60th CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGIONS

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AGENDA ITEM 3: AVIATION SAFETY

ESTABLISHMENT OF A COMPREHENSIVE-LOOP AEROMEDICAL MANAGEMENT FRAMEWORK BASED ON SMS

(Presented by the People's Republic of China)

SUMMARY

With the rapid development of the aviation industry and the continuous emergence of new technologies, existing aeromedical management models are facing new challenges. Constructing a comprehensive-loop aeromedical management framework based on SMS is of great significance for mitigation of medical risks and improving flight safety. This paper aims to explore the value of developing an effective comprehensive-loop aeromedical management framework and outlines key implementation principles.

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1. INTRODUCTION

1.1 The most concerned issue in aviation medicine is medical incapacitations, which always form part of the overall air transport safety risk. Moreover, the health-related factors result in such incapacitation are growing more intricate and varied. These include not only existing physiological health issues such as cardiovascular diseases and hearing loss but also new challenges such as mental health, age limitations, substance abuse, fatigue, and "long COVID".

1.2 As the foundation and core of existing aeromedical management, routine periodic medical examination verifies whether pilots continue to meet the medical standards required to perform flight tasks through periodic check-ups. The rapid advancement of aviation technologies, especially breakthroughs in automation, artificial intelligence, and unmanned aerial vehicle technologies necessitates modern aeromedical management to adapt to the dynamic interactions between these new technologies and pilots' health and capabilities. For instance, highly automated cockpits may reduce pilots' operational workload but increase the demands on their cognitive and decision-making abilities. Additionally, longer routes and operations across multiple time zones may affect the health of crew members.

1.3 The Safety Management System (SMS), long advocated and emphasized by the International Civil Aviation Organization (ICAO), is vital to ensure civil aviation safety. Its core lies in identifying and analysing hazards and implementing control measures to mitigate those risks to an acceptable level. In February 2016, the ICAO Council adopted Amendment 173 to Annex 1, which clearly stated that "as part of their State Safety Programme, States shall apply basic safety management principles to the medical examination process of license holders", and also required that "the Licensing Authority shall implement appropriate aviation-related health promotion for license holders subject to a Medical Assessment to reduce future medical risks to flight safety". This amendment emphasizes the integration of medical assessment, health promotion, and safety management, which provides an international standard for establishing an SMS-based aeromedical management framework to identify and mitigate medical risks proactively and systematically.

2. DISCUSSION

2.1 Limitations of Relying Only on Medical Examinations for Mitigation of Medical Risk

2.1.1 Routine medical examinations are conducted at fixed intervals (e.g., once a year) and "one-time, phased" assessment that only reflects the health status of pilots at the moment of the examination, while health status is dynamically changing. The conditions(such as acute cardiovascular problem,) most likely to result in in-flight medical events usually occur during the period between routine examinations.

2.1.2 With the advancement of medical science and the application of evidence-based medicine, aeromedical standards have shifted their focus from requiring "absolute health" to "fitness to fly". However, many cases deemed fit to fly require continuous monitoring and long-term follow-up to intervene in potential risks in advance and ensure safety—a function that the current medical certification system lacks.

2.1.3 Another significant limitation of medical examination appraisal is its lag in the update of medical standards. Quite often, new medical standards are only considered to be formulated after serious accidents or incident have occurred. This means that the medical standards are often based on past experience and events, failing to keep pace with the emerging medical risks and new types of health problems in the aviation field.

2.2 Comprehensive-Loop Aeromedical Management Framework Based on SMS

2.2.1 This framework integrates SMS principles into all health-related aspects of the entire aviation safety system, including occupational entry, medical assessment, health promotion, and incident investigation,etc. In line with the principles of SMS, it relies on four core elements: safety policy and objectives, risk management, safety assurance, and safety promotion. Building on the foundation of medical examination, the framework carries out risk assessments, performs health-related safety oversight, reviews health-related safety performance evaluation results, and fosters a health safety culture.

2.2.2 By clearly defining the responsibilities of aviation medical examiners, medical assessors, operators, regulatory authorities, and medical certificate holders , this framework forms a multi-layered protection network involving "individuals - teams - organizations", which is a evidence-based, data-driven architecture to combine medical assessment, regulatory compliance, safety management, and health promotion initiatives into a continuously improving closed-loop.

2.3 Benefits of establishing an SMS-Based comprehensive-loop aeromedical management framework

2.3.1 SMS and health promotion share many commonalities in their core philosophies and methodologies. Both prioritize risk prevention and control, employing systematic and preventive approaches to enhance overall effectiveness. By integrating SMS, health promotion, and medical certification, SMS-Based comprehensive-loop aaeromedical mmanagement framework will enable the industry to more proactively, effectively, and comprehensively identify, assess, and mitigate medical risks, thereby enhancing overall aviation system safety.

2.3.2 SMS emphasizes proactive safety management by reducing the likelihood of accidents through preventive measures, rather than merely adopting responsive measures after incidents take place. With the rapid development of new aviation technologies and the increasingly pivotal role of human factors in complex operational environments, an SMS-based comprehensive-loop aeromedical management framework can adapt to new requirements and challenges in a more proactive and flexible manner. Through continuous optimization of health monitoring and evaluation of safety performance, it improves health and safety measures, enhances the efficiency and effectiveness of aeromedical management, refines relevant medical standards, and increases resource utilization.

2.3.3 The SMS-based aeromedical management framework can identify, assess, and control both short-term and long-term health-related risks in a more comprehensive, systematic and structural way. It goes beyond what existing medical examinations and medical assessment could cover, thereby enhancing pilots' health and well-being, extending their professional lifespan, reducing airlines costs , optimizing operational resilience and promoting sustainable development in aviation.

2.3.4 Moreover, this framework facilitates cross-departmental collaboration and information sharing , thereby cultivating a unified medical safety culture while ending stigma and discrimination associated with health issues. It also encourages closer interdisciplinary cooperation between aeromedicine and other fields such as aerospace engineering, psychology, and data science. Such

collaboration can lead to the development of more effective tools and methods for health risk assessment and management.

2.4 Guidance and Implementation

2.4.1 While an SMS-based aeromedical management framework will deliver a range of benefits for improving aviation safety, its effectiveness may be compromised if multiple stakeholders lack practical implementation guidance. Therefore, it is essential to formulate clear guidelines and build a widely recognized implementation framework. This will ensure that all stakeholders—including aviation medical examiners, operators, regulators, and pilots—not only understand how the framework operates but also clearly know their specific responsibilities within the system and the required competencies to accurately identify and analyze health-related risks and develop effective risk control measures to mitigate the risks.

2.4.2 This framework enables Member States to continuously improve the professional and systematic management of aviation medicine, ensure optimal maintenance of aviation personnel's health conditions, and promote the safe development of the entire aviation industry..Member States and stakeholders should utilize ICAO's guidance to actively develop and adopt new methods and tools for health risk assessment, contributing to a more scientific evaluation of aeromedical management effectiveness, ensuring the system remains adaptable to changing operational environments, and thus providing strong support for global aviation safety.

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to:

a) recognize that the rapid development of the civil aviation will continue to challenge existing aeromedical management frameworks, necessitating the adoption of SMS-based comprehensive-loop aeromedical management framework to effectively manage health-related safety risks while accommodating innovation;

b) support ICAO in developing guidance to assist regulatory authorities, operators, and medical examination organizations (if applicable) in establishing the framework of an SMS-based comprehensive-loop aeromedical management framework; and

c) support Member States in utilizing ICAO guidance to develop and adopt new and effective tools and methods for health risk assessment, so as to evaluate the effectiveness of aeromedical management.

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