mortality of approximate 100-fold between the ages of 30 and 65 years, and a lower rate for females.

Although the point is discussed further, in a later section of this report, it requires mention here. The risk of CVS mortality is not the major contributor to the sum total of pilot factors that are responsible for incidents to aircrafts under the control or command of a particular pilot. This point is taken up in Chapter 5 and some evidence of relevance is incorporated within figures 14 to 16 inclusive (pp 61-63).

2.4 The CAA Audit of AMAs

Background to the audit. When the current decentralised system of medical certification was established, an ongoing audit of AMAs was seen as one of the key functions of the CAA. A paper (drafted by a former PMO under contract to the CAA) to the Minister of Transport in 1991 setting out the proposal states the following.

It is vital that the reports and assessments completed by individual DME-Assessors [i.e. AMAs] are audited regularly, as well as the adequacy of the clinical examination facilities in their surgeries, and the thoroughness of examination and follow-up.

There is a high correlation between the error rates of DME's and their overall work standards; DME-As with high error rates, inadequate provision of information in reports and careless administration should be audited most frequently, and consideration given to removal of their designation. DME-Assessor audit assumes greater importance in view of the greater responsibility delegated to them."

This emphasis on regular audit was consistent with the wider changes in aviation regulation at the time, where industry took greater responsibility for compliance, and with the CAA monitoring compliance through surveillance (including formal audit). The intention to audit is set out in Advisory Circular 67-1, which refers to the more detailed procedures contained in the Medical Manual. The requirement to audit and a general audit process and criteria are set out in the Medical Manual (Vol.1; 7.2 – 18 August 1993) and information for new applicants for DME and AMA appointments states that ongoing appointment, as an AMA will involve occasional audit, on a 3-year cycle. For whatever reason, it took almost 6 years for formal (as compared to paper audit) auditing to begin: the first AMAs were appointed in February 1994, but the first AMA audit was not undertaken until October 1999. In August 1999, the then new (and current) PMO wrote to all AMAs setting out the intention to audit and the areas to be audited. She stated the following.

...documents and records will be sampled, and a physical inspection of the relevant equipment or facilities is likely to be carried out.

...all records required to be maintained by the relevant Civil Aviation legislation, including client records.

The audit. Between October 1999 and April 2000, audits of 16 AMAs (out of a total of 28) were undertaken. The audit process was consistent with the CAA's standard auditing procedures, as set out in CAA Surveillance Policy (Revision 1, 30 June 1999). The balance of the audits was scheduled for May and June 2000, but these audits were placed on hold to enable the CAA to deal with urgent issues arising from some of the early audits. At the time of this report, these outstanding audits have still not been undertaken and a number of those conducted have yet to be completed.

As would be expected, the initial audits revealed a number of minor issues, and a smaller number of more significant errors that required further investigation or corrective action by the AMA. The process for advising and correcting errors was initially informal and delivered at the audit exit meeting. In keeping with standard CAA audit practice, a formal audit report was completed for each doctor.

On 22 February however, an audit of an AMA revealed a large number of errors, some of them significant. The AMA concerned was, at the time, conducting approximately a third of the medical assessments for pilot and air traffic controllers in New Zealand. These errors (and others found in a fuller review of the AMA's recent decisions) subsequently lead to the suspension of the AMA; as cited above, action by the CAA included the immediate grounding of 9 pilots pending further investigation. Because of the public safety implications, the Minister was also briefed and a media release made, announcing the decision to suspend the AMA.

2.5 Further AMA audits

Consequent to the AMA's suspension cited above, the CAA medical personnel selected a further 6 AMAs on the basis of their high throughput levels and initial audit performance and undertook a clinical audit by file-review. For each AMA, the file selection was 20 "routine" assessments closed between early February and end March 2000 (with additional files from early April 2000 if necessary). Where an AMA performed more than 20 assessments during that period, a random selection of 20 files was made. The review included all the assessments on each pilot's file dating from the first "de-centralised" (see above) assessment to the current date. An error was defined as a "finding necessitating further comment, clarification or additional/alternative action"; simple administrative errors that could be detected by machine reading of forms, such as employed by the CASA, or by clerical staff, were excluded. The % cited was the relative frequency of applicant's files that had "assessment errors". The file error rate attributable to the AMA under review varied from 21 to 81% (mean = 55.5%), whereas, the file error rate attributable to the AMA under review and or any other assessor varied from 21 to 86% (mean = 58.8%). Even allowing for the cumulative nature of the local audits, these error rates compare unfavourably with the rate of less than 10% cited by the American Federal Aviation Administration (FAA) for similar annual audits. We have reviewed these files and agree qualitatively with the CAA's assessment. Nevertheless, to obtain an independent quantitative assessment of the extent of error, we recommend an independent review by a third party. From our own assessment of the files of these 6 AMAs and others, it is clear that the errors are predominantly procedural and often involve certification practice in "excess" of the authority

delegated to the AMA by the CAA. However, the errors also included pilot files in which the following was seen.

- Un-corrected visual acuity was not recorded.
- Visual acuities were recorded at a higher level than that actually measured.
- ECGs were mounted incorrectly.
- A different person's ECG was included in the file and assessed as being "normal".
- Abnormal ECGs were assessed as "normal" (despite analysing many ECGs in this context, one AMA reported to us that he was not competent to "read" ECGs).
- A series of pilots seen by the one DME had identical cardiovascular parameters.
- Many pilots had identified health problems (such as recent histories of renal colic, depression, malignancy, significant hearing impairment, eustachian tube dysfunction, valvular heart disease and left ventricular hypertrophy, oral warfarin therapy, haemophilia and polycystic kidney disease), which were not followed up.

This list is meant to be illustrative and not exhaustive.

2.6 It is clear then that the current national process of certifying pilots medically fit to fly is characterised by a variable standard of practice and that some of the medical practitioners involved have an unacceptably high clerical, procedural and clinical error rate.

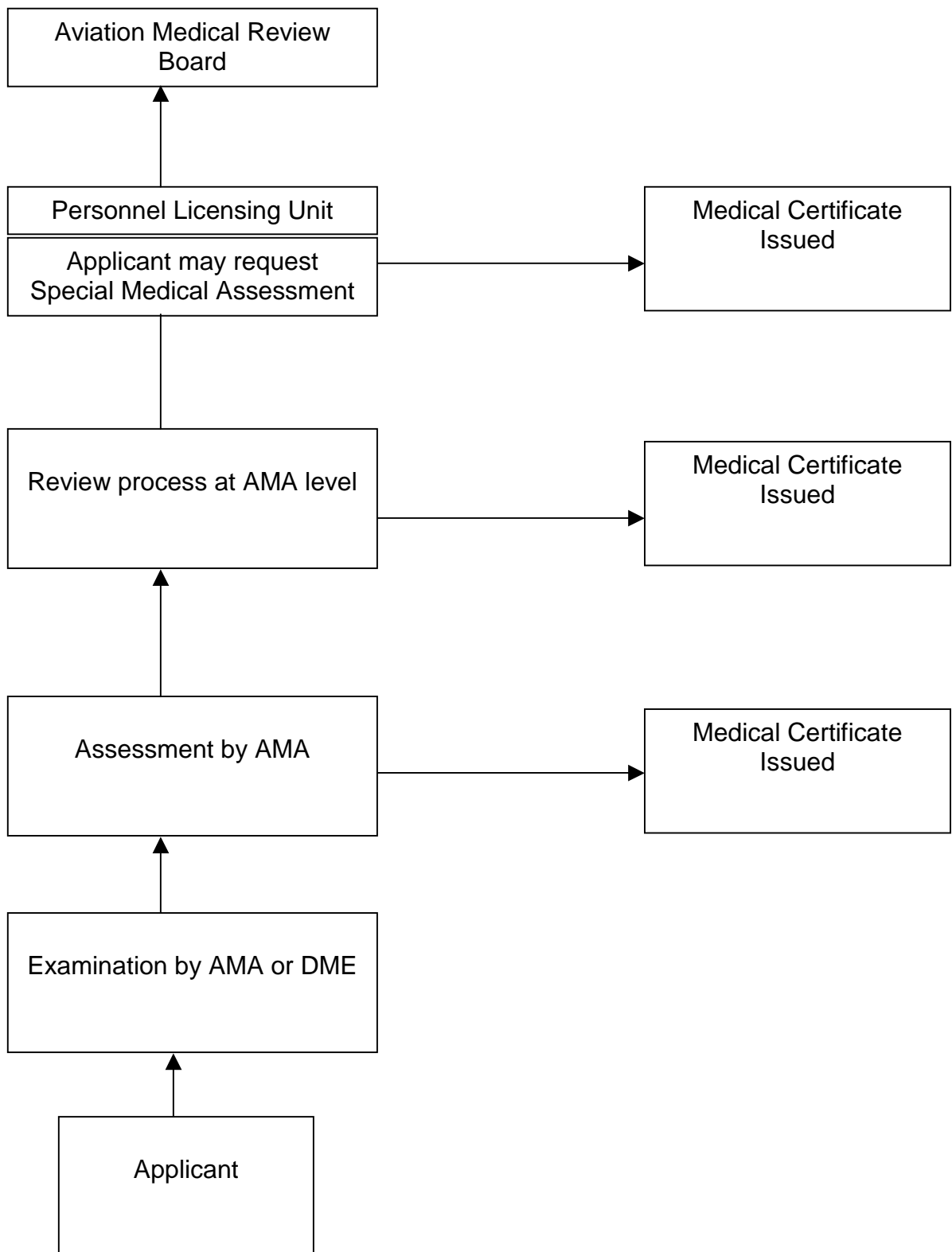


Figure 5: Medical Certification Process – Civil Aviation Authority (NZ)

Chapter Three. International systems of assessing pilots' medical fitness to fly.

3.1 Australia

The process used in Australia is shown schematically in Figure 6 on page 39.

The CASA is responsible for the medical certification of aircrew and air traffic service applicants through the Director of Aviation Medicine and medical practitioners approved by the Authority. These responsibilities are defined by the Civil Aviation Regulations (CARs). An approved practitioner (a designated aviation medical examiner – DAME) acts as a delegate of the Authority when performing examinations of applicants for all classes of medical certificate. The process of certification is centralised, in that the Director of Aviation Medicine issues medical certificates for all classes. The DAMEs are authorised to examine applicants for new or for renewal of medical certificates. Under CAR 5.04 (2), a DAME may issue a temporary medical certificate for original issue, for a maximum period of 2 months from the date of completion of the Original Medical Questionnaire and Examination Form. Under CAR 6.06, a DAME may revalidate the medical certificate of an applicant for a Class 1,2 or 3 Medical Certificate for a maximum period of 2 months from the date of completion of a Renewal Medical Questionnaire and Examination Form. Such a revalidation is permissible only in respect of medical certificates of the same class previously held by the applicant. The DAMEs are not permitted to exercise flexibility in the interpretation of the standards. They have no powers of suspension or re-instatement of a medical certificate. All medical examination forms and questionnaires are forwarded to the Office of Aviation Medicine in the CASA, where they are processed automatically, and a captured electronic image of the assessment form and any related documents are stored as part of the applicant's medical history. When the DAME issues an initial interim, medical certificate or re-validates an existing one, the computer updates the CASA mainframe computer's data, advising all staff with access to the system that the applicant has a valid medical certificate. Wherever possible, the computer will automatically issue the new or renewal certificate with its full validity. Designation as a DAME is for a period specified by the Authority. The DAMEs are required to re-apply for designation at the conclusion of each such period. Wherever possible, DAMEs must have had relevant training in aviation medicine and practical experience in aviation. Possession of the Australian Certificate in Civil Aviation Medicine is a normal minimum requirement for the appointment, which is only waived in exceptional circumstances. Trained medical assessors and aviation medical officers process cases requiring more detailed assessment individually. A panel of doctors, who meet regularly, discuss difficult or contentious cases. Medical standards are promulgated in Schedule 1 of the Civil Aviation Regulations 1988.

In 1994, the Authority introduced CVS risk screening of all Class 1 and 3 certificate holders. Using the Risk Factor Prediction Chart (published by the American Heart Association), individual risk factors are scored and summated. If the total exceeds 15 points (which is the threshold for 1% per annum risk of CVS incapacitation), the applicant must undergo additional CVS testing; specifically, an exercise ECG. If

the exercise ECG is normal, no further routine screening is considered for 5 years. In the event that the exercise ECG is equivocal or positive, further testing is requested. Over the age of 60, all Class 1 and 3 applicants are required to undergo annual risk assessment. The “1% Rule” is also used as a re-certification tool for other organ systems (e.g. following a medical event such as migraine, malignancy, head injury and cerebrovascular accident or myocardial infarction). The CASA uses the 1% threshold as defining the boundary between fitness for single pilots (commercial) operations, and a requirement for multi crew limitation. Class 2 applicants are not routinely subjected to a CVS risk assessment. Re-certification after a medical event is subject to the results of specified testing and case-by-case review. Whenever possible, the incapacitation risk is estimated, but re-certification at Class 2 is usually granted for single pilots (unrestricted) operations above 1%.

3.2 North America

The process used in the USA and that in Canada is shown schematically in Figure 7 on page 40 and Figure 8 on page 41 respectively.

The Federal Air Surgeon (of the USA) provides medical certification services to pilots and air traffic controllers principally through the Aeromedical Certification Division of the Civil Aeromedical Institute (CAMI). The Institute is assisted by 9 regional aviation medical divisions, each managed by a regional flight surgeon; this is a partially decentralised system. Nevertheless, the CAMI handles about 99% of the 450,000 medical certification services rendered annually. The Federal Aviation Regulations (FARs) are codified under Title 14 of the U.S. Code of Federal Regulations (14 CFR). Parts 61, 63 and 65 provide the certification requirements for pilots and flight instructors, flight crew members other than pilots, and aircrew other than flight crew members. Part 67 contains the medical standards for certification of US civil pilots and foreign pilots operating US registered aeroplanes. To supplement the medical standards contained in Part 67 of the FARs, substantial guidance material is provided by the Office of Aviation Medicine specifically for the use by designated aviation medical examiners (AMEs). This “Guide for Aviation Medical Examiners” is designed to assist in the interpretation and application of the regulations. Currently, there are 5,700 designated AMEs, located within the USA or internationally. The majority of physicians who conduct examinations are family practitioners. Management of the national civilian AME system has been delegated to regional flight surgeons. “Practicing, fully licensed physicians in good standing” are designated on the basis of training and experience, adequacy of facilities for performing prescribed examinations and the need for examiners in the geographic area. Designation as an AME authorises the physician to perform medical examinations for the issuance of third class (recreational, private or student pilot certificate), and second class (commercial pilot, flight engineer and civil air traffic controllers not employed by the FAA) medical certificates and to issue or deny issuance of certificates for those cases. Designation as a senior AME with authority to examine and certify applicants for all classes, including first-class certificates, requires 3 years of experience as an AME and additional equipment for performing examinations. All designations are for one year and renewal is contingent upon meeting prescribed currency requirements. Prior to

initial designation, the physician is required to attend a 5-day FAA sponsored seminar on aviation medicine, as well as complete a 4-hour computer based instruction course on the processing of the medical application form. Continued designation as an AME also includes the requirement for attendance at a FAA approved continuing aeromedical education program at least once every 3 years. Regional flight surgeons have the authority to designate and/or terminate AME appointments.

Electronic lodgement of the medical examination by AMEs is now possible, but the system is not yet fully mature.

Applicants who have been refused issuance of medical certificates by an AME may request reconsideration by the FAA and may be asked to provide additional information to support the request. Depending on the complexity of the case, divisional medical officers may review these cases and make determinations regarding the applicant's eligibility. When necessary, medical files are referred to consultant medical specialists located throughout the USA for review and recommendations regarding certification. Pilot applicants who are denied certification by the divisional medical officers may request reconsideration by the Federal Air Surgeon. Authorisation for special issuance of a medical certificate (waiver) is contained in section 67.401 of the FARs. The authority is delegated to the Federal Air Surgeon, the Manager of the CAMI and to each regional flight surgeon. Considerations for waiver against the standard may be given for disqualifying medical conditions. Appeal procedures after denial by the FAA can be pursued by a pilot with the National Transportation Safety Board (NTSB) and then to the US Court system.

The FAA undertakes no formal CVS risk screening of pilots or air traffic controllers. Recertification following a significant medical event is possible, but is based on use of "Special Issuance" (waiver) provisions. The "1% Rule" has no place in the FAA certification process, but may well be used in case-by-case review of applicants by specialist consultants.

In many ways, Transport Canada operates a similar system to that of the FAA. Neither regulatory system is subject to oversight by an industry-based board or committee. Both sets of regulators consider Class 1, 3 and 4 pilots differentially, both with respect to frequency and nature of assessment. Both systems are regionally centralised and experienced aviation medicine specialists at "head office" make decisions about contentious certifications; the number of "in house" physicians enables collegial deliberations where necessary. Transport Canada has 4 regional Civil Aviation Medicine Offices across Canada, 3 of which are under the direction of a Regional Aviation Medical Officer (RAMO) who reports to the Director of Civil Aviation Medicine at the Civil Aviation Medicine Headquarters in Ottawa. The RAMOs are responsible for the selection and training of Civil Aviation Medical Examiners (CAMEs), for reviewing the medical examinations of pilots, flight engineers and air traffic controllers, and for assigning their medical categories. The CAMEs are appointed on a basis of need by the RAMO. The Minister of Transport delegates authority to CAMEs to conduct medical examinations on aviation personnel under Canadian Aviation Regulation (CAR)

404.16. Upon appointment, CAMEs are briefed by the RAMO and are required to attend a regional training seminar. These are conducted annually in each region and the CAMEs are required to attend at least once every 4 years. Appointments are valid for 4 years, renewable upon recommendation of the RAMO. There are approximately 900 CAMEs in Canada and worldwide. All initial and upgrade medical certificates are issued by Transport Canada after review by a medical officer. The CAMEs have the authority to renew existing medical certificates at the same medical category, but are not permitted to exercise flexibility, nor do they have the authority to revoke a medical certificate. Auditing of CAME performance is carried out by the RAMOs. An Internet based electronic system is being developed for the submission of aviation medical examination reports and should be operational by the end of 2001.

In 1995, a second edition of the “Canadian Guidelines for the Assessment of Cardiovascular Fitness in Pilots, Flight Engineers and Air Traffic Controllers” was released. These guidelines included recommendations for targeted CVS risk screening of aircrew and air traffic controllers using algorithms and graphs based on Framingham data. In general, if the five-year risk score exceeded 10%, then a CVS risk assessment, including an exercise ECG, should be undertaken. If abnormalities were found, resulting in an average annual incapacitation risk of >2 and up to 5%, then an applicant was to be considered “unfit” for an unrestricted certificate, but could be considered for a certificate restricted to “with accompanying pilot only”. While such a “2% Rule” is not regulated, it is clear that the Canadians use an “in-house” risk threshold of about 2 to 5% of incapacitating events per annum in considering pilots for restricted certification (e.g. multi-pilot crews). However, as cited above, the FAA denies any such threshold logic.

Both North American systems are clearly experiential, categorical and hierarchal, although regional officers do have some powers of independent operation. In both cases, there has been an experience-based shift from didactic practice to case-by-case determinations. In contrast to the NZ Civil Aviation Rules (Part 67), one of the Canadian regulations (CAR 424.05) is almost identical to ICAO 1.2.4.8. This is the regulation that “enables” Transport Canada to review each case on an individual basis, and, in particular to use an Aviation Medical Review Board to assess “borderline” certification cases. Transport Canada also has extensive medical policies, many of which have been the product of policy development workshops. The integrity of both North American systems is maintained by selection of (preferably already trained) medical examiners, an enforced requirement for initial and ongoing training, and by consistent (paper) audit and counselling and dismissal of examiners as required. Both systems have their own training programs, although alternatives exist in either country. The entry-level training is equivalent to the Monash University Course in Aviation Medicine, which is recommended later in this report as a suitable template for New Zealand. However, and as cited above, the FAA has two levels of examiner and only those with about 3 years experience in the system, appropriate training and satisfactory audit performance are entitled to examine Class I pilots. The FAA operates regular cardiological panels, while Transport Canada uses a multi-disciplinary aviation medical review board; both systems use selected medical specialists extensively.

The Transport Canada Aviation Medicine Review Board reviews complex or contentious cases (see Appendix 2). The Board is independently constituted of medical specialists in disciplines appropriate to specific cases, as well as aviation medicine specialists with operational and clinical backgrounds. Applicants may occasionally be represented by their own medical specialists at the Board, but never appear personally. The Board meets on a regular basis for case discussion and provides a recommendation to the RAMO who submitted the case for review. An “unfit” applicant can appeal to the Civil Aviation Tribunal. This only occurs several times a year. Disputes over process (and not medical decisions) in Canada are considered by this Tribunal, as are disputes over any aspect of civil aviation. In contrast and as already described, a National Transportation Safety Board first deals with procedural disputes in the USA and then both these and disputes over medical decisions can be considered by the court system, up to and including the Supreme Court. The FAA and Transport Canada claim success for their systems on the basis of a low rate of aeroplane accidents and more importantly on a low rate of incidents. The FAA also reasonably claims success for its audit system of medical examiners by citing error rates of less than 10%, in comparison to the mean rate of greater than 55% cited above in New Zealand for equivalent procedural errors. Indeed, the last FAA medical examiner that had an error rate similar to that seen in New Zealand was counselled and then dismissed when his error rate did not decrease sufficiently. In this context, the FAA database is the largest (based on about 650,000 pilots) and is accessible. These data suggest that both systems are operating on the early asymptotic phase of the risk-exposure curve for flying.

3.3 Europe

The process agreed for use in Europe by the Joint Aviation Authorities (JAA) is shown schematically in Figure 9 on page 42.

Although all 33 member states of the JAA in Europe have their own regulatory systems, some are more meaningful than others and only 7 states have been inspected and approved by JAA Headquarters to issue JAR-FCL medical certificates. There is also some conflict between those “approved” 7 member states.

The European Joint Airworthiness Authorities was created in 1970 to produce common certification requirements for large aeroplanes and their engines, and in order to reduce duplication of effort by individual states. Since then, its name has been changed to the Joint Aviation Authorities and its work expanded to cover the certification of other aeroplane types and components (e.g. light aeroplanes, helicopters, auxiliary power units and propellers). In addition, maintenance, operations and flight crew licensing (incorporating medical requirements) are now included. The JAA formulates the Joint Aviation Requirements (JARs); the rules that should apply throughout all member states of the JAA.

Annex 1 of the International Civil Aviation Organisation (ICAO) regulations was chosen by the JAA to provide the basic structure for a set of common medical standards. The structure of the various policy development committees is such

that the medical committee is a sub-committee of the flight crew licensing committee. The title of the medical standards document is consequently the Joint Aviation Requirements – Flight Crew Licensing, Part 3 (Medical). Parts 1 and 2 are concerned with the licensing requirements, in respect of skill and technical knowledge, of pilots of aeroplanes and helicopters respectively. The main difference between the Standards and Recommended Practices (SARPs) of ICAO and the JARs is that the former has some scope for interpretation (flexibility). Consistency of assessment and certification is the main advantage of the didactic JAA approach. In addition, because the procedure is designed to be common, a certificate issued in one state should be valid without further assessment in all other states. The commonality applies not only to medical certification but also to the pilot's licence. The main disadvantage to the JARs is that standardisation limits discretionary certification (e.g. for a pilot that has undergone refractive surgery) and requires that any unforeseen situation and or "medical or technical advance" will necessitate a referral to the medical sub-committee to consider changing the certification requirements.

The format of the JARs is such that each JAA member state "has to" include within its Authority one or more physicians experienced in aviation medicine. Such physicians are either to form part of the Authority, or are to be duly empowered to act on behalf of the Authority. In either case they are known as the Aeromedical Section (AMS). Aeromedical Centres (AMCs) are designated and authorised, or re-authorised, at the discretion of the Authority for a period not exceeding 3 years. An AMC has to be: within the national boundaries of the member state and attached to or in liaison with a designated hospital or a medical institute; engaged in clinical aviation medicine and related activities; and, headed by an Authorised Medical Examiner (AME), responsible for coordinating assessment results and signing reports and certificates. An AMC also has to have staff physicians with advanced training and experience in aviation medicine; and, also has to be equipped with the necessary facilities for "extensive" aeromedical examinations. Each Authority is able to determine the number of national AMCs. The Authority designates and authorises national Aviation Medical Examiners (AMEs), who need to be qualified and licensed medical practitioners and who have had some training in aviation medicine. They must also have practical knowledge and experience of the "conditions in which the holders of licences and ratings carry out their duties". The number of AMEs is based on the number and geographic distribution of the local pilot population. Physicians resident in non-JAA states, who wish to become AMEs for the purpose of JAR-FCL certification, may apply to the Authority of a JAA member state. Such AMEs are restricted to carrying out standard periodic revalidation and renewal assessments and have to report to and be supervised by the Authority of that state.

The basic training for physicians responsible for the medical selection and surveillance of Class 2 flying personnel consists of a minimum of 60 hours of lectures, including practical work (examination techniques). Certification is based on passing a final examination, but such a certificate does not constitute a legal right to be approved as an AME for Class 2 examinations by an AMS.

Advanced training in aviation medicine for physicians responsible for the medical examination and assessment and surveillance of Class 1 pilots consists of a minimum of 120 hours of lectures and practical work, training attachments and visits to aeromedical centres, clinics, research, air traffic control, simulator, airport and industrial facilities. Training attachments and visits may be spread over 3 years. Basic training in aviation medicine is a compulsory entry requirement (AMC FCL 3.090). Again, passing the final examination and subsequent certification does not constitute a legal right to be approved as an AME for Class 1 or Class 2 examinations by an AMS.

During the period of authorisation, an AME is required to attend a minimum of 20 hours approved refresher training. A minimum of 6 hours must be under the direct supervision of the AMS. The AMS may approve scientific meetings, congresses and flight deck experience for this purpose, for a specified number of hours (AMC FCL 3.090). An AME is authorised for a period not exceeding 3 years. Authorisation to perform medical examinations may be for Class 1 or Class 2 or both at the discretion of the Authority. To maintain proficiency and for re-authorisation, the AME has to complete an adequate number of aeromedical examinations to the satisfaction of the AMS (10 aeromedical examinations each year is a recommended minimum) and must have undertaken relevant training during the period of authorisation (AMC FCL 3.090). Authorisation is invalid after the AME reaches 70 years of age.

Section 2 of the JAR-FCL 3 discusses “The Concept of Aeromedical Risk Assessment” and includes specific discussion about a “1% per annum risk of incapacitation” and how it is derived. The JARs do not mandate for formal CVS risk screening of applicants for medical certification. The “1% Rule” appears to be applied following a medical event, when re-certification is first considered. Throughout the JAA Medical Manual, regular reference is made to an incapacitation risk of “less than 1% per annum” or “acceptable risk” where aviation cardiology has “defined risk of incapacitation of up to 1% per year to be acceptable for two crew professional and unrestricted private flying”.

The re-certification of applicants following malignant disease is based on the “1% Rule” and defines risk per year of incapacitation as “less than 0.1%, between 0.1% and 1%, and greater than 1%” and specifies the acceptable level of certification.

The UK-CAA is based at Gatwick Airport and, notwithstanding the constraints of the JARs, has a similar system to those operating in North America. This system is not subject to industry by way of board or committee, is differential (Class 1 (professional), Class 2 (private) and a separate Class D for micro-lights and gyroplanes) and is centralised; again, experienced aviation medicine specialists at “head office” make decisions about certification. In addition, all initial Class 1 pilot examinations are conducted centrally at Gatwick by UK CAA medical examiners. The UK CAA aviation medical specialists usually have access to general practitioner records; the pilots give their consent for these records to be released to the CAA when signing their medical report form. There are 9 “in house” physicians at Gatwick such that collegial deliberations are accessible and hence common. Although and as cited above, the UK-CAA and the other JAA states do not have a

formal incapacitating risk threshold for further study of pilots, the former do use an “in-house” risk threshold of incapacitating events per annum of 1 (Class 1 pilots and Class 2 pilots for single pilot operations) to 2% (Class 4 pilots) in their deliberations. Again as cited above, the general approach of the JAA however is to replace such a threshold and or experiential approach with didactic and prescriptive regulations. This causes considerable difficulty for the UK-CAA and especially in the context of some recreational pilots. The UK-CAA is to introduce a drivers-licence equivalent standard for some recreational pilots. This is to be a national licence for use in British airspace only. It will cover all air-sport activity, up to 4 seater light aeroplanes for day / Visual Flight Rules flying. The professional driving medical standards will cover flying with passengers, whilst satisfaction of car driving standards will allow solo flying or flying with another qualified pilot. The intention is for a medical statement to be co-signed by the pilot and their general practitioner.

The British system is privately well funded, and is clearly experiential, categorical and hierarchal; although, as in North America, there has been an experience-based shift from didactic practice to case-by-case determinations. This is obviously in conflict with the regulatory and hence non-discretionary approach favoured elsewhere in Europe. The integrity of the British system is similarly maintained by selection of (preferably already trained) medical examiners, the enforced requirement for initial and ongoing training, and by consistent (paper) audit and consequent counselling and dismissal of examiners as necessary. Training programs exist throughout Britain; the UK CAA also conducts training programs. Again, the entry-level training is equivalent to the Monash University Course cited above. The UK CAA has had a Medical Advisory Panel reporting to the Chief Medical Officer for the last 20 years. The main panel considers cardiological cases and meets 4 times a year. Other specialist panels (usually neurological) are convened on an ad hoc basis. There is a requirement in JAR-FCL 3 for all JAA states to set up a secondary review procedure (JAR-FCL 3.125 (b)), and many JAA states already have it in some form or another. The Chief Medical Officer of the UK-CAA considers disputes over process and medical decisions, with subsequent recourse to the court system; but the latter has been infrequently used.

The JAA member states claim success for their systems on the basis of a low rate of aeroplane accidents; supportive incident data are limited. These limited data nevertheless, still suggest that JAA systems are operating on the early asymptotic phase of the risk-exposure curve for flying.

3.4 ICAO

Standards and Recommended Practices (SARPs) for personnel licensing were first adopted by the ICAO on 14 April 1948, pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago 1944) and designated as Annex 1 to the Convention. They became effective on 15 September 1948. The present (Eighth) edition of Annex 1 contains the SARPs adopted by the ICAO as the minimum standards for personnel licensing. It incorporates all amendments, including Amendment 161.

Notification of Differences. The attention of contracting states is drawn to the obligation imposed by Article 38 of the Convention by which such states are required to notify the ICAO of any differences between their national regulations and practices and the international standards contained in Annex 1 and any subsequent amendments. Contracting states are “invited” to extend such notification to any differences from the recommended practices contained in this Annex and any amendments, when the notification of such differences is important for the safety of air navigation. Further, contracting states are “invited” to keep the ICAO currently informed of any difference that may subsequently occur, or of the withdrawal of any difference previously notified. A specific request for notification of differences will be sent to contracting states immediately after the adoption of each amendment to the Annex.

Use of the Annex Text in National Regulations. On 13 April 1948, the Council adopted a resolution “inviting” the attention of contracting states to the desirability of using in their own national regulations, as far as practicable, the precise language of the regulatory ICAO Standards; and, also of indicating departures from the standards, including any additional national regulations that were important for the safety or regularity of air navigation. Wherever possible, the provisions of Annex 1 have been written in such a way as to facilitate incorporation, without major textual changes, into national legislation. Annex 1 of the Chicago Convention deals with personnel licensing and Chapter 6 of this Annex deals with medical provisions. Annex 1 contains the SARPs that underpin the regulation of civil aviation medicine practice throughout the world. An ICAO Standard is defined as a specification “recognised as necessary for the safety or regularity of international navigation and to which contracting states will conform in accordance with the Convention”. An example of a standard, applicable to all classes of medical certificate, is that an “applicant shall have no established medical history or clinical diagnosis of epilepsy”. A standard is therefore mandatory and if a state is unable or unwilling to comply it must notify ICAO, thereby “filing a difference”. Other states are made aware of these differences and may, if they wish, refuse permission for airlines regulated by the non-compliant state to fly over their territory. In practice, although many differences have been filed, the latter rarely occurs. An ICAO Recommended Practice, on the other hand, is defined as any specification “recognised as desirable in the interest of safety, regularity or efficiency of international air navigation, and to which contracting states will endeavour to conform”. It is therefore not mandatory to comply with a recommendation, or to notify any non-compliance to ICAO. An example is the recommendation for a routine ECG in Class 2 (private pilot) applicants to be undertaken at initial examination, and then five-yearly after age 30 years. Some states choose not to require this investigation at any stage for private pilots licensed in that state and the provisions of Annex 1 permit this, without reference to ICAO. The SARPs established in Chapter 6 of Annex 1, cannot, on their own, be sufficiently detailed to cover all possible situations. This also applies to Rule Part 67, which is the legal authority for the medical standards of the CAA in New Zealand. Part 67 of the Civil Aviation Rules prescribes the minimum clinical examinations and investigations, and the minimum standards of medical fitness for the issue of medical certificates to New Zealand pilots and air traffic controllers.

Used in conjunction with the CAA Medical Manual (Volume 1 and 2), and the Advisory Circular 67, Part 67 summarises all the detail needed by DMEs and AMAs to perform their duties, and closely reflects the SARPs for Personnel Licensing contained in Annex 1. The differences between the ICAO SARPs and the CAA NZ Certification Procedures are tabulated in Table 2 on page 43.

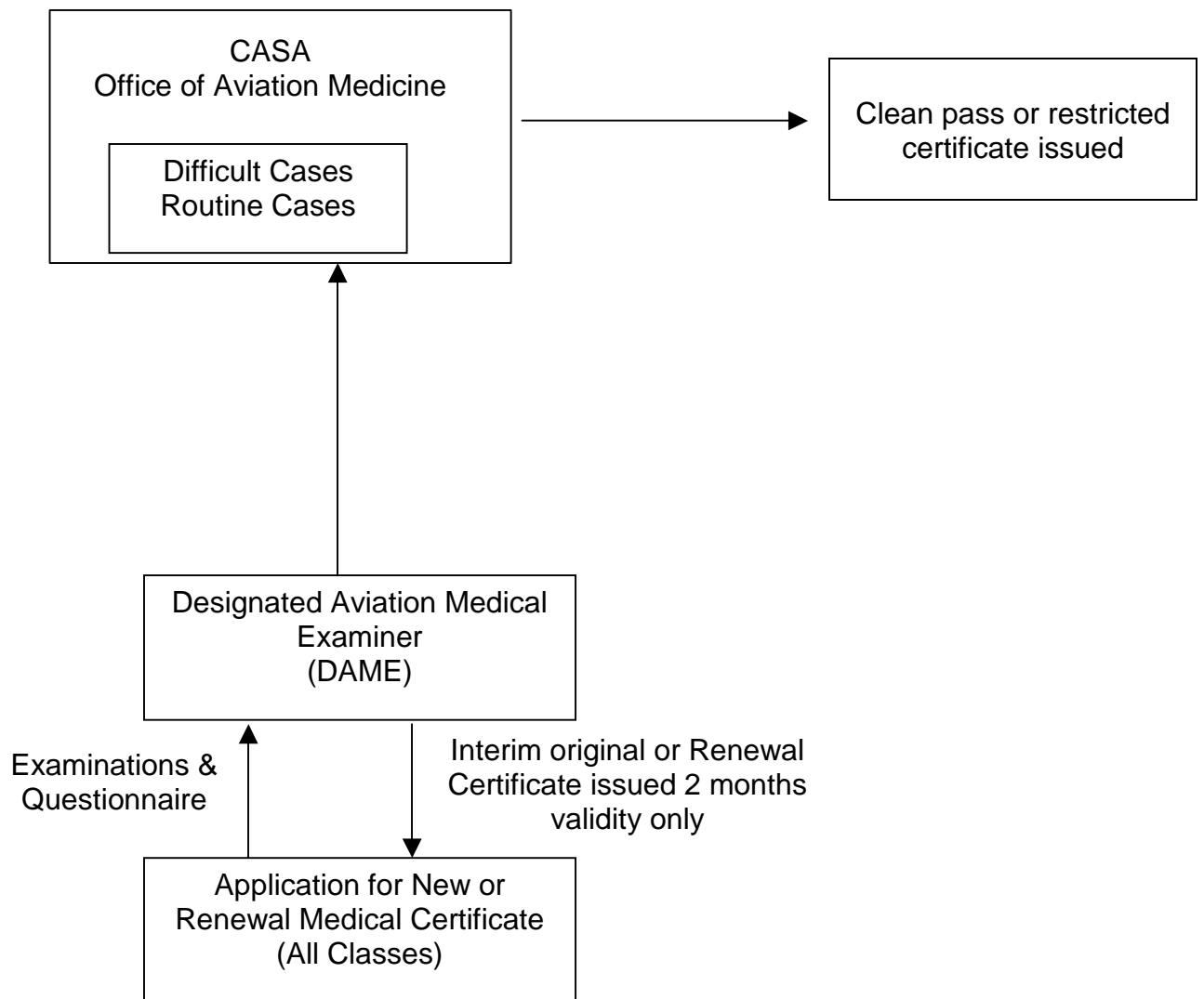


Figure 6: Medical Certification Process – Civil Aviation Safety Authority - Australia

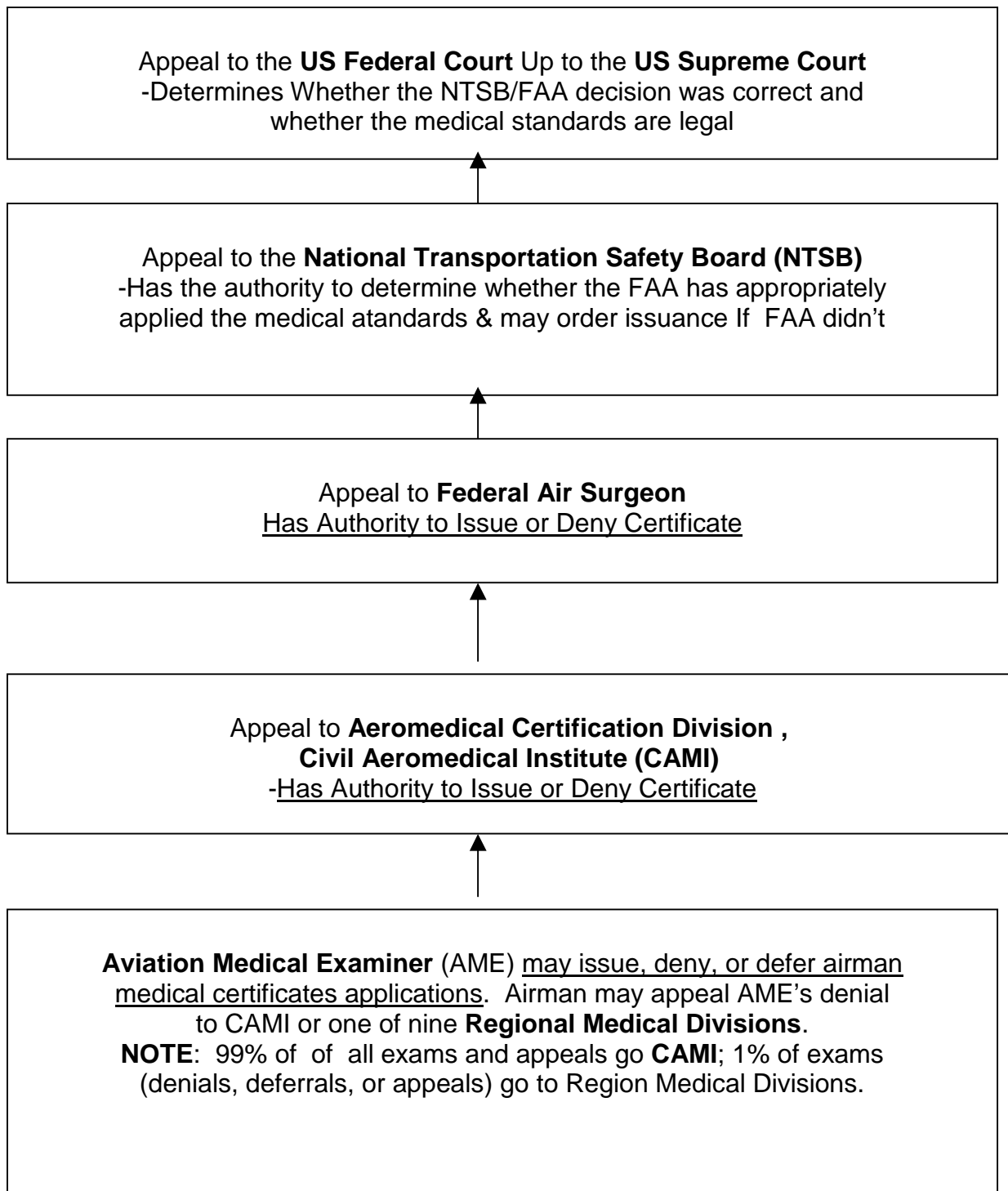


Figure 7: USA/FAA Airman Medical Certification and Appeal Pathway

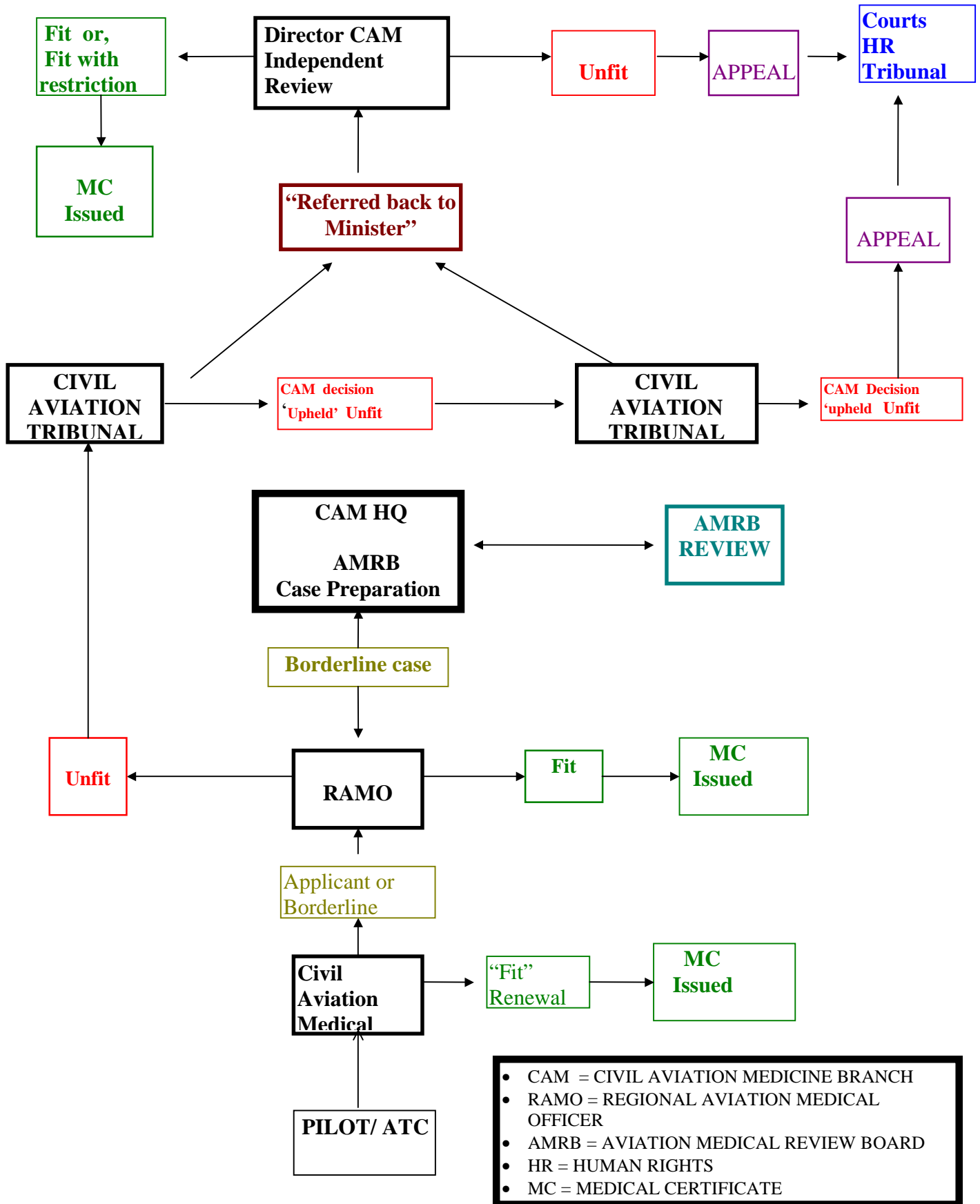


Figure 8: Transport Canada – Aeromedical Certification Flow Diagram

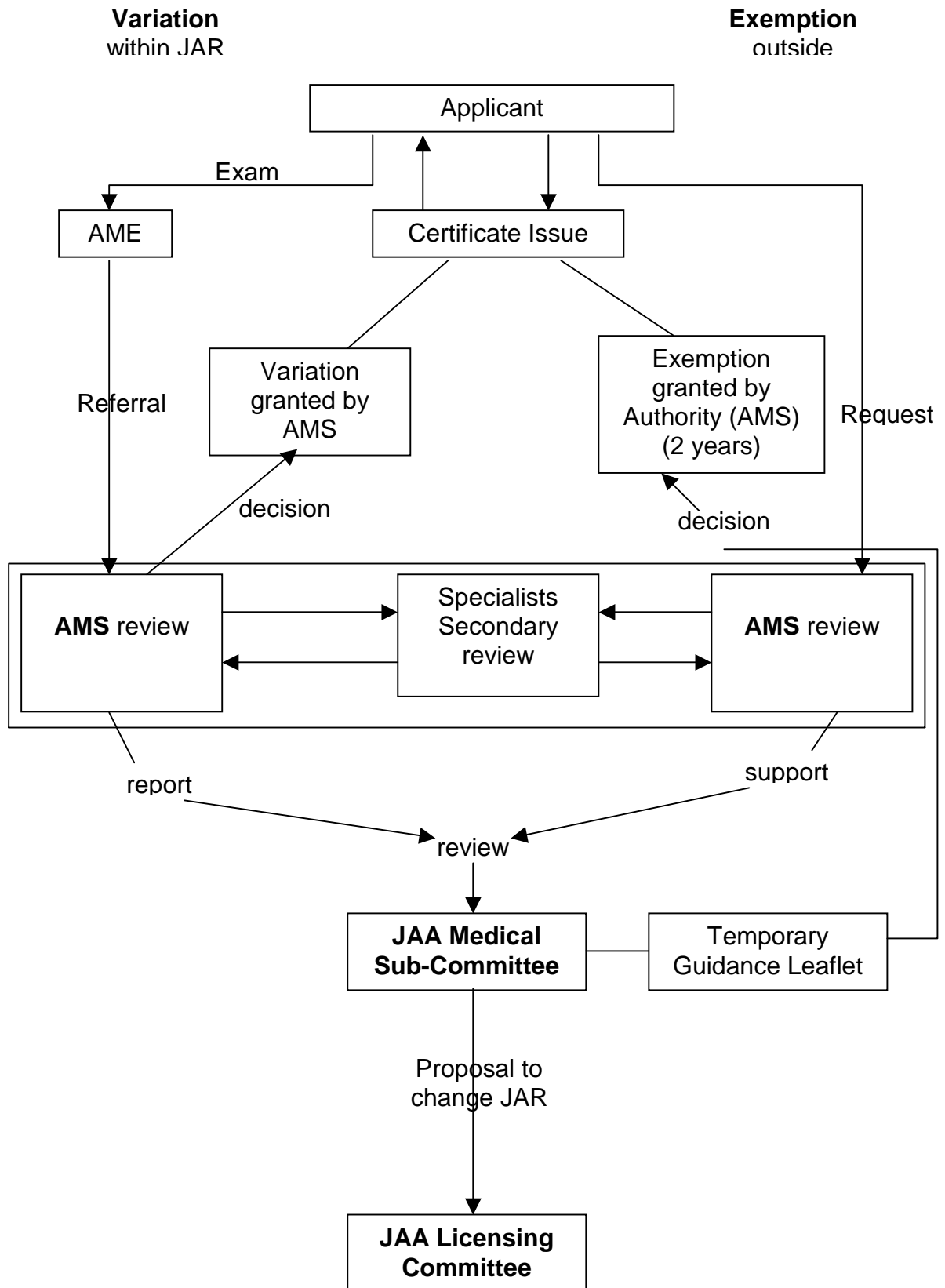


Figure 9: Medical Certification Process - JAA

Table 2: Differences between ICAO SARPS & CAA NZ procedures

	ICAO			CAA NZ		
<u>Certificate</u>	Recertification			Recertification		
	General Medical Exam	ECG	Audio	General Medical Exam	ECG	Audio
Class 1 Professional Flight Crew	ATPL 1 2 mthly to 40, 6 mthly thereafter CPL ⁽¹⁾ 12 mthly Flt Engineer 12 mthly	First issue, then 2 yearly between 30-40 and annually thereafter	First Issue then 5 yearly to 40, then 3 yearly	12 mthly to 40 ⁽³⁾ then 6 mthly	First issue and first exam after 25, 30, 35, 38, 40. Annually thereafter	First Issue, then 4 yearly
Class 2 Student and Private	PPL ⁽²⁾ 24 months	(*) First issue, then first examination after 40, then 5 yearly	Audio Not required. Conversational Voice test	Every 60 mths to 40, then Every 24mths to 50, then Every 12mths thereafter	First Issue, then First Exam after 40, 44, 48, 52, 54, 56, 58, 60 then annually	Every 5 years to age 40 and every 4 years thereafter for pilots who also hold an instrument rating.
Class 3 Air Traffic Controllers	ATC ⁽²⁾ 24 mths	(*) First Issue then First exam after 40, then 5 yearly	First Issue, then 5 yearly to 40, then 3 yearly	Every 24mths to age 40, then 12 mthly thereafter	First Issue then First exam after 25, 30, 35, 38, 40 and annually thereafter	Every 4 years

⁽¹⁾ Recommendation: After 40th birthday, reduce to 6 monthly

⁽²⁾ Recommendation: After 40th birthday, reduce to 12 monthly

⁽³⁾ Extended currency permissible under specified conditions

(*) Recommended Only

Chapter Four. A comparison of the national and international systems of assessing pilots' fitness to fly; identification of best practice.

4.1 Best practice in occupational health surveillance is based on the following principles.

- a. The process must be consistent with all relevant legislation such as health and safety acts, privacy acts, human rights and disability acts, as well as the acts, regulations and codes that apply to the specific industry. In the context of aviation, the primary legislation is the Civil Aviation Act 1990 (and the Civil Aviation Rules). In aviation, it is also essential that national practice is consistent with international standards and especially those of ICAO, as established under the Chicago Convention. Finally, New Zealand aviation is subject to the TTMRA.
- b. Any assessment must be based on an understanding of the functional requirements of the employment tasks, the identification of relevant and prevalent health "conditions" and of predictive survey tools. The latter is often best served by questionnaire. In many circumstances medical examination of the otherwise well is expensive and poorly predictive. Functional human factors, which are critical in flight safety, such as the physical, intellectual and psychological competency to fly aeroplanes should be addressed by functional capacity tests. These tests need to be objective and audited.
- c. Where possible, the outcome should be discretionary on behalf of the primary risk acceptor; that is, the pilot. This encourages veracity. However, secondary risk acceptors, such as the New Zealand public and the airline operators also need to be recognised. This usually results in health "conditions" being categorised as acceptable, acceptable with exercise of discretion and acceptance of risk, or as unacceptable. Hence, the process should be part discretionary and part prescribed. The examining medical examiners should not be risk acceptors and their role should be limited to the assessment and explanation of risk to the risk acceptors; any certification needs to reflect this process. Such a consultative process also requires that any medical practitioner involved should be trained and experienced in both aviation and occupational health surveillance.
- d. The frequency and nature of ongoing surveillance should be dictated by attention to the type and frequency of work practice, that is, flying; and to the prevalence of the relevant health "conditions" for age and sex, and the specific health history of the individual. Health conditions that are not affected by age and or activity, in general do not require iterative assessment.
- e. The process must be audited at every level, including the collection of data from the pilot.

4.2 The current CAA assessment process for determining the medical fitness of pilots to fly aeroplanes has been audited and the results have been presented in Chapter 2. The variance in practice seen is a direct consequence of this system having recognisable strengths and weaknesses.

4.3 The strengths of the current CAA system include the following.

- a. Many pilots have developed a relationship with a single medical practitioner in this context. This, and the exclusion of any perceived interference from a central authority, has often led to a trusting relationship and high levels of veracity.
- b. If the medical examiner is an AMA, then the certificate can often be issued immediately. Alternatively, if the examiner is not an AMA, but has a close relationship with an AMA, then a certificate can be issued reasonable quickly without the involvement of a central bureaucracy.
- c. The relatively large number of DMEs is such that a medical examiner is probably available locally for a pilot to consult and the role of the AMAs is such that a greater “pool” of community expertise is created than that which would exist under a centralised system.

4.4 The weaknesses of the current CAA system include the following.

- a. Many DMEs have neither appropriate training nor experience in aviation and or occupational health surveillance. For this reason and to obtain immediate certification, many pilots elect to be examined by an AMA.
- b. Some AMAs were appointed despite failing to meet the initial criteria set for passing the CAA entry examination; a sub-group of assessors also has no formal training in aviation medicine. The acceptance of some medical practitioners as AMAs, despite their examination failure, occurred as a consequence of a revision of the problematic examination marking system (described above). The “un-qualified” AMAs have been responsible for many thousands of pilot certifications. An audit of these certifications is essential.
- c. There is no audit of the base clinical data, only the resulting paper work; however, critical paper audits were not conducted for the first 6 years of the “de-centralised” scheme.
- d. The pilots fund the system, such that their interests are often paramount and there has been a consequent discounting of the obligation of the system to other risk acceptors. The end result tends to be primary pilot advocacy.
- e. A clerical assistant could perform about 75% of the assessments undertaken by the AMAs, or, in the context of the CASA system, the examination report could be machine read.

- f. The role and “legal” status of the CAA’s medical certification and appeals process is uncertain. This is the result of excessive deregulation, accompanied by inadequate attention to both the formulation of statutes and the writing of Rules.
- g. The “human factors” that are responsible for between 75 and 80% of aviation incidents are generally not addressed. To some extent, this has been left to flight reviews and simulator testing. The former are not objective and are not audited; whereas the CAA has rarely audited the latter.

4.5 In addition to recently discovered problems in legislative authority, the CAA’s medical licensing system of DMEs and AMAs is demonstratively systematically flawed. The consequent poor performance cited above is predictable from a sociological perspective, and also given that the current CAA system is largely inconsistent with international best practice. We believe that reform is essential and recommend the adoption of a simple hierarchy of designated Aviation Medical Examiners (AMEs), a CAA Medical Division, a CAA Aviation Medical Panel, the Director of the CAA, and finally, dispute resolution by the most appropriate branch of the legal/judicial system. The term designated AME is chosen here to achieve commonality with the CASA. We also strongly recommend that the system be partly publicly funded to re-establish the pre-eminence of public safety and the legitimacy of government involvement, that the CAA be staffed with at least 3 full-time aviation medical specialists, with assistance as required for tasks such as manual and policy development, and that the licensing functions of the CAA remain autonomous from the aviation industry, which is a key and valued feature of the successful regulatory systems in Europe and North America. Given both European and North American experience, such a functional divorce of licensing from the aviation industry will not inhibit either dialogue or responsiveness. The reform needs to be expeditious, not only because of issues of public safety and pilot health, but also operationally because of a forecast international pilot shortage.

4.6 Comparison of the CAA system with that operated in Australia, Canada, the USA and Europe shows some elements of practice that could be incorporated into a revised CAA system. It is clear that the pilots want a common system with Australia; the CAA and CASA share this view. It is also clear that the CASA machine-readable form enables about 75% of all assessments to result in certification without need for further medical assessment. The CAA FlightFit software is a for-runner of the definitive solution in this context, which would be an on-line assessment system. Transport Canada is developing such a system, the FAA has components of such a system in place, and CASA has been evaluating a similar system for some time. Finally, the Transport Canada multi-disciplinary Aviation Medical Review Board system is an objective method of determining pilot fitness under conditions of uncertainty or debate.

Chapter Five. A recommended process for assessing pilots' medical fitness to fly in New Zealand.

5.1 General Comments

The certification of a pilot's fitness to fly should be based on guidelines and precedents, with case-by-case considerations of marginal situations (see below). There should be an assessment of the risk of incapacitation in the next year and an assessment of functional capacity where disabilities are concerned. As much as and where possible, these assessments should be evidence based, transparent and auditable. The levels of acceptable risk should be stated explicitly; again, as much as is possible. We do not consider the selection of the actual risk thresholds to be our responsibility. Instead, such selection should be a community responsibility, on an ongoing basis and as advised by the CAA. International best practice (see Chapter 3) should be the basis on which maximum acceptable levels of risk of sudden incapacitation are chosen, taking into account local conditions such as accident compensation law. It needs to be noted that while differentiation between the various classes of certificate in this context is almost universal, the logic underpinning such an approach is controversial. Although the cumulative annual risk for Class 2 pilots will be lower, due to their reduced hours of flying, this argument quickly becomes absurd. This is well illustrated by an example cited by the UK-CAA. A recreational male pilot has a convulsion about once per week and is incapacitated for about one hour. He only wishes to fly for one hour per year. His cumulative annual risk of being incapacitated by a convulsion while flying is much less than 1%, but few would consider him fit to fly and even fewer would agree to fly with him as a passenger. Another strong argument against differential treatment of Class 1 and Class 2 pilots is that an incident is more likely to have an adverse outcome for the latter given that such pilots are more likely to be flying solo, will have less experience of managing such incidents, will have less current flying exposure and hence less work-conditioning, and will have less access to in-flight facilities, such as automated systems. Consequently, the reduced cumulative annual risk is offset by a higher probability of an adverse outcome. Transport Canada medical certification ("Medical Declarations") data shows just this, in that the likelihood of a medical problem causing incapacitation and hence resulting in an accident, for the ultra-light and small aeroplane "end" of the recreational flying spectrum, is about 15%. This contrasts with the equivalent Canadian rate of less than 1% for Class 1 pilots. However, even after taking into account this increased likelihood of an adverse outcome and accepting the difficulty in modeling such an increase in risk, we finally acknowledge the argument that flights involving Class 2 pilots have a much reduced level of direct (passenger) and indirect public risk and that risk acceptance is eventually subjective and communal.

Despite our view that it is not for us to recommend actual risk threshold levels (other than to report the levels used internationally), we nevertheless believe that the existence and use of "tools" such as FlightFit warrants strong support. Given the difficulties inherent in any evolving situation and where critical

knowledge is yet to be acquired, there needs to be some ongoing reference standard against which new experience can be evaluated.

It is also important to recognise that any risk threshold refers to the upper level of tolerable risk and “interventions or outcomes” cannot be applied rigidly within the risk band. For example, some conditions for which the risk of incapacitation will not exceed these thresholds, such as the case cited above of the epileptic, will nevertheless be considered incompatible with flight safety. It also needs to be conceded that previous decisions made by the CAA using a comprehensive 1% threshold were made in the context of the imperfect understanding that existed then. This complexity persists and we do not believe that any subsequent adoption of differential risk thresholds for the various classes of certificate holders would justify a retrospective challenge of those earlier CAA decisions.

In our use of the term, medical incapacitation is considered to have occurred if a certificate holder has developed symptoms or signs of disease that would significantly impede their ability to perform the assigned duties of such a certificate holder. We have accepted the definition of sudden incapacitation as the onset of functional incapacity within one hour. Where there is some doubt in the assessment of the risk, our recommendation is that the CAA uses a lower estimate where the rate of incapacitation is likely to be more rapid. Further, it is our opinion, that: the duration of the period of incapacitation is not relevant to any consideration of fitness to fly; and, that the risk relates to the risk of incapacitation at any time within the next year.

5.2 Our consequent recommended process for assessing pilot’s medical fitness to fly in New Zealand is shown schematically in Flow Charts 1, 2, 3 and 4 (see Figures 10 through 13 on pages 57 to 60). The following commentary refers to the explanatory notes in those flow charts. The superscripted notations also refer to these explanatory notes by way of cross-referencing.

5.3 Note 1. Medical and visual examination.

Following the submission of the revised process to ICAO, an AME will undertake the medical examination of Class 1 pilots second yearly to age 40, and then annually from age 41 to a selected age of compulsory retirement. Although any ageist discrimination is discouraged in New Zealand, Section 39(3)(b) of the Human Rights Act 1993 provides that “qualifying bodies may impose reasonable and appropriate terms and conditions by reason of age on a person holding qualifications or authorisations”. In this context, it is clear that there is a significant and progressive increase in accidents per flight hour in pilots over the age of 59 years (see Figures 14, 15 & 16 on pages 61 - 63). Consequently, we would recommend a pragmatic and common sense approach be taken to the problem of the aging Class 1 pilot. Our recommendation is that Parliament, in the interests of public safety, imposes a retirement age of 65 years for Class 1 pilots. It is noteworthy that many Class 1 pilots elect to retire before this age.

Class 2 pilots would be examined 5 yearly to age 60, and then annually from age 61.

The CAA could increase the frequency of examination for any pilot. In all other years, both Class 1 and Class 2 pilots would be initially (and usually only) assessed by a questionnaire (see below).

An AME would be a registered medical practitioner who has post-graduate training in aviation medicine and in the specific context of fitness-to-fly health surveillance, and who also satisfies the CAA's requirement for ongoing education. The CAA would be responsible for defining the competencies that need to be met for both initial and (3-yearly) ongoing courses. The CAA would keep a register of approved courses and consequently approved medical practitioners (AMEs). Review of currently available courses shows that the initial competencies for an AME could be satisfied by a 10-day course, similar to that taught at Monash University. Desirably, such a 10 day course would be divided into 5 day components; the first being an introduction to aviation and the second a contemporary review of aviation medicine in the context of health surveillance. Both components would be needed to satisfy the competencies for an initial course, while only the latter would be needed for ongoing education needs. Clearly, formats and especially syllabi should be left to the interested educational facilities, but the scheme above would help to obviate the throughput problems currently being experienced by Monash University and the CASA.

In addition to the 3-yearly re-fresher course, an AME would need to satisfy the following conditions.

- Access to necessary equipment (e.g. a multi-channel self-calibrating and reporting ECG that has an output that would be suitable for on-line transmission to the CAA).
- An annual throughput of at least 25 examinations (considered by us to be the minimum to retain skills and experience).
- A commitment to continuing education (e.g. annual attendance at a 2 day CAA seminar or the AMSANZ Conference).

All AMEs would be appointed for 3 year terms and reappointment would be contingent upon both meeting of the required education and satisfactory audit performance. Any one of the counseling and dismissal systems employed by the UK-CAA, Transport Canada and or the FAA is recommended. The requirement for a throughput of 25 examinations per annum will determine the number of AMEs needed and their regional distribution. Given that we believe travel of up to an hour is reasonable for such examination, it is unlikely that there will be much need for exceptional appointments (that is, outside the CAA's requirements), as is occasionally the case in both Canada and Australia.

A visual examination would be conducted at the same time as the medical examination by a designated Aviation Optometrist or Ophthalmologist (AO), or by an AME who successfully completes the training cited below and has access to the necessary testing equipment and conditions (which would appear to be the exception at present). An AO would be a registered optometrist or ophthalmologist who has post-graduate training in aviation medicine in the specific context of fitness-to-fly visual performance testing and who also satisfies the CAA requirements for ongoing education. The CAA would identify the required competencies. Again, as a guide, the initial 5-day introduction to aviation component cited above would be an initial requirement. Instead of the secondary 5-day medical component, a 2-day optical component would be sufficient. Given the interim solution proposed here (pending an on-line system), the AO's report would need to be available for the AME to issue an interim certificate.⁵

The relevant medical manual would be the CAA and CASA modification of the JAA Manual. The manual should only include medical standards, examination and assessment guidelines and administrative procedures. A revision of the CAA rules is needed to not only accommodate the revised process described here, but also to facilitate further revisions of this process consistent with factors such as changes in technology and disease prevalence. The relationship between any manual and rules and the legal status of a manual has been discussed previously elsewhere and will not be considered further here.

The aeroplane component failure logical origins of and the use of a cumulative annual estimate of CVS risk (of an incapacitating event during flight in the next year) to determine those pilots requiring further assessment (the so-called "1% Rule") is described above and is controversial. By definition, the predictive power of any assessment will be low when conditions of about 1% prevalence are considered. Framingham data and National Heart Foundation tables are helpful, but do not provide confidence intervals for the cited risks. Extension to a 5-year risk does not address the shortfall of confidence intervals, is useful from a wellness perspective, but is occupationally punitive. Not surprisingly, a rigid threshold risk estimate system is only in limited use (e.g. Australia). In large part and in the context of this discussion of CVS disease, this may have much to do with the risks of coronary angiography. Consequently, CVS threshold risk approaches may become more acceptable with the increasing use of myocardial perfusion scanning.

European and North American regulators do not use a formal risk threshold approach. The "in house" regulators at the UK-CAA and at Transport Canada use a threshold risk of between 1 and 5% respectively in their deliberations, although this is only formalised in the United Kingdom for the return to flying after some specific event (e.g. myocardial infarction or heart surgery). While the JAA approach is to replace such a threshold with didactic specific regulations, the UK-CAA, the FAA and Transport Canada rely upon their considerable "in house" expertise, collegiality and review panels. As cited above, the Transport Canada system is multidisciplinary, while the FAA and

UK CAA panels are usually only cardiological. All the regulators using an informal non-threshold approach, claim efficacy on the basis of the low incidence of recorded aviation accidents and especially those attributed to pilot health problems. Given the infrequency of such events, this is not statistically valid, with the exception of the FAA incident database, which suggests that their practice is on the early asymptotic phase of the risk exposure curve for flying.

However, the CAA does not have access to such concentrated expertise and the measured performance of the assessment system in New Zealand (see above), shows a clerical, procedural and clinical accuracy rate that is much lower than that of the FAA. The didactic approach adopted by the JAA, with the relative exception of the UK-CAA, is the antithesis of modern health surveillance (see above). Finally, the use of a threshold approach here is also justified by the following observations.

- There are no data to show that “clinical judgment” increases the predictive power of screening tests in the context of low prevalence conditions.
- The use of thresholds, where possible, increases the consistency of multi-examiner and assessor evaluations.
- A threshold risk system is employed in Australia.
- Organisations that do not use a threshold approach, such as the FAA, employ methods such as random in-flight pilot audits and random breath-testing, neither of which are part of the CAA regulatory process.

Initially, the CAA could adopt the CVS assessment process currently used by the CASA in Australia until the FlightFit tool developed for the CAA is assessed (by parallel use). However Flight Fit is based on a more appropriate treatment of the data than the CASA system, should be able to be available on-line and could be enhanced by inclusion of other factors (including lifestyle parameters such as exercise); hence, its preference. A FlightFit assessment would be applied to all pilots. In the absence of any other indications, pilots would be subject to such analysis 5-yearly from the age of 40 (males) or 50 (females) to 60, and then at age 62 and 64, and annually from age 65, as part of their annual medical assessment in those years.

5.4 Note 2. Biannual, annual or biennial flight review.

The reason for such testing is that active and latent human errors and deliberate violations are the major (75 to 80%) contributor to aviation incidents and accidents. The human factors involved are poorly tested, if at all, in a conventional medical interview and examination. To a large extent this form of functional assessment also recognises that current systems have “medicalised” physical performance competency issues. These factors vary from; decision making under conditions of competing priorities to being able to

get into and out of a cockpit, and for the pilot's speech to be able to be understood over a radio. The assessment would consist of both practical and written examination elements. The FAA procedure for assessment of "disabled" pilots is recommended as a template.

The class of certification and the age, health and flight record of the pilot would determine the frequency and nature of these assessments. An objective CAA format would be used. Assessors would be determined by random selection and, at CAA expense; some pilots would be randomly selected and re-called for a re-assessment audit. The obligation to comply with this audit would be integral to the CAA certification. Airline operators would be able to assume responsibility for this testing via simulator, but the CAA would also randomly audit this process.

Any pilot or pilot candidate who "fails" this assessment would be able to appeal to the CAA, and if a medical problem was thought to be the basis, to the Aviation Medical Panel.¹²

5.5 Note 3. Interview and examination by AME and AO.

Both an AME and AO are defined above, as is the manual and CVS cumulative annual risk assessment process to be used.

As cited above and following submission of the revised process to ICAO, an AME would undertake the medical examination of Class 1 pilots second yearly to age 40, and then annually from age 41 to a selected age of compulsory retirement. Class 2 pilots would be examined 5 yearly to age 60, and then annually from age 61. The CAA could increase the frequency of examination for any pilot.

In all other years, both Class 1 and Class 2 pilots would be assessed by questionnaire alone and any physical examination would be determined by the answers given on the questionnaire. This would result in more than 90% of pilots not having to undergo unnecessary physical examinations in those years where an examination is not mandated. The predictive power of such an examination in the absence of some declared (on the questionnaire) problem is very low.

Consent should be obtained as part of the licensing process for access to general practitioner records.

5.6 Note 4. Machine-readable CASA assessment form.

The CASA assessment form is machine-readable and enables an automated "clerical audit". Commonality with the CASA system is a primary objective of any new process. This form is intended for use only until an on-line system is in place.

5.7 Note 5. Interim certification.

Assuming that the AME and AO do not identify any of the conditions listed as either incompatible or possibly incompatible with flight safety,^{7,10,13} a 30-day interim certificate would be issued. For existing pilots this would consist of an amendment to the expiring certificate, as currently is almost universal practice.

5.8 Note 6. Form forwarded to CAA for assessment and random selection for audit.

Again, this would be common with the CASA system operating in Australia; but is considered an interim solution here pending an on-line system. The CASA form is able to be machine read, thus allowing an automatic clerical audit.

Some pilots would be randomly selected and re-called for a re-assessment audit at public cost; that is, they would be interviewed and examined on behalf of the CAA Medical Division.¹⁴ The obligation to comply with this audit would be integral to the CAA certification. If this clinical audit has a different categorical outcome, such as uncertain fitness versus fitness to fly, then the 2 assessments would be forwarded to the CAA Aviation Medical Panel for adjudication. As is the case for paper audit anomalies, the counseling and dismissal system used by the UK-CAA, Transport Canada and or the FAA is recommended.

5.9 Note 7. No anomalies.

This category would include those medical “conditions” that are considered compatible with flight safety. These health problems would be able to be defined by the manual and as a dynamic list that arises from CAA Aviation Medical Panel¹² determinations; the list would be available on the CAA Website.

5.10 Note 8. Issue definitive certificate.

Definitive certification (or a letter denying certification) would be issued by the CAA to candidates within 30 days of interim certification. Certification by the CAA could include conditional certification such as “fit to fly with or as a co-pilot”.

Based on the CASA and CAA experience, this would be possible in about 75% of pilot assessments following an automatic clerical audit.⁶ As the list of medical “conditions” that are considered compatible with flight safety increases, as a consequence of CAA Aviation Medical Panel¹² determinations, this frequency of “automatic” certification may increase. Given current funding streams, this clerical audit would save between \$350,000 and \$400,000, which would then be available to fund additional measures such as the CAA Aviation Medical Panel.¹²

The certificate would cite both the CAA and the ICAO expiry dates.

5.11 Note 9. Request completion; reply forwarded to CAA for assessment.

Once incomplete forms are completed, the usual audit process would occur.

5.12 Note 10. Health problem that is incompatible with flight safety.

Some of these health problems would be able to be defined by the manual and as a dynamic list that arises from CAA Aviation Medical Panel ¹² determinations; the list would be available on the CAA Website.

5.13 Note 11. Deny certification. Appeal to CAA Aviation Medical Panel available.

Any pilot denied medical certification of fitness to fly would be able to appeal for a review to the CAA Aviation Medical Panel; ¹² at their own expense.

5.14 Note 12. CAA Aviation Medical Panel.

The CAA Aviation Medical Panel would be chaired by an appointee of the Director of the CAA and would provide advice to both the Director on specific certifications and to the CAA's PMO for further clinical audits, which might reduce the need for further Panels. It is envisaged that the initial need for Panels would be high as outstanding issues are considered, but then should decrease significantly as the ongoing requirement would only be for pilot candidates being examined for the first time and or for those established pilots who have developed new problems. The Transport Canada Aviation Medical Review Board system is recommended for implementation without modification (see below and Appendix 2).

Disputes over process, and not over medical issues, would be referred immediately to the Director of the CAA. Unresolved procedural issues would be best resolved by the existing legal apparatus, which has the greatest applicability.

5.15 Note 13. Health problem that is potentially compatible with flight safety.

Some of these health problems would be able to be defined by the manual and as a dynamic list that arises from the CAA Aviation Medical Panel ¹² determinations; the list would be available on the CAA Website.

5.16 Note 14. Refer to CAA Medical Division.

The CAA medical personnel.

5.17 Note 15. Medical Division fitness assessment.

This process could include reference to the CAA Aviation Medical Panel ¹².

On the basis of the FlightFit CVS risk estimate, and in order to establish the fitness of a candidate to fly, the CAA would require the referral of some candidates for further assessment (e.g. stress-ECG). This would occur whenever the FlightFit CVS risk estimate exceeds some threshold, the selection of which should be based on international best practice (see Chapter 3). This risk level will eventually be subjective as such subjectivity is always a feature of community risk acceptance.

5.18 Note 16. On-line assessment.

On-line assessment systems are possible in New Zealand for FlightFit, and are in development in the FAA, Transport Canada and in Australia. Once proven by these regulators, we believe that the CAA should purchase the system. This system would enable an on-line multi-national audit system.

5.19 Note 17. Random selection for audit.

Selection for audit⁶ would occur randomly during the on-line audit, but neither the pilot nor AME (or DAO) would be informed until the assessment was complete and downloaded.

Some pilots would be randomly selected and re-called for a re-assessment audit at public cost; that is, they would be interviewed and examined on behalf of the CAA Medical Division.¹⁴ The obligation to comply with this audit would be integral to the CAA certification. If this clinical audit has a different categorical outcome, such as uncertain fitness versus fitness to fly, then the two assessments would be forwarded to the CAA Aviation Medical Panel for adjudication. As is the case for paper audit anomalies, the counseling and dismissal system used by the UK-CAA, Transport Canada and or the FAA is recommended.

5.20 Note 18. Input forwarded to CAA Computer System for assessment and reply downloaded.

Our intention is that this system would be at least common with that operated by the CASA, and preferably with that used by the FAA, Transport Canada and the UK-CAA.

5.21 Note 19. No anomalies.

This category would include those medical “conditions” that are considered compatible with flight safety. These health problems should be able to be defined by the manual and as a dynamic list that arises from CAA Aviation Medical Panel¹² determinations; the list would be available on the CAA Website and would be “flagged” during the downloading of the on-line assessment form.

5.22 Note 20. Issue certificate.

The certificate would be issued “on the spot” to the pilot by the AME. Based on the CASA and CAA experience, this would be possible in about 75% of pilot assessments following an automatic clerical audit.⁶ As the list of medical “conditions” that are considered compatible with flight safety increases, as a consequence of CAA Aviation Medical Panel¹² determinations, this frequency of “automatic” certification may increase. Given current funding streams, this clerical audit could save between \$350,000 and \$400,000, which would then be available to fund additional measures such as the CAA Aviation Medical Panel.¹²

5.24 Note 21. Incomplete data or minor clerical anomaly.

In the event of incomplete data or a minor clerical anomaly, the AME would be requested to provide the information required before any certification could be entertained.

5.25 Note 22. Health problem that is incompatible with flight safety.

Some of these health problems would be able to be defined by the manual and as a dynamic list that arises from CAA Aviation Medical Panel¹² determinations; the list would be available on the CAA Website and would be “flagged” during the downloading of the on-line assessment form.

5.26 Note 23. Health problem that is potentially compatible with flight safety.

Some of these health problems would be able to be defined by the manual and as a dynamic list that arises from CAA Aviation Medical Panel¹² determinations; the list would be available on the CAA Website and would be “flagged” during the downloading of the on-line assessment form.

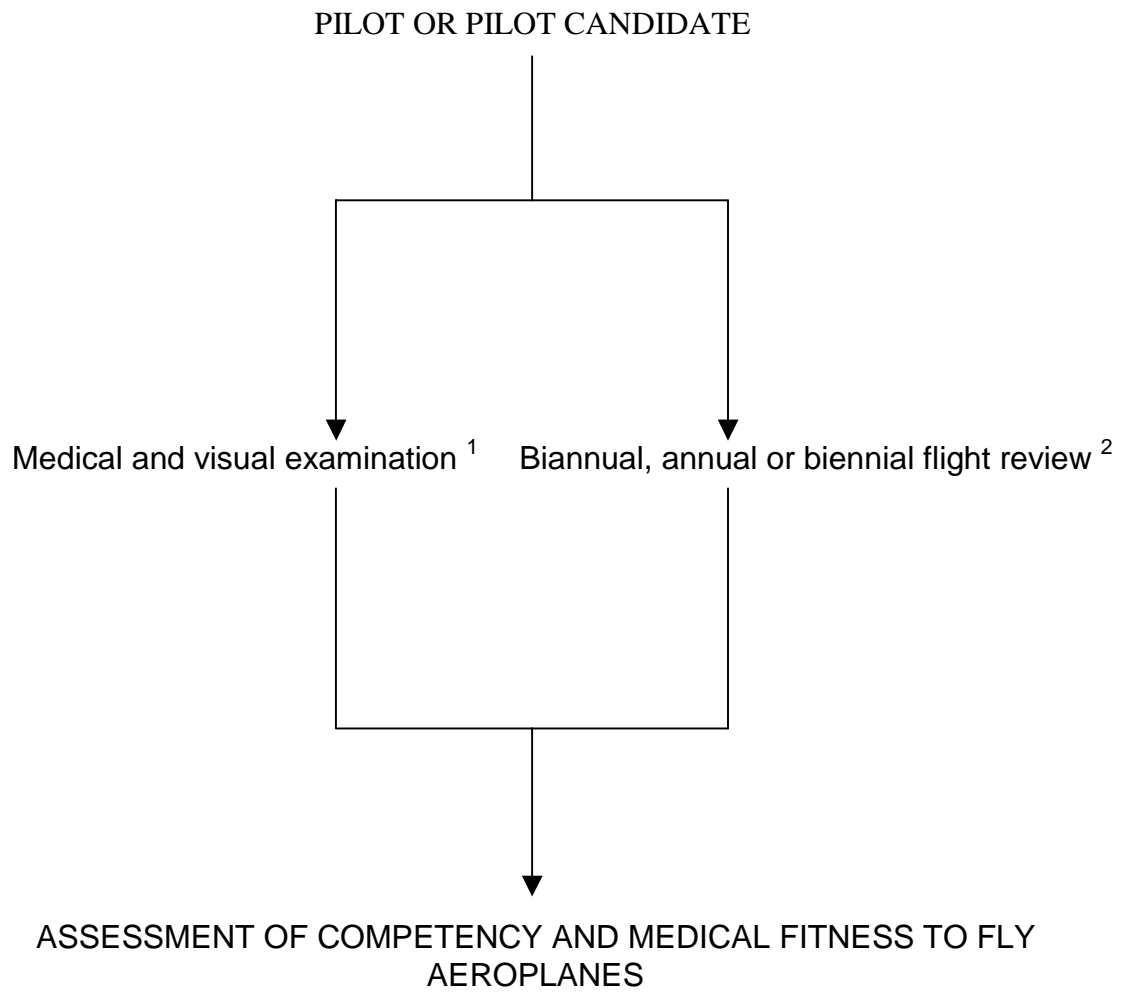
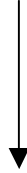


Figure 10: FLOW CHART 1

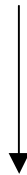
POSSIBLE INTERIM FORMAT

MEDICAL AND VISUAL EXAMINATION ¹

Interview and examination by AME and AO. ³
Machine-readable CASA assessment form. ⁴
Interim certification. ⁵



Form forwarded to CAA for assessment and random selection for audit. ⁶

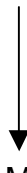


No anomalies ⁷ → Issue definitive certificate. ⁸

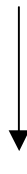
Incomplete data or minor clerical anomaly → Request completion; reply forwarded to CAA for assessment. ⁹

Health problem that is incompatible with flight safety ¹⁰ → Deny certificate. Appeal ¹¹ to CAA Aviation Medical Panel ¹² available.

Health problem that is potentially compatible with flight safety ¹³



Refer to CAA Medical Division. ¹⁴
Medical Division fitness assessment. ¹⁵



Fitness established → Issue or deny certificate. ⁸ Appeal ¹¹ to CAA Aviation Medical Panel ¹² available.

Fitness uncertain → Refer to CAA Aviation Medical Panel. ¹²

Figure 11: FLOW CHART 2

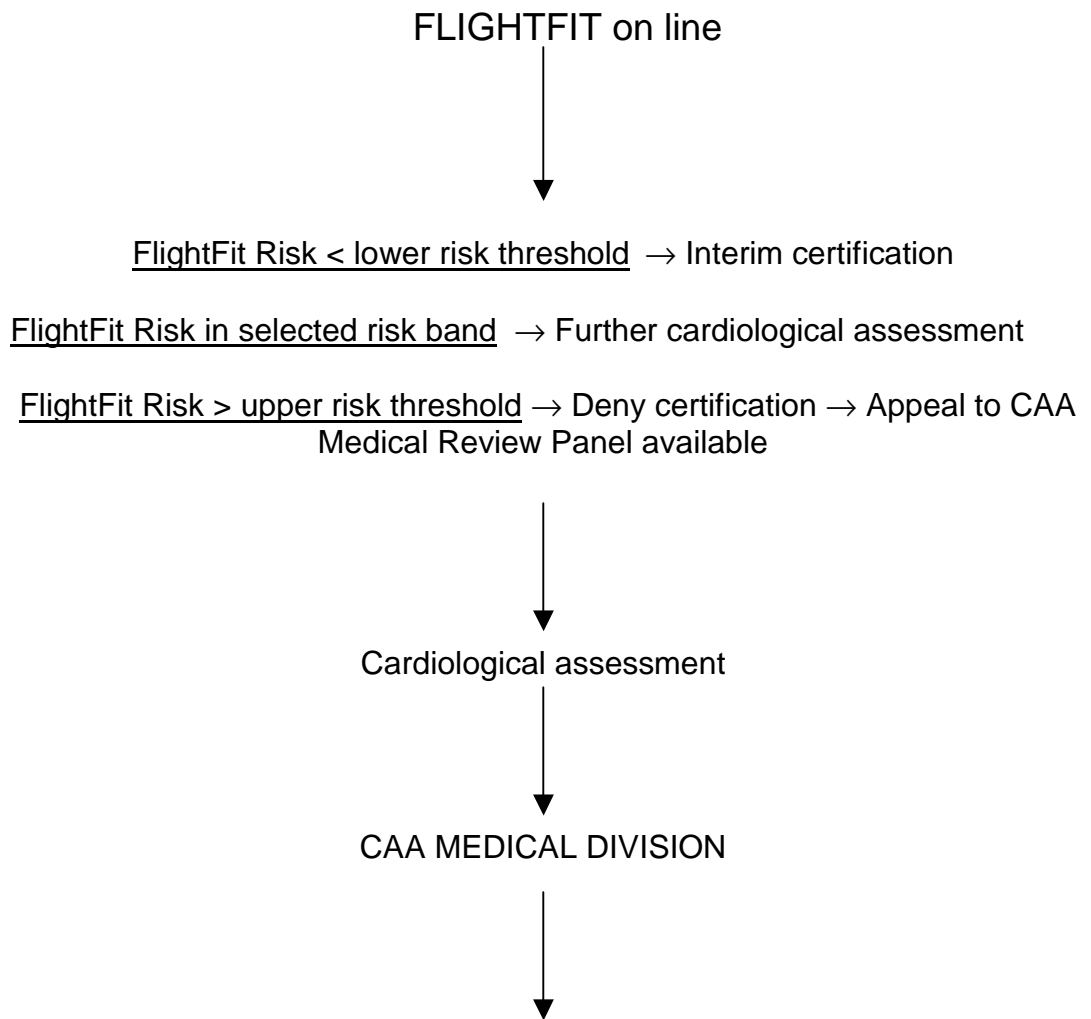
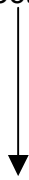


Figure 12: FLOW CHART 3

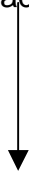
DEFINITIVE FORMAT

MEDICAL AND VISUAL EXAMINATION ¹

Interview and examination by AME and AO. ³
On-line assessment. ¹⁶
Random selection for audit. ¹⁷



Input forwarded to CAA Computer System for assessment and reply downloaded. ¹⁸

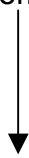


No anomalies ^{7, 19} → Issue certificate. ²⁰

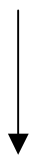
Incomplete data or minor clerical anomaly ²¹ → Request completion; input forwarded to CAA Computer System for assessment and reply downloaded. ¹⁸

Health problem that is incompatible with flight safety ²² → Deny certificate. Appeal ¹¹ to CAA Aviation Medical Panel ¹² available.

Health problem that is potentially compatible with flight safety ²³



Refer to CAA Medical Division. ¹⁴
Medical Division fitness assessment. ¹⁵

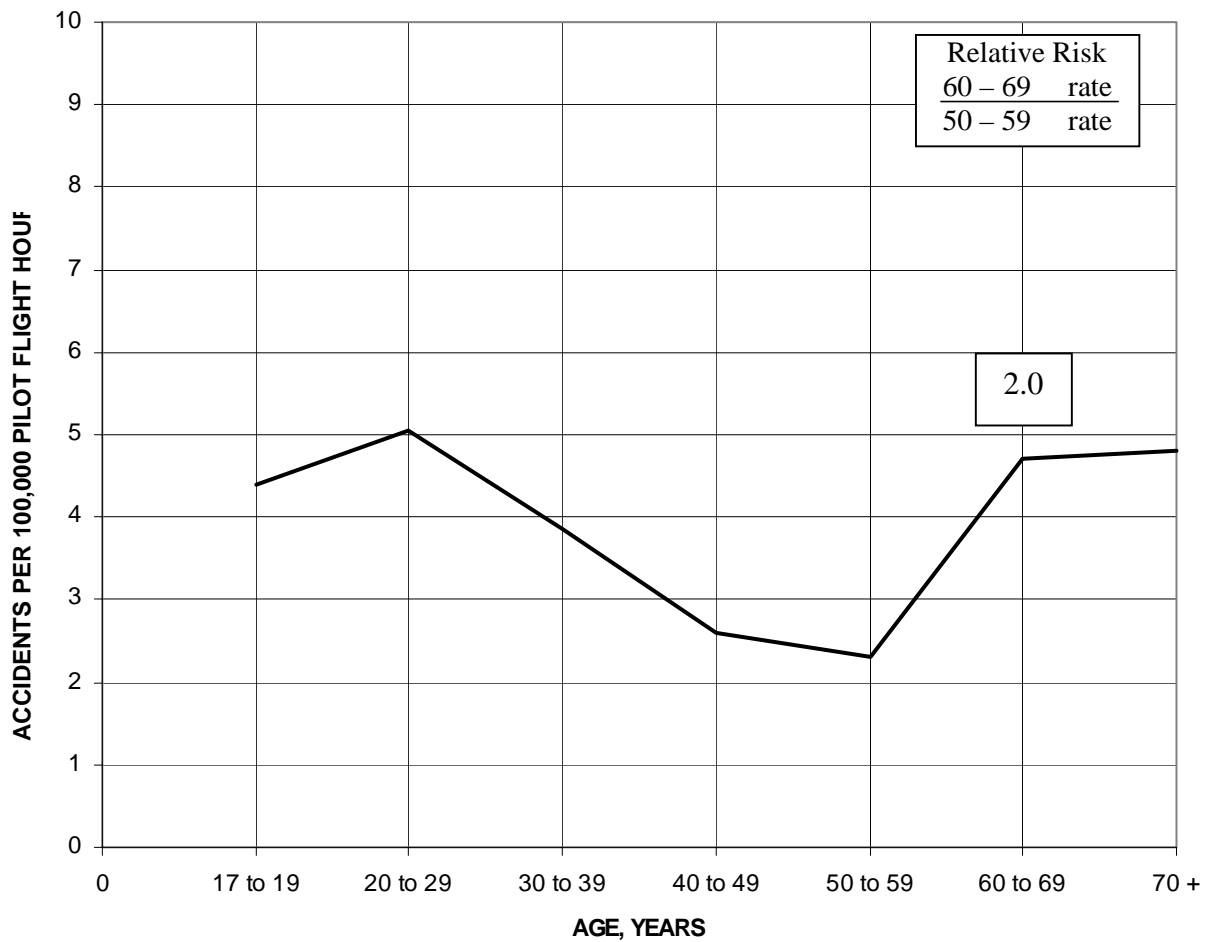


Fitness established → Issue or deny certificate. ⁸ Appeal ¹¹ to CAA Aviation Medical Panel ¹² available.

Fitness uncertain → Refer to CAA Aviation Medical Panel. ¹²

Figure 13: FLOW CHART 4

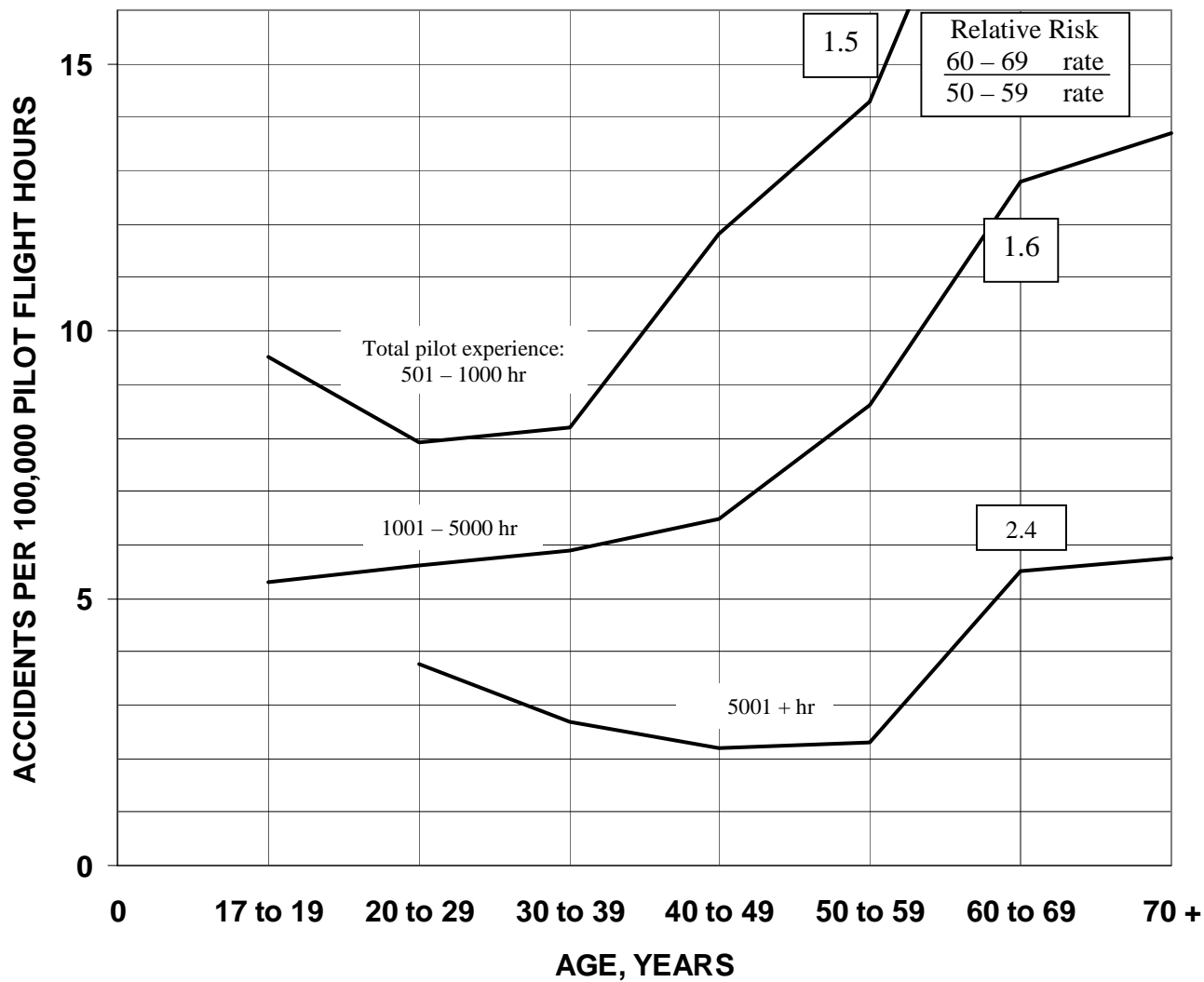
The combined effect of total flight experience greater than 1000 hr, and recent flight experience greater than 50 hours per year, is shown here. Increasing recent flying time reverses the increase in accident rates in the older pilots with over 1000 hr who do not fly as frequently. An age effect is present and is beneficial until 50, after which rates increase.



SOURCE: Dr Charles Billings, NASA Ames Research Center, 1990.
 Data from Golanowski, 1983 and NTSB 1990)

Figure 14: Accident Rates of Class I & II Pilots with > 1000 HR and > 50 HR Recent Flight Experience

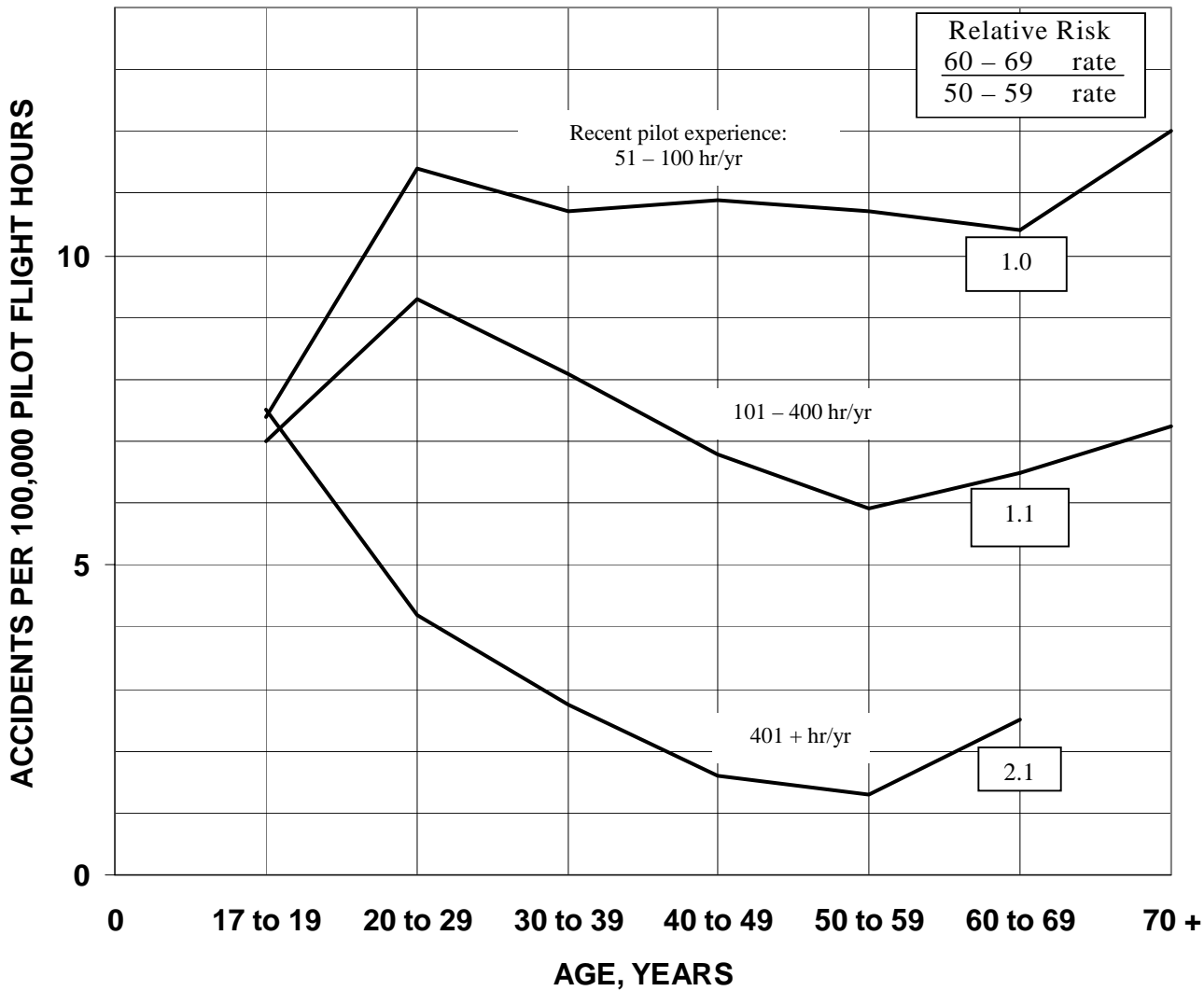
An increase in accident rates with increasing age is seen after age 39 in pilots with 501 – 1000 hr, after age 49 in pilots with 1001 – 5000 hr, and after age 59 in pilots with over 5000 hr. The data are consistent.



SOURCE: Dr Charles Billings, NASA Ames Research Center, 1990.
 Data from Golanowski, 1983 and NTSB, 1990)

Figure 15: Accident Rates of Class I & II Pilots vs Age and Total Time

The beneficial effect of recent flying experience exists at all levels, but there is no interaction with age in pilots flying less than 100 hr/yr. In pilots who fly more than 100 hr/yr, increasing age (and probably total experience) and increased recent flying time both have beneficial effects. After the age of 60, accident rates increase even if pilots continue to fly over 400 hours per year.



SOURCE: Dr Charles Billings, NASA Ames Research Center, 1990.
 Data from Golanazawski, 1983 and NTSB, 1990)

Figure 16: Accident Rates of Class I & II Pilots vs Age and Recency

Chapter Six. An implementation plan for the recommended process for assessing pilots' medical fitness to fly in New Zealand.

6.1 In addition to the CAA submitting the new system to ICAO, we recognise the need for a coordinated implementation of our recommended process for assessing pilot's fitness to fly; consequently, we would suggest the following actions.

6.2 Empowering legislation

Legislation is urgently needed to enable implementation of the revised centralised process of licensing pilots medically fit to fly. This legislation should facilitate a rapid evolution of regulations from an initial transition phase, to an interim solution involving CASA machine-readable forms, and to a definitive on-line system (see above).

6.3 CAA Medical Division

The CAA should appoint a full time PMO and 2 Deputy-PMO's; all need to be aviation medicine specialists. An aviation medicine specialist is defined here as someone who is preferably vocationally registered in occupational medicine, internal medicine and or public health medicine, and who must have a postgraduate qualification and relevant experience in aviation medicine. Salaries for these positions should be at international market rates to ensure appointee quality and credibility.

On the basis of using the Transport Canada Aviation Medical Review Board as a model (see Appendix 2), the CAA should also appoint a chairperson and invite expressions of interest from relevant specialists. A format for the composition of the Panel is tabulated below (Table 3, p. 66). Important features of the Canadian system, which are strongly recommended for the CAA Panels are that they are: the final arbiter of medical decisions; and, with the exception of the CAA medical person or other member of the Panel who has referred the pilot, or the pilot themselves in the case of self-referral, all deliberations are anonymous. An airline company or general aviation company may elect to be represented by one of their own medical personnel, but otherwise such employed medical practitioners are considered unsuitable for general Panel work.

6.4 Appointing AMEs

Existing DMEs and AMAs should be invited to apply for a position as an AME, and dependent on the quality of their audited performance, should be appointed or not. An invitation to other medical practitioners should also be made through newsletters, newspapers and the New Zealand Medical Journal; these applicants should be selected for recruitment on the basis of a CAA examination. All appointed AMEs should be given a 3-year period of grace in which to meet the CAA requirements cited above.

6.5 CASA Machine Readable System

Given that an on-line system will not be available in time, the interim solution outlined in Chapter 5 is recommended. This would require immediate liaison between the CAA and the CASA to purchase (and distribute) forms and to purchase the form reading hardware and software.

6.6 Courses in determining fitness to fly aeroplanes

The CAA should take responsibility for annual re-fresher courses and forward the Monash University Aviation Medicine Course, the FAA Oklahoma City Course, and the UK-CAA Course outlines to all national tertiary institutes as templates and to invite expressions of interest. As a safeguard, the CAA should also tentatively plan to conduct an annual 10-day course, as described above.

6.7 Strategic alliances

The CASA, the FAA, Transport Canada and the UK-CAA have all expressed an interest in multi-national strategic alliances. Such an alliance will be inevitable and highly effective once an on-line system of licensing pilots fit to fly is available. In the interim, the CAA should enter into formal alliances with the following tabulated expectations (see Table 4, p. 69).

Table 3 – Composition of Aviation Medical Panel

<u>Position</u>	<u>Comments</u>	<u>Recommendations</u>
Chairperson x1	<p>Experience in “Board” management would be essential, along with vocational registration in occupational medicine and some past experience of a similar medical certification process.</p> <p>A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.</p> <p>The CAA PMO would be the Deputy Chairperson.</p> <p>Can be dismissed by the Director of the CAA.</p>	<p>Dr Peter Robinson is strongly recommended, given his vocational registration in public health and occupational medicine, his previous experience as the Director General of Defence Medical Services (which involved much of this type of work), his residency in Wellington and his current role with the Medical Protection Society.</p>
CAA Medical Personnel x3	<p>Appointed for the tenure of their employment.</p>	
Cardiologist x1	<p>A cardiologist with an interest in cardiovascular assessment. A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.</p> <p>Employees of airline and aviation companies would be excluded.</p> <p>Appointed for a 3-year term.</p> <p>Can be dismissed by the Director of the CAA.</p>	
Endocrinologist x1	<p>An endocrinologist with an interest in diabetes. A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.</p> <p>Employees of airline and aviation companies would be excluded.</p> <p>Appointed for a 3-year term.</p> <p>Can be dismissed by the Director of the CAA.</p>	

ENT Surgeon x1	<p>An ENT surgeon with an interest in audiology. A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.</p> <p>Employees of airline and aviation companies would be excluded.</p> <p>Appointed for a 3-year term.</p> <p>Can be dismissed by the Director of the CAA.</p>	
General Physician x1	<p>A physician with an interest in respiratory medicine (and perhaps haematology). A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.</p> <p>Employees of airline and aviation companies would be excluded.</p> <p>Appointed for a 3-year term.</p> <p>Can be dismissed by the Director of the CAA.</p>	
Independent Aviation Medicine Specialists x2	<p>A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) would be essential and both vocational registration in occupational medicine and flight experience highly desirable.</p> <p>Employees of airline and aviation companies would be excluded.</p> <p>Appointed for 3-year terms.</p> <p>Can be dismissed by the Director of the CAA.</p>	<p>Dr John Faris is highly recommended as one of the 2 appointees for the first 3-year term, as he is vocationally registered in occupational medicine, is a military and civilian pilot and holds the UK Dip.Av.Med. from Farmborough.</p>
Neurologist x1	<p>A neurologist with an interest in human performance. A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.</p> <p>Employees of airline and aviation companies would be excluded.</p> <p>Appointed for a 3-year term.</p> <p>Can be dismissed by the Director of the CAA.</p>	

Ophthalmologist x1

An ophthalmologist with an interest in optical assessment. A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.
Employees of airline and aviation companies would be excluded.
Appointed for a 3-year term.
Can be dismissed by the Director of the CAA.

Psychiatrist x1

A psychiatrist with an interest in human performance. A postgraduate qualification in aviation medicine (e.g. Dip.Av.Med.) and or experience in flying would be helpful.
Employees of airline and aviation companies would be excluded.
Appointed for a 3-year term.
Can be dismissed by the Director of the CAA.

Table 4 – Strategic Alliances

<u>Organisation</u>	<u>Strategic Alliance Objectives</u>
CASA (Australia)	As common a system as is possible and mutual recognition/issue of each other's licenses, with an intermediate-term aim of a common licence. Data sharing. Exchange program. Monash University Course template.
FAA (USA)	Contribution to and access to the FAA Incident Database. Adoption of the FAA system of assessing, counselling and dismissing medical examiners. Exchange program. Oklahoma City Course template.
Transport Canada	Adoption of the Transport Canada Medical Review Panel system. Data sharing. Exchange program. Transport Canada Course template.
UK-CAA	Data sharing. Exchange program. UK - CAA.

Appendix One. Audit Terms of Reference

Background

1.1 The purpose of Civil Aviation Authority (CAA) medical examinations and assessments is to determine whether an applicant meets certain appropriate medical requirements to hold a medical certificate (Civil Aviation Rule Part 67). Holding an appropriate current medical certificate enables a person holding a pilot licence to exercise the privileges of that licence (Civil Aviation Rule Part 61.35). These Rules cover the requirements for medical entry control as well as enforceable requirements for continued participation and exit control. Administrative processes and codes of practice are found in the CAA Medical Manual and Advisory Circular 67.

1.2 Medical examinations are conducted by Designated Medical Examiners (DMEs). Prior to 1992 the reports of examinations by DMEs were assessed centrally at CAA by CAA officials. Since 1992 the majority of medical assessments have been devolved to private medical practitioners authorised by the Director of Civil Aviation (DCA) as Aviation Medical Assessors (AMAs) who directly issue medical certificates.

1.3 Along with the experience gained by both the CAA and industry from using this system, a number of changes and events have taken place that justify reviewing Part 61, Part 67 and the current model for medical certification including administrative practices. These include:

- The establishment of a Personnel Licensing Unit,
- The appointment of a new Principal Medical Officer,
- Findings from audits of AMAs conducted by the CAA,
- Experience arising from CAA responses to unsatisfactory audits,
- Cardiovascular risk assessment tool development,
- Industry disquiet about perceived changes to the medical assessment process, and
- The judgment in the Presland versus CAA court case.

1.4 The CAA accepts that this review is a high priority.

Objectives

2.1 The objective of this review is to assess the validity and reliability of the current medical assessment model utilised by the CAA in terms of safety at reasonable cost, and make such recommendations to the Director as it sees fit in relation to:

- The model used including monitoring and compliance processes;
- The current rules; and,

- The governance of medical certification processes and the relationships for implementation.

A secondary objective is to review the actions taken by the Personnel Licensing Unit in recent high profile issues and report to the Director on the appropriateness of those actions.

Scope

3.1 The review team will deal with the following matters separately and report back to the Director of Civil Aviation in a report.

3.2 The review team will consider whether the current regulatory and administrative model for medical examinations and assessments,

- is appropriate;
- is functioning effectively; and
- is sustainable.

It shall make recommendations for any changes it considers appropriate. This should be considered in light of CAA's mission to regulate for civil aviation safety at reasonable cost, its international obligations, and the desirability of international harmonisation (in particular the Trans Tasman Mutual Recognition Act).

3.3 The review team will consider the current structure of central medical certification taking into account the following issues:

- (a) The appropriateness of the incorporation of the previous Medical Unit into the Personnel Licensing Unit headed by Manager Personnel Licensing (non-medical);
- (b) The appropriateness of the current number and qualifications of staff;
- (c) The handling of medical records;
- (d) Ownership of, and access to, medical information collected for the purpose of medical certification.

3.4 The review team will review issues relating to AMA and DME entry control criteria including:

- (a) The appropriateness of the appointment criteria for AMA and DMEs and the means of attaining those criteria;
- (b) The appropriateness of the CAA's current policy of limiting the number of AMAs and DMEs;
- (c) The requirements of the New Zealand Medical Council including vocational registration and oversight;

- (d) The harmonisation potential for both Australian and New Zealand requirements, or the direct recognition of Australian and other qualifications.
- 3.5 The review team will review the requirements for continuation training of AMAs and DMEs by addressing the following points:
- (a) Recent experience and re-qualification requirements;
 - (b) The appropriateness of the current relationship between the CAA and AMSANZ;
 - (c) Enforcement by the CAA of continuation training requirements.
- 3.6 The review team will consider issues relating to monitoring and exit control including:
- (a) The role and appropriate content of monitoring (audit);
 - (b) The role of compliance and the current procedure for suspension or revocation as a DME or AMA or referral to exit control;
 - (c) The relativity, if any, between the CAA and the Medical Council;
 - (d) The appropriateness of and criteria for re-entry.
- 3.7 The review team will consider issues relating to complaints and requests for review including a review of medical assessment decisions including the Aviation Medical Review Board.
- 3.8 In considering 3.4, 3.5, 3.6 and 3.7 the review team will consider
- (a) The role, obligations and accountability of the CAA, the Manager Personnel Licensing, the Principal Medical Officer, AMAs and DMEs;
 - (b) The role of the Rules, Advisory Circular and Medical Manual;
 - (c) Compliance with and enforcement of rules, policy and procedures
 - (d) The role of the CAA in issues that have potential commercial ramifications (for example, N action codes).
- 3.9 In considering each matter, the review team should take into account the following:
- (a) New Zealand's obligations as a signatory to ICAO;
 - (b) The outcomes from the ICAO Audit (August 1999);
 - (c) New Zealand's obligations under the TTMRA;
 - (d) Any appropriate international standards;
 - (e) The provisions of the Civil Aviation Act 1990, and established rule-making practices.

Review Team

4.1 The review team has been designated as follows:

(a) Independent reviewers: Professors Des Gorman and Sir John Scott

(b) CAA Liaison: Richard Macfarlane, Manager Personnel Licensing Unit
Kathleen Callaghan, Principal Medical Officer and Barbara Handley,
Executive Officer

Consultation

The review team should seek and receive submissions from appropriate interested parties, and at its discretion hold discussions with those parties

Parties may include:

- Authorised AMAs and DMEs
- Pilots and air traffic controllers who are clients of the CAA
- The public of New Zealand
- Industry organizations
- International experts in Aviation Medicine
- Other civil aviation regulatory authorities

CAA

6.1 The Director is not bound to accept or act upon the findings of the review. The CAA will not revise any recommendations or reports by the independent reviewers since they are the product of expertise that the CAA may not possess. This review is commissioned by and for the Director of Civil Aviation and release of any elements of it to the public domain should be at the Director's discretion, and in accordance with relevant statutes.

Reporting

7.1 The independent reviewers shall report all findings, unresolved issues, and recommendations to the Director with appropriate supporting material. In the first instance, and where deemed appropriate by the independent reviewers, this should be to the CAA liaison group in draft form.

Timing

8.1 The independent reviewers will coordinate meeting times and places.

Budget

9.1 The CAA will meet all costs associated with the review.

Administrative Support

10.1 While on site, the Personnel Licensing Unit will be responsible for providing secretariat functions for the project.

Appendix two. Transport Canada Aviation Medical Review Board Terms of Reference

General

The Aviation Medical Review Board (AMRB) is appointed by the Director, based on the data available without the need of a Board Review if in his judgement this is not necessary. If however the Region requests that any particular case be reviewed by the full AMRB or a specific consultant, this shall be done.

'Minor' cases will be presented to the Consultant selected with a brief summary. The complete medical file will be available to the Consultant.

'Major' cases will be summarized, with all the pertinent information being presented but with the summary and reports being depersonalized. AMRB summaries (discussions) and conclusions of any previous deliberations of the AMRB on the same case will accompany the current report. Each member of the AMRB will receive a copy of the summary for consideration but the file will remain in the hands of the Chairman who will answer questions of the members.

A Specialist in Aviation Medicine, an Airline Medical Officer or a Civil Aviation Medical Examiner (CAME) may attend at the chairman's discretion as a guest or to discuss a case in which he/she has an interest. Physicians involved in aviation medicine coming from International Civil Aviation Organization or any foreign country may be welcomed as guests. Other physicians, experts in different fields of medicine may be invited by the AMRB to shed some light on controversial topics. After the discussion, visiting physicians will be asked to leave before an AMRB's concluding recommendation has been reached. Visiting physicians shall have no voting privilege. Other non-physicians such as aviation association representatives, or agents from Transport Canada, General Aviation Branch, may, from time to time, be invited as guests to discuss operational issues, special topics or proposed new regulations. These non-physician guests shall not be involved in the discussion of actual cases.

Discussion of all cases will be 'protected-sensitive material'. The Chairman will make every effort to obtain a consensus of the members but, if this is not possible, should cast a deciding vote.

After completion of the AMRB session, it will be the responsibility of the Chairman or his delegate to summarize the AMRB's discussion and recommendations, reflecting closely the AMRB views and concerns as they relate to established standards, flight safety, current medical practice and forward them to the appropriate Civil Aviation Regional Medical Office.

Action by RAMO's and their delegated AMO's

RAMOs and their delegated AMOs should submit cases to the AMRB for guidance and advice prior to the allocation of a Category where medical

decisions are not clear, and/or in complicated cases where there may be other reasons to obtain consultation. The AMRB will render a recommendation. If a RAMO does not agree with that recommendation, he should notify the chairman. Because of the concern for national uniformity, the AMRB should reconsider the disposition of the case with the RAMO who should attend such a discussion either personally or through a teleconference.

Regions are encouraged to submit cases to the Board which are of particular medical interest or might be of value for the updating of medical policies or guidelines. Cases of serious disease before and/or after treatment should also be submitted in order that a national data base for follow-up can be established. All Regions will be informed of cases whose recommendations represent changes in policies or guidelines, so as to maintain uniformity in aeromedical dispositions Civil Aviation Medicine Branch (DCAM), to consider cases referred for opinion and recommendation by the Regional Aviation Medical Officers (RAMOs). It consists of a group of specially qualified Medical Consultants and specialists in Aviation Medicine. It meets on a regular basis, usually every two weeks, in the CAM Headquarters in Ottawa. In addition to the regular AMRB meetings it will also, at the request of the DCAM or his representative, submit advice on medical matters and guidelines as required. It may be used as a resource group by the Branch as necessary in aviation medical research and teaching.

Composition

The AMRB shall have the following composition:

Senior Consultant, Clinical Assessment - Chairman.

Senior Consultant, Operations, Policy and Standards.

A RAMO or an Aviation Medical Officer (AMO) - When available.

Appointed Medical Consultants - Members.

The appointed Medical Consultants will generally consist of, but not limited to, specialists in Cardiology, Internal Medicine, Ophthalmology, Psychiatry, Neurology, Otorhinolaryngology, oncology and Aviation Medicine

Quorum

A quorum shall consist of not less than five members, of whom no less than two, will be Specialists in Aviation Medicine and no less than two Medical Consultants. Every effort will be made to ensure that the case to be discussed is reviewed when the relevant Medical Consultant is present for the discussion. All Aviation Medical Officers (RAMOs and AMOs) are encouraged to attend a Board review, ideally, at least once a year.

Meetings

The AMRB shall convene as often as is necessary to avoid delays in assessment. This will normally be every two weeks.

Procedures

It will be the responsibility of the Senior Consultant, Clinical Assessment (SCCA) or his delegate to review the cases referred by the Regions and prepare them for presentation to the AMRB. At the discretion of the SCCA the cases may be considered 'minor' - that is to be presented to a single Consultant (e.g. pure ophthalmological cases) or 'major' and presented to the full AMRB. The SCCA will also have the flexibility of making a decision or giving a recommendation and assessment.

Appendix three. Submissions to the audit team

Aircraft Owners and Pilots Association (New Zealand) Inc.
correspondence - Neil L Stevenson

Aviation Medical Society of Australia and New Zealand (AMSANZ)
correspondence - Dr Robin Griffiths, Dr Tim Sprott,

Health Outcomes Associates – Richard J Milne

New Zealand Airline Pilot's Mutual Benefit Fund
correspondence - Jeremy Kippenberger, Captain M Talbot, Barry
Kirkwood PhD

Royal New Zealand Aero Club Inc
correspondence – R G Sumpter

Sport Aircraft Association NZ Inc
correspondence – Mick Brannigan

The Guild of Air Pilots and Air Navigators
correspondence – Allan Boyce

The New Zealand Air Line Pilots' Association.
correspondence – Philip Seale, Keith Molloy, David Earle

J. Barrowclough	Tauranga
J.N. Buddle	Wellington
D.R Cholmondeley-Smith	Torbay, Auckland
J.Connell	Rotorua
L.J Day	Papakura
R.L.Ewing	Rangiora
J Faris	Auckland
R.J Gunson	Hawkes Bay
Alister Lee	(By email)
J.C Montgomery	Cheviot
Alan Murgatoyd	Kerikeri
John O'Hara	Westpark, Auckland

P.M Rhodes	Wanaka
Graham Robinson	Mairangi Bay, Auckland
P.H. Scotter	Kaiapoi
Dr Brian Spackman	Newmarket, Auckland
R.G. Sumpter	Whangarei
K. van der Helm	Raglan
R.A (Bud) White	Wanaka

In addition a number of people speaking as individuals and, or, as members or representatives of various pilot, company and medical professional groups were involved in direct discussion with us. We are grateful to them for their contribution to our deliberations.

Appendix Four. References

The following listing sets out the bulk of the material specifically examined but excludes submissions by individuals and relevant organisations within New Zealand. A considerable amount of material made available by CAA NZ and some from CASA Australia is not listed. The bibliography is listed under countries of origin and roughly grouped according to topic, rather than being alphabetical. We are most grateful to many organisations from overseas that submitted material, particularly from the FAA.

Australia

Use Your Head: The case for compulsory psychological assessment in aviation. Coetzee J, from Institute for Aviation Safety, Republic of South Africa. Presented to Australian Aviation Psychology Symposium November, 2000.

Course Curriculum. Australian Certificate of Civil Aviation Medicine. Sham T, November 1992 (version two) – CASA.

The Ageing Pilot – Ellard J, 1995. Text of Broome Conference Lecture.

Sundry documents describing aspects of the Australian system.

Lecture Transcript, The Aging Pilot,
John Ellard. 29a Almora St, Balmoral, NSW Australia. 2088

Canada

Flight 2005 – A Civil Aviation Safety Framework for Canada. Transport Canada, December 1999.

Prediction of the high-risk airline pilot. Anderson I H. Civil Aviation (Canada) Medicine Technical Report, 1973. 44th Annual Scientific Meeting of the Aerospace Medical Association, Las Vegas, Nevada, May.

Professionalism: an ideal to be sustained. Cruess R L et al. 2000. Lancet Vol 356 pp 156-159.

Sundry tables of statistics including Summary of Personnel Licences as of September 2000.

France

Clinical Aspects of Inflight Incapacitations in Commercial Aviation. Martin-Saint-Laurent A, et al 1990 – Aviation, Space, and Environmental Medicine Vol 61, pp 256-260

Sudden Incapacitation Encountered in Flight by Professional Pilots in French Civil Aviation, 1948-1972. Raboutet J & Raboutet P, 1975 – Aviation, Space, and Environmental Medicine Vol 46, pp 80 & 81.

Belgium

Lifetime-risk prediction: a complicated business. De Backer G & De Bacquer, 1999. Lancet (commentary) Vol 353, p 82
(This commentary related to an article entitled: Lifetime risk of developing coronary heart disease – Lloyd-Jones DM et al, 1999 Lancet Vol 353 pp 89-92)

Israel

Air Accidents, Pilot Experience, and Disease-Related Inflight Sudden Incapacitation. From P et al, 1988. Aviation, Space, and Environmental Medicine Vol 59, pp 278-281

New Zealand

Sundry publications by Civil Aviation Authority of New Zealand, particularly text of Civil Aviation Rules Part 67 – Medical Standards and Certification.

Various sections of the CAA Medical Manual including Appendix A to Volume 2, Chapter 3 – Notes for DMEs on Taking an ECG. February 1997.

Draft – Flight Test Standards Guide – Private Pilot Licence – Helicopter.

Particular attention was paid to Chapter 3 of the Manual – Cardiology (Cardiac Conditions) – CAA February 1997

Verbatim summary of evidence presented at Taumaranui Coroner's Court

Professional Ethics. Scott PJ 1980. Journal of NZ Dietetic Assn. October pp 2-10

Screening for coronary vascular risk in civil aviation. Milne RJ. Submission – September 29 2000. (plus other material relating to “FlightFit”)

The Effects of ageing on Cognitive and Sensory Functions: Implications for Older Pilots, Margaret A Francis, PhD. Report to CAA NZ October 1999

United Kingdom

Aviation Safety Review 1990-1999. Civil Aviation Authority (CAP701) – October 2000.

The 1% Rule Re-Visited. Evans ADB – Civil Aviation Authority Gatwick, UK.

Airline Pilot Incapacitation Survey. James M & Green R. 1991. Aviation, Space, and Environmental Medicine Vol 62 pp 1068-1072

Exercise testing in clinical medicine. Ashley EA et al. (Oxford, Stanford USA and Palo Alto) 2000: Lancet Vol 356, pp 1592-97

Indications for cholesterol lowering medication: comparison of risk-assessment methods. Durrington PN, 1999: Lancet Vol 353, pp 278-81 and subsequent correspondence Lancet Vol 353, pp 1095-1098

Role of medical factors in 1000 fatal aviation accidents: case note study. Cullen SA et al. 1997 BMJ, Vol 314, p 1592

When primum non nocere fails. Lancet editorial 2000: Vol 355 p 2007

Lancet commentary. The uses of error. 1999: Vol 353 pp 422 & 423

Risk of coronary heart attack in the normal population and how it might be modified in flyers. Tunstall-Pedoe H. 1984: European Heart Journal 5 (Supp 1) pp 43-49

Human performance in general aviation. O'Hare D. 1999. Ashgate Publishing

United States of America

Copies of sundry Federal Aviation Authority publications including those developed jointly with ICAO.

Description of the Department of Transportation Federal Aviation Administration structure and functions.

Civil Aviation regulations (State) Part 2: Personnel Licensing Version 1.0 June 1999

Model Rules for Achieving IACO Safety Standards.

A Guide for Prospective FAA Aviation Medical Examiners. December 2000

Medical Certification – United States of America (MacEachen - December 2000)

Report to Congress – Air Carrier Pilot Pre-Employment Screening Standards and Criteria Study – 1996.

Aviation Medical Examiner System – January 1999

Department of Transportation FAA. Revision of Airman Medical Standards and Certification Procedures and Duration of Medical Certificates; Final Rules. March 1996

The Link Between Employee Mishap Culpability and Aviation Safety. Marx DA. Seattle University School of Law, January 1998.

Illness or incapacitation in aviation safety incidents. Mortimer RG. 1995: in Human Factors in Aviation Operations – Proceedings of the 21st Conference of the European Association for Aviation Psychology Vol. 3

Intercranial Aneurysm and Sudden Death. Berkheiser SW, 1972. Aerospace Medicine Vol 43, pp 331 & 332

A Comparison of Postmortem Coronary Atherosclerosis Findings in General Aviation Pilot Fatalities. Booze CF & Staggs CM. 1985. Office of Aviation Medicine FAA. Report No DOT/FAA-AM-85-6

Sudden in-flight incapacitation in general aviation. Booze CF. 1986. FAA Document No DOT/FAA/AM-8717

Sudden Incapacitation: USAF Experience, 1970-80. Rayman RB & McNaughton GB. 1983. Aviation, Space, and Environmental Medicine Vol 54, pp 161-164

Medical Causes of In-Flight Incapacitation: USAF Experience 1978-1987. McCormick TJ & Lyons TJ. 1991. Aviation, Space, and Environmental Medicine Vol 62, pp 884-887

Multidimensional Risk Assessment versus Age as Criterion for Retirement of Airline Pilots. Stuck AE et al. 1992. Journal American Geriatric Society Vol 40, pp 526-532

Statement of L Nicholas Lacey, Director of Flight Standards Service FAA to Senate Committee, July 2000. Potential Pilot Shortage.

Statement of Thomas McSweeney, Associate Administrator for Regulation and Certification FAA to House Committee on Issues Arising from the Crash of Egypt Air Flight 990. April 2000.

Memo concerning regulations for Flight Review, FAA 1997. Amended April 1998.

Airman Medical Certification – Disqualification procedures. US Department of Transportation FAA. Document 8500.1C

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