CIVIL AVIATION AUTHORITY OF NEPAL

FLIGHT SAFETY STANDARDS DEPARTMENT

AVIATION MEDICAL HANDBOOK

Second edition January 2021

FOREWORD

This Second Edition of Medical Handbook has been developed and issued by Civil Aviation Authority of Nepal (CAAN) pursuant to the Rule 82 of Civil Aviation Regulations 2002. The main purpose of the Medical Handbook is to assist and guide Designated Medical Examiners, Civil Aviation Medical Assessors of Civil Aviation Authority of Nepal in decisions relating to the medical fitness of license applicants as specified in Personnel Licensing Requirements (PELR) and Medical Requirements.

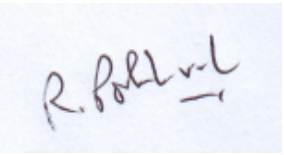
When making a Medical Assessment, the relevant operating environment should be borne in mind. Applicants engaged in single pilot commercial operations carrying passengers clearly require the most careful medical evaluation in order to reduce the risk of in-flight incapacitation. Those engaged in multi crew operations, where there has been effective incapacitation training, may be considered less stringently. In many such cases flight safety may be adequately protected by an operational condition or limitation applied to the license.

When consulting the Medical Handbook, it should be remembered that it is intended as guidance material only and as such has no regulatory status unlike the requirements. Its users should, whenever in doubt, always make reference to the text of the current edition of Personnel Licensing Requirements (PELR) and Medical Requirements (MR) for up-to-date information on SARPs.

The relevant ICAO annexes and CAAN requirements are often referred in this handbook to indicate the international standards and practices while in most of the cases the Nepalese national regulations are quoted in the suitable occasions.

This second edition of this manual takes into account the experience gained during the management of COVID-19 pandemic in Nepal with reference from guidance from ICAO and best practices from other States and agencies.

All stakeholders are invited to assist in improving this handbook by submitting comments to the Licensing and Examination Division, Flight Safety Standards Department by suggesting any pertinent additional information which might usefully be included. This manual will be updated with relevant information in future. This handbook will come into effect from date of approval.



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CHAPTER 1. GENERAL

1.1 RULES CONCERNING LICENCES

1.1.1 The Convention on International Civil Aviation, which was signed in Chicago on 7 December 1944, includes several articles which call for adoption of international regulations in all fields where uniformity facilitates and improves air navigation.

1.1.2 These regulations, known as Standards and Recommended Practices (SARPs), have been promulgated in Annexes to the Convention which are amended from time to time when necessary. Each Annex deals with a specific aspect of international civil aviation. Aspects relating to medical regulations for licence applicants are included mainly in- Annex 1- *Personnel Licensing* and to some degree in Annex 2 - *Rules of the Air* and Annex 6- *Operation of Aircraft*. CAAN has issued Personnel Licensing Requirements (PELR) to encompass the standard and recommended practices (SARPs) of Annex 1. Similarly, the SARPS of Annex 2 are include in Civil Aviation Requirements 2 (CAR 2) of CAAN while SARPS of Annex 6 are transposed into Flight Operations Requirements (FOR) of CAAN.
Issues involving preparedness planning for a communicable disease of public health concern are considered in Annex 6, Annex 9 — Facilitation, Annex 11 — Air Traffic Services (CAAN has issued CAR 11 in this regard) and Annex 14 — Aerodromes (CAAN has issued CAR 14 in this regard) to encompass the standard and recommended practices (SARPs) of annexes.

1.1.3 Standards and Recommended Practices are defined as follows:
Standard. Any specification for physical characteristics, configuration, materiel, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation, and to which Contracting States will conform in accordance with the Convention. In the event that a State finds it impracticable to comply in all respects with any such international standard but allows a less stringent practice, immediate notification to ICAO is compulsory under Article 38 of the Convention.

In case a more stringent regulation is adopted, notification to ICAO is compulsory only when such regulation is applied also on foreign licence holders and aircraft. However, in a Resolution of 5 February 1999, the ICAO Council made it clear that, in principle, national requirements "more exacting" than the SARPs would be detrimental to the framework of the Chicago system within which international civil aviation has developed and continues to develop. In this Resolution the Council also called upon each Contracting State to utilize the multilateral mechanism of ICAO where it believes that changes to the content or level of implementation of the Standards and Recommended Practices in the Annexes to the Chicago Convention are necessary or desirable.

Recommended Practice. Any specification for physical characteristics, configuration, materiel, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interest of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavor to conform in accordance with the Convention.

1.1.4 Although the purpose of SARPs is to provide provisions only for international air navigation, they have greatly influenced national regulations governing domestic aviation in most Contracting States including Nepal. Nepal has issued own national regulation in this regard.

1.1.5 ICAO also originates guidance material which is intended to assist States in the implementation of SARPs, but places no regulatory responsibility upon States for compliance. The ICAO Manual of Civil Aviation Medicine (Doc 8984) falls into this category since it offers guidance on the implementation of the SARPs contained in Annex 1. This manual will serve similar purpose for the CAMA and DMEs like ICAO Doc 8984 to ensure effective implementation of PELR an Medical Requirements.

1.2 PERSONNEL LICENSING

1.2.1 Civil aviation includes different types of operations which, for convenience, can be divided into three major categories.

1.2.1.1 *Commercial air transport (airlines)*. This category includes all operations conducted with large and sophisticated aircraft which used to be piloted by several crew members. In recent years the need for more efficiency has produced some dramatic technological changes which directly involve flight personnel:

— In the early 1960's, the typical operating crew on the flight deck of an airliner consisted of five members (two pilots, a flight engineer, a flight navigator and a flight radio operator). It now consists of two (or occasionally three) members, depending on the type of aircraft.

— The tasks of the flight crew are changing. On modern aeroplanes, computers are handling the systems and the pilot is becoming more and more of a systems manager and decision maker rather than a control operator.

1.2.1.2 Aerial work and small air transport. All professional flying except airline operations is included in this category.
Typical operations are flying instruction, crop spraying, aerial surveying, small commuter operations, air taxi and corporate flying. This category has not faced such important changes as has airline transport. It must be noted that helicopters now perform a significant part of these operations.

1.2.1.3 *Private air transport and pleasure flight*. The majority of the world's pilots belong to this category. The operations are not conducted for remuneration and generally involve small aircraft. In this category, glider pilots form an important subgroup. During the last two decades, a new dimension has been added to this category with the fast-growing popularity of the microlight aircraft. Presently Annex 1 does not include provisions for microlight licensing. However, Nepal has national regulations for such activities.

1.2.2 Very different operating situations result from these various activities. There is a real gap between the bush pilot flying a rugged aircraft solo in a deserted area and the pilot-in-command of a complex aeroplane on one of the major air routes with comprehensive ground support. This difference, which also affects licensed ground personnel, used to increase as technological progress became more involved in airline operations than in other categories, but is now decreasing somewhat as advanced and sophisticated electronics and computer-based equipment are becoming available even to the private pilot. The medical examiner, when making an assessment, must be familiar with the various operating environments.

The concept of licensing

1.2.3 Since the early days of aviation, States have recognized the necessity to check the competency of personnel who perform activities which, unless performed properly, could jeopardize aviation safety. The recognition of this competency was generally made by issuing a licence. This concept has remained valid throughout the years, and the whole of Annex 1 (PELR in Nepal) may be considered as an evolution of this basic idea.

1.2.4 However, civil aviation is very different today from what it was when the first licences were issued, and the provisions of Annex 1(PELR in Nepal) have been established and then regularly updated to manage the increasing complexity of civil aviation. The personnel licensing system, as implemented in Annex 1 (PELR in Nepal), is now built on the following principles:

- The licence is the authorization which allows the holder to perform specific activities, which otherwise would be prohibited.

- A licence is issued by a State when the applicant has demonstrated an acceptable degree of competency. The right to issue a licence is reserved to States either directly or through a body with delegated authority. When the term "ICAO licence" is used, it indicates that the licence is issued by a Contracting State in compliance with the provisions in Annex 1. ICAO does not itself issue licences. The contracting States issue the personnel license. Nepal issues license pursuant to PELR requirements.

- There are different types of licence. Each one grants specific privileges to the holder. Ratings can be added to the licence to extend the basic privileges.

1.2.5 Annex 1 (PELR in Nepal) has provisions for other licences than those listed below (aircraft maintenance mechanic, aeronautical station operator and flight operations officer). However, these licences have no medical fitness requirements due to the nature of duties.

Different types of licences

1.2.6 Some licence types are described below. Detailed descriptions can be found in Annex 1, Chapter 2 and relevant parts of PELR.

Pilot's licences

a) ***Student pilot.*** While it is not formally a licence, many Contracting States issue an authorization for a student pilot, allowing such a pilot to fly solo before licensing as long as the applicant is medically fit. In some States, the Medical Assessment itself, when issued as a certificate, functions as the student pilot's licence. The medical fitness required is the least restrictive of all pilot licences (Class 2). Therefore, the medical examiner should be prepared to counsel the applicant against further time and expense in pursuance of piloting ambitions if a medical condition is established which might prevent his acquisition of a more senior pilot licence, if this is his ambition.

b) ***Private pilot licence — aeroplane (PPL — aeroplane).*** The most commonly held licence permitting the holder to fly an aeroplane other than professionally. Private pilots usually fly small aeroplanes in visual meteorological conditions (VMC). It is, however, not unusual to add an instrument rating to a PPL.

c) ***Private pilot licence — helicopter (PPL — helicopter).*** This is the helicopter licence equivalent to the PPL — aeroplane.

d) ***Glider pilot licence*** permits the holder to act as pilot-in-command of any glider.

e) ***Free balloon pilot licence.*** The holder of this licence is permitted to act as pilot-in-command of

any free balloon.

f) ***Commercial pilot licence — aeroplane (CPL — aeroplane).*** The CPL is the junior licence permitting the holder to perform professional duties either as a pilot-in-command of an aeroplane certificated for single pilot operations or as co-pilot of any aircraft.

g) ***Commercial pilot licence — helicopter (CPL — helicopter).*** This licence is the helicopter equivalent to the CPL — aeroplane.

h) ***Airline transport pilot licence — aeroplane (ATPL — aeroplane).*** The senior pilot licence, permitting the holder to operate any aircraft either as pilot-in-command or co-pilot. The privileges of the instrument rating are included in the ATPL — aeroplane.

i) ***Airline transport pilot licence — helicopter (ATPL — helicopter).*** The helicopter equivalent of the ATPL — aeroplane. The instrument rating privileges, however, are not included in the licence.

j) ***Multi-crew pilot licence — appropriate to the aeroplane category (MPL — aeroplane).*** The equivalent to an ATPL but with restriction to multi-crew operations. The MPL, CPL and ATPL are often referred to as "professional licences".

Ratings for pilot licences

a) ***Type and class ratings.*** Each pilot licence must be endorsed with a rating specifying the type of aircraft the holder is authorized to fly. The larger aircraft (usually those with a maximum take-off mass of more than 5 700 kg) need a specific rating. The smallest aircraft are grouped into classes (single-engine and multi-engine) and the holder of a licence endorsed with a class rating is permitted to fly all the aircraft of the relevant class.

b) ***Instrument rating.*** This rating can be endorsed on a PPL, CPL and ATPL — helicopter. It permits the holder to fly in other than visual meteorological conditions.

c) ***Instructor rating.*** This rating permits the holder to act as a flight instructor.

Licences for flight crew members other than pilot

a) ***Flight engineer.*** The licence permitting the holder to perform the duty of a flight engineer when required by aircraft certification or operational regulation.

b) ***Flight navigator***.

c) ***Flight radio operator.*** These licences, especially the latter two, are becoming obsolete and are seldom issued.

Licences for personnel other than flight crew members

Air traffic controller licence. The licence in itself carries no privileges. These are conferred with additional ratings to the licence which characterizes the duty of an air traffic controller.

The basic ratings for this licence are:

a) ***Aerodrome control rating,*** permitting the holder to provide or to supervise the provision of aerodrome control service for the aerodrome for which he is rated. Aerodrome control handles traffic on ground and in flight at the vicinity of the runway.

b) ***Approach control rating,*** permitting the holder to provide or to supervise the provision of approach control service for the aerodrome or aerodromes for which he is rated. Approach control

handles traffic in flight during departure and during descent on arrival.

c) *Area control rating*, permitting the holder to provide or to supervise the provision of area control service within the control area for which he is rated. Area control handles traffic during the cruise, the last part of climb and the initial part of descent.

When a radar is used to perform the duty, the air traffic controller must hold a radar rating in addition to the relevant basic rating.

Medical certification

1.2.7 The process of establishing and issuing evidence that guarantees that a licence holder meets the medical requirements is called "medical certification". None of the aviation licences listed above can be used for carrying out aviation duties without evidence that the holder of the licence meets the medical requirements for fitness. Many Contracting States, including Nepal, issue medical certificates, valid for a limited period only and designed to be kept together with the licence. The licence itself has usually a longer period of validity, sometimes lifelong or one which expires when the licence holder reaches the upper age limit specified for the type of licence held. Other States endorse aviation licences with the date of the medical examination and the word "passed", thus rendering the licence valid again for a limited period until the next medical examination is due. And some States issue aviation licences only to applicants who have passed the medical examination, with a validity period that corresponds to that of the Medical Assessment. The evidence of meeting the medical requirements is then the licence itself. When such a licence expires, a new one is issued, provided the holder still meets the medical requirements. Nepal uses time limited medical certificates.

1.2.8 ICAO has solved the obvious terminology problem, created by the different administrative methods in use by the Licensing Authorities in Contracting States, by choosing the term, "Medical Assessment", which is defined as "the evidence issued by a Contracting State that the licence holder meets specific requirements of medical fitness". To avoid confusion and mistakes, the term "licence" is used solely about the document that guarantees the professional competency of the holder, and the term "Medical Assessment" is used about the medical certificate (in cases where such a document is issued), about endorsement of a licence to the effect that the holder meets the medical requirements, or about the aviation licence when medical fitness is implied in holding a valid licence.

The Issue of a licence

1.2.9 An applicant who seeks a licence must complete a multi-step process which can be divided into three major parts: prerequisites, training and demonstration of competency.

Prerequisites

1.2.9.1

a) *Age*. A minimum age is specified for each licence.

b) *Experience*. A minimum level of experience depending on the licence is required for all personnel to be licensed. The unit of measurement of experience is flight hours for flight crew, and years of duty for ground personnel. For pilots, experience requirements range from 40 flight hours for PPL to 1 500 flight hours for ATPL.

c) *Medical fitness*. Most of the licences require compliance with medical fitness standards. Guidance on this matter is provided in this handbook.

Training

1.2.9.2 Training is obviously one of the most important parts of the licensing system. For several licences, an applicant may choose to take an approved training course instead of a regular course and thus be eligible for reduced experience requirements. It is expected that even more emphasis will be placed on training in the future. The advent of the multi-crew pilot licence has provided a new method of training of individuals intending to operate only multi-pilot aircraft.

Demonstration of competency

1.2.9.3 Each licence has its specific skill and knowledge requirements, and each applicant must demonstrate compliance with the requirements pursuant to the licence he seeks. Contracting States generally use a written examination and a practical test to check the competency of an applicant. Some other methods are also used concurrently, such as acceptance of a military licence.

Currency of licences

1.2.10 As outlined above, basically two different types of licence can be found, depending on the issuing State.

Some licences (expiring type) have a period of currency which is limited to a defined period. At each renewal, the holder must give evidence of his competency and his medical fitness. Competency is usually judged by considering the recent flight experience and sometimes by an examination. The other type of licence (continuous type) is not limited to a defined period of currency. The holder is allowed to exercise licence privileges as long as he holds a current Medical Assessment and complies with the regulations detailing the actions necessary to ensure maintenance of competency. Nepal also

Medical provisions for licensing

1.2.11 The detailed medical requirements appear in Chapter 6 of Annex 1 and relevant standards of PELR and Medical Requirements (MR). Other chapters of the Annex, contain a number of general administrative provisions which are important for the organization and conduct of the medical examination and medical certification which are also incorporated in the PELR and Medical Requirements. These are given in the following extracts from Chapter 1 of the Annex, PELR and MR together with explanatory remarks.

The designated medical examiner (DME)

1.2.12 Nepal has designated medical examiners, qualified and licensed in the practice of medicine, to conduct medical examinations of fitness of applicants for the issue or renewal of the licences or ratings specified in Chapters 2 and 3, and of the appropriate licences specified in Chapter 4 of Annex 1, PELR and MR.

a. Medical examiners shall have received training in aviation medicine and shall receive refresher training at regular intervals. Before designation, medical examiners shall demonstrate adequate competency in aviation medicine. CAAN Medical Requirements have such provisions.

b. Medical examiners shall have practical knowledge and experience of the conditions in which the holders of licences and ratings carry out their duties. CAAN Medical Requirements have such provisions.

c. Designated medical examiners must be familiar with — "have practical knowledge and experience of" — the operating environments of the various licence holders. Such practical knowledge and experience should include, whenever possible, actual flight deck experience in

aircraft engaged in commercial operation as well as experience in the operational working conditions of air traffic controllers. This is an effective way to promote the medical examiner's understanding of the practical demands, both physiological and psychological, that the licence holder's task and duties impose. An accumulated total of at least ten hours per year of flight deck time might be considered desirable. Practical difficulties may be encountered in the implementation of this recommendation for all designated examiners, but it is desirable that, as a minimum, medical assessors (physicians evaluating the medical reports submitted to the CAAN) be afforded the opportunity of attaining such experience.

The medical assessor

1.2.12 The medical assessor is defined in the Definitions section of PELR as follows:

Medical assessor. A physician, appointed by the CAAN, qualified and experienced in the practice of aviation medicine and competent in evaluating and assessing medical conditions of flight safety significance.
The role of the medical assessor and the evaluation of medical reports are further outlined in Chapter 1 of Annex 1 and relevant part of PELR and MR:

CAAN uses the services of Civil Aviation Medical Assessors (CAMA) to evaluate reports submitted to the CAAN by medical examiners.

The designated medical examiners are required to submit sufficient medical information to the CAAN to enable the CAAN to undertake Medical Assessment audits.

Note.— The purpose of such auditing is to ensure that medical examiners meet applicable standards for good medical practice and aeromedical risk assessment. Guidance on aeromedical risk assessment is contained in the Manual of Civil Aviation Medicine *(Doc 8984) and medical handbook of CAAN.*

i. Medical assessors, because of their functions as employees of or consultants for the CAAN and as supervisors for the designated medical examiners, will normally have advanced training in the specialty of aviation medicine and extensive experience in regulatory and clinical civil aviation medicine.

ii. In addition to evaluating medical reports submitted to the CAAN and making final assessments in borderline cases, the medical assessor will normally be in charge of Accredited Medical Conclusions.

iii. An important duty of the medical assessor is the safeguarding of medical confidentiality, although pertinent medical information may be presented by the medical assessor to other officials of the CAAN when justified by operational concerns or when an Accredited Medical Conclusion is sought.

iv. Also, the audit of medical reports by designated medical examiners and refresher training of medical examiners will usually fall within the remit of the medical assessor.

Applicant's medical history

1.2.13 Applicants for licences or ratings for which medical fitness is prescribed shall sign and furnish to the medical examiner a declaration stating whether they have previously undergone such an examination and, if so, the date, place and result of the last examination. They shall indicate to the examiner whether a Medical Assessment has previously been refused or suspended and, if so, the reason for

such refusal or suspension. Any false declaration to a medical examiner made by an applicant for a licence or rating shall be reported to the CAAN for enforcement actions.

a) It is incorporated in the medical examination form or be a part of the national regulations, as a reminder to the applicant of the consequences of any false declaration.
b) The examiner should be aware that deception may be a problem in aviation medical certification and the potentially serious consequences of any false declaration should be known by the applicant.

The medical examination

1.2.14 Having completed the medical examination of the applicant, the medical examiner shall coordinate the results of the examination and submit a signed report, or equivalent, to the CAAN, in accordance with its requirements, detailing the results of the examination and evaluating the findings with regard to medical fitness.

The medical report may be submitted to the CAAN in electronic format, provided adequate identification of the examiner is established.

If the medical examination is carried out by two or more medical examiners, one of these will be appointed to be responsible for coordinating the results of the examination, evaluating the findings with regard to medical fitness, and signing the report.

Medical confidentiality

1.2.15 Medical confidentiality shall be respected at all times. All medical reports will be received in the sealed envelope.

All medical reports and records shall be securely held with accessibility restricted to authorized personnel only.

When justified by operational considerations, the medical assessor shall determine to what extent pertinent medical information is presented to relevant officials of the CAAN.

It is important that medical confidentiality is respected at all times. Medical information is of a sensitive nature, and a person who has undergone a medical examination for issuance or renewal of his licence has a right to expect that such information is kept confidential and disclosed only to medical officials.

For a number of years ICAO SARPs in Annex 11 (CAR 11 of CAAN) and Annex 14 (CAR 14 of CAAN) have required safety management systems (SMS) to be implemented by organizations responsible for air traffic services and aerodrome operations, and more recently, this has been extended to aircraft operators (Annex 6). Whilst incorporation of an SMS is relevant to organizations providing services, a State Safety Programme (SSP) is the equivalent process for the management of safety by the State. The SSP and SMS frameworks are complementary, yet distinct.

Details on both the SSP and SMS can be found on the CAAN website, but since aeromedical safety is primarily the responsibility of the CAAN, it is considered that an SSP, rather than an SMS, is applicable in the aeromedical area, with the medical assessor of the CAAN assuming responsibility for aeromedical safety. The reader should refer to SSP Nepal and Civil Aviation Requirements 19 (CAR 19) of Civil Aviation Authority of Nepal in this context.

The implementation of an SSP will be commensurate with the size and complexity of the State's aviation system, but needs to consider the following:

1) State safety policy and objectives

2) State safety risk management

3) State safety assurance

4) State safety promotion

Each of these topics is important for aeromedical safety, but the most important is considered to be State safety assurance, in particular, safety data collection, analysis and exchange.

In the area of aviation medicine, as in other aviation-related disciplines, safety policy has often not been based on objective evidence of good quality, on a routine basis, in-flight incapacitations, or the medical findings from routine medical assessments. Without such basic data, regulatory policy is likely to be based primarily on expert opinion — and such opinion varies from specialist to specialist and from State to State.

Significant resources are devoted to the aeromedical assessment process and to applying aeromedical policy. It is important that such resources are utilized in the most cost-effective manner, and the application of safety management principles is one method of encouraging this, which has been demonstrated to be effective. An international review has been published in the journal Aviation, Space, and Environmental Medicine.3 and is recommended reading for this subject.

Flexibility

1.2.16 If the medical Standards prescribed for a particular licence are not met, the appropriate Medical Assessment shall not be issued or renewed unless the following conditions are fulfilled:

a) accredited medical conclusion indicates that in special circumstances the applicant's failure to meet any requirement, whether numerical or otherwise, is such that exercise of the privileges of the licence applied for is not likely to jeopardize flight safety.

b) relevant ability, skill and experience of the applicant and operational conditions have been given due consideration; and

c) the licence is endorsed with any special limitation or limitations when the safe performance of the licence holder's duties is dependent on compliance with such limitation or limitations.

Evidence of medical fitness

1.2.17 In the various ways in which Contracting States provide licence holders with evidence that they meet the medical requirements are outlined as follows:

To satisfy the licensing requirements of medical fitness for the issue of various types of licences, the applicant must meet certain appropriate medical requirements which are specified as three classes of Medical Assessment.

Details are given in 6.2, 6.3, 6.4 and 6.5. To provide the necessary evidence to satisfy the requirements of 1.2.4.1, the CAAN issues the licence holder with the appropriate Medical Assessment, Class 1,

Class 2 or Class 3. This can be done in several ways such as a suitably titled separate certificate, a statement on the licence, a national regulation stipulating that the Medical Assessment is an integral part of the licence, etc.

Validity periods of Medical Assessments

1.2.18 The period of validity of a Medical Assessment shall begin on the day the medical examination is performed.

The duration of the period of validity shall be in accordance with the provisions of 1.2.5.2.

The period of validity of a Medical Assessment may be extended, at the discretion of the CAAN, up to 45 days.

Note.— It is advisable to let the calendar day on which the Medical Assessment expires remain constant year after year by allowing the expiry date of the current Medical Assessment to be the beginning of the new validity period under the proviso that the medical examination takes place during the period of validity of the current Medical Assessment but no more than 45 days before it expires.

The Medical Assessment is valid from the day on which the regulatory medical examination has been carried out. Sometimes the issue of the Medical Assessment has to be postponed until the result of laboratory tests or perhaps a specialist evaluation is known, but this does not change the date for the beginning of the validity period. Many Contracting States allow licence holders to undergo the medical examination for renewal of their Medical Assessment on a convenient date up to 45 days before their current Medical Assessment expires without changing the dates for the new validity period correspondingly, thus extending the validity period by up to 45 days. This is primarily done to accommodate the work schedules of licence holders and medical examiners, but also serves to allow the expiry date of the Medical Assessment to remain the same year after year.

The predictive power of even a very thorough and comprehensive medical examination is limited. This is true for all age groups, but increases in importance with age. Studies in two Contracting States have shown that older licence holders have a significantly increased incidence of medical conditions of importance for flight safety. Consequently, the validity periods are shorter for older licence holders. The periods of validity of the Medical Assessment for various categories of licence holders are as follows:

1.2.5.2 As stipulated by PELR and Medical Requirements Medical Assessment issued in accordance with PELR and MR shall be valid from the date of the medical examination for a period not greater than:
60 months for the private pilot licence — aeroplane, airship, helicopter and powered-lift;
12 months for the commercial pilot licence — aeroplane, airship, helicopter and powered-lift;
12 months for the multi-crew pilot licence — aeroplane;
12 months for the airline transport pilot licence — aeroplane, helicopter and powered-lift;
60 months for the glider pilot licence;
60 months for the free balloon pilot licence;
12 months for the flight navigator licence;
12 months for the flight engineer licence;
48 months for the air traffic controller licence.

Note 1.— The periods of validity listed above may be extended by up to 45 days in accordance with

1.2.4.3.1.

Note 2.— When calculated in accordance with 1.2.5.2 and its sub-paragraphs, the period of validity will, for the last month counted, include the day that has the same calendar number as the date of the medical examination or, if that month has no day with that number, the last day of that month.

As the age of the licence holder increases, these validity periods are shortened:

1.2.5.2.2 When the holders of airline transport pilot licences — aeroplane, helicopter and powered-lift, and commercial pilot licences — aeroplane, airship, helicopter and powered-lift, who are engaged in single-crew commercial air transport operations carrying passengers, have passed their 40th birthday, the period of validity specified in PE:R and MR shall be reduced to six months.

1.2.5.2.3 When the holders of airline transport pilot licences — aeroplane, helicopter and powered-lift, commercial pilot licences — aeroplane, airship, helicopter and powered-lift, and multi-crew pilot licences — aeroplane, who are engaged in commercial air transport operations, have passed their 60th birthday, the period of validity specified in PELR and MR shall be reduced to six months.

1.2.5.2.4 When the holders of private pilot licences — aeroplane, airship, helicopter and powered-lift, free balloon pilot licences, glider pilot licences and air traffic controller licences have passed their 40th birthday, the period of validity specified in PE:LR and MR shall be reduced to 24 months.
Regardless of the validity periods stated above, the medical assessor may in an individual case require this period to be shortened.

The period of validity of a Medical Assessment may be reduced when clinically indicated.

A medical condition, although compatible with licensing, may be of a nature where frequent medical check-ups are required. In such cases the period of validity of the Medical Assessment may be reduced so as to ensure adequate monitoring of the condition in question.

Decrease in medical fitness

1.2.19 PELR states-

"Holders of licences provided for in this PELR shall not exercise the privileges of their licences and related ratings at any time when they are aware of any decrease in their medical fitness which might render them unable to safely and properly exercise these privileges."

The provisions of PELR and MR, would apply if there is a decrease in medical fitness attributable to the effects of intercurrent disease, injury, alcohol or other psychoactive substances, medication, fatigue, sleep disturbances due to time zone changes, adverse climatic conditions and disrupted regular work/rest schedules which might render the holder of a licence or rating incapable of meeting the medical requirements of his licence or rating.

Previous editions of Annex 1 contained a Recommendation that licence holders should inform the CAAN of pregnancy, decrease in medical fitness for more than 20 days, and the continued use of prescribed medication.

However, experience has shown that Licensing Authorities have interpreted this recommendation in different ways and, following discussion with States, it was revised to the wording above.

It is clearly important that licence holders are aware of those medical conditions that may affect flight safety, both immediately and in the long term, so that, if they have developed a medical condition, they know when to seek medical help, and when to cease flying. CAAN places more or less emphasis on particular aspects of fitness for holders of licences issued by, depending on the prevalence of particular diseases in their licence holders.

States can provide information about relevant physical and mental conditions in many ways. Examples include: internet website; information circular; medical examiner briefing. The most effective way(s) is likely to differ from State to State. A medical examiner briefing may be effective, and for Class 1 applicants under 40 years of age it is suggested that this could be formally included in the preventive and educative part of the medical assessment.

For many conditions, modern medical practice has changed the length of time required in hospital, and some conditions, which in the past involved a lengthy hospital stay, can now be dealt with very quickly, sometimes even on an outpatient basis. Nepal lists the following conditions as requiring advice from a designated medical examiner before a return to operations can be considered:

a) any surgical operation

b) any medical investigation with abnormal results

c) any regular use of medication

d) any loss of consciousness

e) kidney stone treatment by lithotripsy

f) coronary angiography

g) transient ischaemic attack

h) abnormal heart rhythms including atrial fibrillation/flutter.

In many instances of ill-health, a medical practitioner without any training in aviation medicine may be unable to provide appropriate advice to a licence holder regarding fitness to fly. Any licence holder should be aware of the action to take in the event of suffering a common cold, without having to seek advice from a designated medical examiner unless there are complicating factors, but for more serious conditions advice concerning fitness to operate should be readily available from those with specialist knowledge, e.g. a designated medical examiner. If a “temporarily unfit” assessment is made, the method for regaining fitness should be clear and, when fitness is regained, return to operations should not be unduly delayed. If a licence holder is affected by any medical condition such as those mentioned in the list above (which is not exhaustive), he should be aware of the need to seek aeromedical advice before again exercising the privileges of his licence.

Use of psychoactive substances

1.2.20 In the context of aviation, any use of psychoactive substances, even when prescribed in accordance with best medical practice for a medical condition and used in amounts that allow normal daily activities to be carried out as usual, is likely to jeopardize flight safety. The term “problematic use”,

which is employed in regulatory aviation medicine, is defined in PELR:

Problematic use of substances.

1.2.21 The use of one or more psychoactive substances by aviation personnel in a way that:

a) constitutes a direct hazard to the user or endangers the lives, health or welfare of others; and/or

b) causes or worsens an occupational, social, mental or physical problem or disorder.

It is important to distinguish between the terms "under the influence of any psychoactive substance" and "engage in any problematic use of substances". The former relates to any person who has recently taken a psychoactive substance (such as some alcohol) and for that reason is temporarily unsafe, whereas the latter relates to a person who is a habitual user of psychoactive substances and consequently is unsafe, also between uses.

PELR states "Holders of licences provided for PELR shall not exercise the privileges of their licences and related ratings while under the influence of any psychoactive substance which might render them unable to safely and properly exercise these privileges."

"Holders of licences provided for in this PELR shall not engage in any problematic use of substances."

Note.— Guidance on suitable methods of identification (which may include biochemical testing on such occasions as pre-employment, upon reasonable suspicion, after accidents/incidents, at intervals, and at random) and on other prevention topics is contained in the Manual on Prevention of Problematic Use of Substances in the Aviation Workplace *(Doc 9654).*

A definition of psychoactive substances is given in PELR:

Psychoactive substances. Alcohol, opioids, cannabinoids, sedatives and hypnotics, cocaine, other psycho-stimulants, hallucinogens, and volatile solvents, whereas coffee and tobacco are excluded.

1.3 MEDICALLY RELATED PROVISIONS IN OTHER ANNEXES

1.3.1 Some other medical provisions exist in Annexes 2 — *Rules of the Air (CAR 2 for CAAN)* and 6 — *Operation of Aircraft (FOR in CAAN)* and are given in the following extracts.

Use of psychoactive substances

1.3.2 A Standard restricting the use of psychoactive substances (such as alcohol, narcotics and certain drugs) is provided in CAR 2, as follows:

Problematic use of psychoactive substances

1.3.3 No person whose function is critical to the safety of aviation (safety-sensitive personnel) shall undertake that function while under the influence of any psychoactive substance, by reason of which human performance is impaired. No such person shall engage in any kind of problematic use of substances."

1.3.4 It is important to note that the above sentence relates to any person who has recently taken a psychoactive substance and for that reason is temporarily unsafe, whereas the second sentence refers to a person who is a habitual user of psychoactive substances.

Flight operations and fatigue

1.3.5 The medically related aspects of this topic are considered in this handbook.

Medical supplies

1.3.6 Flight Operations Requirements (FOR) includes standards and Attachments that concern on-board medical supplies:

All aeroplanes on all flights

1.3.7 An aeroplane shall be equipped with accessible and adequate medical supplies.

Use of Oxygen in flight

1.3.8 Measures to reduce the possibilities of hypoxia which would affect flight safety are specified in FOR:

Oxygen supply

Note.—Approximate altitudes in the Standard Atmosphere corresponding to the values of absolute pressure used in the text are as follows:

Absolute Pressure	Metres	Feet
700 hPa	*3 000*	*10 000*
620 hPa	*4 000*	*13 000*
376 hPa	*7 600*	*25 000*

FOR states- "A flight to be operated at flight altitudes at which the atmospheric pressure in personnel compartments will be less than 700 hPa shall not be commenced unless sufficient stored breathing oxygen is carried to supply":

a) all crew members and 10 per cent of the passengers for any period in excess of 30 minutes that the pressure in compartments occupied by them will be between 700 hPa and 620 hPa;

b) the crew and passengers for any period that the atmospheric pressure in compartments occupied by them will be less than 620 hPa.

" A flight to be operated with a pressurized aeroplane shall not be commenced unless a sufficient quantity of stored breathing oxygen is carried to supply all the crew members and passengers, as is appropriate to the circumstances of the flight being undertaken, in the event of loss of pressurization, for any period that the atmospheric pressure in any compartment occupied by them would be less than 700 hPa. In addition, when an aeroplane is operated at flight altitudes at which the atmospheric pressure is less than 376 hPa, or which, if operated at flight altitudes at which the atmospheric pressure is more than 376 hPa and cannot descend safely within four minutes to a flight altitude at which the atmospheric pressure is equal to 620 hPa, there shall be no less than a 10-minute supply for the occupants of the passenger compartment. Note that one hPa = one mb."

1.3.9 FOR, further specifies that:

"All flight crew members, when engaged in performing duties essential to the safe operation of an aeroplane in flight, shall use breathing oxygen continuously whenever the circumstances prevail for which its supply has been required in relevant section in FOR".

1.3.10 FOR further specifies:

"All flight crew members of pressurized aeroplanes operating above an altitude where the atmospheric pressure is less than 376 hPa shall have available at the flight duty station a quick- donning type of oxygen mask which will readily supply oxygen upon demand."

1.3.11 Recommendation FOR is entitled "Safeguarding of cabin crew and passengers in pressurized aeroplanes in the event of loss of pressurization."

Note.— It is not envisaged that cabin crew will always be able to provide assistance to passengers during emergency descent procedures which may be required in the event of loss of pressurization.

1.4 DEFINITIONS

The following is a selection of definitions pertinent to the responsibilities of an aviation medical examiner. Definitions of terms used in the SARPs and which are not self-explanatory are provided in each Annex. A definition does not have independent status but is an essential part of each Standard or Recommended Practice in which the defined term is used, since a change in the meaning of the term would affect the specification. When the following terms are used in the SARPs they have the following meaning:

Accredited medical conclusion. The conclusion reached by one or more medical experts acceptable to the CAAN for the purposes of the case concerned, in consultation with flight operations or other experts as necessary.

Co-pilot. A licensed pilot serving in any piloting capacity other than as pilot-in-command but excluding a pilot who is on board the aircraft for the sole purpose of receiving flight instruction.

Crew member. A person assigned by an operator to duty on an aircraft during flight time.

Fatigue. A physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member's alertness and ability to safely operate an aircraft or perform safety-related duties.

Flight crew member. A licensed crew member charged with duties essential to the operation of an aircraft during flight duty period.

Flight time — aeroplanes. The total time from the moment an aeroplane first moves for the purpose of taking off until the moment it finally comes to rest at the end of the flight.

Flight time — helicopters. The total time from the moment a helicopter's rotor blades start turning until the moment the helicopter finally comes to rest at the end of the flight, and the rotor blades are stopped.

General aviation. All civil aviation operations other than scheduled air services and non- scheduled air transport operations for remuneration or hire.

Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

CAAN. The authority designated by a Contracting State as responsible for the licensing of personnel. Civil Aviation Authority of Nepal (CAAN) is the CAAN in Nepal.

Note.—CAAN is deemed to have been given the following responsibilities by the Contracting State:

a) assessment of an applicant's qualifications to hold a licence or rating;
b) issue and endorsement of licences and ratings;
c) designation and authorization of approved persons;
d) approval of training courses;
e) approval of the use of synthetic flight trainers and authorization for their use in gaining the experience or in demonstrating the skill required for the issue of a licence or rating; and
f) validation of licences issued by other Contracting States.

Likely. In the context of the medical provisions, ***likely*** means with a probability of occurring that is unacceptable to the Medical Assessor.

Medical Assessment. The evidence issued by CAAN that the holder meets specific requirements of medical fitness.

Medical assessor. A physician, appointed by the CAAN, qualified and experienced in the practice of aviation medicine and competent in evaluating and assessing medical conditions of flight safety significance.

Note 1.— Medical assessors evaluate medical reports submitted to the CAAN by medical examiners.

Note 2.— Medical assessors are expected to maintain the currency of their professional knowledge.

Medical examiner. A physician with training in aviation medicine and practical knowledge and experience of the aviation environment, who is designated by the DG,CAAN to conduct medical examinations of fitness of applicants for licences or ratings for which medical requirements are prescribed.

Pilot-in-command. The pilot designated by the owner or operator as being in command and charged with the safe conduct of a flight.

Problematic use of substances. The use of one or more psychoactive substances by aviation personnel in a way that:

a) constitutes a direct hazard to the user or endangers the lives, health or welfare of others; and/or
b) causes or worsens an occupational, social, mental or physical problem or disorder.

Psychoactive substances. Alcohol, opioids, cannabinoids, sedatives and hypnotics, cocaine, other psychostimulants, hallucinogens, and volatile solvents, whereas coffee and tobacco are excluded.

Rated air traffic controller. An air traffic controller holding a licence and valid ratings appropriate to the privileges to be exercised.

Rating. An authorization entered on or associated with a licence and forming part thereof, stating conditions, privileges or limitations pertaining to such licence or certificates.

Safety management system. A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.

Safety-sensitive personnel. Persons who might endanger aviation safety if they perform their duties and functions improperly. This definition includes, but is not limited to, flight crew, cabin crew, aircraft maintenance personnel and air traffic controllers.

Significant. In the context of the medical provisions in PELR and CAAN Medical Requirements, ***significant*** means to a degree or of a nature that is likely to jeopardize flight safety.

***State safety programme*.** An integrated set of regulations and activities aimed at improving safety.

APPENDIX TO CHAPTER 1
SAFETY MANAGEMENT AS A FOUNDATION FOR EVIDENCE-BASED AEROMEDICAL STANDARDS AND REPORTING OF MEDICAL EVENTS

There are four main areas where, by applying safety management principles, it may be possible to better use aeromedical data to enhance flight safety. These are:

a) adjustment of the periodicity and content of routine medical examinations to more accurately reflect aeromedical risk;
b) improvement in reporting and analysis of routine medical examination data;
c) improvement in reporting and analysis of in-flight medical events; and
d) support for improved reporting of relevant aeromedical events through the promotion of an appropriate culture by companies and regulatory authorities.

This paper explores how the principles of safety management may be applied to aeromedical systems to improve their contribution to safety.

Keywords: examination, risk, systems, incapacitation, pilot, standards.

MEDICAL REQUIREMENTS for pilots were introduced during the early decades of the last century and although the content of the aeromedical examination has changed over time, few attempts have been made to monitor or quantify the safety benefits of the requisite aeromedical standards, it being self-evident that the license holder needs to be 'fit'.

The International Civil Aviation Organization (ICAO) sets medical Standards and Recommended Practices that have been agreed upon internationally. Despite this global agreement on a suitable international system, regulatory authorities interpret the medical Standards and Recommended Practices in different ways. In practice this leads to different fitness levels being required of license holders in different States (countries).

In one State a 55-yr-old professional pilot might have an annual medical examination, and be permitted to operate while taking certain antidepressants or while using warfarin (coumadin). In another, that pilot may be required to undergo a 6-mo medical examination, have periodic exercise and psychological tests, and be refused permission to operate while undergoing treatment with antidepressant medication or warfarin. Such disparate practices result in some pilots who have been denied certification by one regulatory authority attempting to find another that will permit them to operate (a form of aeromedical tourism). However, accident statistics alone do not currently suggest that differences in medical standards between States are a potential safety concern, although such statistics may not be sufficiently sensitive to detect differences between States concerning the aeromedical contribution to safety. Improved reporting might uncover an aeromedical safety concern.

Basis for Regulatory Aeromedical Decision Making

Expert Opinion

Aeromedical policy and individual decisions are often based on expert opinion, ('level 5' evidence). Although expert opinion may be evidence-based, such an approach (which may also be termed 'eminence-based') is not as reliable as one that uses higher levels of evidence. However, expert opinion is often the easiest (quickest and least costly) to implement and may, therefore, be an attractive option for regulatory authorities. If a medical expert has experience in aviation medicine and their own specialty, such an opinion may be of great value (it may be the only possible approach for uncommon conditions), but often opinions vary greatly between experts presented with similar cases.

The potential for variation in expert opinion was noted in 2004 when a European Joint Aviation Authorities (JAA) survey was undertaken to assess the value of the electroencephalograph (EEG) in determining medical fitness. A selection of representative EEG recordings was distributed to neurologists who were advising the chief medical officers of the various JAA member states. Some EEG were assessed as being acceptable for unrestricted Class 1 certification by certain consultant neurologists, while the same recordings were assessed by others as justifying an 'unfit' assessment. Routine screening EEG were subsequently abandoned by the JAA for regulatory purposes*. Given this disparity of views, it is not unexpected that an individual may be assessed as fit in one State and unfit in another, depending on the view of the expert who is advising the CAAN.

Note- Now European Aviation Safety Agency (EASA) has been a supranational regulatory agency in Europe.

Acceptable Aeromedical Risk

Another area where a diversity of views can be found among regulatory authorities is the level of aeromedical risk that is acceptable. Further, authorities differ in their opinions as to whether it is possible to use objective numeric aeromedical 'risk criteria' as a basis for decision making in individual cases or for developing policy. Of the authorities that do use such risk criteria, there are differences regarding the maximum acceptable level of risk for certificate on, although for professional pilots a commonly held norm of maximum risk is 1% per annum. However, 2% per annum has also been proposed (10) and is in use in at least one State. A pilot incapacitation risk of ' 1% per annum ' infers that if there were 100 pilots with an identical condition, 1 of them would be predicted to become incapacitated at some time during the next 12 mo (and 99 would not).

While the data for predicting incapacitation in the next 12 mo for a condition is not always robust, there are some common medical conditions (e.g., ischemic heart disease) where high quality epidemiological data exist and can be used in assessing the aeromedical risk. Without any objective risk criteria, it can be unclear on what basis an aeromedical decision is being made, and expert opinion that seems 'reasonable', often based on similar precedents, is likely to hold sway.

Contribution to Aviation Safety of Medical Examinations

Routine Periodic Examination

There are few published studies on the safety value of the routine medical examination, yet millions of dollars are spent annually on the process. Regulatory authorities require license holders to undergo an aeromedical examination for license issue and each license or medical certificate renewal. This examination varies little throughout a pilot's career, even though the incidence of most medical conditions varies with age, physical disease being less common in professional pilots under 40 yr of age than in those over 40 yr. Accordingly, physical disease is very rarely a significant factor in two-crew airliner accidents involving younger pilots.

In the general population, behavioral factors such as anxiety and depression are more common in the under-40s age group and illicit drug use and alcohol consumption also cause a considerable, increasing disease burden.

Despite this, relatively little formal attention is given to these aspects in the routine periodic encounter with an aviation medical examiner; the emphasis is usually placed on the detection of physical disease. Indeed, although medical examiners may take it upon themselves to include some informal discussion of behavioral or mental health issues, the examination is often colloquially described as a pilot's 'physical'. Particularly in the younger license holder there is an apparent mismatch between the likelihood of the existence of particular pathologies of flight safety importance (mainly mental and behavioral problems) and the tools being used to detect them (the traditional medical examination). ICAO is currently in consultation with its member States concerning whether the current emphasis on the detection of physical disease is appropriate in the periodic medical examination for professional pilots under 40 yr of age.

* The value of undertaking an EEG at initial Class 1 examinations was discussed by the Joint Aviation Authorities Licensing Sub-Sectorial Team (Medical) [LSST(M)] during meetings in 2004 and 2005. A decision to remove the requirement from the Joint Aviation Requirements

— Part 3 (Medical) was taken by the Licensing Sectorial Team [parent body of the LSST(M)] at its 14th full meeting in Cologne, Germany, 14-16 June 2005.

Stringent Medical Requirements

One approach to aeromedical certification embraces a concept that 'more stringent' medical standards result in 'more effective' medical standards. At the 2002 Aerospace Medical Association annual scientific meeting, Hudson reported that 1200 of the professional pilots who sought advice from the U.S. Air Line Pilots Association medical consulting service had been diagnosed with depression and recommended to take antidepressant medication (7). On being advised of the Federal Aviation Administration's policy of not permitting antidepressant use in operating pilots, 710 of the 1200 indicated they would not take the recommended treatment and would continue to fly; 180 indicated they would take the recommended medication and continue to fly while withholding information concerning the medication from their aviation medical examiner; and 300 indicated they would stop flying while taking the medication. If this pilot group acted on their intentions, approximately 75% of pilots diagnosed with depression would have continued to fly, unknown to the regulator.

These data are open to a number of possible interpretations. One conclusion may be that regulating against pilots flying while taking antidepressants is, paradoxically, detrimental to flight safety since this could result in information concerning an important medical condition being withheld from the regulatory authorities while pilots continue to operate after having had a diagnosis of depression, treated or not. Conversely it may be concluded that as the current standards are not being adhered to, additional regulatory action such as more focused interview or survey techniques (to detect depression) and blood testing (to detect antidepressant use) is warranted.

In a recent AsMA position paper, Jones et al. indicated that the use of modern antidepressants by pilots, under adequate supervision, need not be detrimental to flight safety (9). This suggests thatthere are safe subpopulations among those with depressive disorders. Also, if pilots wished to hide their depressive illness and its treatment it is unlikely that interview and survey methods would identify any except the most clinically depressed. Blood testing for antidepressant medications would be very expensive if applied to the entire pilot population. We argue, therefore, that this additional data sways the interpretation of the Hudson data (7) in favor of the first argument: that more stringent standards are not necessarily beneficial to overall flight safety. This, in turn, suggests that it would be a more effective safety strategy both to accept the use of certain selected antidepressants and to structure the routine aeromedical examination to better identify those who may benefit from psychiatric intervention than it would be to try and continue to exclude all pilots with depressive disorders and to institute additional measures to try and increase their detection.

Safety Management as a Way Forward

Safety Management Principles

For some years the concepts of safety management have been applied in the aviation industry, but largely outside the field of aviation medicine. ICAO has mandated the incorporation of a safety management system into the management processes of air traffic and aerodrome operators since 2001 and 2005, respectively (2, 3). Safety management systems became mandatory in January 2009 for aircraft operators (1).

When introducing a safety management system, an important first step is for a company to appoint a senior executive who takes direct responsibility for safety and who has some high-level influence on the distribution

of funds. To fulfill this responsibility, the 'accountable executive' needs to set safety targets, monitor and measure safety-related events, and then revisit and, if necessary revise, the safety targets. In other words, safety should be managed in a manner similar to other aspects of the business. In the past, this has not always occurred, with responsibility for safety often being delegated by senior management to safety officers. Such personnel usually have little influence on the proportion of the company's financial resources that are devoted to protecting safety, as opposed to other necessary expenditure items demanding management attention. If there is no high-level accountability, in the event of an accident senior management may not see themselves as being responsible.

In reality, top level management decisions often impact on safety, since the company culture is developed 'top down' and if little interest is shown in safety at the highest management levels, the same attitude is likely to prevail among other company employees. It is, however, difficult for a senior executive to take responsibility for aeromedical safety in a company (as opposed to other safety aspects), partly because of the confidential and personal nature of the information involved and partly because many companies do not have the necessary expertise among their staff for such a role. It is, therefore, probably more appropriate for the chief medical officer of the CAAN to be the 'accountable executive' responsible for national aeromedical safety.

Collection and Analysis of Aeromedical Data

Just as the senior executives of a company need accurate information (concerning costs, profit, marketing, personnel, etc.) on which to base corporate management decisions, a chief medical officer who is responsible for national aeromedical safety requires sound data on which to base aeromedical policy. Such data can be obtained from three main sources:

in-flight medical events; medical events that occur between flights, but which would have been of importance had they occurred in flight; and medical conditions discovered by the medical examiner during a routine medical examination. The chief medical officer is responsible for using this aeromedical data, along with relevant information from the wider medical literature, to devise and implement appropriate aeromedical policies.

***In-flight medical events*:** When considering what data might be useful to monitor aeromedical safety, a good starting point would be to include in-flight aeromedical events that affect the flight crew. However, while accurate information concerning in-flight medical events is of potential benefit to companies and States alike, there remain some significant challenges in obtaining such data: a) a minor event may not be obvious to the passengers or cabin crew and there may be a temptation not to report it if only the flight crew are aware of the event; b) the flight crew involved may fear adverse repercussions from the employer, or regulator; c) the paperwork regarding such an event may be onerous; d) confidentiality issues may be a concern; or e) the initial report will almost always be made by crewmembers with little or no medical training. This can hinder subsequent analysis.

A recent comparison between in-flight medical events in the United States and the United Kingdom demonstrated that, in the United Kingdom, relatively minor pilot-related in-flight medical events were reported to the CAAN at a rate approximately 40 times greater (55:1.3 per 10 million flight hours) than in the United States (4,5). While it is possible that this observation reflects an actual difference between U.S. and U.K. pilots in the incidence of minor aeromedical events, it seems more likely that the explanation lies with differences in the reporting cultures in the United States and the United Kingdom, with relative under-reporting occurring in the former. The same studies observed similar reporting rates for U.S. and U.K. pilots for more serious medical events. A regular analysis of in-flight events by individual States and a comparison of reporting systems in different States would be of value in helping to better understand why such differences exist.

Efforts to gather and analyze in-flight medical events may also be hampered by the lack of a single, widely accepted, classification system. For example, incapacitation from smoke or fumes may be reasonably regarded as medically related, but there is usually little connection between such events and the fitness of the pilot, as determined by the medical examiner. In addition, classification of events may need to be undertaken with less than full (medical) information, which introduces an element of error and subjectivity. Ideally, in order to maximize benefit from the analysis of in-flight aeromedical events, categorization should be undertaken by an individual who understands both the aviation environment, and aviation medicine.

***Medical events that occur between flights*:** On average, professional pilots spend between 5 and 10% of their time in the air, so noting events that occur between flights would greatly increase the size and utility of any database of medical events that affect pilots. An analysis of the medical conditions that come to light between routine examinations would be particularly useful. Some States require significant medical events to be reported to the regulatory authority after a certain time period, which provides the basis of a useful database for medical conditions that may appear, or deteriorate, between routine examinations. Further, as a medical history is required at each routine medical examination, it should be possible to obtain data on such events, which could be analyzed.

***Information from routine medical examinations*:** There are two types of information available from routine examinations: information from the medical history, and findings from the examination (mental and physical, including any investigations, e.g., electrocardiogram). The aero medical literature contains few studies that have attempted to investigate the relationship between those medical conditions that are identified during the routine periodic medical examination and those that cause in-flight medical events. The results of one such study suggested that the conditions most likely to result in in-flight medical events were usually first observed during the period between routine examinations — they were not discovered during the periodic examination by a medical examiner. If this is the case, it would seem important that the CAAN ensures that the license holder knows what action to take when such an event occurs so that flight safety is not eroded, and that the medical examiner and CAAN are informed of the necessary information.

Reporting of Medical Conditions

Reporting of in-flight incidents involving operational errors may create a fear of adverse repercussions. An analogy can be made with medical events, both in flight and on the ground as a license holder may withhold information if he believes his career may be adversely affected should he report a medical condition. However, systems which encourage reporting of events of safety relevance generate information that can be used to enhance safety.

It is reasonable to assume that if medical conditions of license holders are made known to CAAN, a potential exists to improve safety. Therefore, efforts are made to encourage such reporting by license holders in the form of voluntary reporting. To this end, CAAN has, as part of its regulatory regime, a fair, transparent, and consistent system, developed in consultation with the license holder's representative bodies like airline and Airline Operators Association of Nepal (AOAN). Such a system should be based as much as possible on evidence of aeromedical risk and action in individual cases should be proportionate to the individual risk. Such an approach might include, as a formally stated goal, perhaps included in the mission statement of a regulatory authority's medical department, the aim of returning license holders to operational status whenever possible.

Experience shows that this is often mentioned as a desirable goal in aviation medicine circles, but rarely stated formally.

Conclusions

Despite the growth and acceptance of evidence-based practice throughout most fields of medicine, we still find ourselves routinely using the lowest level of evidence (expert opinion, unsupported by a systematic review) for regulatory aeromedical decisions. Such decisions are often not based on the explicit acceptance of any particular level of aeromedical risk. Without guidelines concerning acceptable risk levels, and with reliance on expert opinion for individual aeromedical decisions, consistent decision making is impeded, and comparisons between States are more difficult.

A cornerstone of a successful future for regulatory aviation medicine is consistent decision making by Authorities using high-level evidence. Such an approach, if applied by different regulatory authorities, would assist global harmonization of medical fitness requirements. The principles of safety management can be used to help achieve both these goals. To promote these aims, several aspects of the aeromedical process should be reviewed and improved, such as:

1. Periodicity and content of routine medical examinations. The periodicity and content of periodic medical examinations should be adjusted to better reflect the medical demographics of applicants and the safety relevance of their medical conditions. For example, an increased emphasis on alcohol, drugs, and mental health may be warranted for younger pilots while it would be appropriate to give greater consideration to cardiovascular disease as pilots age.

2. Improvement in reporting and analysis of medical examination data. Few licensing authorities collect medical examination data in a format that is easily amenable to analysis and there is a lack of data concerning conditions of aeromedical significance that are discovered during routine medical examinations. CAAN will analyze such data.

3. Improved reporting and analysis of in-flight medical event data. Few licensing authorities encourage the reporting of in-flight aeromedical data. Of those that do, it is rare that the reports are assessed in a systematic manner. CAAN has reporting system that includes medical issues as well.

4. Support for better reporting through the development of an appropriate culture by companies and regulatory authorities.

A more supportive approach to license holders who develop medical problems should improve the reliability of data on which aeromedical policies are based by encouraging reporting of medical conditions.

In Nepal SMS principle has been applied in aviation medicine in conjunction with corporate safety management.

CHAPTER 2. MEDICAL REQUIREMENT

2.1 INTRODUCTION

2.1.1 Two basic principles are essential when assessing an applicant's medical fitness for aviation duties as specified in PELR, on medical provisions for licensing," namely:

a) The applicant shall be physically and mentally capable of performing the duties of the licence or rating applied for or held.

b) There shall be no medical reasons which make the applicant liable to incapacitation1 while performing duties.

2.1.2 The main objective of this handbook is to provide guidance material and present concepts on how to achieve these principles by assessing symptoms and signs that occur commonly in medical examinations for the aviation licences but which have not been or cannot be included in detail in PELR, MR and PLM.

2.1.3 It is also envisaged that the guidance material will help ensure international uniformity in the implementation of the SARPs.

2.1.4 The foregoing two basic principles are explicitly detailed in the general, all-embracing PELR:

Physical and mental requirements
An applicant for any class of Medical Assessment shall be required to be free from:

a) any abnormality, congenital or acquired; or

b) any active, latent, acute or chronic disability; or

c) any wound, injury or sequelae from operation; or

d) any effect or side-effect of any prescribed or non-prescribed therapeutic, diagnostic or preventive medication taken; such as would entail a degree of functional incapacity which is likely to interfere with the safe operation of an aircraft or with the safe performance of duties."

Note.— Use of herbal medication and alternative treatment modalities requires particular attention to possible side-effects.

2.1.5 This paragraph outlines the basic general concept of medical assessment and makes reference to any abnormality, disability, wound, sequelae from operations, and effects and side- effects of medication which "would entail a degree of functional incapacity which is likely to interfere with the safe operation of an aircraft or with the safe performance of duties."

2.1.6 The requirements for medical assessments in PELR and MR, are listed under subheadings as follows: ***Physical and mental requirements***, covering matters of a general medical certification nature which apply to all types of licences2.

Visual acuity test requirements, detailing general visual acuity test requirements applicable to all categories of licences.

Colour perception requirements, detailing general colour perception requirements applicable to all categories of licences.

Hearing test requirements, detailing general hearing requirements applicable for all categories of licences.

Class 1 Medical Assessment, covering matters applicable to applicants for a "professional licence" such as a commercial pilot licence — aeroplane or helicopter, an airline transport pilot licence, aeroplane or helicopter, multi-crew pilot licence, a flight engineer or a flight navigator licence.

Class 2 Medical Assessment, covering matters applicable to applicants for a private pilot licence — aeroplane or helicopter, a glider pilot licence, a free balloon pilot licence or a flight radio operator licence.

Class 3 Medical Assessment, covering matters applicable to applicants for an air traffic controller licence.

2.2 GENERAL MEDICAL REQUIREMENTS

2.2.1 The introductory paragraphs of PELR, contain medical certification requirements of a general nature and apply to all types of licences, as given in the following extracts from the PELR:

Note 1.— Of necessity, many decisions relating to the evaluation of medical fitness must be left to the judgement of the individual medical examiner. The evaluation must, therefore, be based on a medical examination conducted throughout in accordance with the highest standards of medical practice.

Note 2.— Predisposing factors for disease, such as obesity and smoking, may be important for determining whether further evaluation or investigation is necessary in an individual case.

Note 3.— In cases where the applicant does not fully meet the medical requirements and in complicated and unusual cases, the evaluation may have to be deferred and the case submitted to the medical assessor of the CAAN for final evaluation. In such cases due regard must be given to the privileges granted by the licence applied for or held by the applicant for the Medical

Assessment, and the conditions under which the licence holder is going to exercise those privileges in carrying out assigned duties.

Note 4.— Attention is called to the administrative dealing with accredited medical conclusion.

Note 5.— Basic safety management principles, when applied to the medical assessment process, can help ensure that aeromedical resources are utilized effectively.

222 While the Standards and Recommended Practices lay down as precisely as possible the minimum levels considered acceptable, it is understood that a degree of interpretation must often be exercised at the discretion of the medical examiner or medical assessor. The important non- medical factors which should be taken into consideration in such cases are the age and experience of the applicant, the privileges of the particular licence or rating applied for or held, and the environmental conditions in which these are to be exercised:

223 The applicant for a Medical Assessment shall provide the medical examiner with a personally certified statement of medical facts concerning personal, familial and hereditary history. The applicant shall be made aware of the necessity for giving a statement that is as complete and accurate as the applicant's knowledge permits, and any false statement shall be dealt with in accordance with applicable enforcement actions of CAAN.

224 The designated medical examiner shall report to the CAAN any individual case where, in the examiner's judgement, an applicant's failure to meet any requirement, whether numerical or otherwise, is such that exercise of the privileges of the licence being applied for or held, is not likely to jeopardize flight safety.

225 The level of medical fitness to be met for the renewal of a Medical Assessment shall be the same as that for the initial assessment except where otherwise specifically stated.

Note.— The intervals between routine medical examinations for the purpose of renewing Medical Assessments are specified in PELR and MR.

226 The purpose of the medical examination is to determine that no physical or mental condition exists which may reduce the applicant's medical fitness to a significant degree during the period of validity of the Medical Assessment.

The medical requirements of PELR and MR are not concerned with social considerations or medical conditions of importance for employment. Nevertheless, on initial issue of a Medical Assessment, it would be poor medical practice to encourage an applicant to pursue flight training if the minimum requirements of PELR and MR are barely met, especially in cases where further deterioration might be expected or is likely to occur. Likewise, it would be poor practice to disregard the preventive aspects of the regulatory examination for renewal.

227 Upon subsequent examination, CAAN is often able to give consideration to such factors as skill and experience which are not present on initial application. However, in keeping with the provisions of PELR, continued fitness for flying upon subsequent medical examination is not guaranteed by success at meeting the medical requirements in the previous examination. Medical information related to decrease in medical fitness, or any information that would provide clarification concerning a

previously noted condition, must be made a part of the periodic reassessment for renewal of a Medical Assessment as provided for in PELR and MR. In 2009, changes were made to the Medical Provisions in PELR and MR to increase the emphasis on mental health aspects and prevention of ill health, especially in the younger age group of Class 1 applicants.

Content of medical examinations

"Except where otherwise stated in this section, holders of commercial pilot licences — aeroplane, airship, helicopter or powered-lift, multi-crew pilot licences — aeroplane, or airline transport pilot licences — aeroplane, helicopter or powered-lift shall have their Class 1 Medical Assessments renewed at intervals not exceeding those specified".

Note.— Guidance to reduce the emphasis on detection of physical disease, whilst increasing the emphasis on health education and prevention of ill health, in applicants under 40 years of age, is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

2.2.8 Class 1 applicants are required to have an annual medical examination from the time they commence flying until they reach 60 years of age, after which the frequency becomes six- monthly. The exception to this is for the passenger-carrying single pilot operator, who requires a medical examination every six months after age 40 years. The medical examination normally varies little during a pilot's career, although after the initial electrocardiogram (ECG) the frequency for ECGs increases with the pilot's age, initially as a Recommendation (two-yearly between ages 30-50 years) and then as a Standard (annually from age 50 years). ICAO therefore recognizes the increase in cardiovascular risk with increasing age, which is an observation made in many Contracting States. There are, however, differences between States regarding the rate of increase in cardiovascular risk with increasing age.

2.2.9 In many Western States, the annual cardiovascular mortality for males reaches around 1 per cent per annum at age 70 years, representing an increase in risk of about 100 times from that at age 30. Further, the risk of developing other physical diseases such as cancer, diabetes and epilepsy is very low in young adults, but increases with increasing age. On the other hand, mental illness and behavioural problems, including those related to drug and alcohol use, do not demonstrate such a steep gradient, and in the general population these categories are usually more frequent than physical disease in younger age groups. It therefore seems appropriate to consider the likely prevalence of different diseases in the pilot population when considering the type of routine periodic examination they should undergo. Further, it is widely accepted that illness in later life, both physical and mental, can be delayed or prevented by lifestyle interventions (and medical treatment, if necessary) at an early stage, and professional pilots represent a group of motivated individuals who have a keen interest in health maintenance. Consequently a change in the emphasis of the medical examination of younger pilots toward preventive aspects will encourage good health and, therefore, bring flight safety benefits later on in a pilot's career.

2.2.10 The annual Class 1 medical examination is unlikely to reveal any significant physical problem in pilots under 40 years, whilst with increasing age the incidence of physical disease generally increases. In younger applicants, some items of the physical assessment could therefore be considered for omission in alternate years without significant detriment to flight safety. This would permit additional time to be used to focus on mental health aspects and on preventive aspects of physical health.

2.2.11 In alternate years, to omit certain items from the physical examination in applicants under 40 years of age, in order for the medical examiner to spend more time discussing medical issues, from an educational viewpoint, with an applicant in this age group. However, a CAAN may wish, for example,

to undertake some evaluation of the vision every year in order to identify those applicants who would benefit from correcting lenses, or a change in lens prescription, since refractive error can change over time. Similarly body weight should in most applicants be checked annually.

2.2.12 An examination of, for example, the heart and lungs, and checking the blood pressure and urine in all pilots under 40 years, on an annual basis, may not be necessary — a two-yearly examination should be adequate. This does not preclude the CAAN from requiring more frequent checks in those who are known to have an increased risk. If the content of the physical examination is reduced in alternate years, this releases some time for discussing aspects of health that may, in the longer term (i.e. with a timescale greater than that of the validity period of the Medical Assessment) improve the pilot's health, and as a consequence, improve flight safety.

2.2.13 Two aspects are particularly worthy of consideration. The first concerns the preservation of physical health. The factors for this are well known. Aspects of diet, exercise, smoking, body weight, etc., and their effect on health should be familiar to all medical examiners and these can be discussed with the individual applicant in light of the particular circumstances of the individual, such as family history of illness, body weight or exercise habits. Licensing Authorities are encouraged to provide guidance to designated medical examiners regarding these aspects of health maintenance. CAAN conducts such information to the targeted population.

2.2.14 The second aspect concerns mental health and use of psychoactive substances. Guidance on prevention of problematic use of substances is given in the ICAO Manual on Prevention of Problematic Use of Substances in the Aviation Workplace (Doc. 9654), but otherwise guidance in this area of aviation medicine is not so readily available. At the request of ICAO a small group of experts reviewed the evidence that raising certain topics with applicants, by means of asking specific questions, may be of benefit. Studies of the general population have demonstrated that some mental illnesses and some kinds of problematic use of psychoactive substances can be reduced or prevented by early intervention, before the situation has deteriorated to an extent where the health or medical fitness for flying of a licence holder has been adversely affected. A separate section on this topic with guidance material is provided below.

2.2.15 Historically, the focus of the periodic medical examination has been to detect medical conditions, and almost exclusively the emphasis has been on detecting physical medical conditions that may pose a threat to flight safety during the ensuing period of validity of the Medical Assessment. The medical examiner's primary role has therefore been to detect significant conditions that may cause incapacitation in the relatively short term. The role of the medical examiner as educator has not played a formal part in the process, although many examiners have taken on this task as a natural part of the role of any doctor conducting a medical examination. Whilst the role of the medical examiner in determining the physical fitness of pilots in all age groups will continue, an opportunity to safeguard the long-term health of the applicant, as well as improve flight safety, presents itself because of the low level of physical pathology encountered in the lower age group. One view, sometimes put forth by pilots or their organizations, is that this is not the role of the regulatory medical examiner, but this attitude disregards the fact that preventive advice is beneficial to flight safety as well as in the best interest of the individual pilot. The medical examiner is in an excellent position to provide this service, and experience has shown that most pilots are unlikely to seek such advice elsewhere.

2.2.16 By reducing the emphasis on the physical examination in those Class 1 applicants less than 40 years of age, time is made available to focus on the non-physical aspects of health, in a non-threatening manner, and at no additional inconvenience or cost to the applicant.

2.2.17 Some medical examiners may be uncomfortable in omitting parts of the physical examination in alternate years, believing that the examination of physical systems naturally leads to a discussion of ill health prevention associated with those systems being physically examined. Medical examiners may therefore prefer to continue to undertake a full physical examination at all renewals, for reasons other than detection of physical disease.

Mental health and behavioural questions for use by medical examiners

2.2.18 As there is evidence that several fatal aviation accidents have been caused by psychiatric disorders or inappropriate use of psychoactive substances, it is reasonable that as part of the periodic aviation medical examination there should be questions that pertain to these issues. Little guidance has been provided concerning how such aspects could be addressed in the periodic medical examination, although experienced medical examiners have often informally and spontaneously included them in their evaluation of the applicant. Further, the number of non- physical conditions that can affect the health of pilots and which can lead to long-term unfitness in those of middle age appears to be increasing. The conditions addressed by the proposed questions have been shown to be amenable to preventive action before they develop into significant health problems and before there is an impact on the pilot's medical status for flying.

2.2.19 There are various questionnaires with various degrees of complexity available for assessing mental health and behavioural aspects of an individual's health. The questions below may serve to promote a relevant discussion between the medical examiner and the pilot. To encourage dialogue, it is recommended that no written record of the conversation is retained (other than a record that mental health and behavioural topics were discussed) unless some item of immediate flight safety risk is uncovered — this understanding should be made clear to the pilot at the outset, thus increasing the likelihood of a frank discussion. It is to be expected that only rarely will any formal action need to be considered by the medical examiner to protect flight safety in the light of response to such questions, since the main aim is to discover behavioural patterns or mental aspects that are amenable to change before they become sufficiently severe to affect the medical fitness.

2.2.20 The questions suggested address those conditions that are most common in the age range of professional pilots and those which are most likely to affect performance on the flight deck. Statistics show that the main psychiatric conditions in this context are mood disorders and certain anxiety disorders, especially panic episodes. Additionally, in many Contracting States, excessive alcohol intake and use of illicit drugs in the general population are occurring with increasing frequency, and pilots are not immune from these social pressures. Questions have been developed to address these issues as well.

2.2.21 In developing the questions, a review of the literature was undertaken by specialists in the field, with the aim of choosing simple questions that can be answered quite quickly. The vast majority of pilots will respond to all questions in the negative, and it is unnecessary to request pilots without any relevant problems to undertake a prolonged screening questionnaire. Those who answer positively, or with uncertainty, can be engaged in further dialogue by the medical examiner. The aim is to encourage pilots to consider their lifestyle and thereby improve the likelihood that they will remain in good mental health during their careers; this, of course, includes the avoidance of problematic use of psychoactive substances. Occasionally, the medical examiner may find conditions that are amenable to medical support or even treatment; it is important to detect these at an early stage, before they become significant problems and before they have a long-term impact on the pilot's medical fitness and on flight safety.

2222 The questions below may not represent the most suitable questions for the pilot populations of all States, but they offer guidance — a starting point — for States that intend to implement and wish to develop an approach that includes these important aspects of medical fitness.

2223 The questions do not necessarily have to be posed verbally by the medical examiner but could, for example, be given to the applicant to read prior to the examination.

Suggested questions for depression:

1) During the past three months, have you often been bothered by feeling down, depressed or hopeless?

2) During the past three months, have you often been bothered by having little interest or pleasure in doing things?

3) During the past three months, have you been bothered by having problems falling asleep, staying asleep, or sleeping too much, that is unrelated to sleep disruption from night flying or transmeridian operations?

4) In the past three months, has there been a marked elevation in your mood lasting for more than one week?

Suggested questions for anxiety/panic attack:

1) In the past three months, have you had an episode of feeling sudden anxiety, fearfulness, or uneasiness?

2) In the past three months, have you experienced sensations of shortness of breath, palpitations (racing heart beat) or shaking while at rest without reasonable cause?

3) In the past year have you needed to seek urgent medical advice because of anxiety?

Suggested questions concerning alcohol use:

1) Have you ever felt that you should cut down on your drinking?

2) Have people annoyed you by criticizing your drinking?

3) Have you ever felt guilty about your drinking?

4) Have you ever needed a drink first thing in the morning?

5) How many alcoholic drinks would you have in a typical week?

6) How many alcoholic drinks would you have on a typical day when you are drinking?

Suggested questions concerning drug use:

1) Have you used drugs other than those required for medical reasons?

2) Which non-prescription (over-the-counter) drugs have you used? When did you last use this drug(s)?

2.3 FLEXIBILITY IN THE APPLICATION OF PELR AND MR MEDICAL REQUIREMENTS

231 The range of variation between individuals is such that if medical Standards are laid down in rigid terms, they will inevitably exclude a number of applicants who, though not meeting the Standards in all respects, might nevertheless be considered capable of performing duties safely in the aviation environment. Since the Chicago Convention lays on Contracting States the duty to promote efficient and safe aviation as well as to regulate it, provision has been made in PELR and MR for the exercise of a degree of flexibility in the application of medical Standards, thus avoiding the hardship and injustice which might otherwise occur. It is essential for the maintenance of flight safety that the manner in which flexibility is exercised should be reasonably uniform throughout the Contracting States if international acceptance of licences is to be maintained. In the past, flexibility has been used in widely differing ways by States. The application of the principles set out in this chapter will assist in achieving uniformity.

The exercise of flexibility

PELR states- "If the medical Standards prescribed in for a particular licence are not met, the appropriate Medical Assessment shall not be issued or renewed unless the following conditions are fulfilled:

a) accredited medical conclusion indicates that in special circumstances the applicant's failure to meet any requirement, whether numerical or otherwise, is such that exercise of the privileges of the licence applied for is not likely to jeopardize flight safety;

b) relevant ability, skill and experience of the applicant and operational conditions have been given due consideration; and

c) the licence is endorsed with any special limitation or limitations when the safe performance of the licence holder's duties is dependent on compliance with such limitation or limitations.

232 The provision of a degree of flexibility must not lead to a situation where its use becomes the rule rather than the exception. PELR, has been worded to make it clear that flexibility may be exercised only in the exceptional case. Failure to observe this requirement could result in routine approval of individuals not meeting specific medical requirements, such as visual standards, thus creating an abuse of the primary object of flexibility. When evidence accumulates that flexibility is being utilized repeatedly in a particular respect, then the appropriateness of regulations defining the medical requirements comes into question and the suspicion is raised that the regulations define a requirement which is not in keeping with the demands of flight safety. However, when decisions to exercise flexibility are backed by an accredited medical conclusion, it indicates that these decisions have not been regarded as a routine measure but that they have been taken following close examination and assessment of all the medical facts and their relationship to occupational demands and personal performance. The degree and intensity of investigation lying behind each decision accurately measures compliance with the principles behind the flexibility Standard.

233 The just and safe exercise of flexibility should be confined to the exceptional case and it ought to be considered in relation to the expertise of those concerned in applying PELR. As a consequence, "accredited medical conclusion" is a basic concept and has been specifically defined in PELR as "the conclusion reached by one or more medical experts acceptable to the CAAN for the purposes of the case concerned, in consultation with flight operations or other experts as necessary." The estimation of risk imposed by the individual upon flight safety is a most difficult task and one often requiring experts in a number of aspects of both medicine and aviation. Decisions should recognize that public interest and safety is the statutory basis for personnel licensing.

Medical deficiency compensation and flight safety

234 Where a medical deficiency exists, the extent to which flight safety is affected is the vital factor, rather than the extent to which failure to attain the medical requirements is capable of being compensated. In some cases the question of compensation for a deficiency will be irrelevant, for example where the risk is one of sudden incapacitation rather than inability to physically carry out a required task. In other cases, the ability to compensate, for example, for an orthopedic dysfunction may be an important factor in the overall assessment of the effect on flight safety. Previously acquired skill and experience may similarly be irrelevant or important to the overall assessment of the safety risk.

Society and the individual

235 Many societies have a concept of individual rights such that if the exercise of those rights does not involve public safety, the individual may decide whether or not to incur a personal risk. In the context of flight, the right of an individual to incur a personal risk can rarely be accepted because of potential effects on flight or public safety. A possible exception may be the private pilot who carries no passengers, flying in an isolated area.

236 Knowledge and technical capabilities are advancing rapidly in both medicine and aviation. The medical assessor and his advisers must be aware of these advances in reaching their decisions but must avoid the appearance of gathering experience through trial and error in the exercise of the flexibility Standard. PELR provisions are not irrevocably permanent and can be amended by constitutional means in ICAO when it is clearly necessary to do so. While they are in force they must be adhered to unless it is demonstrably safe to exercise flexibility and where serious injustice to an individual would otherwise result.

237 The provisions of PELR show that differing assessments are permissible and possible by defining different requirements dependent upon anticipated duties and the category of aviation involved. Society's concern in flight safety varies according to each individual's contact with air transportation. Those who travel as fare-paying passengers in aircraft of commercial air transport operators, those who travel by private aircraft, those whose main duty is the ground control and movement of aircraft, and those over whose property aircraft operate, all show different concern. The accident rate in commercial aircraft operations, although of a low order, invariably elicits public concern quite out of proportion to the apparent lack of dismay at the record of road traffic accidents. The public adopts an attitude towards the commercial air transport operator that automatically demands and expects the highest possible standard of care and efficiency towards those who pay for their service as air carriers. This is understandable when it is remembered that individual passengers generally have no choice or bargaining power in selecting their aircraft, flight crew or flight path. Air transport operators have accepted the duty of performing all their services with the highest possible degree of safety, and the public does not overlook apparent lapses in the exercise of this duty. For this reason, if for no other,

the regulations applied by Nepal must be shown to attain the object for which they were devised and the making of exceptions under a Standard such as 1.2.4.9 of Annex 1 can only be done by bearing in mind the flight safety aspect in its widest context.

The terms "waiver" and "flexibility"

238 PELR standard on waiver is a Standard but is frequently referred to as the "waiver clause", and the term "medical waiver" in connection with medical certification and licensing is generally accepted. The use of the term "waiver", which in legal usage means "an act of dispensing with a requirement", and the verb "to waive" which is defined as "not to insist upon", "to ignore, neglect or disregard", "to refrain from applying or enforcing (a rule etc.) or "to make an exception", is unfortunate.

239 In fact the correct exercise of "flexibility" as described is quite the opposite of "waiver" because the decision to apply the clause is only reached after subjecting the individual involved to a critical analysis, possibly involving detailed personal examination together with deliberations by those who formulate the "accredited medical conclusion" and the decision of the CAAN. PELR sets out to achieve is not the dismissal of a deficiency or discrepancy, but establishment of the fact that allowing a particular individual to exercise the privileges of a licence with or without the imposition of certain limitations on his activities will not be incompatible with the requirements of flight safety.

2310 Consequently, the issuance of a licence based on a Medical Assessment following an accredited medical conclusion under the provisions of does not constitute a departure from the international Standards and Recommended Practices, and no endorsement of the license is required under article 39 b) of the Convention on International Civil Aviation.

The CAAN and accredited medical conclusion

PELR and MR states "Nepal designates medical examiners, qualified and licensed in the practice of medicine, to conduct medical examinations of fitness of applicants for the issue or renewal of the licences or ratings specified in relevant provisions, and of the appropriate licences specified."

Medical examiners shall have received training in aviation medicine and shall receive refresher training at regular intervals. Before designation, medical examiners shall demonstrate adequate competency in aviation medicine.

Medical examiners shall have practical knowledge and experience of the conditions in which the holders of licences and ratings carry out their duties.

Note.— Examples of practical knowledge and experience are flight experience, simulator experience, on-site observation or any other hands-on experience deemed by the CAAN to meet this requirement.

CAAN uses the services of medical assessors to evaluate reports submitted to the FSSD by medical examiners.

The medical examiner shall be required to submit sufficient information to the CAAN to enable that Authority to undertake Medical Assessment audits.

Note.— The purpose of such auditing is to ensure that medical examiners meet applicable standards for good medical practice and aeromedical risk assessment. Guidance on aeromedical risk assessment is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

2311 Medical examiners designated by Nepal are authorized to conduct examinations for the assessment of medical fitness. When the medical requirements are not met, it is the duty of the CAAN concerned to take any necessary steps. The medical examiner is called upon to exercise clinical judgement based upon a careful review of the medical history and a thorough examination of the applicant. The examiner shall report to the CAAN any individual case where, in the examiner's judgement, an applicant's failure to meet the medical requirements does not adversely affect safety, with due consideration given to any relevant ability, skill and experience.

The final decision must be left with the CAAN which is ultimately responsible for flight safety. This authority either has an aviation medical section with permanent medical advisers — medical assessors — or an administrative machinery for obtaining expert aviation medical advice on individual cases from external medical assessors. Either method meets the requirements of PELR and provides the "accredited medical conclusion" as defined in 1.2.4.9 of Annex 1. The decision of a CAAN to exercise the "flexibility" Standard of PELR should be documented in each individual case, and it should show how a particular decision was arrived at by means of the accredited medical conclusion.

2312 In the course of decision making, it is frequently necessary to resort to other sources of information, such as contributions from flight managers, employers, the family physician and, occasionally, members of the family.

2313 Whereas the standard medical examination procedures will normally provide all of the data required by the medical examiner or the medical assessor of the CAAN to take a decision on the applicant's fitness, occasionally more sophisticated tests will be required to enable an informed decision to be made. The content of individual special examinations may very largely be determined by the specialist who is carrying out the investigation, usually inconsultation with the medical assessor of the CAAN.

2314 Whenever possible, the risk of in-flight incapacitation, caused by an existing and diagnosed medical condition, should be estimated as an annual percentage risk. This is particularly important when expert medical advice is sought from medical specialists without aeromedical training and experience. In such cases, every effort should be made to have the specialist evaluation expressed as an annual percentage risk of recurrence, exacerbation, etc.

2315 Whilst the expression of risk of in-flight incapacitation in numerical terms is not always easy to determine, particularly for conditions that are uncommon, for a number of conditions such as certain cardiovascular diseases, good data exist concerning the risk of a future related event. Many States have determined that an acceptable maximum risk of incapacitation for a professional pilot operating a multi-pilot aircraft is one per cent per annum; some States accept two per cent per annum. Where possible, ICAO encourages the use of objective risk assessment for aeromedical fitness decisions as this acknowledges the fact that zero risk is unattainable and provides a benchmark that protects flight safety and at the same time is fair and transparent to the affected pilot. An acceptable level of risk can be developed by a regulatory authority together with pilot representative bodies, thus providing the flying community with some input into the decision-making process. The widespread adoption of such an approach would improve global harmonization of aeromedical decisions. In this handbook, an incapacitation risk of no greater than 1 per cent per annum has been taken as the basis for providing guidance on aeromedical fitness for professional pilots operating multi-pilot aircraft. This is a relatively conservative figure, and States that are familiar with such risk assessments may wish to use a higher figure as their benchmark. However, for States not used to such an approach, the "1% Rule"

is reasonable. Further discussion of the "1% Rule" is in subsequent chapters.

2316 Demonstration of the existence of a functional reserve would be an index of its importance in the prognosis when the medical deficiency is considered to be relatively static and not subject to sudden or insidious adverse changes.

2317 The CAAN should have resources or should have arrangements to permit special practical testing. One example is the medical flight test to allow an amputee to demonstrate his skill and competence in adapting to the use of a prosthesis. If such an applicant has previously held a licence, it is advantageous to conduct the subsequent flight test in an aircraft type with which the applicant is familiar. It may be necessary, when flight competence has been demonstrated, to restrict the applicant to operating the type of aircraft in which the applicant has demonstrated competence.

2318 Medical flights or other practical tests can be utilized in a number of fields such as with applicants having certain vision deficiencies (e.g. monocularity) or defective hearing. In these cases, the presence of a medically qualified pilot on the check flight can add greatly to the value of the subsequent reports.

Licence limitations

2319 It should be noted that PELR and MR do allow for medical Standards to relate to the specific duties that may be undertaken by an individual licence-holder. This is indicated by relevant statements that appear in the Annex text referring to safe operation of an aircraft or to safe performance of duties while exercising the privileges of the licence. It follows that an applicant who has been assessed as unfit for one duty may be found fit for another, and it is possible to envisage a CAAN deciding that an individual would be precluded from flying as a pilot while being judged capable of safely exercising the privileges of a flight engineer's licence.

2320 It is evident that many such possible operational restrictions exist but they should only be established after consultation with flight operations experts. An applicant may be found fit to operate an aircraft as a pilot under supervision or as a co-pilot but not as a pilot-in-command. In cases where prognosis cannot be given with the necessary degree of certainty, any potential risk to flight safety may, in general aviation where two pilots are not normally required, be mitigated by a restriction to fly without passengers, outside controlled airspace or with the carriage of a "safety pilot". Such a pilot should receive adequate information about the medical condition which has led to the restriction "valid with safety pilot only". In addition, he must be capable of acting as pilot-in-command in case of an emergency. In commercial aviation, a restriction to multi-crew operations may serve a similar purpose. In such a manner it is often possible to fit individuals into aviation by restricting their licence or limiting their duties and thus mitigating the risk to flight safety while retaining the experience of individuals who would otherwise be denied a licence.

"The period of validity of a Medical Assessment may be reduced when clinically indicated."

2321 PELR and MR sets out a table listing the normal maximum time intervals between medical examinations for continued validity of a range of licences. In many cases, however, progress reports on an individual at intervals during the period of validity of his licence will suffice, thus making a complete medical certification examination unnecessary. Sometimes it may be relevant to observe the

applicant on the flight deck or in a synthetic flight trainer. In such cases, it is important to obtain the cooperation of operators and qualified flying instructors. It is entirely possible, by utilizing advice from experienced specialists and/or accredited medical conclusion, to introduce some flexibility into the process without degrading the intent of the medical standards in PELR and MR. While this would require an additional effort from the CAAN, it could provide a continuing and critical analysis of the existing medical requirements and could show whether they achieve their purpose. Moreover, it will extend the careers of those who are professionally employed and enable an increasing number of motivated individuals to achieve their ambition to fly while, at the same time, avoiding any compromise of flight safety.

2.4 SAMPLE PROCEDURES FOR EVALUATION OF BORDERLINE CERTIFICATION CASES

Sample medical flight tests

2.4.1 Borderline medical conditions should first be referred to a specialist for a thorough investigation as outlined in the following chapters of this handbook. This should include an evaluation of whether or not the condition is progressive, to what extent function is impaired, and whether there is any risk of future deterioration or sudden incapacitation. If the applicant fails to meet the medical requirements but the condition, in the examiner's opinion, does not affect the regular and safe performance of duties, the CAAN might wish additionally to assess any skill and experience demonstrated during practical flight tests, in order to make certain that the applicant is capable of performing duties without endangering flight safety. A practical flight test is usually most appropriate for assessing static physical conditions, and not for those with normal physical function but who have an increased risk of rapid incapacitation. It is likely to be undertaken mainly for private pilots, for whom the medical standards are less rigorous and where modification to aircraft controls may be feasible, although professional pilots may also require practical testing for certain conditions.

2.4.2 Special medical flight testing, appropriate to the applicant's deficiencies, is conducted to help the CAAN estimate the applicant's ability to perform under normal as well as adverse flight conditions. Therefore, testing of the applicant could include marginal or simulated marginal conditions such as might be encountered in emergency operations, in adverse weather, in twilight or at night, in haze or cloudiness, and in flight towards the sun as appropriate to the condition being assessed.

2.4.3 The flight test report should comment on the conditions under which tests were given.

2.4.4 Reasonable simultaneous tasks should be introduced during medical flight testing (such as map reading and navigation, operation of flight equipment, maintenance of communications, and even equipment or engine malfunction) to estimate the applicant's ability to perform more than one task simultaneously.

2.4.5 Specifications for such special medical flight tests provide guidelines to help in determining the applicant's abilities and limitations. Where the applicant's abilities are compared to those of the flight examiner, it is assumed that the relevant flight examiner's physical attributes are normal. If not, the applicant should be reassigned to another flight examiner.

2.4.6 All of the medical flight test items should be observed and assessed by the flight examiner, but additional tests may be added as deemed necessary at the time of the testing. A medical flight test

should be conducted when assessing borderline cases described below. The descriptions apply mainly to general aviation pilots but the same principles are relevant to professional pilot operations.

Deformity or absence of extremities

2.4.7 An applicant might be assessed as fit if able to demonstrate:

a) ability to reach readily and operate effectively all controls that would normally require use of the deficient extremity (or extremities), noting any unusual body position required to compensate for the deficiency;

b) ability to perform satisfactorily emergency procedures in flight, such as recovery from stalls and power-off control, as well as on the ground, including evacuation of the aircraft.

Defective hearing

2.4.8 Defects in hearing need not normally necessitate tests under actual flight conditions since all pertinent factors may be simulated. Whether conducted on the ground or in flight conditions, the main considerations to be assessed in such cases are:

a) ability to hear radio voice and signal communications;

b) ability to understand ordinary conversational voice on the ground, in the cockpit with engine on and engine off. (The examiner should guard against the applicant lip-reading.)

Speech defects — stammering, stuttering

2.4.9 An applicant might be assessed as fit, if able to demonstrate ability to converse and be clearly understood in direct conversation and over the radio.

Visual deficiencies

2.4.10 The following circumstances represent some of the typical conditions defining the visual abilities required of a general aviation pilot. Possession of these abilities by an applicant or the applicant's inability to meet the required level of proficiency may be established by simulation or, more realistically, in actual flight conditions. In either case, the ability of an applicant to perform specified tasks is a practical requirement which is not easily established by a conventional test.

Suggested testing procedures may determine the following:

a) ability to select emergency landing fields from a distance, preferably over unfamiliar terrain and from high altitude;

b) ability to undertake simulated forced landings in difficult fields. Note the manner of approach, rate of descent, and comparative distance at which obstructions (stumps, boulders, ditches) are recognized;

c) ability to recognize other aircraft approaching on a collision course (possibly by pre-arrangement), especially aircraft approaching from the far right or far left;

d) ability to judge distances (compared with the examiner's judgement), such as distance from other aircraft and from the ground, and to recognize landmarks at the limit of the examiner's vision;

e) manner in which landings are made, including crosswind landings;

f) ability to read aeronautical maps in flight and to tune the radio on a predetermined station accurately and quickly;

g) ability to read instrument panels quickly and correctly (including overhead panel, if any).

Additional colour perception tests

2.4.11 An applicant failing to obtain a satisfactory score when tested with pseudo-isochromatic plates may nevertheless be assessed as fit, as specified in PELR, provided the applicant is able to readily distinguish the colours used in air navigation and correctly identify aviation coloured lights. This can be tested, usually for aviation red, green and white light, by means of a colour perception lantern recognized by the CAAN. Failure of the applicant to name each colour correctly *within the time during which the light is being shown* (usually about four seconds) shall indicate failure of the test. Several such lanterns are in use in States.

2.4.12 Additional diagnostic testing may be carried out by anomaloscopy.

Medical flight test reports

2.4.13 All results of special medical flight tests should be reported to the CAAN. The report should include information about:

a) deficiency, test and recommendations;

b) any additional procedures deemed necessary by the examiner;

c) any physical attributes of the examiner relevant to comparison of the examiner's abilities with those of the applicant;

d) marginal or simulated marginal conditions for the test;

e) the applicant's susceptibility to distraction caused by simultaneous tasks; and

f) any recommended operating limitations for the licence concerned or, alternatively, the fact that no limitations are required.

2.5 APPLICATION FORM FOR AN AVIATION MEDICAL ASSESSMENT

Refer to following attachments for further details.

Attachment:- A-1/6,

Attachment:- A-2/6,

Attachment:- A-3/6

Attachment:- A-4/6

Attachment:- A-5/6

Attachment:- A-6/6

Attachment:- B-1/2

Attachment:- B-2/2

Attachment:- C-1/3

Attachment:- C-2/2

Attachment:- C-3/3

Attachment:- A-2/6

CHAPTER 3. FLIGHT CREW INCAPICITATION

3.1 INTRODUCTION

3.1.1 The impressive growth of international civil aviation during the past decades has been accompanied by a continued concern for safety in air travel. The number of air carrier accidents per year will increase if industry growth continues and accident rates remain unchanged. It is, therefore, essential to continue to examine all areas which have an impact on flight safety. One such area is that of in-flight pilot incapacitation, which can be defined as any reduction in medical fitness to a degree or of a nature that is likely to jeopardize flight safety.

3.1.2 This might be regarded as a "medical definition" focusing as it does on medical fitness. Note, however, that incapacitation can also occur in a medically fit individual, e.g., smoke inhalation or effects of a laser beam on vision. A doctor practicing aviation medicine should be familiar with the relevant operational environment and of the wide variety of possible causes of incapacitation.

3.1.3 Minor degrees of reduced medical fitness may go undetected by other crew members during normal flight operations and lowered levels of proficiency may be rationalized, e.g., poor handling may be attributed to lack of recent handling experience. However, when abnormal conditions or an emergency occurs, flight crew may have to perform complex physical and mental tasks under time constraints, and in such circumstances even a minor deficiency in performance could be operationally significant.

3.1.4 Some effects of mild incapacitation include a reduced state of alertness, a mental reoccupation which may result in a lack of appreciation of significant factors, increased reaction time, and impaired judgement.

Controlling the risk of pilot incapacitation

3.1.5 Pilot incapacitation has been of concern for as long as powered flight has existed. It represents an operational risk, and it can therefore be defined operationally as "any physiological or psychological state or situation that adversely affects performance."

3.1.6 There are sound reasons for considering an operational definition. From the operational standpoint, it is irrelevant whether degraded performance is caused by a petit mal episode, preoccupation with a serious personal problem, fatigue, problematic use of psychoactive substances or a disordered cardiac function. The effects may be similar, and often other crew members will not know the difference.

3.1.7 A great deal about pilot incapacitation has been learned over the past decades. One of the most important things is that the risk to aviation safety in situations where a pilot is physically incapacitated can be virtually eliminated in air transport (multi-crew) operations by training the pilots to cope with such events.

3.1.8 In 1984 the medical director of a major British airline reported the results of a study of pilot incapacitation that remains the most comprehensive to date (see Chapman, 1984). It included over 1 300 "subtle" incapacitations which were simulated to occur at critical phases of flight during routine competency checks in a simulator.

3.1.8.1 Five hundred of these incapacitations were deliberately planned to occur with other major failures in a "worst case" scenario. Major failures were not included in the remaining 800 incapacitations so that

"the simulation was of a subtle incapacitation, still taking place at a critical phase of flight, but as an event in itself and not complicated by other major failures." This latter scenario is the more realistic, since the risk of an incapacitation occurring simultaneously with a major technical failure is extremely remote.

3.1.8.2 In the simulator it was found that only 1 in 400 "uncomplicated" incapacitations resulted in a simulator "crash", because the second pilot successfully took control on the 399 other occasions. If certain assumptions about a typical multi-crew flight are made, this knowledge can be used to calculate an acceptable risk of incapacitation for an individual pilot. These assumptions (see Figure I-3-1) are:

1. Each flight lasts one hour.
2. Only 10 per cent of the flight time is critical, viz. take-off and initial climb, approach and landing (in a one-hour flight this comprises the first and last three minutes).
3. Pilot incapacitations occur randomly during a flight.
4. 1 in 100 real-life incapacitations occurring in the critical periods would result in a fatal accident, a more pessimistic view than that suggested by the simulator studies mentioned above (1 in 400), where simulated incapacitations could be anticipated by the flight crew.

Based on these four assumptions, the so-called "1% rule" has been developed.

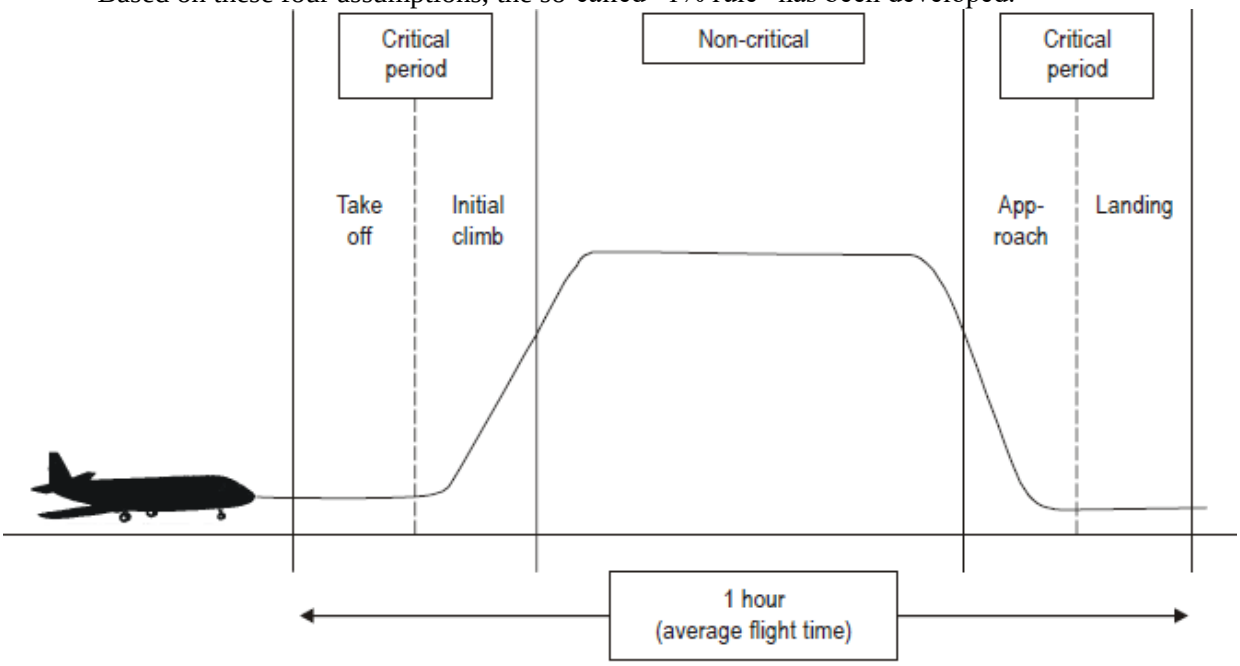

Figure I-3-1. Critical and non-critical phases of flight in a flight of one hour[1]

The 1% rule

3.1.9 During the last decades of the 20th century, a number of Contracting States were approaching a fatal accident rate of one in 107 flying hours. Some Contracting States therefore set as their target *all cause* maximum fatal accident rate a figure of one in 107 flying hours, with human "failure" constituting one tenth of the risk and human failure caused by medical incapacitation comprising one tenth of the human failure risk, or one hundredth of the total risk, i.e., medical incapacitation should not result in a fatal accident more often than one in 109 hours. Based on the assumptions stated above, a pilot flying a two-pilot aircraft can have an incapacitation risk of no more than one in 106 hours, and the

operation will achieve the target medical cause fatal accident rate of no more than one in 109 hours, since the presence of a second pilot reduces the risk by a factor of 1 000. This is because:

- In a multi-pilot aircraft only 10 per cent of flight time is critical (risk reduced by a factor of 10) as incapacitations are assumed to occur randomly. Therefore, only one in ten in-flight incapacitations will occur during a critical stage of flight and thus pose a flight safety risk.

- Only one in 100 incapacitations occurring at a critical stage of flight is likely to result in a fatal accident (risk further reduced by a factor of 100).

- Therefore the total risk reduction with the addition of a second pilot is 1/10 × 1/100 = 1/1 000, i.e., the risk is one 1 000th of the risk of single pilot operations.

- For a pilot with an incapacitation risk of one in 106 hours, a second pilot therefore reduces the risk of a fatal accident from pilot incapacitation from one in 106 hours to one in 109 hours.

3.1.10 In other words, only one fatal accident in one thousand in-flight pilot incapacitations would be expected to result in a fatal accident, because the other pilot would take over safely in the other 999 times. For an individual pilot flying a multi-crew aircraft the acceptable risk of incapacitation may therefore be increased by a factor of 1 000 from one in 109 to one in 106 hours.

3.1.11 An incapacitation rate of one in 106 hours approximates to a rate of one per cent (or one in 102) per annum (since there are 8 760 - close to 10 000 (or 104) - hours in one year). More explicitly:

- 1 in 106 hours = 0.01 in 104 hours (dividing both figures by 100)
- 0.01 in 104 hours = 1% in 104 hours
- 1% in 104 hours approximates to 1 per cent in one year (because there are 8 760 hours per year).

3.1.12 The acceptable maximum incapacitation rate of one per cent per annum outlined above has become known as the "1% rule". This rule specifies a predicted annual medical incapacitation rate which, if exceeded, would exclude a pilot from flying in a multi-crew aircraft. This is widely regarded as an acceptable risk level and was adopted by the European Joint Aviation Authorities as the basis of aeromedical risk assessment.

3.1.13 The "1% rule" cannot apply to a solo pilot flying in public transport operations, because it is derived from two pilot operations and the availability of a second pilot to take over in the event of one pilot becoming incapacitated. However, the "1% rule" has also been applied to the private pilot population by some States, on a pragmatic basis, such that a private 2 A fatal accident is an accident in which one or more persons are fatally injured as a result of being in the aircraft, or being struck by an aircraft or its parts.

3.1.14 It should be noted that if two pilots with a 1% risk per annum of incapacitation happen to be flying together, the chance of one of them becoming incapacitated in a one-hour flight is 2 in 106 hours pilot who develops a medical problem may be permitted to continue to fly as a solo pilot if his risk of an incapacitation is 1 per cent per annum or less. This acceptance of an increased risk of incapacitation in a private pilot seems reasonable since the overall level of safety demanded of private operations is less than that of commercial operations, and it would therefore be out of place to demand a professional pilot medical standard for private pilot operations.

3.1.15 The "1% rule" provides a rational, objective method of assessing the fitness of applicants. However, other limits of acceptable incapacitation risk, such as 2 per cent per annum, or even greater, have been suggested. The important point is that States should endeavour to define objective fitness criteria to encourage consistency in decision-making and to assist in improving global harmonization of medical standards. The practical application of the "1% rule" is discussed in many of the chapters of Part III, in particular Chapter 1 (Cardiovascular System) and Chapter 15 (Malignant Disease).

Causes of incapacitation

3.1.16 A dramatic form of pilot incapacitation, although not necessarily its most hazardous, is death in the cockpit. A survey (1993-1998) of flight crew incapacitation on United States scheduled airlines recorded five deaths in the cockpit, all owing to cardiovascular diseases. The youngest pilot was 48 years of age when he died. No case resulted in aircraft damage or operational incident. It should be noted that ICAO introduced the requirement for incapacitation training in two-pilot operations in the 1970s and this has undoubtedly reduced the risk to flight safety from pilot incapacitation.

3.1.17 Incapacitations from self-limiting illness may be less dramatic but are considerably more frequent. In two studies of airline pilots, in 1968 and again in 1988, more than 3 000 airline pilots completed an anonymous questionnaire survey including questions about whether they had ever experienced an incapacitation during a flight. In both studies, which revealed remarkably consistent results, about 30 per cent answered "yes". However, only about 4 per cent considered their incapacitation a direct threat to flight safety. In both studies the most frequently cited cause of incapacitation was acute gastroenteritis (see Table I-3-1).

3.1.18 As can be seen, most of these incapacitations are caused by gastrointestinal upsets which are usually impossible to predict. Whilst they may represent little more than varying degrees of discomfort and inconvenience, they can also be completely incapacitating. Here is an example taken from a pilot's report:

Trip was normal up to time of incident. Approximately half-way between LAS and LAX, shortly after reaching cruise, I experienced severe abdominal pains which soon rendered me incapable of operating a safe flight. I turned command over to the First Officer and put the Second Officer in the First Officer's seat while I lay in great pain on the cockpit floor.

Trip landed safety at LAX with First Officer . . . at the controls. An ambulance was requested by the crew...

I was taken to the Daniel Freeman Hospital in LAX where . . . (I was given) . . . a diagnosis of gastroenteritis.

I think that spells food poisoning in our language. After some medication I felt wonderfully relieved and was released from the hospital.

Fortunately, gastroenteritis rarely occurs so suddenly as to prevent a planned handover of control, thereby minimizing the flight safety risk.

3.1.19 Pilot incapacitation is clearly both a traditional aeromedical problem and a straightforward training problem.

As long ago as 1970, a past Chief of ICAO's Aviation Medicine Section, wrote:
". . . It is suggested that acknowledgement of pilot on-duty incapacitation . . . as a permanent part of the air transport industry scene in the foreseeable future constitutes a constructive rather than a defeatist medical position. Further, it appears essential that the design, management, operational, training, and licensing disciplines should recognize that pilot incapacitation must be given due weight . . . in the overall judgement of what level of safety is practically available."

3.1.20 Medical screening, by itself, cannot be relied upon to reduce the hazard of incapacitation to an acceptable minimum level, even if significantly more rigorous medical standards were to be applied. Other important aspects include pilot education in the causes of incapacitation, pilot training for safe handover of controls in such an event and, especially, good food hygiene and low-risk, separate meals for the fight crew. From the operational/training viewpoint, the maxim that "any pilot can become incapacitated at any time" is apposite.

Pilot incapacitation training

3.1.21 Pilot training in the early recognition of incapacitation and in safe handover of controls, pioneered in the United States, has been highly effective in preventing accidents from physical incapacitation. It seems less effective in the case of mental incapacitation. Because the majority of accidents result from human failure of some sort, degradation of performance from commonly occurring sub-clinical conditions such as mild anxiety and depression, sleep loss and circadian rhythm disturbance is an important factor in this area of relative incapacitation. Although mostly a small problem amongst flight crew, the problematic use of psychoactive substances is likely to become more important as their general use in society increases.

3.1.22 Incapacitations can be divided into two operational classifications: "obvious" and "subtle". Obvious incapacitations are those immediately apparent to the other crew members. The time course of onset can be "sudden" or "insidious" and complete loss of function can occur. Subtle incapacitations are frequently partial in nature and can be insidious because the affected pilot may look well and continue to operate but at a less than optimum level of performance.
The pilot may not be aware of the problem or capable of rationally evaluating it. Subtle incapacitations can create significant operational problems.

3.1.23 A series of 81 simulated obvious and subtle incapacitations showed that pilots needed help in two areas: their first need was for a method of detecting subtle incapacitations before they became operationally critical; their second need was for an organized method of handling the incapacitations once they were recognized. It was learned that all pilot incapacitations create three basic problems for the remaining crew. This is true whether the incapacitation is obvious or subtle and whether there is a two- (or more) member crew. Although this study was carried out many years ago, its recommendations are still valid. If an in-flight incapacitation occurs, the remaining flight crew has to:

a) maintain control of the aircraft;

b) take care of the incapacitated crew member;
(An incapacitated pilot can become a flight deck hazard and, in any case, is a major distraction to the remaining crew. For this reason, responsibility for the incapacitated pilot, who should preferably be removed from the flight deck, should be given to the cabin crew.)

c) reorganize the cockpit and bring the aircraft to a safe landing.

These three steps became the organized plan for handling in-flight incapacitation. They should be taken separately and in order.

"Two communication" rule

3.1.24 The "two communication" rule was developed to meet the need for a method of detecting subtle incapacitations before they become operationally critical. The rule states: "Flight crew members should have a high index of suspicion of a 'subtle' incapacitation any time a crew member does not respond appropriately to two verbal communications, or any time a crew member does not respond appropriately to any verbal communication associated with a significant deviation from a standard operating procedure or a standard flight profile." This rule is easy, straightforward and effective.

Cognitive incapacitation

3.1.25 A particular category of incapacitations has been identified as "cognitive." The problem created by these incapacitations is how to deal with a pilot who is "mentally disoriented, mentally incapacitated or obstinate, while physically able and vocally responsive." In this category, the captain presents the most difficult case.

3.1.26 While cognitive incapacitations may seem to be psychologically based, in some cases the underlying causes are pathological, as with a brain tumour, causing an erratic performance. Retrospectively, there often seems to have been ample warning of an impending problem. In most cases of cognitive incapacitation, the pilot demonstrates manifestly inappropriate behaviour involving action or inaction, and the inappropriate behaviour is associated with failures of comprehension, perception, or judgement.

3.1.27 These kinds of incidents seldom occur in isolation because, in most cases, they represent a pattern of behaviour. Two excerpts from reports to NASA's ASRS (National Aeronautics and Space Administration's Aviation Safety Reporting System) illustrate the repetitive nature — or pattern — of what may be examples of this grey, but important, problem area.

a) "On two occasions we descended through our assigned altitude. I was the non-flying pilot and made all the call-outs . . . On both occasions, in addition to the required call-outs, I informed the flying pilot that we were descending through our assigned altitude. His corrections were slow and on one occasion we went 400 feet below, and on the other, 500 feet below the assigned altitude. In addition, his airspeed and heading control were not precise . . ."

The reporter elaborated further in a telephone call:

". . . Captain reacted almost catatonically to his altitude call-outs and the additional call-outs that they were descending through the cleared altitudes. Definitely very delayed reactions. Other aspects of the trip were reasonably normal except that Captain missed several radio transmissions. `It was as if he simply didn't hear them' . . ."

b) From a telephone call to a pilot reporting a different incident:
"Reporter believes Captain has serious and persistent 'subtle' incapacitation problem. Reported incident (which included successive altitude deviations) . . . happened on first trip of the month
.
. . Remainder of month with Captain has had same pattern with many cases of very poor performance . . . Seems to be increasingly slow thinker in the aeroplane. Has to be reminded of things several times, even including getting his signature on required papers . . ."

3.1.28 The deliberate failure to follow established rules and procedures is a very old problem and the

"maverick" pilot is by no means a new phenomenon. One Chief Medical Officer commented on the difficulties with dealing with aberrant behaviour in the medical context. The following paragraph is taken from his paper given at an aeromedical examiner symposium in the 1980s: Psychiatric disturbances giving rise to unusual behaviour are . . . like alcoholism . . . often covered up. There is, however, genuine difficulty here, for aviation attracts eccentrics — indeed, aviation has only reached its present state because of eccentrics. It is often very difficult to define the boundaries between normality, eccentricity, and psychiatric disorder, and individuals, not uncommonly, cross over these boundaries from day to day. The ICAO definition — 'manifested by repeated overt acts' — is a useful indicator of the need for, at least, investigation.

3.1.29 The nature of air transport operations is such that the individuals in the best position to observe repeated overt acts and, from a practical standpoint, the only ones situated to do so, are other crew members. This creates a different sort of resource management problem. It is an obvious challenge for management. It is also a challenge for pilot-representative organizations.

3.1.30 Control of the incapacitation risk is dependent upon effective operational monitoring. A basic requirement for that monitoring is that all flight crew members must know what should be happening with and to the aeroplane at all times.

This is one of the most important reasons for following standard operating procedures (SOPs) and flying standard flight profiles. The real importance of SOPs lies as much in the area of information transfer as it does with respect to the issue of the proper way to fly the aircraft.
Routine adherence to SOPs helps to maximize information transfer in much the same way that the use of standard phraseology does in air traffic control communications.

3.1.31 Detection of subtle incapacitation may be indirect, i.e., as a result of a pilot not taking some anticipated action. If, for example, the pilot conducting the approach to land silently loses consciousness and his body position is maintained, the other pilot may not be aware of his colleague's predicament until the expected order of events becomes interrupted. Regular verbal communication, built into standard operating procedures, and use of the "two communication rule" are helpful to detect subtle incapacitation, especially when physical control inputs are unnecessary, e.g. automatic approach.

"Fail-safe crew"

3.1.32 The object of "fail-safe crewing" is to provide an adequate number of crew members to cope with flight crew workloads, and to make it possible fully to integrate the flight crew members into a flight crew team so as to establish a crew in which there is always at least one fully competent pilot at the controls. Ideally the actions of each crew member should continuously be monitored by his fellow crew member(s). The concept aims at achieving maximum safety in the operation of the aircraft and equitable distribution of cockpit workload so as to ensure the crew can cope with all requirements including peak demands in adverse weather or under emergency conditions — such as in-flight pilot incapacitation.

3.1.33 The "fail-safe crew" concept is the key ingredient for successfully dealing with any form of pilot incapacitation. Support at all levels of management and pilot representation is needed for the "fail-safe crew" to, in practice, do justice to the concept. Meaningful simulator training, reinforced with a suitable education programme, is a requirement.

3.1.34 The story of controlling the incapacitation risk in air transport is the story of a progress made in a series of small but important steps. Learning to manage the cognitive incapacitation risk remains an

important goal.

Crew resource management

3.1.35 In modern flight operations, line-oriented flight training (LOFT) emphasizes that resource management is making a substantial contribution to flight safety.

3.1.36 A captain representing a pilots association explained the concept as follows:
". . . One of the basic fundamentals of this philosophy is that it is the inherent responsibility of every crew member, if he be unsure, unhappy or whatever, to question the pilot-in-command as to the nature of his concern. Indeed, it would not be going too far to say that if a pilot-in- command were to create an atmosphere whereby one of his crew members would be hesitant to comment on any action, then he would be failing in his duty as pilot-in-command . . ."

3.1.37 Training in crew cooperation, called crew resource management (CRM), is now provided by most major airlines but frequently not to the same extent by smaller operators. In smaller companies, procedures are less standardized and a greater degree of individuality is tolerated, so behavioural problems can be expected to be more common, and experience has shown that this is the case. Over several years CRM has been expanded to include the interaction between flight and cabin crew in recognition of the fact that cabin crew members can sometimes have operationally relevant knowledge that flight crew do not have. This was dramatically demonstrated in the United Kingdom in 1989 when a flight crew shut down the wrong engine of a Boeing 737. Although the pilots believed their action was correct, the cabin crew had seen flames issuing from the other engine, but unfortunately this information was not communicated to the flight crew. In the ensuing crash several passengers and crew members were killed or severely injured.

3.1.38 While most would agree that CRM training is helpful in promoting flight safety, its assessment is more controversial. Interpersonal relationships are not particularly amenable to measurement, and there is much suspicion among pilots about any process which attempts, or seems to attempt, to measure personality.

Medical standards and prevention of pilot incapacitation

3.1.39 One of the major purposes of medical examinations and determination of medical fitness of an applicant is to assess the probability of a medical condition resulting in in-flight incapacitation. Based only on such an assessment can the authority objectively consider certification that is compatible with generally accepted flight safety standards. In this context a discussion of the "1% rule" can be found above.

3.1.40 The medical examiner is in many cases handicapped in making such an assessment, because adequate predictive epidemiological data are not available for the condition itself or, if they are, they cannot be readily applied to the flight environment. This situation is, however, improving. Figures for the risk of a future cardiac event in an individual recovering from a common cardiac problem such as myocardial infarction are available. Figures may also be available for certain other relatively common diseases, such as the risk of a cerebral metastasis from a recurrence of a surgically removed malignant melanoma, or the recurrence of an epileptic seizure after a first fit. It should be remembered that a medical condition in a pilot that might potentially result in only a loss of efficiency or a moderate decrease in safety in a multi-pilot aircraft might incur great risk in single-pilot operations.

3.1.41 However, more demanding medical requirements cannot alone adequately control the flight safety risk posed by the possibility of an in-flight incapacitation. Grounding older pilots who have medical

problems may incur a high price in terms of sacrifice of pilot expertise. This might, paradoxically, have the opposite effect of that desired because it is possible that flight safety would suffer if older experienced pilots with minor health problems were replaced by younger and healthier, but less experienced pilots. At the same time, it seems reasonable to assume that uneventful flying experience may breed complacency and also that experience, obtained many years ago in aircraft types no longer flown and with navigational systems and other equipment no longer in use, may be of little value today. Unfortunately, the data relating pilot experience to risk of accident are sparse, although there is little evidence to suggest that the risk changes much between 60 and 65 years of age, and in 2006, 65 years became the upper age limit for professional pilots in multi-crew aircraft (increased from 60 years).

3.1.42 It should also be mentioned that very demanding medical standards, at least ones that are perceived as unjust by licence holders, may result in applicants withholding important medical information from the medical examiner with a consequent decrease of flight safety. Since the medical history is usually more important than the medical examination in eliciting conditions of flight safety concern, it is desirable that an applicant believes he will be treated fairly, should he volunteer that he has a particular medical problem. In cooperation with all stakeholders, including representative bodies of licence holders, States should strive to develop the appropriate culture to minimize this risk.

Evidence-based decision making

3.1.43 A continued assessment of in-flight crew incapacitation as a flight safety hazard requires collection of related data. Reporting of incapacitation incidents to ICAO is an integral part of an accident/incident reporting system on a worldwide basis, but suffers from two major difficulties: firstly, the data are incomplete as not all Contracting States send information on accidents and incidents, and secondly, the data are rarely assessed and classified by personnel who understand the medical implications. Moreover, Contracting States which have their own reporting system are often hampered by the confidential nature of the information supplied. For example, a report following an incapacitation is often filed by another crew member who does not reveal the name of the incapacitated person, making follow-up difficult.

3.1.44 Further, incapacitation data classified by means of a layman's diagnosis may be incorrect or misleading: a pilot who collapses with abdominal pain may be suffering from one of a number of medical problems, but is likely to be diagnosed by other crew members as having a gastrointestinal upset. The diagnosis might not be relevant at the time of incapacitation, but is important for monitoring medical standards and in determining where the maximum benefit for a given effort is achieved with respect to reducing the incidence of in-flight incapacitation. Attention needs to be given to devising a more accurate, preferably international, method of recording and classifying data on in-flight incapacitations. In recent years ICAO has taken the initiative to require a Safety Management System (SMS) to be incorporated into the routine management of aerodromes, air traffic and airlines. An integral part of SMS is that of measuring and recording safety events, and of setting targets. In 2010 medical provisions became applicable in Annex 1 (1.2.4.2) that recommend the application of safety management principles to the medical assessment process of licence holders, including the routine analysis of in-flight incapacitation events. It is to be hoped that this development will provide the stimulus towards a more evidence-based application of aeromedical standards. Safety management principles as applied to the medical certification process are addressed in more detail in Part I, Chapter 1, of this handbook.

3.2 CONCLUSIONS

3.1.45 In-flight pilot incapacitation is a safety hazard and is known to have caused accidents. Such incapacitation occurs more frequently than many other emergencies that are routinely trained for, such as sudden decompression.

Incapacitation can occur in many forms, ranging from sudden death to a not easily detectable partial loss of function, and has occurred in all pilot age groups and during all phases of flight.

3.1.46 It is important to recognize the operational ramifications of pilot incapacitation. Medical officers working for regulatory bodies should be fully aware of the operational aspects.

3.1.47 Instruction and training of flight crew concerning action in the event of in-flight pilot incapacitation should include early recognition of incapacitation as well as the appropriate action to be taken by other flight crew members.

CHAPTER 4. AVIATION PHYSIOLOGY

REFER LATEST VERSION OF MANUAL OF AVIATION MEDICINE 'ICAO DOC 8984' AND CAAN MEDICAL REQUIREMENTS

CHAPTER 5. MEDICAL FACTORS IN AIRCRAFT ACCIDENT INVESTIGATION

5.1 INTRODUCTION

5.1.1 This chapter of the Medical handbook is intended as a general guide for a medical examiner appointed as a member of the accident investigation team. It outlines how specialists in aviation medicine, pathology and human engineering may contribute to an accident investigation and the nature of the work involved in their contribution. It supplements guidance material for the conduct of an investigation in accordance with Annex 13 to the Convention on International Civil Aviation — *Aircraft Accident and Incident Investigation*. Nepal Civil Aviation (Accident and Incident Investigation Regulation 2014).

5.1.2 The Standards and Recommended Practices for aircraft accident investigation contained in Annex 13 have been adopted by the ICAO Council as the procedure to be followed by Contracting States for inquiries into accidents involving death or serious injury and instituted in accordance with the provisions of Article 26 of the Convention. Annex 13 to the Convention, Chapter 5, deals with the investigation and refers also to the *Manual of Aircraft Accident and Incident Investigation* ("AIG Manual", ICAO Doc 9756).

5.1.3 The fundamental purpose of inquiry into an aircraft accident is to determine the events, conditions and circumstances pertaining to the accident so that appropriate steps may be taken to prevent a recurrence of the accident and the factors that led to it. An equally important purpose is to determine the facts, conditions and circumstances pertaining to the survival or non-survival of the occupants and to the crashworthiness of the aircraft.

5.1.4 The prime object of the human factors investigation is to obtain evidence (related to the sequence, cause and effect of the accident) through an examination of the flight crew, the cabin crew and the passengers. Coincidentally with the investigation, evidence as to identification will automatically emerge — particularly if each examination is assisted by the coordinated efforts of a Human Factors Group that includes aviation medicine specialists, pathologists and human engineering experts.

5.1.5 Aircraft accident investigation is a highly specialized task which should only be undertaken by personnel trained in investigation techniques and with a sound working knowledge of aviation and professional skill in their specialties. To achieve its purpose an investigation should be properly organized, carried out, coordinated and supervised by qualified personnel. It is essential that the magnitude and scope of the task be assessed at an early stage so that the size of the investigation team may be planned, the appropriate skills marshalled and individuals allotted their various tasks.

5.1.6 The Investigator-in-Charge, or in certain countries a Board of Inquiry, is appointed to be responsible for the organization, conduct and control of the investigation and for coordinating the activities of all personnel associated with it.

It is the responsibility of the Investigator-in-Charge to review the evidence as it is developed and from this initial evidence make decisions that will determine the extent and depth of the investigation. It should be recognized that the precise extent and depth of a particular investigation will be contingent upon the nature of the accident and possibly also upon the availability of investigative resources.

5.1.7 The Investigator-in-Charge should establish working groups as required to cover various aspects of the investigation. The Group System as described in the AIG Manual is an excellent method of conducting an extensive investigation into major accidents. The decision to employ such an organization does depend, however, on the size and complexity of the task, the nature of the accident and the investigative skills available. The location of the accident may also be a deciding factor. The primary purpose of the Group System is to establish the facts pertinent to an accident by making use of the specialized knowledge and practical experience of the participating individuals with respect to construction and operation of the aircraft involved in the accident and of the facilities and services that provided service to the aircraft prior to the accident. It also ensures that undue emphasis is not placed on any single aspect of the accident to the neglect of other aspects that might be significant to the investigation and that, whenever it is possible to verify a particular point by means of several methods, all those methods have been employed and the coordination of results has been ensured. Thus the investigation effort may require participation of some or all of the following groups: operations; meteorology; air traffic services; witness statements; flight recorders; maintenance records; and specialists in structures, power plants, systems, aviation medicine, human factors, evacuation, search and rescue or fire fighting, as detailed in the AIG Manual. It is emphasized that the medical and human factors contributions to the investigation are as important as the efforts of the other investigative groups in the team. Therefore it can be expected that the participating aviation medicine and psychology specialists will be supervised and controlled by an Investigator-in-Charge in the same manner.

5.1.8 The Human Factors Group is responsible for the aeromedical, crash injury and survival aspects of the investigation with regard to the events and the cause of the accident. The Human Factors (or Medical) Group will be concerned with:

a) establishing the presence of any physical or psychological disorder which may have contributed to impaired function of the flight deck crew;

b) discovering any specific environmental factors which may have similarly affected the crew;

c) searching for items in the medical, paramedical and psychological background of the flight crew which might indicate or explain a decrement in its function or efficiency;

d) identifying the flight crew, and cabin crew if relevant, their location at the time of the accident by review of their injuries, and activities at the time of the impact.

5.1.9 Bio-engineering aspects will include, among other things, an attempt to establish the relationship of damage received by cockpit or cabin structures, seat orientation, harness restraint and so on; and to identify factors that may have affected evacuation of the aircraft and escape. The efficiency of survival aids will come under scrutiny. The pattern of injuries may provide sound evidence as to the sequence of events or even the cause of the accident.

5.1.10 The concept that the pilot-in-command or other flight crew members might precipitate an accident by being less than usually efficient (though suffering neither from organic disease nor impairment due to drugs) and that this could influence or cause an accident is rather intangible and is likely to be difficult to prove. It will normally be least difficult in the investigation of a non-fatal accident when the crew can be interviewed and medically examined, or when cockpit voice and flight data recordings are

available. Regarding bio-engineering aspects, the non-fatal accident is also easier to investigate in that injuries will be fewer and less severe than when an accident is fatal, and their precise cause and mode of production will be more obvious. The human factors investigation of a non-fatal accident essentially calls for a specialist in aviation medicine, and such specialists are available in many Contracting States.

5.1.11 The totally fatal accident is a rather different proposition. This is a problem in deductive reasoning from the outset, and the approach and expertise of a forensic pathologist are generally required. Few forensic pathologists have had much experience in investigating aircraft accidents, and these accidents pose problems that are quite distinct from those encountered in routine medico-legal pathology practice. It is largely by personal experience that expertise in this field is acquired. The appointment in each Contracting State of a relatively small number of pathologists, one of whom could be called to participate in the investigation of every fatal accident in that State, would be a positive step towards establishing a source of such expertise for the future. Many articles have been published in appropriate journals, and there are also a few books available dealing specifically with this subject which will be of help to a pathologist inexperienced in this work. Some States offer courses of varying lengths for medical officers wishing to specialize in aircraft accident investigation.

5.1.12 It is the purpose of this chapter to summarize the potential value of medical investigation of aircraft accidents, and to detail some of the important steps in the approach to the various aspects of the task. Some material is a repetition of the material in the AIG Manual where the subject is presented for the non-medical accident investigator; the rest consists of material more properly the concern of the medical investigator.

5.2 DISASTER PLANNING

Human factors evidence will vary mainly in emphasis, rather than substance, depending upon whether the accident involves large or small aircraft. In either case its full value will not be achieved unless there has been pre-planning by aviation authorities and accident investigation units. It is to be expected that one or more of the aviation medicine specialists or pathologists designated to assist in aircraft accident investigation will be called upon to help in such pre- planning. This pre-planning should be based on the supposition of the largest likely disaster; a small accident merely means using fewer of the resources provided. The matters to be considered are detailed either in the AIG Manual or in subsequent sections of this chapter, but may be summarized as follows:

a) the large aircraft, non-fatal accident: the plans are concerned with the provision of rescue equipment, the availability of hospital facilities, and the interview and examination of the crew to determine possible medical and psychological factors, and of both crew and passengers regarding injuries and their causes, and escape and survival aspects;
b) the major fatal accident: the disaster plan will include training in the mapping and recovery of bodies, the provision of mortuary and refrigeration facilities, and the establishment of a medical team of investigators together with an identification secretariat or commission.

5.3 RECONSTRUCTION

Circumstances and cause of the accident

5.3.1 Some medical evidence relating to the reconstruction of the circumstances of the accident may come from surviving crew members or passengers. In the main, however, medical evidence related to the reconstruction of the accident circumstances is associated with the autopsy of the victims of the

accident.

5.3.2 In fatal light aircraft accidents, the examination of the pilot is likely to contribute most. Here the medical investigations should be directed towards determining or excluding disease and its possible association with the accident and towards such aspects as alcohol, drugs and toxic substances as possible accident causes. However, in light aircraft with dual controls, one cannot be certain that a "passenger" was not actually flying the aircraft. Additionally, toxicological examination of passengers' tissues may validate findings in the pilot's body such as raised carbon monoxide levels.

5.3.3 The presence of two or more pilots on the flight deck of larger aircraft makes pilot incapacitation from disease or drugs as a cause of a major accident unlikely. This is, however, not entirely true when the accident has occurred at a critical phase of flight, such as take-off or landing. Nevertheless, the pathologist may often find it appropriate in a large accident to concentrate on the search for evidence of conditions likely to affect all members of the flight crew — in particular carbon monoxide or other noxious fumes that may have contaminated the cockpit air. He must also seek evidence to eliminate or confirm the involvement of a criminal act such as unlawful interference with the operation of the aircraft. A full examination of the flight crew may give valuable evidence about who was controlling the aircraft at the time of the crash. In this respect, identification has direct technical value to the investigation as distinct from judicial value.

5.3.4 In the major fatal aircraft accident, however, there is the possibility of deriving evidence from the cabin crew and passengers. A main concern of this chapter is to illustrate why this opportunity must not be lost. A full examination, particularly when it can be based upon previous experience, may reveal evidence as to the sequence of events, the stage of flight and the degree of emergency anticipated. The pattern of injuries may indicate clearly the type of accident — fire in flight, structural failure in flight, sudden or gradual deceleration at impact, etc. An examination of the passengers may be the prime method of demonstrating sabotage as an accident cause.

Human engineering and survival

5.3.5 The Human Factors Investigation may provide medical evidence of great value in relation to human engineering and survival. Such evidence will be equally relevant in both fatal and non- fatal accidents but again there may be a difference of emphasis according to whether the accident involves a large or small aircraft.

5.3.6 In the case of a small aircraft accident, the examination will generally be directed to the pilot(s); however, whether the aircraft is large or small, one should consider such factors as the relevance of the type of harness restraint in use, the provision or lack of other items of safety equipment, and the injury-producing potential of the controls, instruments and other cockpit structures.

5.3.7 In the case of a transport aircraft accident, interest will inevitably include the passengers. The Human Factors Group will be searching for evidence of injury resulting from seat structures with or without adequate harness restraint — and the missile effect of the various contents of the cabin. Medical or pathological evidence will also be available as to the adequacy or inadequacy of walkways, exits and survival equipment.

Identification

5.3.8 Clearly the useful interpretation of human factors findings is dependent upon accurate identification of the casualties involved. Identification is, therefore, pre-eminently a tool of investigation but it also has major medico-legal significance and judicial application. The head of the Human Factors Group

must be prepared for any evidence determined by members of his group, particularly the pathologist, to be used for medico-legal purposes. The Human Factors Group will, therefore, have special needs for coordination with local or national authorities with particular regard to identification. These needs should be recognized during the pre-planning and should not be overlooked during the investigation. There is, however, no conflict of interests — investigation and identification are interdependent as recognized in Annex 13. In the following sections of this chapter, they are discussed together under the same headings, in particular:

a) tasks at the accident site;

b) tasks at the mortuary;

c) evidence to be derived from the pathological examination;

d) consideration of the medical history of the crew and, where appropriate, interrogation of surviving crew and passengers.

5.4 THE STATUS OF THE PATHOLOGIST; LIAISON WITH THE INVESTIGATOR- IN-CHARGE

5.4.1 The Investigator-in-Charge may appoint as head of the Human Factors Group a specialist in aviation medicine with experience in aircraft accident investigation. In the event that there are fatalities, he may also appoint a pathologist, ideally with experience in aviation pathology or at least in forensic pathology, to perform necessary full autopsy examinations on all those victims killed. If the pathologist has experience in aviation pathology, he may be appointed as head of the Human Factors Group but this will depend on the type of accident being investigated and on human factors considerations. The fatal accident is, generally, more difficult to investigate than the non-fatal accident, and it is for this reason that the role of the pathologist is stressed in this chapter. In the event that no pathologist experienced in aircraft accident investigation is available in the State investigating a major fatal accident, the Investigator-in-Charge should consider requesting other States to provide the necessary specialist(s).

5.4.2 Ideally, the appointed pathologist would obtain a complete “case history” before beginning the examination:

He should acquaint himself with the details of the circumstances of the accident, details of the operating crew’s medical and personal histories, familiarize himself with the internal layout of the cockpit and passenger compartments of the aircraft type concerned, and make a thorough examination of the accident site — all before commencing the examination of the bodies. Such an approach is rarely, if ever, practicable. The pressures that exist following most fatal aircraft accidents are such that examination and disposal of the bodies must be handled as quickly as practicable and any delay avoided. Many factors may demand speed; the extreme example is that of a tropical climate with no refrigeration facilities.

5.4.3 A practical approach has been found to be for the pathologist to be briefed at the outset by the Investigator-in-Charge concerning the salient features of the accident and to be informed whether any particular ideas as to the type of accident may have been aroused. This does not have to be a lengthy or detailed briefing but sufficient only to allow the pathologist an opportunity to make a special point

of searching, during the course of the normal complete examination, for supporting or contradictory evidence relative to any other evidence which may already be available to the Investigator-in-Charge. At frequent intervals during the investigation, the pathologist and the head of the Human Factors Group, or the Investigator-in- Charge as appropriate, should confer. The pathologist can thus get an up-to-date picture and learn of developments that may bear upon his work; he in turn can report any of his findings that could provide a lead for members of other groups. This is the principle of the Group System in which it is essential that the human factors team play a full part.

Tasks at the accident site

5.4.4 Authorities differ in opinion as to the extent to which the pathologist should be personally involved in the tasks at the accident site. He must, of course, be aware of all that has to be done there and the evidence he may expect to be collected or preserved by others. He will have to utilize and correlate this evidence with his own findings. These tasks are discussed in the AIG Manual.

5.4.5 As is implied in that manual, it is probably ideal that the pathologist goes to the accident site as soon as possible — certainly this is so in the accident involving many fatalities. It is always a great advantage to the pathologist to be aware from the beginning of the general situation at the accident site. His presence and interest are likely to ensure that the procedures (outlined in Chapter 18 of the AIG Manual), designed essentially to preserve all evidence of possible value in the medical investigation, are carefully and satisfactorily carried out.

Tasks at the mortuary

5.4.6 Whether or not the pathologist visits or works at the scene, he must be intimately aware of conditions in the local mortuary for it is there that his main pathological duties will be carried out. For this reason it is highly desirable that authorities involved in the pre-planning of an aircraft disaster situation should be advised by a pathologist on the matters referred to in Chapter 18 of the AIG Manual with special reference to the suitability, and the methods of adaptation, of any buildings proposed for use as main or temporary mortuaries.

5.4.7 The tasks in the mortuary cover both the search for evidence relating to accident investigation and identification of the bodies of the dead. The general principles of the identification of the dead will be known to most physicians and certainly to all pathologists. They are outlined for the information of non-medical accident investigators in the AIG Manual, Chapter 18 and subsequent appendix.

5.4.8 It is difficult, if not impossible, to design the perfect form to document something so variable as the findings arising from the examination of a body from an aircraft accident. It is necessary to record details about a body relating to its identification, the cause, and the circumstances of its death. Since ever-increasing numbers of persons may be killed in a given accident, it is expedient to reduce the number of forms for each body as far as possible, to reduce their complexity, and to provide forms that can be used and handled with ease. They should be at once simple yet comprehensive; they must be appropriate whether a body is substantially intact and fully clothed, or naked and partially disintegrated. Thus any form to be of value in an aircraft accident must be a compromise between a many-paged document, comprehensively listing every feature that might need to be recorded with ample space for their descriptions and, at the other end of the scale, an essentially plain piece of paper with minimum headings, placing upon the examiner the burden of remembering every detail to which attention should be given and recordings made. The International Police Organization, INTERPOL, has designed a Disaster Victim Identification Form that is available in English, French, Spanish and Arabic. It can be downloaded from INTERPOL's website (see further reading list).

Equipment

5.4.9 A list of instruments and equipment suitable for autopsy procedures in the mortuary is not given here. Only normal standard items are required, and pathologists who become involved in the work of aircraft accident investigation will ensure that arrangements are made for the particular instruments they favour to be made available.

Teamwork in the mortuary

5.4.10 The work in the mortuary is most efficiently carried out as a team operation, such a team comprising the aviation accident investigation personnel and the judicial personnel. Both of these groups should cooperate as a team and their actions should be interrelated. It is preferable that the pathologist is in charge of this team since the examination of bodies is obviously his prime responsibility. The procedures to be undertaken will be enumerated as they would be undertaken in the event.

5.4.11 The pathologist must select those to be examined first from the packaged remains housed in the temporary mortuary. The work is often eased if complete and readily identifiable bodies are examined first; these may be followed by whole bodies mutilated beyond recognition or by remains constituting more than half a body; the examination of detached members and body fragments is conveniently undertaken last. It cannot be overemphasized that seriously incorrect deductions may result from the examination of only a single class of injury. The remains selected for examination should be transferred to the mortuary table, removed from the container at the table and the container checked for any loose fragments or material that might have become detached during transit.

5.4.12 The series of numbers used for labelling the human remains at the accident site will bear no relationship to the total number of victims when there has been severe mutilation and fragmentation of bodies. Experience has shown that in such cases it is expedient to commence a new and distinct series of numbers to be used as cadaver numbers; in these circumstances the first thing to be done when the body is placed on the mortuary table is to give it a new cadaver number. The decision whether or not it is necessary to adopt this procedure must be made at the outset, and when it is adopted written and photographic records should be made as soon as a body is given its cadaver number so that the remains, the site number and the new cadaver number can be related.

5.4.13 In addition to a general photograph showing these two labels on the body, further photography should be carried out at this stage as considered necessary, either for identification purposes or to record unusual damage or features about the clothing (e.g. stains), which could be of significance to the accident investigation. Only rarely will there be such features whose likely importance is obvious at this stage but it is a good rule to take too many photographs rather than too few and to be as comprehensive in written record as the size of the whole task load will allow.

5.4.14 The next step is for clothing and personal possessions on the body to be removed, examined and catalogued.

Jewellery and other personal possessions should be preserved for further examination and ultimate disposal to relatives; other items may need to be preserved as evidence. Much of this task is for identification purposes. It is desirable to examine and keep fragments of any distinctive garment, laundry marks, manufacturers' labels and so forth. The pathologist will examine the garments before, as, and after they are removed for evidence significant to the accident investigation; such evidence

will generally be either unusual staining or damage that can be related to injury to the body and which may have arisen in some unusual way, e.g. from an explosive device in a case of sabotage.

5.4.15 The unclothed body must now be carefully examined externally by the pathologist. All external features of possible help in identification of the body must be observed and recorded. A general assessment of injuries can be made with particular attention being given to any that appear unusual. Any that could be due to fragments of an explosive device should be examined with special care and samples taken from around and within the wound for a later search for trace evidence. The method of preservation of such samples will depend upon what is being sought. If, for example, a body has a number of tiny puncture wounds that could have been caused by small fragments of shrapnel, an excision of tissues around several such fragments should be made. Some of the specimens should be preserved in 10 per cent formol saline1 for histological examination while those for metallurgical study should be deep frozen. Should a body have what appears to be a gun-shot wound, which could have been inflicted by a weapon fired at close quarters, it would be better for the excised tissues around the wound to be preserved deep frozen so that there could be later analysis of any chemical deposits on the skin. Of course, in such an instance a search for the missile deep in the tissues would be undertaken, and it would be preferable for a radiograph to be taken before this search is commenced.

5.4.16 It is at this stage that the whole question of radiography must be considered. Its use will depend on the availability of suitable apparatus and technicians. If equipment is readily available, full body radiographs of all fatalities would be ideal. They will provide a permanent record of all major skeletal damage and detect any unexpected metallic foreign bodies that may be present. Such foreign bodies may contribute also to identification. In children, ossification centres in particular would be included in the radiographic survey. If radiography is not readily available, the pathologist may have to decide whether to press for it to be made available for some or even all bodies. This decision can only be made on his assessment of the probability of its value in a given instance. If sabotage were strongly suspected, radiography would be very important. In instances where identification is difficult, or likely to be difficult, radiography is important as it might be the only source of evidence.

5.4.17 At the stage when the pathologist has completed his external examination of the hands and the head, he should allow the judicial team to proceed with finger-printing and the dentist with the examination of the jaws and teeth.

The pathologist will continue with his internal autopsy with the cranial cavity being examined possibly as the last procedure when the dental records are finished. These minutiae are unimportant as a team will rapidly develop a rhythm and routine of working together.

5.4.18 The comprehensiveness of the internal autopsy must be a matter for the pathologist to decide on the basis of the total volume of work, the probable identity of the body (i.e. flight crew, cabin crew or passenger), and his briefing by the Investigator-in-Charge. As a guide, the following should generally be regarded as a minimum requirement for all casualties:

a) establishment of the cause of death;

Formol saline: a 10 per cent solution of formalin in 0.9 per cent aqueous NaCl, used as a general fixative for histologic and histochemical preparations.

b) discovery of major disease likely to influence life expectancy;

c) assessment of deceleration force and direction based on injury to:
   - cardiovascular system, liver and diaphragm
   - head, sternum, spine and pelvis

d) collection of specimens for carboxyhaemoglobin studies;

e) collection of lung specimens for estimation of the agonal period.

5.4.19 If the body is that of a member of the flight crew or could be that of a member of the flight crew, specimens of all major organs should be taken for histological examination, including the whole heart or at least a very large sample of myocardium from the interventricular septum and the ventricular walls. All these samples should be preserved in 10 per cent formol saline.

5.4.20 Specimens of tissue should be collected for toxicological examination for drugs, alcohol and carboxyhaemoglobin. It should be noted that carbon monoxide poisoning from exhaust fumes is unlikely from the exhaust of gas turbine engines, whereas its concentration is much higher in the exhaust from reciprocating engines. The possibility of a post-mortem alcohol production in tissues demands that some thought be given to the matter of appropriate samples for this purpose. If available, urine is the best material to preserve for alcohol estimation. If available, blood should also be collected from the heart and from deep vessels at two peripheral sites as well. When mutilation results in blood and urine not being available, it will often be possible to obtain a vitreous humour or bile specimen. Cerebrospinal fluid is also a suitable material for analysis for alcohol, but it will be very rarely obtainable when the other body fluids mentioned are not.

If no fluid sample can be obtained, muscle from three widely separated sites should be taken. Fluid samples should be preserved in l per cent sodium fluoride; samples of solid tissues must be deep frozen.

5.4.21 The samples of urine, blood and muscle may also suffice for toxicological examination for drugs. However, when specimens are being collected for drug analysis, it is advisable that at least 200 grams of liver tissue are preserved.

It is also desirable to retain the whole of one kidney and at least one lobe of lung, particularly if blood and urine are not available. Tissues such as these may produce adequate blood for gas/liquid chromatographic techniques. All these samples should be preserved in the deep frozen state.

5.4.22 Glass jars are too heavy and cumbersome for the preservation of the numerous specimens collected during autopsy examinations following a large aircraft accident. Plastic bags are recommended as suitable containers for specimens taken for histological examination. They must be of a standard or heavy gauge plastic and be adequately sealed. A single size, 25 x 36 cm, will be found suitable for most specimens and the stocking of many sizes can be avoided.

These plastic bags are also suitable for samples collected for toxicological examination except that it should be noted that volatile substances can pass through plastic. It is necessary therefore to put samples for analysis for alcohol or other volatile substances into glass containers, which should be filled as completely as possible to minimize contact with air.

5.4.23 On completion of the joint examination of all whole bodies and all remains making up more than half a body, it will be necessary to examine the fragments. The possibility of important evidence concerning the accident investigation itself being present in a dismembered part must not be overlooked. Commonly the examination of the fragments will be of most value with regard to the final count of victims and with regard to the individual identification of a major fragment. Since clues to identity may be present in a separated part, the whole body may be identified when the various fragments can be associated on anatomic comparison.

5.4.24 Provided that the judicial team and pathologists have carried out a thorough comprehensive examination including making a full record of findings, and fully labelling and carefully preserving all suitable material evidence for further reference and for laboratory tests or analysis, the bodies may then be casketed and, if required, embalmed. It is, however, advised that individual bodies should not be released until the pathological processes of investigation and identification are complete with respect to the accident as a whole. In view of the possible need to re-examine bodies, the caskets should be left in such a state that they can be re-opened if necessary.

5.4.25 The accurate identification of the bodies that the pathologist has examined can be essential to the interpretation of his findings in the context of the accident investigation. His medical evidence may contribute significantly to the identification in many instances. Some authorities regard his involvement as very important in the assessment of all the evidence about the identity of a body and in the decision about whether the evidence is conclusive. However, it would be superfluous to repeat here details of the contribution of others in this field since it is discussed in Chapter 18 of the AIG Manual. Advice on an expeditious way to deal with the comparison of records in which the pathologist may or may not find himself involved is given in Chapter 18 and subsequent Appendix of that manual.

5.5 SUBSEQUENT LABORATORY INVESTIGATIONS

Histology

5.5.1 There are many reasons for performing histological examinations on tissues of air accident victims, including the detection of pathology:

a) indicating the presence of causal or contributory disease states in flight crew;

b) influencing survivability or egress;

c) providing possible indication of drug usage through fixed tissue reactions;

d) corroborating evidence of severe artefactual change such as putrefaction and fermentation with bacterial growth producing or reducing ethanol;

e) providing an indication of disease prevalence for future research.

5.5.2 Emphasis should be placed on obtaining well-labelled samples from the major organ systems and well-documented specimens of specific lesions or areas of artefactual change. Precise descriptions are extremely important. All specimens should be immediately placed in a container of 10 per cent buffered formalin solution for preservation.

5.5.3 While it is beyond the scope of this section to comprehensively review the broad field of histology,

the necessity to sample specific sites or organs must be emphasized.

5.5.4 The main cardiac vessels should be serially sectioned to detect the presence of occlusal disease. Similarly, the detection of cardiomyopathy requires multiple cardiac sections.

5.5.5 Histological examination of the liver may reveal a variety of conditions ranging from fatty liver to cirrhosis.

Microscopic changes in this organ could provide the only indication of ethanol abuse or drug use.

5.5.6 Pulmonary embolization may provide vital information concerning survivability and the timing of death. Soot in the airways and the alveoli will indicate survivability in conditions of post-impact fire.

5.5.7 As well as taking specimens from all major organs, any suspected abnormality, including tumour growth, should automatically be sampled.

Toxicology

5.5.8 The adequate toxicological investigation of tissue and fluid specimens from air accident victims requires a careful examination for the presence of prescription and over-the-counter medicines and illicit drugs, substances of social use and abuse, environmental contaminants and toxins as well as the detection and discrimination of artefactual changes such as the production of ethanol due to post-impact fermentation. The range of tests will ideally be broad and the sensitivity at the therapeutic and subtherapeutic level. Since in many instances, physical trauma is severe, toxicological examination may provide the only evidence of the existence of disease states that could produce insidious or sudden incapacitation such as hypertension, epilepsy, etc.

5.5.9 If possible, examinations should be carried out by a central reference laboratory which will have developed methods specific for air accident services as opposed to general forensic testing (see Attachment A).

5.5.10 A variety of tissues and fluids are required for successful testing. Due to the high impact forces often involved, fluids may not be available, but adequate quantities of blood from three separate sites, sterile urine from an unpunctured bladder, bile and vitreous humour are all extremely useful to the toxicologist. The tests commonly performed on usually available fluids and liver tissues are as follows:

Blood

5.5.11 Qualitative and quantitative analyses for:

a) ethanol;

b) other alcohols, solvents, fuels, hydraulic fluids, etc.;

c) carbon monoxide;

d) hydrogen cyanide;

e) delta-9-THC (tetrahydrocannabinol) and metabolites (i.e. marijuana);

f) gas chromatography-mass spectrometry (GC-MS) screen and quantitation for medicines and drugs and their metabolites;

g) GC-MS screen and quantitation of pesticides and herbicides;

h) High Performance Liquid Chromatography (HPLC) screen and quantitation of medicines and drugs;

i) Radioimmunoassay (RIA) analyses when indicated;

j) Enzyme-multiplied immunoassay technique (EMIT) analyses of medicines.

Urine

5.5.12 Qualitative and quantitative analyses for:

a) ethanol;

b) other alcohols and solvents;

c) GC-MS screen for medicines, drugs and their metabolites;

d) GC-MS screen for pesticides, herbicides, etc.;

e) HPLC screen for medicines and drugs;

f) RIA screen of digoxin, various antibiotics, THC metabolites, amphetamines, barbiturates, morphines and cocaine;

g) EMIT screen for illicit drugs.

Liver fluid extracts

a) See blood tests.

b) The following table indicates the optimum sample size required for specific types of testing by most laboratories:

c) Specimens should be uncontaminated if possible and preserved as indicated. Prevention of bacterial or fungal growth is especially important in the examination for the presence of ethanol.

d) The rationale behind toxicological testing should not require much elaboration. However, some pertinent points will be emphasized.

e) The detection of some classes of medicines such as tranquillizers and illicit compounds may indicate the need to investigate the victim's psychological status. Psychomotor, perceptual or judgemental performance decrements may result from drug ingestion or accidental exposure to a variety of environmental toxins.

f) Samples should be obtained from all accident victims, if possible. Specimens from passengers may function as controls for samples obtained from flight crew and provide valuable evidence as to, for example, the presence of fermentation producing ethanol.

g) Fire patterns may be discerned through the detection of distribution patterns in the levels of hydrogen cyanide or carbon monoxide in cabin crew and passengers. Carbon monoxide in flight crew may suggest a causal contamination problem due possibly to faulty heat exchangers.

h) Victims of crop-spraying accidents should be screened for the presence of pesticides or herbicides and the inhibition of cholinesterase. Accident investigators should be warned of the dangers of contamination in investigating agricultural accidents and be given adequate protective suits and equipment. They too should be tested if they experience symptoms.

Post-mortem biochemistry

5.5.13 Apart from those post-mortem biochemistry tasks normally part of forensic toxicology, other tests are generally not useful in air accident investigations owing to the length of time elapsing from time of death to discovery and autopsy.

5.6 INTERPRETATION AND VALUE OF THE PATHOLOGICAL EVIDENCE- DETERMINATION OF THE CAUSE OF DEATH OF EACH PERSON

5.6.1 Many bodies from an air crash will be extensively damaged by mechanical forces and by burns. It is tempting for those not aware of the value of the pathological contribution to an aircraft accident investigation to ascribe death to burning or to multiple injuries based on a superficial external post-mortem examination. A fire produces so many additional factors that such an analysis represents little more than guess work; moreover, a superficial examination fails to distinguish between ante-mortem and post-mortem injury. The investigator must keep in mind the differences between ante-mortem and post-mortem injuries particularly in the flight crew; it is important to establish whether death occurred in flight and led to the accident or whether death was the result of the accident.

5.6.2 It is important to determine, if it is at all possible, the precise cause of death in each case in relation both to the technical aspects of the accident investigation and to later medico-legal problems.

5.6.3 The careful external post-mortem examination and internal autopsy and the laboratory investigations referred to earlier will frequently allow a precise diagnosis of the cause of death to be made as in the following examples:

a) following the death from heart disease of a pilot at the controls of an aircraft, the resultant crash could cause multiple injuries to his body which external examination alone might suggest were the cause of his death. Internal examination supplemented by histology may reveal severe coronary artery disease, coronary artery thrombosis, recent silent myocardial infarction, or myocarditis — whichever heart disease had caused his death at the controls;

b) if a passenger had sustained head injury of lethal severity, important conclusions could be drawn

as to the survivability of the accident. Internal and subsequent laboratory examination, however, showing swallowed carbon in the oesophagus and stomach, inhaled carbon in the trachea and bronchi, congested oedematous lungs and a raised carboxyhaemoglobin level in the blood, would show the true cause of death as burning. The head injury might then be ascribable to heat and its interpretation would be quite different;

c) a husband and wife might both appear to have sustained multiple injuries and incineration. Detailed autopsy and laboratory examinations might show the one to have died as the passenger referred to in b) above while the other, having a ruptured aorta and no evidence of survival during the post-crash fire, had died from injury. It could then be held that the former had survived the latter with far-reaching medico-legal implications regarding the disposal of estates.

Nature and cause of injuries and their timing

5.6.4 This refers in particular to a single major lethal injury sustained by a victim or to potentially incapacitating injuries that would have prevented a conscious and otherwise capable person from effecting his own escape. An assessment of the nature and cause of injuries is required so that consideration can be given to appraising safety features within the aircraft and to improving them. Examples include penetrating head injuries or crushing fractures of the lower legs.

Both of these may suggest an unsatisfactory design of the back of the seats in relation to those situated immediately behind them.

5.6.5 The causes of unusual types of injury need to be fully examined. On more than one occasion conclusions have been reached as to which pilot was actually at the controls of an aircraft when it crashed, based upon the nature of the injuries to the hands and wrists or feet and ankles as determined both by naked eye examination at autopsy and by radiographs.

5.6.6 Sabotage and the possible injuries due to blast or shrapnel from explosive devices must not be missed.

Tissues from around any such suspect wounds should be preserved by the pathologist for laboratory analysis for the appropriate trace evidence. Injuries so caused will be reflected in damage to the clothing; the dangers of premature removal of clothing purely for the purpose of identification are, thereby, emphasized.

Detection of disease or impaired efficiency in the flight crew

5.6.7 The autopsy and subsequent examinations may reveal disease as the unequivocal cause of death of one of the pilots and, therefore, as already suggested, provide a strong clue to the likely circumstances or cause of the accident. It cannot be too strongly emphasized, however, that evidence that a medical abnormality was present in a pilot is usually a long way from proof that the abnormality was either the cause of his death or connected with the accident. A list of diseases known to cause sudden complete incapacitation and death in apparently normal healthy persons can readily be prepared.

It would include coronary artery disease with or without thrombosis, myocarditis and ruptured cerebral arterial aneurysm, for example. However, severe coronary artery disease and myocarditis can be present and consistent with normal function, and both are known to have an appreciable incidence in the normal population. The presence of either could be coincidental in a pilot whose aircraft had crashed because of some technical failure. Similarly, in the presence of extensive cranial injury it would be only a careful examination that would reveal a cerebral arterial aneurysm. Even if found, it

might be difficult to be sure whether it had ruptured in life or had been traumatically ruptured as part of the cranial injury.

5.6.8 Pilot function may be adversely affected, especially in managing some in-flight emergency, by almost any form of illness, however minor, even though clinically unsuspected. The detailed autopsy and subsequent laboratory investigations advocated imply that every effort will be made to discover whether the flight crew were suffering from any disease or illness or whether they were suffering from any form of intoxication or any possible effect of having taken drugs.

When all investigations have been completed and no evidence of any disease or cause for impaired function has been found, it is possible to state that this has been excluded, for practical purposes, as an event or cause of the accident. When some evidence has been found of disease or potential cause of impaired function, very careful consideration must be given to the nature of the condition, its potential for affecting function, and any discovery of an alternative hypothetical cause for the accident derived from the engineering and general investigation of the accident. When correlation of all this evidence has been effected by the Investigator-in-Charge, through the reports of the Human Factors Group and other groups, it will be possible to put forward any theory formed concerning human factors on the flight deck in relation to the circumstances and the cause of the accident with a balanced judgement as to its probability.

Evidence to be derived from the examination of passengers and cabin crew

5.6.9 The volume of work involved in an accident with many fatalities dictates that the autopsy examinations and organ and tissue sampling of bodies known to be those of the passengers should be less extensive than for the operating crew on the flight deck or in the cockpit. Nevertheless, there are certain points that should not be overlooked in the examination of any body.

5.6.10 Sufficiently detailed examination and sampling of these bodies are required to provide the precise cause of death:

a) an estimate of deceleration forces, derived from the state of the heart, aorta, diaphragm, liver and spleen together with the presence of fractures in sternum, spine and pelvis;

b) an assessment of any evidence of seat belt injury and associated cranio-facial damage;

c) evidence of survival in fire as shown by the presence of raised carboxyhaemoglobin levels in blood or tissues;

d) the presence of microscopic changes in the lungs relevant to ante-mortem injury, to life during fire and possibly to such medico-legal questions as survivorship which may subsequently arise;

e) for medico-legal reasons note must also be taken of the presence of any pre-existing disease if subsequent compensation claims are to be settled with equity.

5.6.11 Examination of the bodies of passengers can establish a pattern of injuries. Such a pattern may be uniform or discordant. A uniform pattern suggests that all the passengers were subjected to much the same type and degree of force.

A typical example is the combination of cranio-facial damage, seat belt injury and crushing of the

lower legs associated with passenger tie-down failure in the classic crash situation. Much additional information may be derived by comparing the pattern of injuries in the passengers with the pattern in the cabin crew, e.g. were the cabin crew braced for an emergency or were they in their normal operating positions.

5.6.12 In the discordant pattern, one group of passengers may show injuries distinctive from the remainder. This could suggest some unusual incident and the interpretation of the findings depends to a large extent on accurate identification and location in the aircraft according to the passenger seating plan. The possibility of a single body showing a deviation from the norm must always be remembered. It may be the only means by which a case of sabotage or unlawful interference with the operation of the aircraft is revealed.

5.7 RELEASE OF HUMAN REMAINS AND PERSONAL PROPERTY

5.7.1 Although it is preferable to retain all bodies either until all have been identified or until no further identifications are possible, bodies should be released to the local or national authorities when possible provided:

a) all the information relevant to the investigation has been derived from the cadaver;

b) there is no possible doubt as to the identity of the body.

5.7.2 After identification of all bodies has been established and there is no further need to retain bodies from the point of view of the accident investigation, it is normally the responsibility of the local or national authorities to return them to their families with a suitable identification notice and death certificate. (Where repatriation is required, additional permits and certificates might have to be obtained permitting the transport of the bodies or remains to other localities, districts or States.)

5.7.3 Regulations vary, but it will often be found that a certificate in the language of the victim's State, signed by the pathologist who carried out the autopsy, stating the body's identity and recording the precise cause of death, will facilitate repatriation and ultimate disposal.

5.8 CORRELATION WITH THE AIRCRAFT WRECKAGE EXAMINATION

The Cockpit

5.8.1 Correlation between the degree of cockpit damage and the degree of injury to the pilot is essential. Anomalous findings may give a clue to such accident causes as failure of the automatic pilot or attempted interference with the normal operation of the aircraft. Injuries discovered should be, whenever possible, related to specific items of equipment in the cockpit. To this end a search should be made for the presence of blood and other tissues on the seats, instruments and control columns. In certain circumstances it may be necessary to identify such evidence as being related to specific flight crew members or, conceivably, to show that the tissues are not human for example, evidence of bird strike.

5.8.2 The damage to and the general status of the flight crew seats and safety harness should be recorded

as being pertinent to the reconstruction of events in the cockpit at the time of the accident, immediately afterwards, and to the possibilities of survival and escape.

The passenger compartment

5.8.3 A detailed examination and description of all seats, their attachments, seat belts, and other safety equipment and surrounding structures should be made. It is a prerequisite to a survivability study. Displacement of fasteners and evidence on the belts themselves may give an indication of the forces involved. The size of fastened but torn belts should always be measured. It might be possible to deduce the size of the seat occupant from such measurement although it should be borne in mind that seat belt adjustments may vary considerably. Of greater importance, the overall tightness of belts should enable the investigator to distinguish between a cabin that has been prepared for an emergency landing and one in which the passengers have been sitting with their belts lightly fastened as a routine. Findings of this nature must certainly be correlated with passenger seating plans when available and with the results of the autopsy examinations.

When seating plans are not available and when local or national authorities removed bodies but did not record their location, clues may often be discovered as to the seating of passengers; for example, a book or handbag found in the compartment on a seat back will suggest a probable location of its owner. Fragments of fabric, fused to aircraft structure, compared with clothing removed from bodies may permit deductions about the location of bodies — at least where the bodies came to rest, if not their seat locations.

5.9 OTHER MEDICAL ASPECTS OF THE HUMAN FACTORS INVESTIGATION

Flight crew medical and personal records — Mental and physical health

5.9.1 The medical records of the flight crew must be studied to find out whether any condition was known to exist which might have precluded the successful completion of the demanded task in the prevailing circumstances. Particular attention should be given to any condition likely to have led to incapacitation in flight or to a deterioration in fitness and performance. The possible cause of incapacitation or lowered efficiency of performance is, theoretically, the range of the diseases of man but, with adequate medical supervision of crews, gross abnormalities are unlikely to be present.

5.9.2 Any information obtained from the medical records must be correlated with the pathological findings. Many functional abnormalities, however, are not demonstrable at autopsy epilepsy being the prime example. Visual and auditory acuity of the crew should also be noted but, again, it will be the essentially negative pathological findings in an accident suspected of having a human factor cause that will focus attention on these systems.

5.9.3 In certain circumstances, the flight crew background should be investigated and this will include consideration of such matters as motivation for flying, general intelligence, emotional stability, character and behaviour. However, well-documented abnormalities of this sort are scarcely compatible with modern flight crew selection methods or effective working as part of an airline operation. It may be that information obtained from friends, relatives, acquaintances, supervisors, instructors, personal physicians and other observers as to both the recent activities and attitudes of the flight crew and to their long-term personal and flying habits, general health and ordinary behaviour

may provide information which is of far greater value. This has been called a psychological autopsy (see further reading list).

5.9.4 The recognition and investigation of the psycho-physiological elements underlying many accident causes have not always been given the proper degree of attention. Human elements of perception, judgement, decision, morale, motivation, ageing, fatigue and incapacitation are often relatively intangible, yet highly pertinent variables. Even when detected, they are difficult to measure and document. It should be emphasized that a positive association between any such abnormality discovered and the cause of the accident can seldom, if ever, be better than conjecture. Despite these difficulties, every effort must be made to investigate and report upon such human factors as fully as possible. It may be necessary to include a psychologist familiar with aviation in the Human Factors Group.

Problems of a particular flight

5.9.5 Many matters that are not of a medical nature may be pertinent to the Human Factors Group, and it is here that a close liaison with the Operations Group is essential.

5.9.6 Some of the general problems of this type include:

a) the flight plan — with particular reference to instructions given and deviations made from those instructions;

b) the flight equipment — ranging from items such as the aircraft type, to cockpit layout, mechanisms for cabin pressurization, ventilation and temperature control;

c) the navigation aids — particularly whether they were used to their full extent;

d) the flight environment and flight phase — which should include a consideration of the possible presence of fumes from the engine fluids and fuel and also of toxic substances from the cargo;

e) assessment of the workload of the crew at the time of the accident.

5.9.7 The importance of this information to the Human Factors Group is essentially to guide them into significant areas of investigation on their own account. For example, a deviation from the flight path might suggest a need for an examination for carbon monoxide intoxication; a suspect pressurization system might indicate a need to confirm or exclude hypoxia as a cause of the accident. The itemization of likely toxic causes will simplify and direct the work of the toxicologist.

These are the sort of matters that emphasize the need for frequent meetings of the heads of the investigation groups and the need for adequate exchange of information at such meetings.

5.9.8 Special problems of the particular flight especially concern those aspects of possible impairment of flight crew fitness and performance that are not demonstrable by autopsy. Errors and deficiency of performance may occur whether operations are as planned, whether unexpected conditions develop, or whether emergencies arise. The cause of these errors and performance decrements may be found in:

a) errors of perception. These may be related to auditory, visual, tactile or postural stimuli;

b) errors of judgement and interpretation. Misjudgement of distances, misinterpretation of

instruments, confusion of instructions, sensory illusions, disorientation, lapse of memory, etc., fall into this category;

c) errors of reaction. These particularly relate to timing and coordination of neuromuscular performance and technique as related to the movement of controls;

Contributing causes of errors and performance deficiency may lie in such areas as:

d) attitude and motivation;

e) emotional affect;

f) perseverance.

5.9.9 All these factors are likely to be exaggerated by fatigue which is an ubiquitous but elusive factor in aviation operations. It is in the evaluation of these potential factors that the Human Factors Group may be of invaluable assistance to the Investigator-in-Charge.

5.9.10 The Human Factors Group must distinguish carefully between hypothesis and genuine evidence; whenever possible, factual evidence must be adduced before an accident can be ascribed to a psycho-physiological factor. For example, it may be suggested that the pilot was particularly irritable at the time of the flight. However, a replay of the recordings of his in-flight transmissions may give far better evidence as to whether this effect was operative at the time of the accident.

The medical contribution in the survived accident

5.9.11 Generally, this is a more straightforward matter than the accident in which all the aircraft occupants were killed for it largely involves the examination of living and probably cooperative subjects. Essentially the Human Factors Group will be looking for the same type of evidence as that derived from the pathological examination of those killed.

5.9.12 A medical examination, preferably by an aviation medical specialist or qualified aviation medical examiner, should be made on surviving flight crew members to find out whether any physical, physiological or psychological factors in the operating crew had a bearing on the circumstances of the accident. Such interrogations are likely to be harrowing to those being questioned. Interviews should be properly planned and coordinated through the Investigator-in- Charge. A medical assessment might differ depending upon whether it was carried out soon after the accident before debriefing by other investigators, or at a later time after interview by others.

5.9.13 It might be desirable for blood and/or urine samples to be taken for analysis both for the presence of therapeutic substances and to help to determine whether any abnormal state such as hypoglycaemia may have been present. Before taking such specimens, however, the investigator should ensure that there are no local legal contraindications. The consent of the subject should be obtained and the purpose of the tests explained before they are undertaken.

5.9.14 The crew should be interviewed but this should be coordinated through the Investigator- in-Charge to ensure that there is no undue duplication because of the needs of the various Groups.

5.9.15 A detailed record should be made of injuries to all occupants with an assessment of their cause. The findings must be collated with their seat position, or location in the aircraft, and adjacent environment

so that preventive action such as redesign may be considered.

5.9.16 If the aircraft has been evacuated in the presence of fire or similar hazard (e.g. sinking with a ditching), a full account of each person's escape is a valuable contribution to an assessment of factors influencing success or failure.

5.9.17 As the aim of accident investigation is prevention, attention should also be given to the psychological effects of the accident upon the flight crew before they are allowed to return to flying duties. The psychological effects of any accident upon the rescuers should not be forgotten. Adequate, regular debriefing sessions may help prevent the occurrence of Post Traumatic Stress Disorder.

5.10 SUMMARY

5.10.1 The composition of the Human Factors Group must be chosen on the basis of the type of accident and the evidence likely to be available from human sources. Specialists in aviation medicine will be of greatest value when there are many survivors but pathological assistance will be required whenever there are fatalities.

5.10.2 Particularly in the event of a totally fatal accident, the pathological evidence is an essential part of the medical investigation. The Investigator-in-Charge must ensure that important investigative information is not sacrificed to meet social and legal desires for rapid identification and disposal of bodies. To this end, he should, if possible, obtain the services of a pathologist familiar with aircraft accident investigation who is capable of coordinating the two interdependent functions of investigation and identification.

5.10.3 The prime object of the pathologist should be to obtain evidence as to the cause, sequence and effect of the accident through an examination of the operating crew, the cabin crew and the passengers. Coincidentally with this investigation, evidence of medico-legal significance as to identification will automatically emerge, particularly if each examination is enhanced by the coordinated efforts of the pathologists, police, odontologists, radiologists, etc.

5.10.4 The pathological examination will be greatly helped by adequate pre-planning — particularly in relation to the recovery of bodies and the provision of whole-body refrigeration. In the event that plans do not exist, the Investigator-in-Charge should ensure facilities for the pathologist to carry out the following minimal requirements based on investigative, medico-legal and sociological needs:

a) identification and complete examination of the operating crew on the flight deck or in the cockpit;

b) a full external examination of all fatal casualties;

c) identification of the cabin crew and comparison with the passengers;

d) minimal internal autopsy on all casualties to include:

1) establishment of the cause of death;

2) discovery of major disease likely to influence life expectancy; and

3) assessment of deceleration injury to:
– cardiovascular system, liver and diaphragm;
– head, sternum, spine and pelvis;

e) selection of blood specimens from all casualties for carboxyhaemoglobin studies;

f) collection of lung specimens from all casualties for estimation of the mode of death.

5.10.5 An experienced pathologist will interpret his findings with caution. For their part, the head of the Human Factors Group and the Investigator-in-Charge must ensure that the pathological findings are taken as but part of the investigation as a whole and are fully correlated with evidence adduced within the Group and by other Groups. Experience has shown that this is facilitated and maximum advantage gained if the pathologist attends the periodic briefings by the Investigator-in-Charge.

Attachment -5-1

AIR ACCIDENT LABORATORY SUPPORT

1. Some of the reasons for a national reference laboratory include the following:

a) to ensure standard results across the country, with a high level of expertise;

b) to provide rapid response to investigators;

c) to offer special tests not performed by other forensic laboratories, but which are required by air accident investigators;

d) to work at levels of sensitivity which would pick up sub-therapeutic and trace concentrations of analysed compounds;

e) to provide forensic analyses on tissue samples in cases where fluids are unavailable;

f) to assist in the interpretation of results with respect to a causal, contributory or incidental role in accident occurrence or impact on survivability;

g) to undertake special studies as may be required to determine human factor input to the accident;

h) to keep a computerized data archive of relevant toxicological, biochemical and pathological findings to detect disease prevalence, drug use or toxin exposure from a national perspective.

2. State-of-the-art methods and instruments should be used by the laboratory to ensure competent screens and specific analyses. Appropriate standards should be tested with every sample to verify results.

3. The laboratory should participate in national level proficiency testing for quality and quantity control tests of alcohol and common drugs in biological fluids.

4. The verbal reporting time for ethanol, carbon monoxide and hydrogen cyanide should be within five to seven working days after receipt of samples. More demanding tests require more time, but a complete report should be issued after two to five weeks.

CHAPTER 6. ODONTOLOGICAL IDENTIFICATION

6.1 INTRODUCTION

6.1.1 Forensic odontology is the area of dental practice encompassing the interaction of the dental team with the legal system. The major contribution of forensic odontology is assisting the police or other authorities in charge with identification of unknown human remains. Forensic odontology may include further activities as determination of age; tooth mark and bite pattern analysis; physical assault (child abuse); and malpractice. Forensic odontologists synthesize principles, knowledge and competence from many aspects of dentistry with those of other disciplines, as for example forensic pathology/medicine, genetics, anthropology and criminology.

6.1.2 Identification by dermal-ridge fingerprints, dental means and/or DNA profiles are widely acknowledged as scientific and therefore used as so-called primary evidence, which means that the can stand alone as identification tools.

This chapter is aimed at presenting an overview of forensic odontology with special emphasis on person identification as it is practiced today in mass disasters. The presentation will focus on the approach recommended by the International Criminal Investigation Organization — Interpol — and described in the Interpol Guidelines for Disaster Victim Identification (DVI) which are available from the website (see list of further reading). The guidelines include a form set of which two pages (F1 and F2) are reserved for recording dental ante-mortem (AM) and post- mortem (PM) information.

6.2 ORGANIZATION AND TASKS OF THE DENTAL IDENTIFICATION TEAMS

6.2.1 Planning is crucial for successful DVI in situations with multiple casualties, such as natural disasters and aircraft accidents. A forensic odontologist with extensive experience in identification work involving foreign nationals should be appointed to the identification commission (the aviation pathology team) responsible for the organization and legal aspects of the identification process. During the investigation, the appointed forensic odontologist should confer with the chairman of the identification commission or the investigator-in-charge as appropriate. The forensic odontologist is able to contribute both to the accident investigation and to the identification of victims. The odontologist will further ensure availability of instruments and equipment needed and call upon additional staff as required.

Recovery group

6.2.2 Dental knowledge is essential for recovery and preservation of odontological evidence. On the site, the main task of the forensic odontologist is to give a preliminary description of the face and dentition of recovered bodies and otherwise help in the search for bodies or body fragments and assist whenever required. In case of badly burnt or maimed bodies, a preliminary description of the teeth has to be made and dental radiographs taken with portable X-ray equipment before handling and transporting the body. The forensic odontologist may even choose to complete the post-mortem registration at the scene of the accident.

Ante-mortem recording group

6.2.3 An ante-mortem (AM) dental data collection centre chaired by an experienced forensic odontologist should be set up as early as possible after the accident. In the aftermath of a disaster with significant

numbers of victims, the local police or other approved authorities will contact dentists known to have treated specific missing persons. Access to AM dental data may differ widely from country to country, usually as a consequence of different regulations for dental record keeping. Forensic odontologists, with or without assistance from other professionals (police, forensic pathologists, etc.) may facilitate the collection of dental AM data by making use of their national or worldwide contacts. The collection of AM dental information is routine in many countries, but less well established in other countries. In the latter case, guidelines from the AM data centre should be provided detailing material to collect: dental records that are on file, conventional or digital radiographs of teeth, jaws and/or scull, dental casts or models, etc. It is equally important to give instruction on how to forward and ensure proper labeling of the AM information. Original records including X-rays are irreplaceable and may get lost if sent by ordinary mail or released to relatives or other individuals acting on behalf of the victim. To cope with this obstacle, dental AM data (records, X-rays, photographs) should be duplicated and originals kept and stored safely by the AM dental data collection centre based in the country of residence of the victims. The forensic odontologists attached to this centre may be referred to as the "home dental AM team" or just the "home team". Duplicated radiographs and photographs should be clearly labeled. Alternatively the home team could enter the AM information on the DVI dental forms (yellow pages F1, F2) and forward the data to the on-site personnel via electronic transmission through a secured website and after encrypting the data. The latter method would take advance of home AM teams being able to better understand text written in their own language and translate abbreviations and characteristics which may be difficult to interpret for international teams. In case of foreign nationals, it may be advisable to obtain assistance of forensic odontologists who are compatriots of the victims involved, and who may contribute by working together with the on-site personnel by translating and checking information forwarded to the AM data collection centre. As a rule, teams of two forensic odontologists are preferable in the handling of the incoming AM material to check for discrepancies and to minimize errors while transferring the data to the appropriate forms. It is equally important that the AM data from dental records are quality checked, whether the entry is done by the home team or at the site of accident.

Post-mortem dental examination group

6.2.4 There will always be pressure from distressed relatives, media and political authorities to start the PM examination immediately. Priority ought to be given to photographing faces of the victims before decomposition starts and to planning a system of numbering that follows the victims, their forms and samples throughout the identification process.

At present, bar coding would be a proper system to consider. As the teeth and dental structures are fairly stable under variable conditions, the forensic odontological examination may wait until adequate working conditions are established.

Provided working conditions are adequate, several re-examinations may be avoided and, in the long run, time may be saved. Essential dental autopsy equipment includes cameras, preferably digital cameras, and portable X-ray machines. The examination kit may further include UV-light to trace tooth-coloured restorations that may otherwise easily be overlooked. The PM examination should be carried out in the mortuary, whether permanent or temporary. Beforehand the identification commission should decide on the management of the DVI operation, preferably based on the Interpol DVI guide, and subsequently provide standardized protocols and procedures for pathology, odontology, photography, fingerprinting, re-examination, transportation of bodies, chain of custody and DNA profiling. Furthermore a decision should be made on the sequence of examinations to follow, for example, fingerprinting, pathology and odontology.

6.2.5 A post-mortem (PM) dental data collection centre chaired by an experienced forensic odontologist should be set up as early as possible after the accident. Instruction to all PM teams should be given by the on-site PM team leader in charge before work is begun; the initial instruction should be followed by regular updating. The standards for the dental operating procedures should clearly define details included in the examination, such as type and number of photographs, type and indications for radiographs, level of details for tooth and dentition registration, and sampling of teeth for potential DNA profiling. The standards could further state that, as a rule, the recording of the dental status of the body, including the production of a radiographic and photographic record, should be performed by teams of two forensic odontologists — one is the examiner and the other is the recorder who fills in the DVI forms (pink pages F1 and F2) and monitors the registration.

Working in pairs of two forensic odontologists would allow for cross-checking (quality control) and for discussion of problems and exchange of opinions. Finally the standards decided upon should state whether it is acceptable to deglove the face, to resect the mandible, and to remove jaws or jaw fragments from the body.

Dental comparison and identification group

6.2.6 The comparison and identification centre should, just like the AM and PM data collection centres, be chaired and staffed with forensic odontologists experienced within the field. Individuals with numerous complex dental treatments are usually easier to identify than those with no or fewer restorative treatments. Difficult cases (e.g., cases with insufficient AM information or where comparison of AM and PM data sets does not result in immediate identification) accumulate over time, and therefore it is of paramount importance that the reconciliation and identification team continues to be staffed for the duration of the operation with odontologists of adequate forensic experience. By carefully exploring the written dental records, the dental charting and the dental X-rays, clues for comparison can be found. Photographs of a dentition may be helpful in the comparison situation and provide clues on whether to pursue further investigations. Facial photographs, in particular smile photographs, may disclose specific features of the anterior teeth to be compared for a match against other available photographs. An evaluation of concordant features and of their relative importance should be performed. Similarities and discrepancies, both those that can be explained and those that cannot, should be recorded in the comparison report. Explainable discrepancies usually relate to the time elapse between AM and PM records but if a discrepancy is unexplainable, then exclusion must be made. The dental comparison report is then transferred to the identification team/board-in-charge for evaluation and discussion at reconciliation sessions ending up with the statement on the dental identification, including a description of the essential evidence, and written in a way understandable to non-experts. Finally the identification form is signed, preferably by two forensic odontologists to ensure strict control and accountability. In case of foreign citizens, the form may as appropriate be countersigned by forensic odontologists delegated from the countries involved.

6.3 ODONTOLOGICAL IDENTIFICATION

6.3.1 Proper collection, handling, storage and processing of data are prerequisites to arrive at correct person identification by dental means. In single person accidents as well as in mass disasters, the underlying principles of dental identification remain the same: recording and comparing of the AM and PM data, and from there drawing an identification statement, which the forensic odontologist must be prepared to defend in court, if necessary. In mass disasters, however, challenges are magnified due to multinational victims, body fragmentation, mutilations, comingling, incineration, etc.

6.3.2 Changes brought about by age, pathological conditions, anomalies or by intervention of a dental surgeon result in the mouth being unique to the individual. Most often dental identification is based on a detailed consideration of the restorative work replacing areas damaged by dental caries. A full description of the individual dental restoration, including type of material used and surfaces restored, serves as a baseline for the comparison of the dental status AM and PM. Moreover, a comparison between AM and PM radiographs is essential and may often lead to identification or convincing proof of exclusion of an individual. The comparison between AM and PM data may yield one out of three outcomes: positive identification (identity established), corroborative identification (identity possible, identity probable), or identity excluded. The number of concordant characteristics that satisfy established dental identity has been and is still a subject for discussion. Many years ago twelve concordant characteristics, as required for dermal-ridge fingerprint identification, were proposed as the threshold for dental identification. However, distinction between common dental characteristics and those that are individual is a key factor to be considered before establishing that a combination of individual characteristics is unique to a person. In some cases a single tooth can be used for identification if it contains sufficient unique features. Radiographs and clinical photos will often provide the key for the uniqueness.

6.3.3 The success rate of dental identification is thus dependent not only on the character of the case (physical destruction by mutilation, fire, putrefaction, etc.) but also on community-based parameters as for example prevalence of dental disease, predominant modality of treatment, availability of dental service, and the existence and accessibility of good AM records. The contribution of dental evidence in person identification has been and continues to be substantial in single as well as mass disasters. Identification by dental means is less powerful in children and young adults with no or few restorations. In these situations dental structures, as mirrored on intraoral radiographs, can provide indicators of the individual's chronological age; in children by analysis of tooth development and subsequent comparison with developmental charts, in sub- adult ages by use of eruption dates of the teeth, and in young adults by use of third molar development.

6.3.4 There is no universally accepted form on which to transcribe the dental AM and PM information. While forensic odontologists continue to use a variety of dental forms, the dental data sheets of the Interpol DVI form set are now being adopted by more and more forensic odontologists in a number of countries. This trend may ultimately minimize the international diversity of information from which to draw the identification statement. The Interpol form set is reviewed every five years; the forms can be downloaded from the Interpol website (see list of further reading).

6.3.5 The key to successful mass disaster identification is preparedness, and many countries have appointed national or regional multi-disciplinary DVI teams or identification commissions to handle situations with multiple casualties.

Other countries have no official mode of proceeding in case of mass disasters but employ "ad hoc" committees in DVI or contract private companies. Overall, DVI teams should, as a minimum, include experienced police officers/fingerprint experts, forensic pathologists and forensic odontologists.

6.3.6 A number of software programmes have been designed to speed up the paper handling in mass disaster situations. Direct entering of data into the computer programme, as part of both the PM data recording in the mortuary and the AM recording at home, is expected to become routine and will undoubtedly save time and manpower. Furthermore, the ease of electronic import and export of data keeps writing errors, etc., to a minimum. It can be foreseen that data miners/software experts will be attached to the

DVI teams. Among the available programmes is a software programme designed to handle information from all sections of the Interpol DVI form that was developed by Plass Data Software A/S (see list of further reading) in the mid-1990s on initiative from the Norwegian and Danish Identification Commissions. Since then the software has been revised, updated and further improved as a result of close cooperation between the developers and users representing DVI teams and experts across the world. The system, known as DVI System International, is at present the only internationally approved DVI software programme. It provides exact replica of the Interpol DVI form set and works in the four Interpol languages: English, French, Spanish and Arabic. The forms have further been translated into a number of other languages on request from the customers. The system provides a number of functionalities, including search options to assist in dental data matching, necessary for final assessment.

6.4 COMMUNITY-BASED PARAMETERS AFFECTING THE SUCCESS RATE OF ODONTOLOGICAL IDENTIFICATION

National dental health data

6.4.1 A working knowledge of the oral health status among citizens is essential to forensic odontologists. Further demographic factors to be aware of are differences in achievement of dental health gain between groups of the society, in dental health status between indigenous population and ethnic minority groups, and between men and women.

Variability in standard and quality of dental records

6.4.2 The identification statement is based on the assumption that the ante-mortem records relied on were correct and adequate as to name, dates, written and charted notations, etc. The information available so far suggests large variations in the standard of dental record-keeping around the world. Experience from mass disasters indicates that dental records of good quality, including charts and X-rays, are available from Northern, Western and Central Europe, North America and Oceania, whereas dental records are limited and hard to obtain from other parts of the world, in particular Eastern Europe and Asia. In the early 1970s, a two-digit notation was proposed as an international standard, but so far this so-called FDI notation or its variant ISO 3950 is not universally used. Abbreviations for recording dental treatment in notes and charts are commonplace worldwide, but no internationally approved standard codes for the recording of various forms of dental treatment, anomalies, etc., exist. The variations in dental recording with regard to notation, charting systems and abbreviations, make it important that forensic odontologists and not police officers or forensic pathologists interpret, record and translate AM dental information.

6.5 IDENTIFICATION BY DNA "FINGERPRINTING" OF DENTAL TISSUE

In case of an inadequate number of teeth in the bodily remains or unavailability of dental records, identification and gender determination based on DNA analysis can be performed, provided tissue samples from parents or siblings (buccal swabs) or a known AM sample can be obtained and used for comparison. Teeth are a useful source of DNA material and various regions of the teeth, such as the crown body, root tip and, in particular, root body, provide sufficient quantity of DNA to support DNA extraction thus justifying extraction from a found tooth fragment. The latter may occur after explosions or airplane crashes, because human remains are then often fragmented and comingled.

Genomic DNA found in the nucleus of each cell of a tooth's calcified tissues (dentine and cement) and pulp is the primary source for forensic application but the cells also contain mitochondrial DNA, which with time may become the basis of a powerful technique in dental identification.

The major protein found in human enamel has a slightly different size and pattern of the nucleotide sequence in male and female enamel. These differences are sufficient to be used as a sensitive gender determinant for very small samples of DNA from unknown human skeletal or dental remains.

6.6 INTERNATIONAL COOPERATION AND COMMUNICATION IN FORENSIC ODONTOLOGY

6.6.1 Interpol is the official channel for exchange of information on dental as well as other evidence related to missing persons and unidentified bodies. To ensure minimum standards, the Interpol DVI Standing Committee is continuously working on guidelines for identification of foreign disaster victims. The Interpol DVI guidelines further provide specific recommendations to member states on international cooperation for identification of victims of mass disasters, according to which member states are encouraged to establish a national DVI team as well as a liaison team to be activated in case of mass disasters abroad. Whenever foreign nationals are involved in mass disasters, the country in charge of the identification should rapidly establish and maintain, directly or through Interpol, close cooperation with corresponding authorities in the victims' home countries. Member states are advised to explore the possibility of one or more of their experts travelling to the site to attend or assist in identification of their own as well as other nationals. Despite effective collaboration between forensic experts, the differences existing between legislation and medico-legal systems may still hamper the rational and optimal coordination of the medico-legal investigation of a mass disaster. These obstacles were faced initially but mostly overcome with time during the hitherto largest, multinational DVI operation ever conducted after the Indian Ocean tsunami disaster in Thailand in December 2004. Complex challenges arose, related to identifying about 3 000 victims from approximately 30 countries while working in temporary morgues. The DVI teams consisted of about 600 persons from Thailand and approximately 30 other countries and included forensic odontologists from over 20 countries. Identification of most tsunami victims in Thailand relied on dental means and fingerprints rather than DNA results; the significant contribution of dental evidence in this large- scale multinational operation is consistent with experience in other disasters. The operation resulted in relationships being built between DVI teams and experts from many nations, and skills, experiences and knowledge have been exchanged. To further increase and consolidate the forensic odontology response capabilities, the DVI Forensic Odontology Working Group, working under the auspices of the Interpol Standing Committee on DVI and comprising specialists in DVI responses and methods, has established a number of subgroups to work on important issues identified during recent disaster operations; among the action points to work on are updating and improvement of the DVI Guide and Forms and the software DVI System International including suggestions on an international standard for dental codes. Accreditation of DVI forensic odontologist, based on qualifications and experience, is a further issue of concern, because forensic odontology is a specialty that cannot be carried out by dentists without training and experience within the field.

6.6.2 The International Organization for Forensic Odonto-Stomatology (I.O.F.O.S.; see list of further reading) works as a unity among its constituent national societies (June 2008: 20 societies). A major objective for the organization is to provide a liaison between societies for forensic odontology on a global basis. The Worldwide Forensic Odontology Contacts archive, also called "The Burgman List", is a list of forensic odontologists to be used by dental DVI teams or other authorities requiring

assistance on ante-mortem dental information, etc. (Country index as of November 2005 encompassing 120 countries). The list is periodically updated and hosted by the I.O.F.O.S.

6.7 SUMMARY

Planning is crucial for successful DVI in situations with multiple casualties, whether a man-made accident or a natural disaster. The key to successful mass disaster identification is preparedness, and many countries have appointed multidisciplinary DVI teams or identification commissions to handle such situations. Standardized protocols and procedures for odontology including radiography and photography should be provided from the team leaders in charge before the recordings are initiated. There is no universally accepted form on which to transcribe the dental AM and PM information but the dental data sheets of the Interpol DVI form set are now being adopted by more and more forensic odontologists in several countries. As a rule, teams of two forensic odontologists are preferable for recording and handling AM and PM data. The data should be quality assessed during recording and before being entered into databases. The concluding comparative dental identification makes use of and evaluates the two sets of recordings systematically, tooth by tooth. The system, known as DVI System International, is at present the only internationally approved software programme that supports data processing and dental data matching required for the final identity assessment.

CHAPTER 7. AEROMEDICAL TRAINING FOR MEDICAL EXAMINERS

7.1 INTRODUCTION

Medical examiner. A physician with training in aviation medicine and practical knowledge and experience of the aviation environment, who is designated by the CAAN to conduct medical examinations of fitness of applicants for licences or ratings for which medical requirements are prescribed.

….

PELR and MR state "Designate medical examiners will be designed who are qualified and licensed in the practice of medicine, to conduct medical examinations of fitness of applicants for the issue or renewal of the licences or ratings specified in Chapters 2 and 3, and of the appropriate licences specified in PELR. Similar procedures have been developed in PLM.

PELR and MR state – "designated medical examiners shall have received training in aviation medicine and shall receive refresher training at regular intervals. Before designation, medical examiners shall demonstrate adequate competency in aviation medicine.

PELR and MR state- "designated medical examiners shall have practical knowledge and experience of the conditions in which the holders of licences and ratings carry out their duties.

Note.— Examples of practical knowledge and experience are flight experience, simulator experience, on-site observation or any other hands-on experience deemed by the CAAN to meet this requirement."

7.1.1 A designated medical examiner as specified in PELR and MR, is a physician who is authorized by the appropriate national authority to carry out clinical examinations as required for issue of aviation-related licences. Usually such physicians are engaged primarily in some other field of medical practice in the course of which they also act as designated medical examiners on request.

7.1.2 Aviation medical examiners should understand the importance of the authority and responsibility vested in them. Incompetence in the medical fitness evaluation of an applicant might permit a physically or mentally unfit person to exercise the privileges of a licence which can have serious implications for flight safety, for the Administration and indeed also for the examiner himself. However, an overly stringent approach by the examiner should be avoided, since this is likely to adversely affect the relationship between examiner and applicant. As most conditions of relevance to flight safety will be elicited from the history, a relationship of trust must be fostered by the examiner. Adequate aeromedical training for potential examiners and recurrent training for those designated as medical examiners is necessary but the examiner must also develop the skills needed to conduct a thorough examination in an atmosphere of trust.

7.1.3 The appropriate environment for the medical examination can be facilitated by the medical department of the CAAN, which should strive for a certification process that is transparent and based as far as possible on scientific evidence. Applicants are more likely to be forthcoming with personal information if they believe that, should they declare a condition that could have aeromedical significance, they will be treated fairly by the Authority, and that efforts to keep the applicant

operating will be made wherever possible by those having decision-making authority over the issuance of Medical Assessments.

7.1.4 A need for special post-graduate aviation medical training has been recognized by responsible authorities in most countries with significant civil aviation activities. No basic medical curriculum or post-graduate training in a specialty other than aviation medicine provides the specific instruction desirable for a designated medical examiner. Improving the quality of aviation medical examinations in a State will result in a more rational and uniform application of the medical provisions of Annex 1. This in turn may not only positively affect the general flight safety level within the country, but may also be expected to favour increased international recognition and reciprocity with regard to medical fitness requirements of personnel licences.

7.1.5 In some Contracting States medical examiners are encouraged to become involved in the medical aspects of aircraft accident investigation. However, for examiners to function effectively in this role, it is desirable that they receive formal instruction on fundamental procedures. Whilst such training may be included in an aviation medical examiner training course curriculum, normally additional, specific training is required.

7.1.6 In addition to ICAO-sponsored seminars, several Contracting States offer post-graduate programmes in aviation medicine. Information on some of these programmes can be found in the ICAO Training Directory, available at www.icao.int.

7.2 COMPETENCY-BASED TRAINING FOR MEDICAL EXAMINERS

7.2.1 The objective of this section is to provide guidance for implementation of competency- based training of medical examiners applying for designation by a CAAN. It contains guidance for providers of training as well as for States who are implementing such training or assessing it. The aim is to encourage States to adopt a systematic approach to aeromedical training so that medical examiners attain an appropriate and harmonized level of expertise.

7.2.2 The competency-based approach to training has been adopted by ICAO in a number of areas, including the multi-crew pilot licence and the training of government safety inspectors; it is designed to achieve consistent and standardized outcomes from training. As stated in the *Procedures for Air Navigation Services — Training* (ICAO Doc 9868), Chapter 2, paragraph 2.2: "The development of competency-based training and assessment shall be based on a systematic approach whereby competencies and their standards are defined, training is based on the competencies identified, and assessmentsare developed to determine whether these competencies have been achieved."

The ICAO document further states that competency-based approaches to training and assessment shall include at least the following features:

a) the justification of a training need through a systematic analysis and the identification of indicators for evaluation;
b) the use of a job and task analysis to determine performance standards, the conditions under which the job is carried out, the criticality of tasks, and the inventory of skills, knowledge and attitudes;
c) the identification of the characteristics of the trainee population;
d) the derivation of training objectives from the task analysis and their formulation in an observable

and measurable fashion;

e) the development of ***criterion-referenced***, valid, reliable and performance-oriented tests;

f) the development of a curriculum based on adult learning principles and with a view to achieving an optimal path to the attainment of competencies;

g) the development of ***material-dependent*** training; and

h) the use of a continuous evaluation process to ensure the effectiveness of training and its relevance to line operations.

Note.-A detailed description of the ICAO course development methodology, a competency- based approach to training and assessment and an example of an ISD methodology, can be found in the Attachment to Chapter 2.

7.2.3 In a competency-based training approach:

- training is outcome-oriented. It is what trainees can do and how well they can do it that matters (rather than their level of knowledge about a particular subject);
- training materials clearly state what is expected of trainees in terms of performance, under given conditions, and to what standards;
- training is material-dependent as opposed to trainer-dependent;
- assessment during and after training measures the performance of the trainee against a specified standard in a valid and reliable fashion; and
- trainees are provided with regular and immediate feedback during training.

Scope

7.2.4 This chapter relates primarily to examiners of professional pilots (ICAO Class 1 Medical Assessment).

Accordingly, the discussion which follows will refer primarily to this group and their work environment. However, most of the principles are also applicable to the other categories of applicant. Comments on Class 2 and Class 3 applicants follow.

7.2.5 ICAO Class 2 (primarily private pilots): Mostly the same principles as for Class 1 apply, although a lower overall level of fitness is required and greater flexibility is likely to be applied by Medical Assessors. In some States, the process for medical certification for Class 2 applicants differs from other classes in that there may be greater authority delegated to examiners of Class 2 applicants. However, the processes undertaken by examiners are broadly similar, although the requirements of the regulator in terms of training and competency for designated medical examiners (DMEs) examining only Class 2 applicants may be less stringent than those examining Class 1 (or Class 3).

7.2.6 ICAO Class 3 (air traffic controllers): While there may be differences in Standards and application of flexibility for Class 3 applicants as compared to Class 1, air traffic controllers are professionals within

the same aviation system. Most of the medical considerations for Class 1 also apply to Class 3, and therefore the same core set of competencies is likely to be required of their medical examiners. The guidance given in this chapter is also applicable to medical examiners designated to examine Class 3 applicants.

7.2.7 In addition to the three ICAO classes of Medical Assessment, some States medically evaluate other aviation personnel, such as recreational pilots, tandem parachute instructors, pilots of microlight and ultralight aircraft and cabin crew, all operating under licences that are not necessarily compliant with ICAO Standards. For these groups the level of legislation varies greatly from State to State, and the training of medical examiners designated to determine their medical fitness is outside the purview of ICAO.

Development of the guidance material

7.2.8 A survey of several contracting States was undertaken concerning existing training programmes and required competencies and tasks of aviation medical examiners. The States that responded to the survey represented a variety of geographical regions and regulatory approaches. The responses were highly diverse.

7.2.9 In some States all examiners were directly employed by the State. In some, the examiners were entitled or required to issue the Medical Assessment (even if only as a temporary Medical Assessment) while in others the examiner only performed examinations and the Assessment was issued centrally, based on examination findings.

7.2.10 Few States had formal competencies established for their medical examiners, although many had established goals and objectives for training. In terms of prerequisites to undergo training, some States required only basic medical qualifications, while others required additional qualifications, skills or experience. In some States, completion of the training allowed the doctor to commence working as a medical examiner but in others, further requirements were added, sometimes including a probation period. In about half the States, there was an established process for review or audit of examiner performance.

7.2.11 All responding States conducted medical examiner training, but the variation in size, duration and frequency of training courses was wide. In some States the CAAN itself provided the training, and in others this was done by external organizations. The principal training method was by lectures, often with clinical demonstrations and sometimes practical visits (to altitude chambers or aviation worksites, for example).

Computer-based training was mentioned by some States. A variety of written reference material was used including textbooks, on-line resources and regulatory documents.

7.2.12 In terms of assessment at the end of training, written examination was the commonest method, but other methods included practical or oral examination, or none at all. The experience or training required of trainers also varied greatly, but in general there were few explicit requirements.

7.2.13 The wide variety of approach to DME training confirmed the need to harmonize the training programmes while considering the different regulatory contexts in which the medical examiners practice and the different training environments in which they learn. The successful implementation of competency-based training for medical examiners should take into account the variety of State-specific parameters while at the same time ensuring that internationally agreed competency standards

are met.

7.2.14 Formulation of the competency framework was achieved by an ICAO Medical Provisions Study Group (MPSG), composed of representatives from 12 States along with other invited participants (including the European Aviation Safety Agency, the International Federation of Airline Pilots' Associations, the International Air Transport Association, the International Academy of Aviation and Space Medicine, and the Aerospace Medical Association) and external consultants, who corresponded initially by e-mail. The MPSG met over a three-day period in 2009 and consulted further by e-mail to agree on the framework content.

7.2.15 The competency units and elements were derived from an analysis of the processes which occur during a medical examination. Although the framework lists those units and elements sequentially, in reality they do not necessarily occur in a specific order or as individual units, as many functions are conducted concurrently or iteratively.

7.2.16 The processes were grouped into three broad sections (units):

- facilitating communication;
- gathering and processing medical information; and
- utilizing that information to facilitate a Medical Assessment.

Note.— The medical examination is part of a wider process of medical evaluation for fitness, the other aspects of which may be conducted by individual(s) who have not been personally involved in the conduct of the medical examination. The purpose of the examination is to facilitate the decision concerning fitness for issuance of a Medical Assessment, and the two parts of the process (clinical examination, and issuance decision based on the examination and any other clinical findings) should be considered in totality rather than in isolation.

Assumptions

7.2.17 A series of assumptions underpin the formulation of the competency framework. Text in italics is explanatory.

1. The goal of the examination process is to optimize flight safety through managing aeromedical risk.

   Whether or not the State requires the examiner to make certification decisions, the ultimate goal of the examination and evaluation process is to minimize the risk of safety being compromised as a result of aeromedical factors. These factors include, but are not limited to, incapacitation of pilots or other licence holders.

2. Competency-based aviation medical examiner training should contribute to achieving the goal in (1) above.

In order to provide appropriately targeted evaluations, medical examiners should have a clear understanding of the considerations which underlie aeromedical decisions.

3. The periodic medical examination and evaluation process should use a risk-based approach. Characteristics of the applicant will help determine the areas on which the examination should focus. For example, in older applicants, cardiovascular risk becomes relatively more important as a potential cause of incapacitation. In younger applicants, depression is relatively more common. Aside from age, a number of demographic and other considerations may be important including

gender, ethnic background, culture, and type of flying.

4. Potential examiners are fully registered/licensed medical practitioners who already have acquired core clinical skills.

   Being registered to practice medicine is taken to denote an acceptable level of competence in basic skills of history-taking, physical examination, diagnosis and medical treatment. It is therefore assumed that medical examiner training does not need to ensure that all basic clinical skills or core medical knowledge are in place. Rather, it is accepted that this has been verified within each State prior to training commencement. The aim of medical examiner training, as addressed in this chapter, is to build upon basic clinical skills and knowledge and provide additional, task-related knowledge and skills, and to foster those attitudes, that are required to achieve competency in the specialized tasks required of a medical examiner. The training and its assessment should therefore be focused on developing and verifying that such additional competencies have been achieved.

5. Potential designated medical examiners have currency in medical knowledge and practice. *Ongoing education and clinical practice are essential to maintaining competency. States employ various means to ensure that examiners are receiving ongoing education and training and are maintaining currency in clinical practice.*

   Verifying such currency is somewhat beyond the scope of the medical examiner training, although it may reveal deficiencies if present. Nonetheless, it may be necessary for States to verify that each applicant for medical examiner training remains fully conversant with the basic medical skills, especially if the applicant's usual work does not include practicing such skills.

Background

1. Guiding Principles
   The following premises provide background to the rationale behind the formulation of the competency framework:

   a) Physical incapacitation is a rare cause of accidents in two-pilot aircraft undertaking commercial flight operations.

   b) Overall incidence of physical disease increases significantly with age.

   c) In many States, the incidence of mental health problems, such as depression and problematic use of psychoactive substances is increasing, whilst cardiovascular disease is declining.

   d) For some conditions, preventative strategies have been demonstrated to be effective in the general population, e.g. depression, alcohol misuse.

   e) The current periodic medical examination does not formally address mental health or behavioural problems associated with ill health to the same extent as the detection of physical disease.

   f) The periodic physical examination, like all medical examinations, benefits from a thorough history.

g) Current life events can adversely affect the performance of licence holders.

2. Safety context
   Since soon after the birth of aviation, medical standards have been applied to aviators with an overriding focus on maintaining the safety of flight. In the 100 years since the first fatal aircraft accident involving heavier-than-air aircraft in 1909 (DeJohn, 2004), the industry has evolved from aircraft carrying a few people to aircraft carrying several hundreds of passengers; consequently, a single aircraft accident today may have very severe consequences. Large aircraft are flown by professional pilots, a reason for this chapter being focused primarily on the professional pilot group, as mentioned above. When private pilots are involved in aircraft crashes, the number of individuals involved is much smaller since the aircraft typically flown carry only 1-3 passengers. Furthermore, the likelihood of causing harm to members of the public, either on the ground or in other aircraft, is minimal (although such accidents do very occasionally occur).

In reality, it is rare for medical factors to be the primary cause of aircraft crashes – probably 1 per cent or less, and for professional airline operations, well below this. It has been estimated that across the industry 3 per 1 000 aircraft accidents (15 per 1 000 fatal aircraft accidents) result from pilot incapacitation (Booze, 1989), although this does not include accidents in which medical factors may be a contributory, as opposed to primary, cause. Because of difficulties in identifying medical causes, there may also be situations in which a primary medical cause may have been present but which cannot be established through investigatory processes.

Importantly, in accidents caused by medical factors, certain causes predominate. In an analysis of fatal commercial (two-pilot) crashes over a 20 year period (1980-2000) in which medical factors were identified as the cause(s), ten incidents were found. Of the ten, eight were ascribed to a psychiatric disorder with the majority (six) being related to alcohol and/or other drugs (Evans, 2007). The discussion which follows will therefore place particular emphasis on these conditions.

3. Aims and limitations of the examination process
   The primary purpose of a medical examination is often considered to be the detection of conditions with a propensity to cause incapacitation (Evans, 2006). Examples include seizures, disturbances of heart rhythm, loss of consciousness.

This, however, is only one aspect of the medical examination; one with important limitations. Incapacitation can be sudden or insidious, and the degree of warning will affect the consequences. By far the commonest cause of in-flight incapacitation is acute gastro-intestinal upset, which is almost never predictable by routine medical examination. In considering incapacitation, there are also differences between obvious and subtle incapacitation with the latter having the potential for even more serious consequences due to delayed detection. A distinction may also be drawn between passive incapacitation, in which the individual becomes unresponsive, and active incapacitation, such as in a seizure, whereby the pilot has the potential to interfere directly with the control of the aircraft.

There is a further category of in-flight incapacitation which is related not to medical factors (although these are often attributed to medical causes in incident reporting systems) but to exposures relating to the operational environment, such as exposure to hypoxia, carbon monoxide or toxic fumes from combustion. These types of incapacitation are not strongly related to individual factors and are not predictable by medical examination.

Some degree of incapacitation risk is always present. For example, all individuals have a background risk of seizures, which is reported as between 0.1 per cent and 1 per cent annually depending on age

(Heaney, 2002). Therefore, judgement will be required as to the acceptable level of risk. Much has been written on this subject, and many States apply a threshold of risk of no greater than 1 per cent per annum for an individual in the multi-pilot, professional operational environment, this being derived from a computation of acceptable risk of a catastrophic accident, relative to risks from other causes relating to aircraft operation (Tunstall-Pedoe, 1984). The detail will not be repeated here but the essential concept is that the 1 per cent threshold was calculated to produce a risk of catastrophic pilot incapacitation which was no greater than other catastrophic system failures such as those of major aircraft engineering systems. It has been argued more recently that the threshold of 1 per cent could be revised (Mitchell and Evans, 2004), but the important principle is that medical examiners should have a good understanding of the way in which aeromedical risk is assessed and of its limitations. (See Part I Chapter 3, Flight Crew Incapacitation, for further discussion of in-flight incapacitation and acceptable aeromedical risk.)

The frequency of actual in-flight incapacitations is not known (De John, 2004) and in order to gain better information, ICAO has adopted a recommendation that States establish mechanisms to collect data on in-flight incapacitation (ICAO Annex 1, paragraph 1.2.4.2, applicable November 2010). The chief protection against incapacitation in air transport aircraft is the presence of a second pilot, coupled with the training of pilots in dealing with an incapacitation emergency (De John, 2004). Similarly with air traffic controllers, protections exist when multiple controllers and supervisors can detect incapacitation and take over duties.

However, risk of incapacitation occurring from some unexpected event is only one of the areas evaluated in the aviation medical examination. Others include:

— assessment of functional ability to conduct aviation duties. Obvious examples include impairment of vision, hearing or mobility. Assessment of such functions requires application of standards and consideration of the aviation environment in which the individual may be working;

— assessment of conditions which may deteriorate because of the flight environment and thus impair flight safety. For example, an applicant with asthma could remain well on the ground, but experience an acute exacerbation when exposed to reduced oxygen pressures and cold temperatures associated with an explosive decompression at altitude. Alternatively, a pilot who has recently had a retinal detachment treated by injecting gas into the eyeball will be at risk of adverse effects on vision if exposed to low atmospheric pressure at high altitude;

— assessment of conditions which may be aggravated by the work environment. Examples include hearing loss which could be accelerated by exposure to noisy aviation environments. This is a slightly different consideration, related more to the occupational health of the individual than directly to the safety of flight – such aspects involve the effect of work on health, rather than the effect of health on work. It is arguable whether protection of the health of an individual is an appropriate objective of the regulatory authority, but in practice it is almost certain to be encompassed within the medical examination process.

In addition, two other processes may be considered. The first is the provision of health advice (for example, discussion of lifestyle factors such as smoking and exercise). Whilst it may be argued that this is not strictly the role of the aviation medical examiner, many medical practitioners, and applicants, would consider it appropriate, indeed best practice, to discuss such factors as they arise in the course of the medical examination process, and advice on these factors may be relevant to the applicant's future fitness for aviation duties.

The second process is that of building rapport between examiner and applicant, to facilitate declaration of medical conditions or events. At the time of the periodic medical examination, the applicant answers direct questions about such aspects, but since such examinations tend to occur annually or less frequently, most medical conditions arise in between medical examinations, and the processes for reporting them (including use of medications) are generally less regulated than those for the periodic medical assessments. Thus it is the pilot or air traffic controller who must decide whether to notify the CAAN, and the degree of rapport with the medical examiner may be a factor in his decision.

ICAO has made progress in this area, and has introduced a recommendation in Annex 1 regarding reporting illness on occasions other than the routine medical examination:
Handling such reporting should therefore be a competency of medical examiners so that they can make sound decisions on whether a pilot may continue to fly with a certain condition or treatment.

7.3 EXPLANATORY NOTES ON THE COMPETENCY FRAMEWORK

7.3.1. Structure

The competency framework has four tier levels:

a. Competency unit ("The main processes are…")

b. Competency element ("The steps within those processes that a competent designated medical examiner is expected to take are…..")

c. Performance criteria ("The DME will normally be expected to perform ……")

d. Evidence and assessment guide ("At the completion of training, the examiner will be able to demonstrate that he can….. ")

7.3.2. Context

Some States have well-established training programmes which produce examiners who meet the competencies set out in this document. Other States may be seeking to establish courses which meet ICAO requirements, and this competency framework will provide the foundation for creating such programmes. In addition, programmes may be established to train medical examiners for a variety of different States. This framework provides direction as to the generic training applicable to all States, as well as those aspects which will need to be provided for, or on behalf of, each individual State to meet its specific requirements.

Amongst the various performance criteria and evidence and assessment guides are many items which will vary depending on the State in which the examiner is working. These context-specific items are shown in *italics*. If training is delivered for a future examiner who will work for a specific CAAN, e.g. a CAAN in a State other than that in which the training is being provided, it will be necessary for the information relevant to these items to be provided to the future DME by that CAAN. For example, the medical form to be completed by an applicant may vary from one CAAN to another, as may the administration process after its completion.

The relevant information could be provided in two ways — either the training organization will access the relevant up-to-date training requirements from the other State's CAAN and provide these to the student(s) as part of the training course, or the examiner will receive extra training from the CAAN

separate from the training course. In the absence of requirements to the contrary, the training provider may wish to train in accordance with normal practice for the State in which training takes place, in order to illustrate one acceptable method.

7.3.3. Foundation knowledge

The draft competency framework is based on the need to train for skills required by the medical examiner in order to undertake a medical assessment of a licence applicant. In addition to the competency-based framework, foundation knowledge is essential for a medical examiner. It is up to the States/training providers to determine whether such foundation knowledge can be acquired as an integral part of a competency-based training programme for medical examiners or through a separate training programme acceptable to the CAAN. This foundation knowledge includes aspects of aviation physiology, knowledge of clinical aviation medicine as it pertains to conditions of relevance for aviation, and aspects of regulatory medicine (such as ICAO terms, and relevant Standards and Recommended Practices). Included in this chapter is an item on the critical analysis of medical information, such as specialist reports — which is important since the writers of such reports may take the role of advocate for their patient, or they may express opinions as to fitness for flying which are not based on a sound understanding of the flying environment and their patient's role in it. Also included is an item on the concepts of risk management (including risk assessment through evaluating likelihood and consequence, and application of risk mitigation strategies) and how they can be applied to aeromedical decisions.

Appendix 7/A outlines suggested minimum contents for this foundation knowledge.

Notes on specific aspects of the competency framework

The competency units and elements, performance criteria, and evidence/assessment guide items are listed here with explanation of key items (context-specific items are in italics). The complete Competency framework, without the addition of explanatory notes, is in Appendix 7/B

1. FACILITATE COMMUNICATION

1.1 Initiate the interaction and agree the terms

This unit is largely procedural but is an important competency for the examiner to demonstrate. As each State will have its own procedures, these elements are mainly context-specific.

1.1.1 Identify the applicant

1.1.1.1 Explain the importance of positive identification

1.1.1.2 List the CAAN's requirements for identification of applicants

1.1.1.3 Describe the process by which an applicant is identified

1.1.2 Have appropriate forms completed (including any declarations and consents)

1.1.2.1 Describe how to access the current versions of all available forms

1.1.2.2 Explain how to select the appropriate forms for the given applicant

1.1.2.3 List any aspects of the forms requiring particular explanation to applicants

1.1.2.4 Describe process for checking the completion of the forms (including declarations and consents)

1.1.2.5 Describe the actions in the event of improperly completed forms (including declarations and consents)

1.1.2.6 Explain the consequences of false declaration

1.1.3 Clarify administrative details

1.1.3.1 Explain the CAAN's requirements for checking background details (e.g. licence, current/previous certificate, existing limitations) and the reasons for checking these

1.1.3.2 Explain the CAAN's other administrative requirements (e.g. collecting a fee)

1.1.4 Verify that the regulatory context of the process has been addressed

1.1.4.1 Explain the medical examiner-applicant relationship

1.1.4.2 Describe any potential/actual conflicts of interest (e.g. personal relationship, airline examiner) and how they would be managed

1.1.5 Provide applicant with information about privacy/confidentiality

1.1.5.1 Explain who owns and who has access to the medical assessment report and associated documentation and information provided by the applicant

1.1.5.2 Outline how this is explained to the applicant

In that medical examiners are designated by the State, the responsibility of those examiners is to assist States in fulfilling their responsibility to minimize flight safety risk. This role is different from many,

or most, other clinical roles in which the doctor's primary responsibility is to the patient. In situations where these interests may be in conflict, the designated medical examiner's ultimate responsibility is to the State. In many States this can be complicated by the fact that the applicant may pay the regulatory examiner for the medical examination. However the lines of responsibility should be clear.

An example of where a conflict may arise is when an applicant does not want a medical condition disclosed to the CAAN, but the examiner believes the condition to have important safety implications. The examiner needs to be clear on how the safety obligation relates to the applicant's wishes, and what the examiner's legal obligations are regarding the release of this information. Any conflicts of interest must be understood by the examiner and managed carefully. The processes for dealing with confidentiality, consent, and disclosure need to form part of medical examiner training.

1.2 Establish rapport and encourage an open reporting environment

The use of the terms "medical examiner" and "medical examination" are relevant. The perception of many, including aviators, legislators and even DMEs themselves, is that the process of examination is an inspection aimed to identify medical conditions with potential adverse effect upon the safety of flight. This is true for only a few conditions; many relevant disorders are not detectable on physical examination, and the examiner often has to rely on information provided by the applicant. For example, a pilot or controller who suffers seizures or frequent fainting attacks is likely to appear normal on physical examination. In most cases, such conditions will only come to light when declared by the applicant, and the most effective mechanism for learning about such conditions is by encouraging open declaration by applicants.

Potential barriers to declaration by the applicant may include:

i) Not understanding the requirement to declare, or the significance of, a particular medical condition.

ii) Forgetting a medical condition or event.

iii) Fear of losing a valid Medical Assessment — of being unable to fly/work either temporarily or permanently.

iv) Mistrust of the examiner or of the aviation regulatory system. If the perception is that declaration of a problem will inevitably or unreasonably lead to cessation of flying or working, this will represent a barrier to reporting.

v) Guilt, shame or embarrassment — particularly for conditions in which a degree of denial is a recognized feature (such as substance dependence, psychiatric illness, eating disorder).

It is apparent that non-declaration is a common occurrence in some jurisdictions. Canfield et al (2006) compared medications found post-mortem in pilots involved in fatal crashes with the medical conditions and medications which they had declared to the U.S. Federal Aviation Administration, and found evidence of under-reporting by pilots in that jurisdiction: of 387 pilots found to be taking medications, only 26 per cent had reported taking any medication, and only 8 per cent had reported correctly. Other studies have described similar evidence of under- reporting (Hudson, 2002; Sen, 2007).

It is believed by ICAO that medical conditions are more likely to be communicated when an environment of trust is achieved between the examiner and applicant. This is most easily achieved

when a relationship is established over time. While some commentators have pointed to the risks of collusion between examiner and applicant (a factor addressed in 1.1.4.1 above), there is potentially a greater risk in the examiner not being provided with important safety-related information. Therefore, through the creation of an environment where open disclosure is encouraged, the medical examiner may potentially have a great impact on flight safety. Contact between examiner and applicant is typically infrequent and brief; it is therefore suggested that medical examiners should be encouraged to put effort into building rapport with the applicant as far as is possible within these constraints. Many factors in the environment and the interaction of the medical examination can contribute to such rapport.

1.2.1 Initiate interaction and discussion about general issues in such a way as to promote a non- threatening environment:

a) explain the importance of the initial moments of interaction;

b) list aspects of design/setup of the office or consulting room likely to help put applicants at ease;

c) list factors in the aviation medical process that may create a threatening environment;

d) list opening questions and comments appropriate for an aviation medical examination; and

e) list aspects of body language that facilitate rapport.

1.2.2 Enquire about work and home situations and challenges:

a) explain the importance of domestic and professional stressors on aviation performance and safety;

b) list areas of home and work life which may be appropriate to discuss;

c) identify suitable times in the encounter to enquire about work and home situations;

d) describe an open-ended question and explain the value of such questions and follow-up questions; and

e) list typical work and home challenges faced by aviation professionals.

If appropriately timed and executed, this discussion of work and home life has the dual benefit of promoting rapport and providing insight into the current circumstances of the applicant (item 2.2.7 below refers).

1.2.3 Demonstrate familiarity with typical aviation workplaces:

a) demonstrate familiarity with the workplaces of professional pilots and air traffic controllers; and

b) provide evidence of having visited a range of such workplaces (such as airliner flight decks, aircraft/ air traffic control simulators, flying schools, control towers, radar centres).

An examiner who has a familiarity with the work and workplace of an applicant is more likely to be trusted to understand the information provided by the applicant. An effective medical examiner will understand the flight environment, the stressors of flight and the roles of pilots and air traffic controllers, and will have gained familiarity with their workplaces; knowledge and experience of those

workplaces is a requirement of medical examiners under ICAO Annex 1 which states:
Medical examiners shall have practical knowledge and experience of the conditions in which the holders of licences and ratings carry out their duties.

When unfamiliar with the applicant's particular workplace, the examiner should at least display an interest in learning more.

1.2.4 Show interest in the applicant's general health and well-being:

a) explain the importance and relevance of discussing lifestyle/wellness characteristics and behaviours such as exercise, diet, alcohol and drug use, smoking and sleep;

b) describe typical health queries that may arise in discussion;

c) explain the importance of addressing these queries when they arise and providing advice; and

d) explain the process for dealing with health issues beyond the scope of the aviation medical examination.

Usually the medical examiner does not act as treating physician and, traditionally, the formal regulatory approach considers only the fitness for a Medical Assessment which may not appear to require evaluation of lifestyle or provision of preventive advice. However these issues have potential long-term implications for the applicant's health (Feig, 2005; About USPSTF, 2010) and the regulatory examination may provide an opportunity to engage in discussion about important health-related issues, as well as building trust. For some conditions, it may well be that efforts to encourage interventions which prevent future illness are of greater long-term safety benefit than efforts to detect such illness once they have developed. For example, the US preventive services task force found better evidence for benefit to health from advice on stopping smoking than from routine screening for coronary heart disease.

2. GATHER AND PROCESS RELEVANT INFORMATION ON THE APPLICANT'S HEALTH STATUS

2.1 Elicit and evaluate medical history

As outlined above, a large number of the medical conditions relevant to safety will be identified only when declared by the applicant. An essential part of the aviation medical examination is thus a comprehensive medical history. This is usually facilitated by written questionnaire. The answers provided by the applicant may lead to further questioning by the examiner. It is easily argued that this medical history is a more critical component than the physical examination, and the examiner needs to be skilled at evaluating the information which has, or has not, been provided. Evaluating medical history is a core clinical skill of any medical practitioner, but in the aviation setting it is conducted and applied somewhat differently.

2.1.1 Question the applicant on the written history to elicit further detail on positive or omitted responses:

a) explain limitations of a written history questionnaire;

b) describe process used to check for omissions;

c) describe process for identifying key positive responses;

d) describe process for enquiring further into key positive responses;

e) list examples of key omitted responses; and

f) list examples of key positive responses.

2.1.2 Question applicant on negative responses in written history which may be relevant (as indicated by other responses):

a) describe process for identifying key negative responses;

b) describe process for enquiring further into key negative responses; and

c) list examples of key negative responses.

2.1.3 Question further in accordance with the risk profile of the applicant:

a) identify typical demographic and other factors which lead to risk of underlying conditions; and

b) list examples of specific questions that would be appropriate for specific risk profiles.

2.1.4 Continually update mental picture of potentially important issues:

a) list examples of areas from history that may require particular attention during subsequent examination;

b) describe how to identify and prioritize these issues for subsequent examination;

c) identify from a given medical history, the potentially important issues; and

d) demonstrate how to prioritize these issues with respect to flight safety risk.

2.2 Perform examination

The systematic physical examination is, on its own, not highly effective as a means of detecting important medical illness. However, as mentioned earlier, it may be the part of the medical assessment which is accorded the greatest weight by applicants. This is useful as it is important as a means of verifying matters raised in the history, and of conveying professionalism and trustworthiness.

2.2.1 Perform a systematic examination according to the requirements of the CAAN:

a) demonstrate how to find the CAAN's requirements for examination;

b) explain the objectives, purpose and limitations of physical examination;

c) describe a logical sequence of a full physical examination;

d) list processes used to avoid omissions; and

e) describe how the examination may be targeted to focus on specific systems or areas.

Much of the physical examination is routine and is part of the daily practice of all doctors. The examiner should be able to perform it in a systematic and comprehensive manner, but with extra

attention to target areas which may have been highlighted in the foregoing medical history. Additionally, certain components stand out in terms of relevance to aviation safety and the frequency of problems, and therefore merit particular focus during the examination, and these are outlined below.

2.2.2 Perform targeted examination as indicated:

a) describe how the examination may be targeted based on the history findings; and

b) describe how the examination may be targeted based on general examination findings or observation of the applicant.

The age and other demographic characteristics of the applicant should be considered; the more likely issues for the current age group or profile should be given particular attention. ICAO has recommended (2009) that States allow medical examiners to omit certain elements of the routine physical examination of applicants aged under 40, in favour of concentrating on those items considered most relevant to the risk profile of the applicant (Annex 1, 6.3.1.2.1).

2.2.3 Focus examination on higher risk areas pertaining to incapacitation:

a) identify aspects of the physical examination which may require particular attention with regard to incapacitation risk; and

b) describe the process for carrying out these aspects of the examination.

As discussed earlier, most causes of an incapacitation that is potentially possible to identify during a periodic medical examination are more likely to be identified from medical history than from medical examination; however, the examination of the cardiovascular system in particular may provide valuable information, especially in the older applicant.

2.2.4 Focus examination on high risk areas pertaining to functional capacity, specifically visual acuity:

a) *list the CAAN's requirements for testing distance and near vision*;

b) demonstrate or describe the process for testing and recording distance and near visual acuity, corrected and uncorrected;

c) identify potential errors in the process and how to avoid them; and

d) *describe the actions to be taken following an abnormal result*.

Of the special senses, vision (including colour vision) and hearing should be highlighted, both as part of the examination and in the training of examiners.

2.2.5 Focus examination on high risk areas pertaining to functional capacity, specifically colour vision:

a) list the CAAN's requirements for testing color vision;

b) demonstrate or describe the process for color vision screening using pseudoisochromatic plates;

c) identify potential errors in the process and how to avoid them; and

d) describe the actions to be taken following an abnormal result.

Pseudoisochromatic plates are mentioned specifically because of their prominence in colour vision assessment and because they are mentioned in Annex 1, Standard 6.2.4.3: The applicant shall be tested for the ability to correctly identify a series of pseudoisochromatic plates in day-light or in artificial light of the same colour temperature such as that provided by CIE standard illuminants C or D65 as specified by the International Commission on Illumination (CIE).

However if new technologies are developed and introduced, medical examiners will need to be competent with their use.

2.2.6 Focus examination on high risk areas pertaining to functional capacity, specifically hearing:

a) demonstrate the whispered voice test; and

b) describe techniques using a tuning fork or other suitable methods to distinguish conductive from sensorineural hearing loss.

While many States use audiometry routinely it is not required at every examination and there is still a need to employ clinical techniques in the assessment of hearing.

2.2.7 Focus examination on high risk areas relating to behaviour, specifically evaluating psychiatric and psychosocial factors:

a) describe methods for assessing psychiatric function in an aviation medical setting;

b) identify important indicators as to abnormal psychiatric function;

c) describe methods for further evaluating these indicators;

d) explain the importance of current psychosocial factors;

e) describe methods for gaining insight into psychosocial factors; and

f) describe methods for further evaluating the severity and impact of these factors.

Perhaps the most important areas of the examination relate to behaviour. An important competency in this regard is the evaluation of psychiatric and psychosocial factors. This phrase may appear to confuse different elements, but is chosen deliberately. A full psychiatric examination would not normally be conducted by an aviation medical examiner: it should, however, be normal in the course of an assessment to undertake some empirical evaluation of the features of psychiatric illness including behaviour, appearance, orientation, memory, form and content of thought, mood and affect/emotion.

Similarly, although time precludes a full psychological evaluation, it would be valuable for medical examiners to gain some degree of insight into the psychological milieu and social circumstances of the applicant, in a discussion of such areas as domestic/family situation and work stresses, which is referred to in 1.2.2 above. It could be argued that this is at least as important as many other parts of the traditional physical examination. Many of the conditions which could be contributory to an accident are not major medical problems but situational i.e. dependent on the current circumstances

in which an individual finds himself. Current life events or concerns such as relationship worries, domestic strife, family stress, financial difficulty, work challenges (including fatigue), or workplace conflict (or even positive events such as marriage, new baby or promotion) have potential to cause preoccupation and distraction in pilots or air traffic controllers and may thus have a significant impact on flight safety, even if they do not constitute a medical condition or diagnosis.

The DME is well placed to identify such situations and discuss them with the applicant to ensure that adequate professional support is provided, whether non-medical or medical, and also that good judgement is exercised by the applicant as to temporarily avoiding flying where appropriate. Further guidance concerning mental health and behavioural issues can be found in Part I, Chapter 2 and Part III, Chapter 9.

2.2.8 Focus examination on high-risk areas relating to behaviour, specifically identifying abnormal cognitive functions:

a) list typical important causes of abnormal cognition in aviation applicants;

b) list indicators of abnormal cognitive function; and

c) identify available tools for further evaluating cognitive function.

A distinction is drawn between psychiatric and psychosocial factors, and cognitive function. While decline in cognitive function is often discussed in connection with the ageing pilot, it is relevant to many other situations such as head injury, depression, cerebrovascular disease, and problematic use of substances. Cognitive decline occurs normally with age, but the rate and onset are not predictable, and it may present in aviation professionals well before their typical retirement age. Whilst such decline might be better detected in an operational environment (such as by simulator assessments or in-flight performance checks ('line checks')) it may also be the medical examiner who is first able to detect such changes. Competency in evaluating cognitive function would in such cases support the required evaluation of psychiatric/ psychological factors. The use of short-term memory tests, mini-mental status questionnaires, and other simple office-based assessments can form an initial evaluation of cognitive function when a suspicion of deterioration exists.

2.2.9 Focus examination on risk areas relating to behaviour, specifically assessing for potential problematic use of substances (such as alcohol, prescription and non-prescription medications, and non-prescription drugs used for recreational purposes):

a) explain the importance of problematic use of substances in the aviation workplace;

b) list features of problematic use of substances including the differences between abuse and dependence;

c) describe how prescription medication may result in problematic use;

d) describe how non-prescription (over the counter) medication may result in problematic use;

e) list indicators of problematic use of substances;

f) identify available tools for further evaluating problematic use of substances;

g) outline processes for determining the likelihood of substance dependence; and

h) identify available management options for applicants with problematic use of substances. Detection of problematic use of substances, including potential substance use disorders and particularly substance dependence and substance abuse, is emphasized here. Substance dependence is accepted as a medical condition under both the American Psychiatric Association's DSM-IV and the World Health Organization's ICD-10 ("dependence syndrome") and its detection is made difficult by the characteristic feature of denial. It is therefore suggested that medical examiners should be required to have a level of competency in the detection and evaluation of substance use disorders. This should include familiarity with the ICAO *Manual on Prevention of Problematic Use of Substances in the Aviation Workplace* (Doc 9654).

The management of substance dependence in aviation is one demonstration of the value of open reporting systems, in the form of programmes such as that known in the United States as the Human Intervention Motivation Study (HIMS).

Prior to the 1970s a diagnosis of substance dependence, including dependence on alcohol, led to permanent disqualification, with the consequence that detection rates were very low (as most pilots were unwilling to admit to their problem). The HIMS programme introduced a pathway by which substance-dependent pilots could, with successful treatment and follow-up measures in place, be allowed to return to flying in a supervised ongoing recovery programme.

Well over 4 000 pilots have been returned to flying through HIMS in the past few decades (Hudson, 2009). Many other States have analogous programmes in place. Medical examiners should have a sound understanding of such programmes and their place in the management of substance use disorders in aviation.

Whilst it might be argued that problematic use of substances is merely a component of psychiatric and psychological evaluation, it is emphasized separately here because of the disproportionate contribution of alcohol and other drug-related issues in medical cause accidents (see also Part III, Chapter 9, *Mental Health*). It is suggested that these or similar tools should be incorporated into the training and competencies of examiners.

2.2.10 Focus examination on high risk areas pertaining to functional capacity, specifically sleep disorders and fatigue:

a) explain the importance of sleep disorders in commercial aviation;

b) list features of circadian rhythms, normal sleep patterns, and common sleep disorders;

c) list appropriate questions to ask about sleep and fatigue;

d) list physical signs associated with sleep disorders;

e) describe processes for further evaluating and treating a possible sleep disorder;

f) describe how risk of fatigue can be minimized by sleep hygiene measures; and

g) describe how medication may be used to minimize fatigue risk, and list precautions to be taken.

The final area which deserves highlighting is that of common sleep disorders, principally obstructive sleep apnoea. The potential flight safety consequences of somnolence are evidenced by a 2009 case of two pilots overflying their destination while asleep (National Transportation Safety Board, 2008), which has been linked in part to a diagnosis of sleep apnoea in one of the pilots. Sleep apnoea is probably significantly under-diagnosed in commercial aviation as it is in drivers (Krieger, 2007) and is likely to be missed unless specific questioning is undertaken on symptoms such as snoring, observations on breathing by the bed partner, daytime sleepiness and nocturnal sweating, and the examiner should be extra vigilant in applicants with Type 2 diabetes mellitus or a large neck circumference. This latter measurement is therefore one area which should be noted on physical examination.

The use of hypnotics by applicants is also an issue that needs to be addressed during training. Many Licensing Authorities accept that such medication has a place in regulatory aviation medicine, but clearly some hypnotics are unsuitable. Topics that should be addressed are:

- Acceptable medications
- Relevant pharmacology, e.g., duration of effect
- Minimum time required between ingestion and reporting for duty
- Need for licence holders to avoid "over the counter" medication or unsupervised treatment
- Requirement for those providing advice to licence holders to fully understand the operational context of licence holders.

2.3 Conduct and interpret results of routine investigations required by the CAAN

Additional reports are received in association with the medical examination and need to be interpreted by the examiner.

In some States these may be numerous, but as a minimum, examiners will be receiving electrocardiograms, audiometry (in most States) and in some cases, vision reports. These relate to key organ systems and a degree of expertise in their interpretation should be expected of medical examiners.

2.3.1 Conduct and interpret electrocardiograms:

a) *identify the CAAN's requirements for conducting electrocardiograms*;

b) describe how to prepare applicant and set up equipment;

c) describe how to optimize electrode contact and avoid interference;

d) demonstrate the correct positioning of leads and how to identify lead reversal;

e) identify common normal electrocardiographic variants;

f) identify important disturbances of rate, rhythm and axis such as heart blocks, atrial fibrillation,

supraventricular tachycardia, and bundle branch blocks;

g) identify left ventricular hypertrophy; and

h) identify old or recent myocardial infarction, and current ischaemia.

2.3.2 Interpret pure-tone audiometry (or alternative methods of assessing hearing):

a) *identify the CAAN's requirements for conduct of audiometry*;

b) describe how pure-tone audiometry is undertaken;

c) explain temporary threshold shift and its importance;

d) identify significant hearing loss;

e) identify asymmetric hearing loss and describe its importance;

f) describe how to distinguish conductive from sensorineural hearing loss;

g) list potential causes of conductive hearing loss;

h) list potential causes of sensorineural hearing loss;

i) identify follow-up actions for various causes of hearing loss; and

j) describe alternative methods of assessing hearing and their merits.

2.3.3 Interpret vision testing:

a) *identify the CAAN's requirements for vision testing*;

b) identify the applicable standards for distance and near vision;

c) explain myopia, hyperopia (hypermetropia), presbyopia and astigmatism;

d) correctly interpret refractive errors from ophthalmology or optometry reports;

e) explain the importance of phorias to flight safety;

f) describe the features of spectacles and contact lenses;

g) list flight safety concerns with common spectacle and contact lens types; and

h) list flight safety concerns with common types of refractive surgery.

2.4 Request and interpret additional investigations and reports, as indicated

On the basis of findings from history, examination and any required routine investigations, the

medical examiner may request and organize further investigations. This process requires the application of skills which are fundamental to medical practice, using an understanding of the patterns of findings from history, examination, and routine investigations, and formulating new questions to be answered by further investigation.

2.4.1 Recognize common patterns from clinical findings which suggest the need for further examination:

a) identify examples of common symptom patterns from history which suggest the need for investigation;

b) identify examples of common patterns of examination signs which suggest the need for investigation; and

c) identify examples of common abnormalities of routine investigations which suggest the need for further investigation.

2.4.2 Arrange appropriate investigations:

a) from common examples of medical conditions, describe the approach to selecting investigations;

b) describe how to arrange the appropriate investigations; and

c) review the investigation findings and report findings.

3. USE THE AVAILABLE MEDICAL INFORMATION TO FACILITATE A COMPLETE MEDICAL ASSESSMENT

3.1 If required by the CAAN, provide a risk-based aeromedical opinion In assessing an applicant who does not fully meet the relevant medical Standards, often a degree of judgement is involved and this is recognized by ICAO in the concept of "flexibility" wherein, even though there is a medical Standard, and the applicant does not meet that Standard, "accredited medical conclusion indicates that ….exercise of the privileges of the licence applied for is not likely to jeopardize flight safety" and this conclusion takes into consideration the relevant ability, skill, and experience of the applicant as well as any limitations placed on the licence holder.

In many States medical examiners not only conduct examinations, they also have the authority to issue or decline a Medical Assessment. In some States this is a temporary decision pending confirmation by the CAAN; in others it is the substantive decision. In some States, the medical examiner may even have the authority to form an accredited medical conclusion. Even in States where the regulatory authority makes the "issue/decline" decision centrally, the medical examiners may be asked to advise pilots or controllers on temporary unfitness. Almost inevitably, examiners will be making aeromedical dispositions, which is the core function of civil aviation medicine practitioners.

3.1.1 Compile and review findings

a) describe process for reviewing the findings from history, examination and investigations, and compiling a list of relevant medical conditions and considerations; and

b) describe process for checking completeness of the compiled information and preparing for communication to relevant parties.

3.1.2 Consider work context and assess risk:

a) identify aspects of the applicant's work and work environment which affect the level of flight safety risk associated with the medical condition;

b) identify possible restrictions or other risk mitigating factors which could be applied; and

c) taking those factors into account, describe the process for assessing the flight safety risk imposed by the applicant's medical conditions, to estimate the severity and likelihood of aeromedical consequences from those conditions.

3.1.3 Formulate recommendation:

a) list the steps for preparing a recommendation or opinion to the CAAN; and

b) demonstrate how to make a recommendation from an example of clinical material.

3.1.4 Communicate opinion to applicant and authority as required:

a) state the CAAN's requirements for provision of recommendations and opinions;

b) describe the required process for communicating the recommendation/opinion;

c) list any potential legal considerations associated with communicating this information.

The procedures for communication will be context-specific, and each State will need to ensure that its examiners are familiar with the relevant procedures.

3.2 Conduct administrative processes

Although the processes and detail may vary greatly amongst States, it is inevitable that one of the key areas of competency for examiners will be the administrative process associated with medical examinations. These will include elements such as record keeping, reporting and communicating with the CAAN, and maintaining medical confidentiality. It will also encompass participating in and supporting whatever review or audit process is undertaken by the CAAN. There may be elements of follow-up required of the applicant such as periodic review during the period of validity of the Medical Assessment. Good medical practice requires that one examiner alone is not responsible for assessing fitness without some form of routine audit by another appropriately trained individual. All of the administrative processes will be context-specific so that each State will need to ensure the competency of its examiners in this area.

3.2.1 Collate documents and correspond with the CAAN:

a) describe the process for collating the documents and assembling those required to be sent to the CAAN;

b) State requirements for communication with the CAAN;

c) State requirements imposed by the CAAN for review or audit of medical examinations; and

d) describe the process for participating in review or audit.

3.2.2 Communicate and store information as required:

a) describe the requirements for communicating with the CAAN, the applicant, and any other applicable party;

b) describe how to reference the data protection/privacy requirements which apply to medical examination records;

c) describe the processes for protecting and securing records; and

d) describe to whom records may be released, and under what circumstances.

Appendix 7/A

SUGGESTED MINIMUM FOUNDATION KNOWLEDGE REQUIRED FOR A MEDICAL EXAMINER

As explained earlier, all examiners will be involved to some extent in making fitness decisions concerning medical conditions. To do this the medical examiner must build on a sound understanding of the regulatory framework, responsibilities and accountabilities, including the process of flexibility as per PELR provisions. This will be achieved by employing knowledge of clinical aviation medicine, taking into account aspects of risk management.

As background for evaluating aeromedical issues, examiners need to learn about the psychological and physiological challenges of flight. The following summary is suggested as a reasonable basis of knowledge to support the specific competencies within the framework given above. These subjects could be taught in a knowledge-based manner or as part of a competency- based programme.

Aviation physiology

a) Cognition and aviation

b) Decision making and communication in aviation

c) Sleep and fatigue as related to commercial aviation

d) Physics of the atmosphere; effects of altitude on trapped gas

e) Effects of hypoxia

f) Functional aspects of vision relevant to aviation

g) Spatial disorientation

h) Effects of acceleration

Clinical aviation medicine

a. Aspects of incapacitation in flight

b. Effects of ageing as related to flight safety

c. Cardiological conditions relevant to flight

d. Neurological conditions relevant to flight

e. Ophthalmological conditions relevant to flight

f. Ear/nose/throat conditions relevant to flight

g. Respiratory conditions relevant to flight
h. Psychiatric conditions relevant to flight

i. Metabolic/endocrine conditions relevant to flight

j. Other conditions relevant to flight (especially gastro-enterological, haematological, urological, renal, gynaecological/obstetric, orthopaedic and oncological disease)

k. Medication relevant to flight

Public Health

a. Introduction to the World Health Organization International Health Regulations (2005)

b. Knowledge of SARPs related to public health Annex 6 — *Operation of Aircraft*: On board medical supplies

Annex 9 — *Facilitation:* Public Health Emergency preparedness planning, Aircraft General Declaration Annex 11 — *Air Traffic Services*: Aspects relevant to public health emergencies in contingency planning

Annex 14 — *Aerodromes*: Aspects relevant to public health emergencies in aerodrome emergency planning *Procedures for Air Navigation Services — Air Traffic Management*: See Part III, Chapter 18,

Annex 18 — *The Safe Transport of Dangerous Goods by Air:* Carriage of medical items by air e.g. radioactive materials and biological specimens *Regulatory medicine*

a. Convention on International Civil Aviation and its Annexes

b. ICAO Standards and Recommended Practices, with focus on medically related SARPs

c. Licence types and differences in medical requirements between them

d. ICAO Annex 1: difference between "Licence" and "Medical Assessment".
Validity periods of Medical Assessments

e. Application of "Flexibility Standard" 1.2.4.9 in Annex 1 and accredited medical conclusion

f. Evaluation of evidence — critical appraisal of specialist reports and data

g. Decrease in medical fitness — administrative process for an "unfit" decision

h. Other medical regulations in the ICAO Annexes (psychoactive substances, fatigue, oxygen)

i. Principles of risk management

j. Principles of safety management, as applied to aviation medicine

Appendix 7/B

COMPETENCY FRAMEWORK

The competency framework has four tier levels:

0. Competency unit ("The main processes are…")

0.0 Competency element ("The steps within those processes that a competent designated medical examiner is expected to take are…..")

0.0.0 Performance criteria ("The DME will normally be expected to perform ……")

0.0.0.0 Evidence and assessment guide ("At the completion of training, the examiner will be able to demonstrate that he can…..")

1. FACILITATE COMMUNICATION

1.1 Initiate the interaction and agree the terms

This unit is largely procedural but is an important competency for the examiner to demonstrate. As each State will have its own procedures, these elements are context-specific.

1.1.1 Identify the applicant

1.1.1.1 Explain the importance of positive identification

1.1.1.2 List the CAAN's requirements for identification of applicants

1.1.1.3 Describe the process by which an applicant is identified

1.1.2 Have appropriate forms completed (including any declarations and consents)

1.1.2.1 Describe how to access the current versions of all available forms

1.1.2.2 Explain how to select the appropriate forms for the given applicant

1.1.2.3 List any aspects of the forms requiring particular explanation to applicants

1.1.2.4 Describe process for checking the completion of the forms (including declarations and consents)

1.1.2.5 Describe the actions in the event of improperly completed forms (including declarations and consents)

1.1.2.6 Explain the consequences of false declaration

1.1.3 Clarify administrative details

1.1.3.1 Explain the CAAN's requirements for checking background details (e.g. licence, current/previous certificate, existing limitations) and the reasons for checking these

1.1.3.2 Explain the CAAN's other administrative requirements (e.g. collecting a fee)

1.1.4 Verify that the regulatory context of the process has been addressed

1.1.4.1 Explain the medical examiner-applicant relationship

1.1.4.2 Describe any potential/actual conflicts of interest (e.g. personal relationship, airline examiner) and how they would be managed

1.1.5 Provide applicant with information about privacy/confidentiality

1.1.5.1 Explain who owns and who has access to the medical assessment report and associated documentation and information provided by the applicant Part V. Aviation medical training Chapter 1. Aeromedical training for designated medical examiners

1.1.5.2 Outline how this is explained to the applicant

1.2 Establish rapport and encourage an open reporting environment

1.2.1 Initiate interaction and discussion about general issues in such a way as to promote a non- threatening environment:

a) explain the importance of the initial moments of interaction;

b) list aspects of design/setup of the office or consulting room likely to help put applicants at ease;

c) list factors in the aviation medical process that may create a threatening environment;

d) list opening questions and comments appropriate for an aviation medical examination; and

e) list aspects of body language that facilitate rapport.

1.2.2 Enquire about work and home situations and challenges:

a) explain the importance of domestic and professional stressors on aviation performance and safety;

b) list areas of home and work life which may be appropriate to discuss;

c) identify suitable times in the encounter to enquire about work and home situations;

d) describe an open-ended question and explain the value of such questions and follow-up questions; and

e) list typical work and home challenges faced by aviation professionals.

1.2.3 Demonstrate familiarity with typical aviation workplaces:

a) demonstrate familiarity with the workplaces of professional pilots and air traffic controllers; and

b) provide evidence of having visited a range of such workplaces (such as airliner flight decks, aircraft/air traffic control simulators, flying schools, control towers, radar centres).

1.2.4 Show interest in the applicant's general health and well-being:

a) explain the importance and relevance of discussing lifestyle/wellness characteristics and behaviours such as exercise, diet, alcohol and drug use, smoking and sleep;

b) describe typical health queries that may arise in discussion;

c) explain the importance of addressing these queries when they arise and providing advice; and

d) explain the process for dealing with health issues beyond the scope of the aviation medical examination.

2. GATHER AND PROCESS RELEVANT INFORMATION ON THE APPLICANT'S HEALTH STATUS

2.1 Elicit and evaluate medical history

2.1.1 Question the applicant on the written history to elicit further detail on positive or omitted responses:

a) explain limitations of a written history questionnaire;

b) describe process used to check for omissions;

c) describe process for identifying key positive responses;

d) describe process for enquiring further into key positive responses;

e) list examples of key omitted responses; and

f) list examples of key positive responses.

2.1.2 Question applicant on negative responses in written history which may be relevant (as indicated by other responses):

a) describe process for identifying key negative responses;

b) describe process for enquiring further into key negative responses; and

c) list examples of key negative responses.

2.1.3 Question further in accordance with the risk profile of the applicant:

a) identify typical demographic and other factors which lead to risk of underlying conditions; and

b) list examples of specific questions that would be appropriate for specific risk profiles.

2.1.4 Continually update mental picture of potentially important issues:

a) list examples of areas from history that may require particular attention during subsequent examination;

b) describe how to identify and prioritize these issues for subsequent examination;

c) identify from a given medical history, the potentially important issues; and

d) demonstrate how to prioritize these issues with respect to flight safety risk.

2.2 Perform examination

2.2.1 Perform a systematic examination according to the requirements of the CAAN:

a) demonstrate how to find the CAAN's requirements for examination;

b) explain the objectives, purpose and limitations of physical examination;

c) describe a logical sequence of a full physical examination;

d) list processes used to avoid omissions; and

e) describe how the examination may be targeted to focus on specific systems or areas.

2.2.2 Perform targeted examination as indicated:

a) describe how the examination may be targeted based on the history findings; and

b) describe how the examination may be targeted based on general examination findings or observation of the applicant.

2.2.3 Focus examination on higher risk areas pertaining to incapacitation:

a) identify aspects of the physical examination which may require particular attention with regard to incapacitation risk; and

b) describe the process for carrying out these aspects of the examination.

2.2.4 Focus examination on high risk areas pertaining to functional capacity, specifically visual acuity:

a) *list the CAAN's requirements for testing distance and near vision*;

b) demonstrate or describe the process for testing and recording distance and near visual acuity, corrected and uncorrected;

c) identify potential errors in the process and how to avoid them; and

d) *describe the actions to be taken following an abnormal result*.

2.2.5 Focus examination on high risk areas pertaining to functional capacity, specifically colour vision:

a) *list the CAAN's requirements for testing color vision;*

b) demonstrate or describe the process for color vision screening using pseudoisochromatic plates;

c) identify potential errors in the process and how to avoid them; and

d) *describe the actions to be taken following an abnormal result.*

2.2.6 Focus examination on high risk areas pertaining to functional capacity, specifically hearing:

a) demonstrate the whispered voice test; and

b) describe techniques using a tuning fork or other suitable methods to distinguish conductive from sensorineural hearing loss.

2.2.7 Focus examination on high risk areas relating to behaviour, specifically evaluating psychiatric and psychosocial factors:

a) describe methods for assessing psychiatric function in an aviation medical setting;

b) identify important indicators as to abnormal psychiatric function;

c) describe methods for further evaluating these indicators;

d) explain the importance of current psychosocial factors;

e) describe methods for gaining insight into psychosocial factors; and

f) describe methods for further evaluating the severity and impact of these factors.

2.2.8 Focus examination on high risk areas relating to behaviour, specifically identifying abnormal cognitive functions:

a) list typical important causes of abnormal cognition in aviation applicants;

b) list indicators of abnormal cognitive function; and

c) identify available tools for further evaluating cognitive function.

2.2.9 Focus examination on risk areas relating to behaviour, specifically assessing for potential problematic use of substances (such as alcohol, prescription and non-prescription medications, and non-prescription drugs used for recreational purposes):

a) explain the importance of problematic use of substances in the aviation workplace;

b) list features of problematic use of substances including the differences between abuse and dependence;

c) describe how prescription medication may result in problematic use;

d) describe how non-prescription (over the counter) medication may result in problematic use;

e) list indicators of problematic use of substances;

f) identify available tools for further evaluating problematic use of substances;

g) outline processes for determining the likelihood of substance dependence; and

h) identify available management options for applicants with problematic use of substances.

2.2.10 Focus examination on high risk areas pertaining to functional capacity, specifically sleep disorders and fatigue:

a) explain the importance of sleep disorders in commercial aviation;

b) list features of circadian rhythms, normal sleep patterns, and common sleep disorders;

c) list appropriate questions to ask about sleep and fatigue;

d) list physical signs associated with sleep disorders;

e) describe processes for further evaluating and treating a possible sleep disorder;

f) describe how risk of fatigue can be minimized by sleep hygiene measures; and

g) describe how medication may be used to minimize fatigue risk, and list precautions to be taken.

2.3 Conduct and interpret results of routine investigations required by the CAAN

2.3.1 Conduct and interpret electrocardiograms:

a) *identify the CAAN's requirements for conducting electrocardiograms*;

b) describe how to prepare applicant and set up equipment;

c) describe how to optimize electrode contact and avoid interference;

d) demonstrate the correct positioning of leads and how to identify lead reversal;

e) identify common normal electrocardiographic variants;

f) identify important disturbances of rate, rhythm and axis such as heart blocks, atrial fibrillation, supraventricular tachycardia, and bundle branch blocks;

g) identify left ventricular hypertrophy; and

h) identify old or recent myocardial infarction, and current ischaemia.

2.3.2 Interpret pure-tone audiometry (or alternative methods of assessing hearing):

a) *identify the CAAN's requirements for conduct of audiometry*;

b) describe how pure-tone audiometry is undertaken;

c) explain temporary threshold shift and its importance;

d) identify significant hearing loss;

e) identify asymmetric hearing loss and describe its importance;

f) describe how to distinguish conductive from sensorineural hearing loss;

g) list potential causes of conductive hearing loss;

h) list potential causes of sensorineural hearing loss;

i) identify follow-up actions for various causes of hearing loss; and

j) describe alternative methods of assessing hearing and their merits.

2.3.3 Interpret vision testing:

a) *identify the CAAN's requirements for vision testing*;

b) identify the applicable standards for distance and near vision;

c) explain myopia, hyperopia (hypermetropia), presbyopia and astigmatism;

d) correctly interpret refractive errors from ophthalmology or optometry reports;

e) explain the importance of phorias to flight safety;

f) describe the features of spectacles and contact lenses;

g) list flight safety concerns with common spectacle and contact lens types; and

h) list flight safety concerns with common types of refractive surgery.

2.4 Request and interpret additional investigations and reports, as indicated

2.4.1 Recognize common patterns from clinical findings which suggest the need for further examination:

a) identify examples of common symptom patterns from history which suggest the need for investigation;

b) identify examples of common patterns of examination signs which suggest the need for investigation; and

c) identify examples of common abnormalities of routine investigations which suggest the need for further investigation.

2.4.2 Arrange appropriate investigations:

a) from common examples of medical conditions, describe the approach to selecting investigations;

b) describe how to arrange the appropriate investigations; and

c) review the investigation findings and report findings.

3. USE THE AVAILABLE MEDICAL INFORMATION TO FACILITATE A COMPLETE MEDICAL ASSESSMENT

3.1 If required by the CAAN, provide a risk-based aeromedical opinion.

3.1.1 Compile and review findings:

a) describe process for reviewing the findings from history, examination and investigations, and compiling a list of relevant medical conditions and considerations;

b) describe process for checking completeness of the compiled information and preparing for communication to relevant parties.

3.1.2 Consider work context and assess risk:

a) identify aspects of the applicant's work and work environment which affect the level of flight safety risk associated with the medical condition;

b) identify possible restrictions or other risk mitigating factors which could be applied; and

c) taking those factors into account, describe the process for assessing the flight safety risk imposed by the applicant's medical conditions, to estimate the severity and likelihood of aeromedical consequences from those conditions.

3.1.3 Formulate recommendation:

a) list the steps for preparing a recommendation or opinion to the CAAN;

b) demonstrate how to make a recommendation from an example of clinical material.

3.1.4 Communicate opinion to applicant and authority as required:

a) state the CAAN's requirements for provision of recommendations and opinions;

b) describe the required process for communicating the recommendation/opinion; and

c) list any potential legal considerations associated with communicating this information.

The processes for communication will be context-specific, and each State will need to ensure that its examiners are familiar with the relevant procedures.

3.2 Conduct administrative processes

3.2.1 Collate documents and correspond with the CAAN:

a) described the process for collating the documents and assembling those required to be sent to the CAAN;

b) State requirements for communication with the CAAN;

c) State requirements imposed by the CAAN for review or audit of medical examinations; and

d) describe the process for participating in review or audit.

3.2.2 Communicate and store information as required:

a) describe the requirements for communicating with the CAAN, the applicant, and any other applicable party;

b) describe how to reference the data protection/privacy requirements which apply to medical examination records;

c) describe the processes for protecting and securing records; and

d) describe to whom records may be released, and under what circumstances.

CHAPTER 8. MEDICAL FACTORS FOR PILOTS

8.1 GENERAL

8.1.1 The designated medical examiner is frequently called upon to provide advice and briefings to aviation personnel on medical aspects of aviation. To facilitate this task, a sample of such a briefing to pilots is attached to this chapter. It briefly covers the main topics, but additional information is likely to be required for completeness, depending on the audience and the circumstances. It may be adapted for other aviation personnel.

8.1.2 The chapter was written before the requirement for pilots to be trained in human performance was introduced, which has largely superseded it. In addition, pilots and other licence holders now have better access to relevant information than was the case previously. However, the chapter is retained in this handbook as it may provide useful information to some, especially inexperienced or trainee pilots.

Attachment-8/A

SAMPLE BRIEFING GIVEN TO PILOTS INTRODUCTION

1. Just as an aircraft is required to undergo regular checks and maintenance, pilots are also required to undergo regular medical examinations to ensure fitness to fly. One does not have to be a perfect specimen to fly. Many deficiencies can be compensated: short sight, for example, by wearing spectacles or contact lenses. In some cases, you may be required to demonstrate by a medical flight test that you can compensate for a certain defect of potential significance to flight safety.

2. It should be recalled that humans are essentially earth-bound creatures. However, if one is aware of certain aeromedical factors and pays attention to these, we can leave the earth's surface and fly safely. What follows concerns the more important factors with which you should be familiar prior to flying.

3. Modern industry's record in providing reliable equipment is very good. When the pilot enters the aircraft, he becomes an integral part of the man-machine system. He is just as essential to a successful flight as the control surfaces.

   To ignore the pilot in preflight planning would be as senseless as failing to inspect the integrity of the control surfaces or any other vital part of the machine. The pilot himself has responsibility for determining his fitness prior to entering the cockpit for flight.

GENERAL HEALTH

4. While piloting an aircraft, an individual should be free of conditions which are harmful to alertness, ability to make correct decisions, or affect reaction times. Persons with conditions that are apt to produce sudden incapacitation, such as seizures, serious heart trouble, uncontrolled diabetes or diabetes requiring insulin, and certain other conditions hazardous to flight, are medically unfit. Conditions such as acute infections, anaemias and peptic ulcers are disqualifying while they last. Consult your designated medical examiner when in doubt about any aspect of your health status, just as you would consult a licensed aviation mechanic when in doubt about the engine status.

SPECIFIC AEROMEDICAL FACTORS

Fatigue

5. Fatigue generally slows reaction times and causes errors due to inattention. In addition to the most common cause of fatigue, insufficient rest and loss of sleep, the pressures of business, financial worries and family problems can be important contributing factors. If your fatigue is marked prior to a given flight, don't fly. Ensure you obtain a good night's sleep before you fly and if scheduling prevents this, discuss your situation with an aviation medicine specialist.

Hypoxia

6. Hypoxia, in simple terms, is a lack of sufficient oxygen to keep the brain and other body tissues functioning properly. Wide individual variation occurs with respect to susceptibility to hypoxia. In addition to a progressive lack of oxygen at higher altitudes, anything interfering with the blood's ability to carry oxygen can contribute to hypoxia (e.g. anaemias, carbon monoxide, certain drugs).

7. Your brain has no built-in alarm system to let you know when you are not getting enough oxygen. A major early symptom of hypoxia is an increased sense of well-being (referred to as "euphoria"). This progresses to slowed reaction, impaired thinking ability, unusual fatigue and a dull headache.

8. The symptoms are slow but progressive, insidious in onset, and become marked at altitudes above 10

000 ft (3 300 m). Night vision, however, can be impaired at altitudes even lower than that.

9. If you observe the general rule of not flying above 10 000 ft without supplemental oxygen, you are unlikely to get into trouble.

Alcohol

10. Do not fly while under the influence of alcohol — in Nepal this is a legal requirement. Typical regulations demand a minimum of 8 to 24 hours of abstinence from alcohol before reporting for duty. Remember that if a significant amount of alcohol has been consumed, performance can be affected up to 48 or even 72 hours after the last drink, because of a hangover effect. Even small amounts of alcohol in the system can adversely affect judgement and decision-making abilities.

11. Your body metabolizes alcohol at a fixed rate, and coffee or medication does not affect this.

12. Do not fly with a hangover or a "masked hangover" (symptoms suppressed by aspirin or other medication).

Medication

13. Self-medication when you are flying can be hazardous. Simple "over-the-counter" (obtained without prescription) remedies such as aspirin, antihistamines, cold tablets, cough mixtures, laxatives, tranquillizers and appetite suppressors may have unwanted effects. Herbal remedies can also have significant adverse effects. The safest rule is to take no medicine while flying, except on the advice of your aeromedical advisor. The condition for which the medicine is required may of itself be hazardous to flying, even when the symptoms are suppressed by the medication.

14. Certain specific medicines which have been found in post mortem samples after fatal aircraft accidents are: antihistamines (widely prescribed for hay fever and other allergies); tranquillizers (prescribed for nervous conditions, hypertension, sleep disorders and other conditions); weight-reducing drugs (amphetamines and other appetite suppressing drugs can produce sensations of well-being which have an adverse effect on judgement); barbiturates or nerve "tonics" (barbiturates produce a marked suppression of mental alertness).

15. Following general anaesthesia, a period of at least 48 hours should be spent on the ground. Twelve hours is reasonable for a local anaesthetic. If in any doubt concerning the right time to resume flying, then seek appropriate medical advice.

Spatial disorientation

16. On the ground we know which way is "up" by the combined use of three senses:
    a) Vision — we can see where we are in relation to fixed objects;
    b) Pressure — gravitational pull on muscles and joints tells us which way is down;
    c) Special parts in our inner ear — the otoliths — tell us which way is down by gravitational pull.

17. It should be noted that rotation of the head is detected by the fluid in the semi-circular canals of the inner ear, and this tells us when we change angular position. However, in the absence of a visual reference, such as flying into a cloud, the rotatory accelerations can be confusing, especially since their forces can be misinterpreted as gravitational pulls on the muscles and otoliths. The result is often disorientation.

18. Pilots should have an instructor demonstrate manoeuvres which will produce disorientation. Once experienced, later unanticipated incidents of disorientation can be overcome as long as instruments (for pilots trained to use them) or reliable ground references are available. Such a demonstration will show you how confusing the false inputs from the inner ear can be. Many accidents have occurred when pilots without adequate instrumentation in the cockpit or without proper training in instrument flying have flown into instrument meteorological conditions, and have become disorientated.

19. Pilots are susceptible to experiencing disorientation at night, and in any flight condition when outside visibility is reduced to the point that the horizon is obscured. An additional type of vertigo is known as flicker vertigo. Light, flickering at certain frequencies, from four to twenty times per second, can produce unpleasant reactions in some persons. These reactions may include nausea, dizziness, unconsciousness, or even reactions similar to an epileptic fit. In a single engine propeller aeroplane heading into the sun, the propeller may cut across the sun to give this flashing effect, particularly during landings when the engine is throttled back and propeller rotation is relatively slow. These undesirable effects may be avoided by not staring directly through the propeller for more than a moment, and by making frequent but small changes in RPM. The flickering light traversing helicopter blades has also been known to cause this effect, as has the reflection from rotating beacons on aircraft while flying in clouds. If the beacon is bothersome, shut it off during these periods, advise air traffic control and remember to turn it back on when clear of clouds.

Carbon monoxide

20. Carbon monoxide (CO) is a colourless, odourless, tasteless product of an internal combustion engine and is always present in exhaust fumes. The concentration in exhaust fumes from piston engines is much greater than from turbine engines — carbon monoxide poisoning from turbine engine exhausts is rare.

21. For biochemical reasons, carbon monoxide has a greater ability than oxygen to combine with the haemoglobin of the blood. Furthermore, once carbon monoxide is absorbed in the blood, it sticks “like glue” to the haemoglobin and actually prevents oxygen from attaching to the haemoglobin.

22. Most cockpit heaters in light aircraft work by air flowing over the exhaust manifold, being heated and then delivered to the cockpit. So if you have to use the heater, be very wary if you smell exhaust fumes — there may be a leak from the engine exhaust pipe into the air used for cockpit warming. The onset of symptoms is insidious, with “blurred thinking”, a possible feeling of uneasiness, and subsequent dizziness. Later headache occurs. Immediately shut off the heater, open the air ventilators, descend to lower altitudes, and land at the nearest airfield. Consult a designated medical examiner for advice. It may take several days to fully recover and clear the body of the carbon monoxide. Use carbon monoxide detectors in the cockpit, since affected pilots may otherwise be completely unaware that they are being exposed to CO.

Vision

23. To avoid eye fatigue in bright light, use colour-neutral (rather than coloured) sunglass lenses as this will permit normal colour discrimination. If you need to use correcting lenses for good vision (for near or distant vision) make sure you keep a spare pair of spectacles within easy reach, so that you can easily find them if you lose or break your first pair, or develop problems with contact lenses if you wear them. Visit an eye care specialist if you notice a change in visual acuity.

Middle ear discomfort or pain

24. Certain persons (whether pilots or passengers) have difficulty balancing the air pressure on either side of the ear drum while descending. Sometimes pressure equalization can occur at different times in each ear, resulting in a form of disorientation named “alternobaric vertigo”. Problems arise if a head cold or throat inflammation keeps the Eustachian tube (from the middle ear to the throat) from opening properly. If this trouble occurs during descent, try swallowing, yawning, or holding the nose and mouth shut and forcibly attempting to exhale (Valsalva manoeuvre — pilots should know how to do this manoeuvre, and if you do not, ask your medical examiner about it). If no relief occurs, climb back up a few thousand feet (if feasible) to relieve the pressure on the eardrum. Then descend again, using these measures. A more gradual descent may be tried, and it may be necessary to go through several climbs and descents to “stair step” down. If a nasal inhaler is available, it may afford relief. If trouble persists several hours after landing, co nsult your aeromedical advisor.

Note.— If you develop symptoms of a cold when airborne, you may possibly avoid trouble by using a nasal spray, kept as part of the flight kit. Take aviation medicine advice before purchasing one. Remember that if you fly with an upper respiratory infection, you are at increased risk of developing middle ear or sinus problems.

Panic

25. The development of panic in inexperienced pilots is a process which can give rise to a vicious circle with unwise and precipitous actions resulting in increased anxiety. If lost or in some other predicament, forcibly take stock of yourself and do not allow panic to mushroom. Panic can be controlled. Fear is a normal protective reaction and occurs in normal individuals. If you believe it occurs frequently or too easily to you, seek medical advice — there are techniques that can be learned and used to reduce the effects.

Underwater diving

26. If you go flying after scuba diving or any underwater activity using compressed air, you should be aware that if insufficient time has elapsed between surfacing and take-off, the medical consequences can be serious or even fatal.

Due to greatly increased pressures underwater, nitrogen is absorbed into the blood and tissues. The amount depends on the depth and duration of exposure. If take-off follows the dive too soon to allow the body to rid itself normally of this excess nitrogen, the gas may form bubbles in the blood or tissues causing discomfort, pain, difficulty in breathing, or even death, at altitudes of 7 000 ft (2 135 m) or less, altitudes attained by most light aircraft. Older or overweight individuals are more susceptible to this condition. As a general rule, individuals should not fly within 12-48 hours following diving using compressed air, the difference depending mainly on the duration and how deep the dive(s) were.

27. Occasionally a medical emergency arises as a result of compressed air diving, when a diver has been unable to adequately decompress before surfacing. In some of these cases air- evacuation is the only feasible method of getting the patient to a recompression chamber in time to treat the condition. Flight should be at the lowest possible altitude to avoid aggravating the condition. Information concerning diving, decompression and flying is readily available from various diving organizations, such as the Professional Association of Diving Instructors (PADI):

Blood donations

28. Following a blood donation, time off flying is needed for the body to readjust. Allow 24 hours before flying after donation unless you have received specific medical advice that this period can be safely shortened.

Hyperventilation

29. Hyperventilation, or over-breathing, is a disturbance of respiration that may occur in individuals as a result of emotional tension or anxiety. Under conditions of emotional stress, fright or pain, the breathing rate may increase, causing increased lung ventilation. More carbon dioxide is exhaled from the lungs than is produced by the body and as a result, carbon dioxide is "washed out" of the blood. The most common symptoms of hyperventilation are: dizziness; hot and cold sensations; tingling of the hands, legs and feet; muscle spasms; nausea; sleepiness; and finally unconsciousness.

30. In an individual who is behaving in an unusual manner, and you suspect hyperventilation or hypoxia (the initial symptoms are similar), assume the condition is hypoxia and supply oxygen. Select 100 per cent oxygen, check the oxygen supply, oxygen equipment and flow mechanism. If the condition was hypoxia, recovery is rapid. If the symptoms persist, consciously slow the breathing rate until symptoms clear and then resume normal breathing rate. Breathing can be slowed by breathing into a paper bag, and this increases the amount of carbon dioxide taken into the lungs, since expired carbon dioxide is re-breathed.

CHAPTER 9. PUBLIC HEALTH EMERGENCIES AND AVIATION

9.1 INTRODUCTION

9.1.1 With the possible exception of airline medical advisors, the primary role of civilian doctors specializing in aviation medicine has been to undertake medical selection of applicants and to ensure the medical fitness of licence holders for the duration of the period of validity of their Medical Assessment. The importance of these two fields of activity is demonstrated by the fact that, apart from this chapter, almost the entire *Manual of Civil Aviation Medicine* is dedicated to achieving this goal. In recent years, however, interest has focused on another topic of relevance to aviation medicine, that of the role of air travel in the spread of communicable disease.

9.1.2 Article 14 of the Convention on International Civil Aviation deals with the spread of communicable disease by air:

Each contracting State agrees to take effective measures to prevent the spread by means of air navigation of cholera, typhus (epidemic), smallpox, yellow fever, plague, and such other communicable diseases as the contracting States shall from time to time decide to designate, and to that end contracting States will keep in close consultation with the agencies concerned with international regulations relating to sanitary measures applicable to aircraft. Such consultation shall be without prejudice to the application of any existing international convention on this subject to which the contracting States may be parties.

Written in 1944 (the year the Convention was developed), it shows its age by referring to smallpox, a disease eradicated in 1979. Nevertheless, it remains relevant as demonstrated by events related to communicable disease outbreaks during the first decade of the 21st Century, and it places a formal onus on States to play their part in public health initiatives to reduce the risk of disseminating such disease by air transport.

9.1.3 Air transport plays an important role with respect to the spread of communicable disease as it is one of the main means by which such diseases can spread globally. An infected air traveler can be virtually anywhere on earth within a day or two, often within the incubation period of many important communicable diseases, such as the various sub-types of influenza. The remainder of this chapter considers the issues raised by this observation and how they may be managed.

9.2 AVIATION MEDICINE AND MANAGEMENT OF COMMUNICABLE DISEASE

9.2.1 Public health is the specialty most involved in prevention of spread of communicable disease. Public health specialists (supported by infectious disease specialists) are experts in aspects of communicable disease such as incubation periods, virulence, disinfection, diagnosis and protective measures, and they are likely to play the lead role in any national pandemic preparedness plan. Aviation medicine specialists clearly need the advice of such experts when developing a preparedness plan specific to aviation. On the other hand, the aviation environment differs in several important respects from most others that are encountered by public health officers. In particular, the aircraft cabin environment varies from other modes of transport with respect to aspects such as reduced air pressure, reduced humidity and specialized environmental control systems. Further, by its very nature, aviation is an international business, unlike many areas related to public health, and is affected to varying degrees by public health policies and procedures at each airport into which there are international flights.

9.2.2 Public health officers, therefore, need assistance of experts in aviation medicine and for this reason a collaborative effort by the public health and aviation sectors is essential in order to manage the aviation-related public health risk posed by communicable disease.

9.2.3 At an international level, ICAO collaborates with the World Health Organization (WHO) to help produce requirements and guidelines. Such collaboration between the aviation and public health sectors should also occur at regional, national and local levels, and medical officers working in the field of aviation medicine are encouraged to help forge the necessary communication links to foster effective cross-organizational collaboration.

9.2.4 The role of WHO and the national public health authorities in managing public health issues related to international aviation is considered in the next section, followed by an outline of the role of ICAO and an overview of relevant international Standards and Recommended Practices (SARPs).

9.3 INTERNATIONAL HEALTH REGULATIONS

9.3.1 In 2005, WHO published a revised edition of the International Health Regulations (IHR). This second edition came into force in 2007. The purpose and scope of the IHR (2005) are "to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade." The IHR (2005) sets out the roles and responsibilities of different entities with respect to minimizing the risk of spread of disease by transport of people and cargo across international borders. Many regulations apply to "points of entry" (international airports) and "conveyance operators" (aircraft operators). The IHR (2005) also provides instructions for dealing with "public health emergencies of international concern". The IHR (2005) is a legally binding document but, as with other United Nations agencies (including ICAO), the WHO has no power of enforcement over States that do not comply with the relevant Articles. Nevertheless, by means of international pressure from UN agencies and other States, influence can be brought to bear on non-compliant States which, for the most part, do their best to comply.

9.3.2 It required ten years to revise the earlier edition of the IHR and obtain the World Health Assembly's approval of the new edition: the IHR (2005) should be implemented by States no later than 2012, unless particular difficulties in implementation are encountered. The document has been adopted by the 194 States Parties (member countries) of the World Health Assembly, the governing body of WHO. As with most internationally agreed documents, in order to gain consensus the requirements are general in their scope and lack details — to attempt otherwise would be too time consuming and too difficult a task, given the great variety of health-related conditions experienced in different countries worldwide. Therefore, the IHR (2005) sets out general requirements such as Article 24, 1(c) which states that conveyance operators shall:

permanently keep conveyances for which they are responsible free of sources of infection or contamination, including vectors and reservoirs. The application of measures to control sources of infection or contamination may be required if evidence is found.

To understand how, in practice, such conveyance operators might comply with this Article in the IHR (2005), reference to guidance material is necessary.

9.4 WHO COMMITTEES

In order to provide "competent authorities"1 with guidance on implementation of the IHR (2005), the WHO established a number of committees to address particular issues. Key industry stakeholders were invited to participate in such meetings, including the major aviation-related trade associations, the International Air Transport Association (IATA) and Airports Council International (ACI), as well as ICAO. Work by these committees has resulted in important guidance being provided in two specific areas: management of cases of Influenza A(H1N1) on board aircraft, and recommendations concerning cleaning and disinfection of commercial aircraft. Other guidance material is currently (as of 2011) being developed.

9.5 ICAO WORK CONCERNING COMMUNICABLE DISEASE 2003 — Severe Acute Respiratory Syndrome (SARS)

9.5.1 In the second quarter of 2003, SARS was believed to pose a major threat to human health. Overall, around 8 000 individuals were infected and of these 10 per cent died from the illness. In historical terms this was not an important disease, at least in terms of the number infected and who subsequently died. Influenza, by comparison, causes death in an estimated 250 000 to 500 000 individuals annually. During the SARS outbreak, however, it became very clear that the international spread of disease was primarily by air travel. It also became clear that, potentially, unwell air travelers could be identified by airport screening and prevented from departing, thereby reducing the risk of spreading the disease.

9.5.2 ICAO was requested by some States in Asia to develop guidelines for port health authorities and airport operators to identify travelers with SARS before they embarked an aircraft. Such guidelines were developed by the Aviation Medicine Section of ICAO, assisted by, amongst others, WHO and IATA.

9.5.3 An international airport was considered as having adequate protection against SARS if eight protective measures were adopted. Guidelines for inspectors and an inspector's checklist were also developed. The guidelines enabled airports to announce publicly that they were in compliance with such ICAO guidelines and that the risk of catching SARS during air travel, as well as importing it from States in which it had been identified, was minimal. At the time, thermal scanning of travelers (to identify those with raised body temperature) was introduced by some States. Although theoretically useful for detecting infectious cases of SARS (since an individual suffering from this disease becomes infectious at about the same time as his body temperature increases) very few SARS cases were identified by this method during the outbreak, and the value of such screening was later questioned.

2005 — Avian influenza

9.5.4 In 2005 avian influenza posed (and does still, in 2011, pose) a major threat to human health. WHO therefore produced several guideline documents for States concerning the systems that needed to be implemented in order to plan for a possible human influenza pandemic. However, when read from an aviation perspective, these guidelines appeared to provide insufficient detail to enable the aviation sector to adequately manage individual cases that might be detected on board an aircraft in flight; nor did the guidelines explain how aviation could continue to operate in the event that staffing at airports and on aircraft was dramatically reduced because of the effects of illness. ICAO felt that more detailed guidance should be developed for the aviation sector.

1 The IHR (2005) defines "competent authority" as "an authority responsible for the implementation

and application of health measures under these Regulations".

2006 and later — Development of ICAO SARPs and guidance material

Guidance material

9.5.5 The non-specific nature of the WHO IHR (2005) and the focus of public health officials on providing guidance for mainstream public health activities such as surveillance, health care provision, vaccination and treatment led ICAO to consider how it might provide information specific to the aviation sector on management of communicable disease. It convened meetings in Singapore to consider how best to advise States, airport and aircraft operators. In addition, it was recognized from the outset that ICAO needed assistance from WHO and from airport and aircraft operators in order to produce guidelines that were not only accurate from the public health viewpoint but also of practical relevance to operators.

Assistance was therefore sought from WHO, IATA and ACI. The United States Centers for Disease Control and Prevention also provided support.

9.5.6 These activities led to the ICAO "Guidelines for States concerning the management of communicable disease posing a serious public health risk", which were posted on the ICAO public website in 2006. The guidelines have been updated a number of times since then. As the title indicates, these guidelines were aimed at States, and whilst they were being developed, additional material was developed that was of particular interest to airport and aircraft operators. This was subsequently posted on the websites of ACI and IATA, respectively. In fact, by 2006 IATA had already developed guidelines for operators, so all that was needed was to update and harmonize these with other guidelines.

Standards and Recommended Practices (SARPs)

9.5.7 The traditional ICAO manner of addressing an emerging problem, such as the spread of communicable disease by air transport, is to develop SARPs and, at the same time, develop guidance material to support these SARPs.

On this occasion time was of the essence and it was quicker to produce guidance initially, since, unlike SARPs, guidance material from ICAO does not require formal consultation with States. It was clear, however, that the guidance material could not stand alone — it required SARPs to be developed in the relevant Annexes to give the subject a more formal grounding.

9.5.8 ICAO Annex 9 — *Facilitation*, was the first Annex to the Convention on International Civil Aviation to be amended in light of the contemporary threat from communicable disease. This Annex deals primarily with global harmonization of customs and immigration procedures and associated health-related topics. Some changes to the Annex were made, including the addition of new SARPs. An important new Standard and associated Note was introduced: A Contracting State shall establish a national aviation plan in preparation for an outbreak of a communicable disease posing a public health risk or public health emergency of international concern.

Note 1.— Guidance in developing a national aviation plan may be found on the ICAO website on the Aviation Medicine page.

This Standard and its *Note* is the single most important ICAO Standard concerning preparedness planning in the aviation sector. All other related SARPs cover particular aspects of preparedness

planning.

9.5.9 Included in Appendix 1 to Annex 9 is the aircraft General Declaration, commonly abbreviated to "Gen Dec". This document forms an official record of the arrival of an aircraft at an airport and includes a section on aircraft registration, crew number and names, airport of departure and, most importantly from the point of view of managing the international spread of disease, a "Declaration of Health". The Declaration of Health requires the pilot-in-command to identify individuals on board who may be suffering from a communicable disease. The recommended method for identifying such an individual is contained in the Declaration of Health:

"a fever — temperature 38°C/100°F or greater — associated with one or more of the following signs or symptoms, e.g. appearing obviously unwell; persistent coughing; impaired breathing; persistent diarrhoea; persistent vomiting; skin rash; bruising or bleeding without previous injury; or confusion of recent onset, increases the likelihood that the person is suffering a communicable disease".

The Declaration of Health can also be found in Annex 9 to the IHR (2005).

9.5.10 Not all States require a General Declaration to be completed by an arriving aircraft, but all crew members should be aware of the document and its contents, what it is used for, and its importance in providing guidance in identifying cases of communicable disease. If all States train their crews to follow the guidance in the Declaration of Health, this will greatly improve the consistency of information passed to the public health authority at destination with respect to notification of suspected cases of communicable disease on board.

9.5.11 Another appendix to ICAO Annex 9, Appendix 13, contains the Public Health Passenger Locator Card. This can also be found on the websites of WHO and IATA: it provides a standardized method of collecting details about passengers who may have been exposed to a fellow traveler with a communicable disease. Whilst recording such information on paper can be useful, a better way would be to utilize electronic systems, with the potentially infected traveler completing the required information on line. Thus far, the resources needed to develop such a system have not been allocated.

9.5.12 In 2009, a number of changes to other Annexes became applicable. Annex 6 now includes as a recommended practice that a universal precaution kit (UPK) should be carried on flights requiring a cabin crew member (two kits for aircraft with more than 250 passengers). Whilst Annex 6 for many years has had recommendations concerning first aid and medical kits, this was the first time that a UPK was recommended to be carried on-board. The recommended contents of such a kit are listed in Attachment B to Annex 6 and include:

— Dry powder that can convert small liquid spill into a sterile granulated gel;
— Germicidal disinfectant for surface cleaning;
— Skin wipes;
— Face/eye mask (separate or combined); and
— Gloves (disposable).

9.5.13 Annex 11 — *Air Traffic Services*, and Annex 14, Volume I — *Aerodrome Design and Operations*, were also amended in 2009. These Annexes require air traffic services providers and airport operators to have a contingency plan to address the possibility of an incident or accident or other event occurring that could affect aviation safety. However, the list of scenarios that these plans should consider did not, until 2009, include public health emergencies. Now Annex 11, Attachment C, paragraph 4 states:

"4.2 ….States should take preparatory action, as appropriate, for facilitating timely introduction of contingency arrangements. Such preparatory action should include:
b) assessment of risk to civil air traffic due to military conflict or acts of unlawful interference with civil aviation as well as a review of the likelihood and possible consequences of natural disasters or public health emergencies. …;"

Similarly, Annex 14 includes, from 2009, public health emergencies as an example of an emergency that should be included in an aerodrome emergency plan: "9.1.2 The aerodrome emergency plan shall provide for the coordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity.

Note 1.— Examples of emergencies are: aircraft emergencies, sabotage including bomb threats, unlawfully seized aircraft, dangerous goods occurrences, building fires, natural disaster and public health emergencies."

9.6 NOTIFICATION OF PUBLIC HEALTH AUTHORITY AT DESTINATION

9.6.1 The IHR (2005) includes an Article that addresses the notification of the "competent authority" at destination. Article 28 (4) of the IHR (2005) states:

Officers in command of ships or pilots-in-command of aircraft, or their agents, shall make known to the port or airport control as early as possible before arrival at the port or airport of destination any cases of illness indicative of a disease of an infectious nature or evidence of a public health risk on board as soon as such illnesses or public health risks are made known to the officer or pilot. This information must be immediately relayed to the competent authority for the port or airport. In urgent circumstances, such information should be communicated directly by the officers or pilots to the relevant port or airport authority.

9.6.2 This is an example of how the aviation medicine specialist can work with the public health officer to ensure the appropriate interpretation of this Article. The aim is to facilitate the timely notification of the public health officer at destination of an arrival of a suspected communicable disease on board an aircraft. However, the wording of the Article is not clear with respect to how this should be carried out in practice. The term "airport control" is not one that is readily recognized in aviation, and pilots-in-command do not normally have the ability to contact "directly" the "relevant port or airport authority."

9.6.3 The challenge in ensuring that the public health authority at destination is notified in a timely manner has been addressed by ICAO. ICAO Annex 9, paragraph 8.15 states: "8.15 The pilot-in-command of an aircraft shall ensure that a suspected communicable disease is reported promptly to air traffic control, in order to facilitate provision for the presence of any special medical personnel and equipment necessary for the management of public health risks on arrival."

9.6.4 This specific requirement for the pilot-in-command to notify air traffic control (which can then notify the destination aerodrome) makes the process explicit and simple – it can be followed anywhere in the world as pilots are virtually always in direct communication with an air traffic controller. It is more reliable than other communication channels that may be available to the pilot (such as company radio frequencies). The detailed procedure to be followed by the pilot-in- command and by the air traffic services unit receiving the information has been included in the ICAO *Procedures for Air*

Navigation Services — Air Traffic Management (Doc 4444) and is attached to this chapter as an Appendix. Note that once the public health authority has been notified of the expected arrival of a communicable disease case, further communication with the aircraft as it approaches the airport should be made through the aircraft operator's company frequency, and not via air traffic control (since the latter communication system should be maintained primarily for flight safety purposes).

9.7 COOPERATIVE ARRANGEMENT FOR THE PREVENTION OF SPREAD OF COMMUNICABLE DISEASE THROUGH AIR TRAVEL (CAPSCA)

In order to assist States and other stakeholders to implement the SARPs, procedures and guidelines associated with preparedness planning in the aviation sector, ICAO established the CAPSCA project in 2006. Assisted by funding from States and the United Nations Central Fund for Influenza Action, CAPSCA undertakes training of local officers and evaluations of international airports against the ICAO SARPs, IHR (2005) and relevant guidance material.

These evaluations are conducted primarily for gap analysis — comparing the existing situation to the desired one — training, and improvement of preparedness plans, rather than for audit purposes. In 2011, CAPSCA is active in four regions of the world (Asia Pacific, Africa, the Americas and the Middle East); it is hoped to extend the project globally in future years — a website describing its activities has been developed. One of the main aims of the project is to foster development of communication links and collaborative partnerships between the public health and aviation sectors. Such an approach is considered essential to effective preparedness planning in the aviation sector.

9.8 COVID-19

The COVID-19 pandemic has been regarded as the most difficult public health challenge globally in this century.
Detected in late 2019, it has spread all over the world and caused tremendous impact in global health system. Various initiatives have been undertaken by ICAO with collaboration with various State and agencies e.g. WHO, IATA, IFALPA etc. to prepare for the control and recovery from the pandemic.
WHO describes COVID-19 as:

"Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus.

Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness.

The best way to prevent and slow down transmission is to be well informed about the COVID-19 virus, the disease it causes and how it spreads. Protect yourself and others from infection by washing your hands or using an alcohol-based rub frequently and not touching your face. "

The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it's important that you also practice respiratory etiquette (for example, by coughing into a flexed elbow).

Nepal managed the spread of virus at national level by coordination at various levels namely:

COVID-19 Crisis Management Center (CCMC) at national level that represented by various stakeholders including civil aviation along with health authorities.

In addition, CAAN, in consultation with public health authorities, took various initiatives for control of virus by air travel and issued various guidance for the safety of aviation professionals and traveling public. At international level CAAN represented at following ICAO forums.

a. ICAO APAC DGCA meetings- representation by DGCA Nepal

b. ICAO APAC ACCRPG representation by DGCA Nepal

c. ICAO APAC ACCRPG Focal point representation of Chief of Flight Safety Standards Department

d. ICAO ACCRPG Safety Sub-group representation of Chief of Flight Safety Standards Department

e. ICAO CRRIC focal point representation of Chief of Aerodrome Safety Standards Department

f. Three sub groups for CRRIC- Safety, Public Health and Facilitation and Aviation Security

Since the pandemic has multiple implications at global level, the management of pandemic with three C strategy of Communication, Cooperation and Collaboration has been effective in containing the spread of virus at global level among all stakeholders.

9.9 CONCLUSION

Although Article 14 of the Convention on International Civil Aviation places an onus on States to take effective measures to prevent the spread of communicable disease by air navigation, little work related to this Article was undertaken by ICAO until 2003. However, since the appearance of SARS, much effort has been devoted to issues related to the management of dissemination of communicable disease by air travel. Medical officers in the field of aviation medicine can work with public health experts to help them understand the unique features of the aviation environment and thereby significantly contribute to improved management of any future outbreak of communicable disease, with benefit to the health of the global population.

APPENDIX

EXTRACT FROM THE *PROCEDURES FOR AIR NAVIGATION SERVICES — AIR TRAFFIC MANAGEMENT* (PANS-ATM, DOC 4444)

NOTIFICATION OF SUSPECTED COMMUNICABLE DISEASES, OR OTHER PUBLIC HEALTH RISK, ON BOARD AN AIRCRAFT

The flight crew of an en-route aircraft shall, upon identifying a suspected case(s) of communicable disease, or other public health risk, on board the aircraft, promptly notify the ATS unit with which the pilot is communicating, the information listed below:
a) aircraft identification;
b) departure aerodrome;
c) destination aerodrome;
d) estimated time of arrival;
e) number of persons on board;
f) number of suspected case(s) on board; and
g) nature of the public health risk, if known.

The ATS unit, upon receipt of information from a pilot regarding suspected case(s) of communicable disease, or other public health risk, on board the aircraft, shall forward a message as soon as possible to the ATS unit serving the destination/departure, unless procedures exist to notify the appropriate authority designated by the State and the aircraft operator or its designated representative.

When a report of a suspected case(s) of communicable disease, or other public health risk, on board an aircraft is received by an ATS unit serving the destination/departure, from another ATS unit or from an aircraft or an aircraft operator, the unit concerned shall forward a message as soon as possible to the public health authority (PHA) or the appropriate authority designated by the State as well as the aircraft operator or its designated representative, and the aerodrome authority.

Note 1.— See Annex 9 — Facilitation, Chapter 1 (Definitions), Chapter 8, 8.12 and 8.15, and Appendix 1, for relevant additional information related to the subject of communicable disease and public health risk on board an aircraft.

Note 2.— The Health Ministry, Government of Nepal is expected to contact the airline representative or operating agency and aerodrome authority, if applicable, for subsequent coordination with the aircraft concerning clinical details and aerodrome preparation. Depending on the communications facilities available to the airline representative or operating agency, it may not be possible to communicate with the aircraft until it is closer to its destination. Apart from the initial notification to the ATS unit whilst en-route, ATC communications channels are to be avoided.

Note 3.— The information to be provided to the departure aerodrome will prevent the potential spread of communicable disease, or other public health risk, through other aircraft departing from the same aerodrome.

Note 4.— AFTN (urgency message), telephone, facsimile or other means of transmission may be used

Chapter 10. MISCELLANEOUS PROCEDURES

10.1 NOTIFICATION OF SUSPECTED COMMUNICABLE DISEASES, OR OTHER PUBLIC HEALTH RISK, ON BOARD AN AIRCRAFT

10.1.1 The flight crew of an en-route aircraft shall, upon identifying a suspected case(s) of communicable disease, or other public health risk, on board the aircraft, promptly notify the ATS unit with which the pilot is communicating, the information listed below:

a) aircraft identification;

b) departure aerodrome;

c) destination aerodrome;

d) estimated time of arrival;

e) number of persons on board;

f) number of suspected case(s) on board; and

g) nature of the public health risk, if known.

10.1.2 The ATS unit, upon receipt of information from a pilot regarding suspected case(s) of communicable disease, or other public health risk, on board the aircraft, shall forward a message as soon as possible to the ATS unit serving the destination/departure, unless procedures exist to notify the appropriate authority designated by the State and the aircraft operator or its designated representative.

10.1.3 When a report of a suspected case(s) of communicable disease, or other public health risk, on board an aircraft is received by an ATS unit serving the destination/departure, from another ATS unit or from an aircraft or an aircraft operator, the unit concerned shall forward a message as soon as possible to the public health authority (PHA) or the appropriate authority designated by the State as well as the aircraft operator or its designated representative, and the aerodrome authority.

Note 1.— See Annex 9 — Facilitation*, Chapter 1 (Definitions), Chapter 8, 8.12 and 8.15, and Appendix 1, for relevant additional information related to the subject of communicable disease and public health risk on board an aircraft.*

Note 2.— The PHA is expected to contact the airline representative or operating agency and aerodrome authority, if applicable, for subsequent coordination with the aircraft concerning clinical details and aerodrome preparation.

Depending on the communications facilities available to the airline representative or operating agency, it may not be possible to communicate with the aircraft until it is closer to its destination. Apart from the initial notification to the ATS unit whilst en-route, ATC communications channels are to be avoided.

Note 3.— The information to be provided to the departure aerodrome will prevent the potential spread of communicable disease, or other public health risk, through other aircraft departing from the same aerodrome.

Note 4.— AFTN[*] (urgency message), telephone, facsimile or other means of transmission may be used.

10.2 GUIDANCE FOR DESIGNATED MEDICAL EXAMINERS AND CIVIL AVIATION MEDICAL ASSESSORS

10.2.1 The designated medical examiners (DME) are medical examiner's selected and designated by Civil Aviation Authority of Nepal (CAAN) and will follow all terms and conditions stated in the designation letter.

10.2.2 The DMEs will refer CAAN PELR, MR, PLM and this medical handbook while discharging their assigned duties.

10.2.3 They will refer ICAO medical manual for any additional medical information.

10.2.4 They will use the checklists given in this handbook.

10.2.5 Civil Aviation Medical Assessors (CAMA) are medical practitioners appointed by CAAN with terms and conditions pursuant to CAAN Civil Aviation Regulations 2002.

10.2.6 This handbook will be used as guidance for the CAMA while discharging the assigned duties from CAAN.

10.2.7 It is expected that all guidance contained in this handbook will be followed by the CAMA and DME all the times while discharging the assigned duties.

ATTACHMENT: A-1/6
APPLICATION AND STATEMENT FORM

Complete this page fully using a black ballpoint pen and in block letters. See instruction page for details.

1. Full Name:			2. Date of birth:
1. Full Name:			2. Date of birth:
3. Gender: Male / Female/ Others	4. Address: Tel/Mobile: E–mail:		5. Nationality:
6. Occupation:	7. Employer/Airline name and address:	8. Family physician's or Airline Doctor's Name: Address: Tel/Mobile: E–mail:	
9. Aviation Licence held (type): Licence number: Country issue: e applied for ATPL ( ) CPL ( ) PPL ( ) UPL( ) F/E ( ) ATC ( ) Other ( )		10. Total flight time: Hours	11. Last Medical examination: Date: Place:
12. Any limitations on Licence/ Medical certificate: Yes / N o If yes, details:		13. Have you ever had an aviation medical assessment denied, suspended or revoked by any Licensing authority? Yes / No If yes, Date: Place: Details:	
14. Any aircraft accident or reportedincident: Yes / No If yes, Date: Place: Details:		15. Aircraft currently flown (e.g. Piston engine, Turbo prop, Jet):	
16. Type of application: Initial / Renewal / Others	17. Class of medical assessment applied for: I/ II / III /Others	18. Type of flying intended: Single–crew / Multi–crew Commercial / Instructor / Private	
19. Do you smoke tobacco products? Never viously: Date stopped: Currently: State type: Amount: Number of years:	20. Do you drink alcoholic beverages? Yes / No If yes, state average weekly intake in units	21. Do you currently use any medication, including non-prescribed medication or psychoactive substances? Yes / No If yes, state name of medication, Date commenced: Daily or weekly dose: Cause (Diagnosis):	

22. **General and Medical history**: Do you have, or have you ever had, any of the following? YES or No must be ticked after each question. Elaborate YES answers in the REMARKS section (23) and discuss them with the medical examiner.

	Yes	No		Yes	No		Yes	No
101. Eye disorders/ eye surgery			117. Neurological disorders: stroke, epilepsy, seizure, paralysis, etc.			**Females Only**		
						133. Gynecological disorder (including menstrual)		
102. Spectacles and /or contact lens ever worn			118. Psychological/ psychiatric trouble of any sort			134.Are you pregnant?		
103. Spectacle/ contact lens / change since last medical exam			119. Alcohol/ drug/ substance abuse					
104. Hay fever, other allergy			120. Attempted suicide			**Family history of**		
105. Asthma, lung disease			121. Motion sickness requiring medication			135. Heart disease		
106. Heart or vascular disease			122. Anemia/sickle cell trait/other blood Disorder			136. High blood pressure		
107. High or low blood pressure			123. Malaria or other tropical disease			137. Dyslipidemia		
108. Kidney stone or blood in urine			124. Positive HIV test			138. Epilepsy		
109. Diabetes, hormone disorder			125. Sexually transmitted disease			139. Mental illness		
110. Stomach, liver or intestinal Trouble			126. Admission to hospital			140. Diabetes		
111. Deafness, ear disease			127. Any other illness or injury			141. Tuberculosis		
112. Nose or throat disease or speech Disorder			128. Visit to medical practitioner since last medical examination			142. Allergy/asthma/eczema		
113. Head injury or concussion			129. Refusal of life insurance			143. Inherited disorder		
114. Frequent or severe headaches			130. Refusal of issue or revocation of aviation licence			144. Glaucoma		
115. Dizziness or fainting spells			131. Medical rejection from or for military service					
116. Unconsciousness for any reason			132. Award of pension or compensation for injury or illness					

23. **Remarks**: If previously reported and unchanged, state

24. **DECLARATION**: I hereby declare that I have carefully considered the statements I have made above and that to the best of my belief, they are complete and correct. I further declare that I have not withheld any relevant information or made any misleading statements. I understand that if I have made any false or misleading statement in connection with this application, the Authority may refuse to grant me a Medical Assessment or may withdraw any Medical Assessment granted without prejudice to any other legalaction.

CONSENT TO RELEASE OF MEDICAL INFORMATION: I hereby give my consent that all relevant medical information may be released and submitted to the Civil Aviation Medical Assessor of the CAAN and Civil Aviation Medical Assessor may release this medical information to relevant doctor/authority if deemed necessary.

…….

…….. Signature of Applicant Signature of SME Eye/SME ENT/DME (Witness)

Date

ATTACHMENT: A-2/6
MEDICAL EXAMINATION FORM
For use by Designated Medical Examiner

1) Name:	2) Date of Birth:	3) Sex: Male / Female

4) Type of application: Initial / Renewal / Others Type of License applied for ATPL ( ) CPL ( ) PPL ( ) UPL( ) F/E ( ) ATC ( ) Other ( )	lass of medical applied assessment for: I / II / III / Others	6) Type of flying intended: Single–crew / Multi–crew Commercial / Instructor / Private

7) Height (in cm)/Weight (in kg):	8) BMI:	9) Eye Color:	10) Hair Color:	lood Pressure– seated mm Hg		12) Pulse– resting:	
				Systolic	Diastolic	Rate(bpm):	Rhythm: Regular/ Irregular

CLINICAL EXAMINATION:

	Normal	Abnormal		Normal	Abnormal
13) Head, face, neck, scalp			nus, rectum (examine if applicable)		
14) Mouth, throat, teeth			Genito– urinary system (examine if applicable)		
15) Nose, sinuses			24) Endocrine system		
16) Ears			Upper and lower limbs, joints		
17) Eyes			26) Spine, other musculoskeletal		
18) Lungs, chest, breasts (indicate if breasts not examined)			27) Nervous system		
19) Heart			28) Psychiatric		
20) Vascular system			29) Skin and lymphatic system		
21) Abdomen, hernia, liver, spleen			30) General system		
31) Any other relevant observation or findings:					
entifying marks, tattoos, scars, etc.:					
33) Notes: Describe every abnormal finding. Enter applicable item number before each comment.					

34) EAR, NOSE, THROAT AND HEARING (ATTACHMENT: A - 3/6)

Medical Examination Form (Ear, Nose, Throat and Hearing) filled in by Specialist Medical Examiner Dr.…… on date is attached.

35) EYE, VISUAL ACUITY AND COLOR PERCEPTION (ATTACHMENT: A - 4/6)

Medical Examination Form (Eye, Visual Acuity and Color Perception) filled in by Specialist Medical Examiner

Dr. ……on date ..... is attached

Accompanying reports	Normal	Abnormal/comment	Not performed
51**)** Urinalysis			
52) ECG			
53) Chest X-ray			
54) Audiogram			
55) Others			

56) Mental health aspects of fitness discussed.	Yes / No
57) Behavioural aspects of fitness discussed.	Yes / No
58) Physical aspects of fitness discussed	Yes / No
59) Preventive health advice given.	Yes / No

60**) Comments, restrictions, limitations:**

61)**Designated Medical Examiner's Recommendation**:

I hereby certify that I have examined the applicant named on this Medical Examination form. All the statements in Application and Statement form, Medical Examination forms, along with attachments, if any, embodymy findings completely and correctly. I also have studied specialist medical reports and have attached herewith.

I RECOMMEND / DONOT R COMMEND for INITIAL/RENEWAL/OTHER licence as the applicant

MEETS/ DOES NOT MEET the medical standards prescribed in Medical Requirements, CAAN for CLASS I / II / III

Medical Certificate.

62) Clinic Address and Date:	63) Designated Medical Examiner's: [Block Capitals and/or stamp] Name: Telephone No: E-mail: Fax (if available):	64)Designated Medical Examiner's signature:

ATTACHMENT: A-3/6
MEDICAL EXAMINATION FORM
(Specialist - Ear, Nose, Throat and Hearing)

For use by Specialist Medical Examiner

1) Name:	2) Date of Birth:	3) Sex: Male / Female

4) Type of application: Initial / Renewal / Others Type of License applied for ATPL ( ) CPL ( ) PPL ( ) UPL( ) F/E ( ) ATC ( ) Other ( )	lass of medical assessment applied for: I / II / III / Others	6) Type of flying intended: Single–crew / Multi–crew Commercial / Instructor / Private

	Normal		Describe abnormality in detail, use additional sheet if necessary & attach to this form
	Yes	No	
14) Mouth, throat, teeth			
15) Nose, sinuses			
16) Ears (especially eardrum appearance and mobility)			
36) Any other relevant observation or findings			

37) Hearing test, back turnedto examiner	Whispered voice	Conversational voice	Rinne's Test	Weber Test
Right ear	1m	2m		
Left ear	1m	2m		

38) Audiometry	500	1000	2000	3000	4000	8000
Right ear dB loss	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Left ear dB loss	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

39) Remarks, if any:

I certify that the applicant MEETS / DOES NOT MEET the medical standards prescribed in Medical Requirement, CAAN in Ear, Nose, Throat and Hearing for INITIAL/RENEWAL/OTHER for CLASS I / II / III medical certificate.

If not, specify ……..... ……

Name of Specialist Medical Examiner: ……..…… Signature: …….

Place ofexamination: ..... Date: .....

ATTACHMENT: A-4/4
MEDICAL EXAMINATION FORM
(Specialist - Eye, Visual Acuity and Color Perception) For use by Specialist Medical Examiner

1) Name:	2) Date of Birth:	3) Sex: Male / Female
4) Type of application Initial /Renewal / Others Type of License applied for ATPL ( ) CPL ( ) PPL ( ) UPL()	5) Class of medical assessment applied for: I/ II / III / Others	6) Type of flying intended: Single–crew / Multi–crew Commercial / Instructor / Private
F/E ( ) ATC ( ) Other ( )		

	Normal		Describe abnormality in detail, use additional sheet if necessary & attach to this form
	Yes	No	
40) Eyes– orbit and adnexa; visual fields			
41) Eyes –ocular motility; nystagmus, eye muscle balance			
42) Eyes– pupils and optic fundi			
43) Any other relevant observation or findings			

44) Distant vision at 6 m

	Uncorrected		Glass	Contact Lenses
Right eye		Corrected to		
Left eye		Corrected to		
Both eyes		Corrected to		

45) Intermediate vision: N14 at 100 cm

	Uncorrected		Glass	Contact Lenses
Right eye		Corrected to		
Left eye		Corrected to		
Both eyes		Corrected to		

46) Near vision: N5 at 30-50 cm

	Uncorrected		Glass	Contact Lenses
Right eye		Corrected to		
Left eye		Corrected to		
Both eyes		Corrected to		

47) Spectacles		48) Contact Lens	
Yes	No	Yes	No
Type: unifocal/ bifocal/ varifocal/ look-over		Type: hard/ soft/ gas permeable/ disposable	

49) Color Perception	Normal / Abnormal
Pseudo-isochromatic plates	Type:
No. of plates:	No. of errors:

50) Remarks, if any

I certify that the applicant MEETS / DOES NOT MEET the medical standards prescribed in Medical Requirement, CAAN in Eye, Visual Acuity and Color Perception for INITIAL/RENEWAL/OTHER for CLASS I / II /III medical certificate.

If not, specify
……

Name of Specialist Medical Examiner: …… Signature: ……

Place ofexamination: ..... Date: .....

ATTACHMENT: A-4/5

CIVIL AVIATION AUTHORITY OF NEPAL

MEDICAL ASSESSMENT FORM

For use by Civil Aviation Medical Assessor

Part A

Full Name:	Sex: Male / Female	Date of birth:
Address:		
Contact Details	Mobile:	E–mail:
Licence No. (ATPL/CPL/MPL/PPL/UPL/FE/ATC)……		Expiry Date:
Airline:	Family physician's or Airline Doctor's Name:	
	Address (Clinic/Hospital):	
	Mobile:	E–mail:
Total flight hours:	Total flight hours since last medical:	Last Medical examination: Date/Place
Any aircraft accident or reportedincident? Yes / No If yes, Details, Date & Place:		
Any inflight incapacitation? Yes / No If yes, Details, Date & Place:		

Part B

Aviation medical assessment previously denied, suspended or revoked by any Licensing authority? Yes / No If yes, Details, Date & Place:
Medical events or illness any time: Yes / No
Any abnormal findings in ―Application and Statement Form and in ―Medical Examination Forms: Yes / No
Limitations/Restriction on Licence/ Medical Assessment previously prescribed? Yes / No If yes, Details:
Assessment, Remarks, Recommendation:
Any communication to the applicant:

Part C

Limitations:

I RECOMMEND / DONOT RECOMMEND for INITIAL/RENEWAL/OTHER licence as the applicant MEETS / DOES NOT MEET the medical standards prescribed in Medical Requirements, CAAN for CLASS I / II / III

Medical Certificate.

……..

ATTACHMENT: A– 6/6

CIVIL AVIATION AUTHORITY OF NEPAL

MEDICAL CERTIFICATE

Name & Address **Licence Number:**						
Date of Birth	**Height in cm**	**Weight in Kg**	**Hair color**	**Eyescolor**	**Sex**	**Blood Group**
This certifies that the holder has met the medical standards prescribed in Medical Requirements, CAAN for class .....Medical Certificate.						
LIMITATIONS						
Date of Medical Certification			**Valid until**			
Signature of Civil Aviation Medical Assessor			**Stamp**			
Signature of Holder						

Note: Bring this Certificate on next medical examination.

ATTACHMENT: B– 1/2

CIVIL AVIATION AUTHORITY OF NEPAL

INSTRUCTION FOR APPLICANTS

This Application and Statement Form, along with all attached Report Forms and papers will be transmitted to the Medical Assessor of the Licensing Authority. Medical confidentiality will be respected at all times. The Applicant must personally tick or circle or complete in full all questions (boxes) on the Application and Statement Form. Writing must be in Block letters with a black ballpoint pen and must be legible. If more space is required to answer any question, attach a plain sheet of paper and sign with the date.

NOTICE: Failure to complete the Application and Statement Form in full or to write legibly will result the form not being accepted. Making false or misleading statements or withholding relevant information in respect of this application may result in criminal prosecution, refusal of this application and/or withdrawal of any Medical Assessment(s) previouslygranted.

1. FULL NAME: State name in full.	2. DATE OF BIRTH: Specify in order: day (DD), month (MM), year (YYYY) in numerals, Example: 22-08-1960.
3. GENDER: Tick appropriate item.	4. ADDRESS: State main place of residence, with contact details, telephone number and e-mail address.
5. NATIONALITY: State name of country of citizenship	6. OCCUPATION: State occupation.
7. EMPLOYER /AIRLINE: State principal employer.	FAMILY PHYSICIAN'S AND/OR AIRLINE DOCTOR"S NAME AND ADDRESS (if applicable). Provide contact details of family physician or airline doctor.
9.AVIATOIN LICENCE HELD (TYPE): Write Licence number and country of issue. Provide information concerning Licences already held.	10. TOTAL FLIGHT TIME (HOURS): For pilots, state total number of hours flown in an operating capacity. For others, write "Not applicable.
11. LAST MEDICAL EXAMINATION: State date (day/month/year) and place (city/town and country) of last aviation medical examination.	YLIMITATIONSONTHELICENCE/MEDICAL CERTIFICATE: Provide details of any limitations on your Licence(s) and/or medical certificate(s), e.g. correcting lenses, valid daytime only, multi-pilot operations only
13. HAVE YOU EVER HAD AN AVIATION MEDICAL ASSESSMENT DENIED, SUSUPENDED OR REVOKED BY ANY LICENSING AUTHORITY? Tick "Yes" if you have ever had a Medical Assessment denied, suspended or revoked, even if temporarily. Provide the date, place and details, and discuss with the medical examiner.	14. ANY AIRCRAFT ACCIDENT OR REPORTED INCIDENT: If "Yes" provide details. If already given in earlier statement, state so.
15. AIRCRAFT CURRENTLY FLOWN: State the name of aircraft currently flown e.g. Piston engine, Turbo prop, Jet etc.	16. TYPE OF APPLICATION: Tick appropriate item. Tick "initial" if this is your first application to this Licensing authority, even if you hold other similar Licence issued by another Licensing authority. Mention validation of foreign licence, if applicable
17. CLASS OF MEDICAL ASSESSMENT APPLIED FOR: Tick appropriate item.	18.TYPE OF FLYING INTENDED : Provide details of intended flying e.g. Single crew or Multi crew; Commercial, Instructor, Private. Write NA if not applicable.
19. DO YOU SMOKE TOBACCO PRODUCTS? Tick applicable box. Current smokers should state type and amount e.g. 20 cigarettes per day; pipe, 30 grams weekly.	
20. DO YOU DRINK ALCOHOLIC BEVERAGES? State average weekly intake in units Example: 10 units/wk, 20 units/wk (spirits, beer, wine). Note: 1 unit = 10 g of alcohol. 1 unit corresponds to 30 ml of spirits, 100 ml of wine and 300 ml of beer. Spirits include whisky, brandy, gin, rum, vodka.	
21. DO YOU CURRENTLY USE ANY MEDICATION INCLUDING NON- PRESCRIBEDMEDICATION OR PSYCHOCATIVE SUBSTANCES? State medications prescribed by a medical practitioner and also non-prescribed medication e.g. herbal remedies, medications bought without prescription. If "Yes" is ticked, provide details: name of medication, date treatment was commenced, daily/weekly dose and the condition or problem for which the medication is taken. Psychoactive substances include opioids, cannabinoids, cocaine, sedatives, hypnotics, hallucinogens, psycho stimulants etc.	
22. GENERAL AND MEDICAL HISTORY: All items from 101 to 132 and 135 to 144 must have answers "Yes" or "No" ticked in appropriate boxes. Items 133 and 134 to be ticked by females only. Do not tick "Yes" to occasional self-limiting, mild illnesses like common cold, aches, pains etc. All the questions asked are medically important, even though this may not be readily apparent. Items 135 to 144 relate to history of immediate family members.	
23. REMARKS: For yes on any of the items in 22, kindly elaborate. If the information has been reported in a previous Application and Statement Form to the Licensing authority issuing the Medical Assessment applied for and there has been no change in your condition, you may state "Previously reported, Unchanged". However you must tick "Yes" for that condition.	
24. DECLARATION AND CONSENT TO RELEASE OFMEDICAL INFORMATION: Do not sign or date this section until indicated to do so by the Designated Medical Examiner who will act as witness and sign also.	

PPLICANT HAS THE RIGHT TO REFUSE ANY EXAMINATION AND TEST AND TO REQUEST REFERRAL TO THEAUTHORITY.HOWEVER, THIS MAY ENTAIL TEMPORARY DENIALOF MEDICAL CERTIFICATION.

ATTACHMENT: B— 2/2

CIVIL AVIATION AUTHORITY OF NEPAL

Instruction for designated medical examiner (DME) /specialist medical examiner on how to complete medical examination form

All questions (boxes) on the Medical Examination Form must be completed in full.

Writing must be in BLOCK LETTERS with a black ballpoint pen and must be legible. Exert sufficient pressure to make legible copies. If more space is required to answer any question, attach a plain sheet of paper with the applicant‘s name and birth date, the additional information required, followed by your signature and the date. The following instructions apply to the same numbered headings on the Medical Examination Form.

NOTICE: Failure to complete the Medical Examination Form in full as required or to write legibly may result in rejection of the application in total and may lead to withdrawal of any Medical Assessment issued. Making false or misleading statements or withholding relevant information by Designated Medical Examiner/ Specialist Medical Examiner may result in disciplinary action including criminal prosecution.

1. NAME: State name in full.
2. DATE OF BIRTH: Specify in order: day(DD), month(MM),year(YYYY) in numerals, Example: 22-08-1960.
3. SEX: Tick or circle appropriate item.
4. TYPE OF APPLICATION: Tick or circle appropriate item.
   Initial: Initial examination for Medical Assessment Class I, II or III. Renewal:
   Subsequent routine examinations.
   Other: Examinations other than initial or subsequent renewal examinations.
5. CLASS OF MEDICAL ASSESSMENT APPLIED FOR: Tick or circle appropriate item.
6. TYPE OF FLYING INTENDED: Provide details of intended flying e.g. Single crew or Multi crew; Commercial, Instructor, Private. Write NA if not applicable.
7. HEIGHT in cm/ WEIGHT in kg: Measure height without shoes in centimeters. Measure weight in light dress in kilograms
8. BMI: Calculate BMI using formula weight in kg divided by (height in meter)2
9. EYE COLOR: State color of applicant's eyes from the following list: brown, blue, green, hazel, grey, multi.
10. HAIR COLOR: State color of applicant's hair from the following list: brown, black, blonde, auburn, red ,grey, white.
11. BLOOD PRESSURE: Blood Pressure readings should be recorded as Phase I for Systolic pressure and Phase V for Diastolic pressure. The applicant should be seated. Record blood pressure in mm Hg. You may be required to check BP after a few minutes of rest if found high in the first reading.
12. PULSE (RESTING): The pulse rate should be recorded in beats per minute and the rhythm should be recorded as regular or irregular.

SECTIONS 13 to 30 inclusive constitute the general clinical examination and each of the sections must be checked as Normal or Abnormal.

13. HEAD, FACE, NECK, SCALP: To include appearance, range of neck movements, symmetry of facial movements, etc.
14. MOUTH, THROAT, TEETH: To include appearance of buccal cavity, soft palate motility, tonsillar area, pharynx as well as gums, teeth and tongue.
15. NOSE, SINUSES: To include appearance and any evidence of nasal obstruction or sinus tenderness on palpation.
16. EARS: To include otoscopy of external ear, ear canal, and tympanic membrane. Eardrum motility assessed by valsalva maneuver or by pneumatic otoscopy. If wax is obstructing the view, clean it first.
17. EYES: General examination of both eyes, do visual fields examination by confrontation. To include appearance, size, reflexes, light reflex and fundoscopy. Look for presence of any corneal scars. To include range of movement of eyes in all directions; symmetry of movement of both eyes; ocular muscle balance; convergence; accommodation; nystagmus.
18. LUNGS, CHEST and BREASTS: To include inspection of chest for deformities, operation scars, abnormality of respiratory movement, auscultation of breath sounds. Physical examination of the female applicant's breasts is optional. If not examined, state so.

19. HEART: To include apical heartbeat, position, auscultation for murmurs, carotid bruits, palpation for thrills.
20. VASCULAR SYSTEM: To include examination for varicose veins, character and feel of pulse, peripheral pulses, evidence of peripheral vascular disease.
21. ABDOMEN, HERNIA, LIVER, SPLEEN: To include inspection of abdomen; palpation of internal organs; particularly check for inguinal hernias.
22. ANUS, RECTUM: Clinical examination is done if applicable and indicated by history. If not examined, state so.
23. GENITO-URINARY SYSTEM: Clinical examination is done if applicable and indicated by history. If not examined, state so.
24. ENDOCRINE SYSTEM: To include inspection, palpation for evidence of hormonal abnormalities/imbalance; thyroid gland.
25. UPPER AND LOWER LIMBS, JOINTS: To include full range of movements of joints and limbs, any deformities, weakness or loss. Look for evidence of arthritis.
26. SPINE, OTHER MUSCULOSKELETAL: To include range of movements, deformity, abnormalities of joints.
27. NEUROLOGIC – REFLEXES ETC: To include reflexes, sensation, power, vestibular system– balance, Romberg test.
28. PSYCHIATRIC: To include evaluation of appearance, mood/thought, behaviour (see also 56-57).
29. SKIN and LYMPHATICSYSTEM: To include inspection of skin; inspection and palpation for lymphadenopathyetc.
30. GENERAL SYSTEM: All other areas and systems, including nutritional status.
31. ANY OTHER RELEVANT OBSERVATION OR FINDINGS: Write down any other relevant observation or findings seen during examination.
32. IDENTIFYING MARKS, TATTOOS, SCARS, ETC: List items that may be used for physical identification.
33. NOTES: Any notes, comments or abnormalities to be described – add extra notes if required on separate sheet of paper, write name, date of birth of applicant; then sign and date.
34. EAR, NOSE, THROAT AND HEARING: Write the name of Specialist Medical Examiner from ENT group who examined the applicant along with date examined.
35. EYE, VISUAL ACUITY AND COLOR PERCEPTION: Write the name of Specialist Medical Examiner fromEYE, VISUAL ACUITY AND COLOR PERCEPTION group who examined the applicant along with dateexamined.
36. ANY OTHER RELEVANT OBSERVATION OR FINDINGS RELATED TO ENT EXAMINATION: Write any other relevant findings related to ENT examination.
37. HEARING: Tick appropriate box to indicate hearing ability as tested separately in each ear in whispering voice at 1m and conversation voice at 2m.The applicant should not be able to observe the examiner‘s lips.
38. AUDIOMETRY: If pure-tone audiometry is required, the frequencies from 125 to 8000 Hz should be measured and the audiometric results recorded in an audiogram. The full range of frequencies has diagnostic value and is useful for provision of advice concerning hearing conservation.
39. REMARKS, IF ANY: Write down any other remarks if it is relevant.
40. EYES – ORBIT AND ADNEXA, VISUAL FIELDS: General examination of both eyes, do visual fields examination by confrontation.
41. EYES – PUPILS AND OPTIC FUNDI: To include appearance, size, reflexes, light reflex and fundoscopy. Lookfor presence of any corneal scars.
42. EYES – OCULAR MOTILITY, NYSTAGMUS: To include range of movement of eyes in all directions; symmetry of movement of both eyes; ocular muscle balance; convergence; accommodation; nystagmus.
43. ANY OTHER RELEVANT OBSERVATION OR FINDINGS RELATED TO EYE EXAMINATION: Write any other relevant findings related to EYE examination.
44. DISTANT VISION AT 6 METRES: Each eye to be examined separately, then both together. First without correction, then with spectacles (if used) and lastly with contact lenses, if used. Record visual acuity in appropriate boxes. Use Snellen‘s chart or any other standard chart.
45. INTERMEDIATE VISION AT 1 METRE: Each eye to be examined separately and then both together. First without correction, then with spectacles if used and lastly with contact lenses if used. Record visual acuity in appropriate boxes as ability to read N14 at 100 cm.
46. NEAR VISION AT 30–50 CM: Each eye to be examined separately and then both together. First without correction, then with spectacles if used and lastly with contact lenses, if used. Record visual acuity in appropriate boxes as ability to read N5 at 30–50 cm. Note: Bifocal contact lenses and contact lenses correcting for near vision only are not acceptable.
47. SPECTACLES: Tick appropriate box signifying if spectacles are or are not worn by applicant. If used, state whether unifocal, bifocal, varifocal or ―look-over‖.
48. CONTACT LENSES: Tick appropriate box signifying if contact lenses are or are not worn. If worn, state type from the following list; hard, soft, gas-permeable or disposable.

49. COLOR PERCEPTION: If required, tick appropriate box signifying if color perception is normal or not. State which test is used e.g. Ishihara 24 plate. If abnormal, state number of plates read incorrectly.
50. REMARKS, IF ANY: Write down any other remarks if it is relevant.
51. to 55. ACCOMPANYING REPORTS: One box opposite each of these sections must be ticked. If the test is not required and has not been performed, then tick the NOT PERFORMED box. If the test has been performed (whether required or on indication) complete the normal or abnormal box, as appropriate. In Other, write the name of any accompanying reports done like chest X-ray, exercise ECG, ECHO, lipid profile, blood sugar, or any other additional test.
56. MENTAL HEALTH ASPECTS OF FITNESS DISCUSSED: Applicants should be asked about their mental health and if they have any concerns about this aspect of their medical fitness. Mental health aspects refer to conditions such as depression and anxiety. Questions based on those that have been validated in primary health care settings should be used where possible, e.g. concerning depression. Fatigue-related issues can also be addressed in this part of the examination. Medical examiners should be conversant with the causes, prevention and treatment of fatigue, especially those related to sleep apnea and/or which require medication to be alleviated. It is not required that the contents of such discussions are recorded unless they impact on the Medical Assessment (see Manual of Civil Aviation Medicine for guidelines).
57. BEHAVIORAL ASPECTS OF FITNESS DISCUSSED: Applicants should be asked about behavioral aspects related to their health and if they have any concerns about this aspect of their medical fitness. Behavioral aspects refer to such behaviors
,e.g. as problematic use of substances.
58. PHYSICAL ASPECTS OF FITNESS DISCUSSED: Applicants should be asked about physical aspects of their health and if they have any concerns about this aspect of their medical fitness. Questions concerning physical exercise, weight, diet, smoking, etc., can be covered in this portion of the medical examination. Examiners should be aware of standard preventive guidelines concerning common physical diseases and provide such advice as appropriate. Since gastrointestinal upset is a common cause of in-flight incapacitation, advice concerning healthy eating habits, especially when abroad, may usefully be given in this section. It is not required that the contents of such discussions are recorded unless they impact on the Medical Assessment (see Manual of Civil Aviation Medicine for guidelines).
59. PREVENTIVE HEALTH ADVICE GIVEN: The goal of items56-58is to address adverse aspects of mental, behavioral and physical health that are amenable to prevention. State whether preventive advice has been given by ticking Yes or No.
60. COMMENTS, RESTRICTIONS, LIMITATIONS, ETC: Enter here your findings and assessment of any abnormality in the history or examination. State also any limitation required.
61. CIVIL AVIATION MEDICAL EXAMINER'S RECOMMENDATION: Tick or circle as appropriate. FIT/UNFIT; INITIAL/RENEWAL/OTHERS; CLASS I /II / III. If recommendation is not made, the reason must bestated.
62. CLINIC ADDRESS AND DATE: Enter the address of clinic where applicant was examined and the date of examination. The date of examination is the date of the general examination and completion of all required tests.
63. DESIGNATED MEDICAL EXAMINER'S NAME, TEL NUMBER, E MAIL, FAX (if available): Write your name, contact telephone number and e-mail address (and fax if available) or put in stamp stating all details.
'DESIGNATED MEDICAL EXAMINER'S SIGNATURE: Sign in this box.

----------END----------

ATTACHMENT: C– 1/3

CIVIL AVIATION AUTHORITY OF NEPAL

CLINIC/HOSPITAL INSPECTION CHECKLIST

DESIGNATED MEDICAL EXAMINER

Name of Applicant DME:_____Address (Clinic /Hospital): Contact Number:_____ Email:

. Equipment	Present	Not Present	Remarks
Stethoscope			
BP Instrument			Taken by Doctor/Technician/Nurse
Weighing Machine			
Height scale			
Knee hammer			
Torch			
ECG machine			
X-ray view box			
Urine strip test			

2. Physical Facility	Present	Not Present
Examination Room		
Waiting Room		
Parking Area		
Driveway/Approach		

3. Other Facilities	Present/Adequate	Not Present/Inadequate
Telephone		
Lighting		
Heating		
Cleanliness		
Noise management		

4. Staff	Present	Not Present
Nurse		
Physician Assistant		
Technician		
Receptionist		

5.	Clinic
Type	Hospital/Nursing Home/Polyclinic/Private
Preferred Days	
Preferred Time	

6. Comments if any:

Recommendations : Approved /Not approved

Signature of Applicant DME Signature of CAMA Signature of Inspector, FSSD

Date: _____

ATTACHMENT: C-2/3
CIVIL AVIATION AUTHORITY OF NEPAL
SPECIALIST MEDICAL EXAMINER CLINIC/HOSPITAL INSPECTION CHECKLIST
SPECIALIST MEDICAL EXAMINER: EYE

Name of Applicant SME:_____Address (Clinic / Hospital):

Contact Number:_____Email:

1. Equipment	**Present**	**Not Present**	**Remarks**
Distant Vision Chart			
Near Vision Chart			
Color Vision Plates			
Ophthalmoscope			
Slit Lamp			
Torch			

2. Physical Facility	**Present**	**Not Present**
Examination Room		
Waiting Room		
Parking Area		
Driveway/Approach		

3. Other Facilities	**Present/Adequate**	**Not Present/Inadequate**
Telephone		
Lighting		
Heating		
Cleanliness		
Noise management		
4. Staff	Present	Not Present
Nurse		
Physician Assistant		
Technician		
Receptionist		

5. Clinic	
Type	Hospital/Nursing Home/Polyclinic/Private
Preferred Days	
Preferred Time	

6. Comments if any:

Recommendation: Approved / Not approved

Signature of Applicant SME Signature of CAMA Signature of Inspector, FSSD

Date: _____

ATTACHMENT: C-3/3
CIVIL AVIATION AUTHORITY OF NEPAL
SPECIALIST MEDICAL EXAMINER CLINIC/HOSPITAL INSPECTION CHECKLIST

SPECIALIST MEDICAL EXAMINER: ENT

Name of Applicant SME:_____ Address (Clinic / Hospital):

Contact Number:_____ Email:_____

1. Equipment	Present	Not Present	Remarks
Otoscope			
Tuning Fork			
Headset: mirror/lamp			
Audiometry			
Torch			

2. Physical Facility	Present	Not Present
Examination Room		
Waiting Room		
Parking Area		
Driveway/Approach		

3. Other Facilities	Present/Adequate	Not Present/Inadequate
Telephone		
Lighting		
Heating		
Cleanliness		
Noise management		

4. Staff	Present	Not Present
Nurse		
Physician Assistant		
Technician		
Receptionist		

5.	Clinic
Type	Hospital/Nursing Home/Polyclinic/Private
Preferred Days	
Preferred Time	

6. Comments if any:

Recommendations : Approved /Not approved

Date:

Signature of Applicant SME Signature of CAMA Signature of Inspector, FSSD

ATTACHMENT: D– 1/1

MEDICAL EXAMINATION AUDIT

CORRECTIVE ACTION FORM

Designated Medical Examiner Name:	
Clinic/Hospital Location:	**Date(dd-mm-yy):**
Associated Finding Number:	
Finding: Statement of finding	
Factual Review of the Findings **Identify what happened, how widespread it is, where it occurred within your system of medical check, and what type of problem it is**	
Root cause Analysis **Identify what type of analysis was used to identify potential causes leading to the finding, how it was used to derive root causes resulted from the analysis**	

Proposed Corrective Action	
1. Short Term Corrective Action	
2. Long Term Corrective Actions (Including an assessment of any induced hazards or risks associated to the implementation of the corrective action(s)	
Timeline for implementation of all Corrective Actions	
Designated Medical Examiner Name: **Signature:**	**Date(dd-mm-yy):**