ZRÍNYI MIKLÓS
NATIONAL DEFENCE UNIVERSITY
Doctorate Council

Lieutenant Colonel Alexander Andrew SZABÓ, M.D.

The qualification and training of military aircrew with special regard to NATO Standardization Agreements

(Considering the adaptation and maladaptation of cardiovascular system in complex simulated flight stress environment)

AUTHOR'S SUMMARY OF PHD DISSERTATION

and official reviews

BUDAPEST
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Scientific Leader:

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MAIN POINTS OF DISSERTATION

The DEFINITION OF SCIENTIFIC PROBLEM

Topicality of research

The Hungarian Home Defence Forces are now well on the way to put in service the JAS 39 GRIPEN multi-role combat aircraft, th last fighter aircraft with Hungarian signals has landed in January 2008 at Air Force Base Kecskemét. The problem of changing interceptor/combat aircraft type has emerged in other joining countries: the tender and the establishment for a new aircraft characterized by interoperability with combat flight technics of Allied Countries was really urgent. All the offers are excellent interceptor or combat aircrafts with high manoeuverability, brand new avionics and armaments.

High manoeuverability can be identified as a priority since the very beginning of military combat flying. At the same time – due to the multi task role of this aircraft generation - these aircrafts put a high demand on the pilots, requiring an increased and broad spectrum of performance from the operator. New navigation methods, armament deployment, communication tasks are also involved, as an integrant part of the air defence system the pilots are member of an information network, so the responsibility is increased for others as well.

The new technical solutions are at the cutting edge of human performance. In the dynamic approach of the **man (pilot) – environment – machine (aircraft) system** the man is once again the weakest link of chain. The analysis of aeromedical physiological reaction caused by new technical developments, the harmonisation of potencially dangerous challenges with physical and psychical characteristics of successfull pilot has led to a brand new and wide spectrum of aeromedical solutions and training requirements. The aim of these methods is to maintain the working capacity of the pilot, to protect him or her (tailored personally) during training flight or real combat deployment as well.

In the frame of NATO the human factor has overall priority, the standardised evaluation and protection of aircrew based on uniform principles is getting more and more important. New challenges and requirements for the flight surgeons to introduce common or uniform selection and training methods, to adopt new aspects of evaluation of fitness for flight, to manage exhaustion, to administer medications. These aspects are demonstrate the

colourful job of flight surgeon: qualification from the aspect of preventive medicine (work health), the training from the side of flight physiology specialist, while the medication or rehabilitation from the viewpoint of clinician might cause challenge. This complex process is organized by the NATO Standardization Agency and embodied in Standardization Agreements (STANAGs). This process what I would like to analyse and demonstrate.

The aim of research

1. Demonstration and analysis of the aeromedical challenges provoked by 4th and 5th generation fighter aircrafts. Systematic approach of error opportunity and probability, embedding into the dynamic evolution process of pilot error. For this purpose I also analyse the flight safety database as well. Furthermore I am going to demonstrate some key points of selection of the best pilot candidates, who are able for the highest level of physical and psychical performance, so less susceptible to make mistakes.

2. Analysis of NATO Standardization process, with special regards to the work and tasking of Aeromedical Working Group (presently Panel). I consider in details the national adoptation, ratification process, the possibility of the introduction of each STANAGs, without neglecting the problems.

3. In the context of STANAG 3114 („Aeromedical training of flight personnel") I emphasize and analyse our own statistics evolved during the new profile in the low –pressure chamber (barochamber), since 2004, when we introduce the new protocol for hypoxic demonstration at 7600 meters. (For the GRIPEN candidates the new altitude profile is 8000 meters for 4 minutes). I also demonstrate the importance of centrifuge (or Dynamic Flight Simulator) training, including the importance of AEA (Aircrew Equipment Assembly) protective garment against hypoxia and acceleration/overload. As a unique method, I compare the physiological data observed during the routine hypoxic test (performed at 5500 meters high) with the bicycle exercise test parameters using the monitoring system of Impedance Cardiography.

4. I am mentally committed to improve the pilot working capacity, fighting ability, to prolong his/her fitness to fly by all means, following the work of my professors and based on the functional diagnostic principles. For this purpose I am ready to investigate and recommend any benefit of changing lifestyle or introducing new therapeutic possibilities, medication. Through these methods I try to improve the international recognition of Hungarian military aircrew, their preparedness and readiness for deployment.

Methods of Reseaerch

In order to reach my aims:

I studied the technical-technological solutions of new aircraft generation. In my dissertation I analysed their effects on flight safety and the new challenges for the aviation medicine specialist. I demonstrated with examples the challenges emerged by development of military flight and the aeromedical answers. I draw the attention for the new problems as well: high speed and manoeuvreability in extreme altitude, dynamic G (acceleration and overload) vector modification require significant cardiovascular adaptation from the pilot.

I followed with attention the national and international scientific literature, collected information from scientific websites. I requested the opinion and experience of the active and retired Hungarian pilots: how the pilot work (and fighting method) has changed over the decades, how they could/can cope with physiological stressors.

In my practical research work I have adapted the clinical impedance cardiography method into a unique simulated stress situation, working out the protocol and perform all the measurements personally.

Going into details I have fully written up the aeromedical Standardization Agreements in order to evaluate their developments, compliance in content with the changing military technical parameters, deployment requirements and tasks. On the Working Group (later Panel) meeting, on behalf of the Chief Air Surgeon I successfully enforced the standpoint of Hungarian Home Defence Forces in specific debates.

I worked out all the relevant documents (especially Working Group 26 report of the NATO Research and Technology Organization (RTO/AGARD)) in order to analyse and compare the national guidelines for aircrew medication in each NATO countries. Based on these statistics and my own clinical practice and judgement I have outlined the rules of medication, the algorithm of possible introduction and periodical check-ups.

I have also utilized the knowledge obtained on the lectures of the PhD Institute in Military Technology. Especially gratefully I have builded in the Dissertation all the practical and theoretical knowledge what I have got at the Occupational Faculty of King’s College London, Aviation Medicine Diploma Course of Royal Air Force (RAF Henlow) in 1999.

THE EXECUTED RESEARCHES IN DIFFERENT CHAPTERS

1. In the **First Chapter** I analyse the new technical-technological solutions of modern fighter aircrafts, demonstrate the new physiological problems and the possible protective garments as technical solutions. I study the role and benefits of barochamber and centrifuge trainings, based on the air disaster statistics data related to lack of oxygene (hypoxia), G-LOC (loss of consciousness due to high Gs), and spatial disorientation: these are the main causes of pilot error with human physiological origin.

I conclude that – while the redundancy and reliability of technics / technical engineering solution are continously improving – the reliability of the pilot has not changed significantly (from cybernetic point of view). I confirm, that due to the high prioritiy of manoeuvreability the weakest point is the human being („as a suffering subject"). The challenge is the flight safety statistics, which emphasize the acceleration and disorientation problems (although the hypoxia in emergency situation also could cause fatal disaster). There is an urgent need for improvement of protective garments and training methods, to enhance the psychical and physical (operator) performance simultaneously and to reduce the number of adverse events.

The human error leading to disaster is examined in complexity: not only the physiological parameters but the mental-psychical breakdown can also occur, mainly in time constraint. The retrospective analysis of accident statistics could help in identifying the causes, in developing efficient countermeasures (on technical-technological, training-instruction and organizational levels as well).

I also give some details about the principles of selection and medical evaluation of candidates, about the trends of requirements in physical and mental parameters, about the efforts to prevent error possibilities. Overviewing the structure and timeflow of pilot error I find out, that as a dynamic process, more sources of error can interfere, coincide. Both the errors of perception and intention are of great importance, while some predisposing factors can promote the process. Interrupting the erroneous chain, decreasing the predisposing constituents, improving the perception-intention-action chain it is a real perspective to diminish the human role in airdisasters. That is the common aim of flight surgeon, flight safety specialist, psychologist and the pilot.

Presently we have no general, absolutely reliable, predictive examination or method to select the best candidate and exclude those, who have larger chance to suffer (or being involved in) disaster. It is justified by personality tests, that neurotic traits shold be avoided at

selection phase, but otherwise ambitious, motivated candidate could perform well, even if his/her personality introverted: better, than an extroverted, but risk-taking subject. We should consider some situation-dependent socialpsychological effects as well (cooperation, conformity, cockpit gradient, interpersonal communication, coordination). So we put emphasize on the complex psychological evaluation even at selection phase then at the annual folllow-ups. New possibility the use of simulators for conditioning /overdrill of mental - cognitive functions, measuring the accompanying stress level as well.

From the side of physical fitness I do recognize and support the sufficient level of aerob capacity; the pilots are obliged to fulfill the physical fitness requirements of the Army, including running distance and time limit, push-ups. But at the same time – like at the USAF – the low cardiovascular riskprofile (abdominal circumference, body mass index, BMI below 25 kg/m^2) is also very important. Over emphasized aerob capacity and running performance is not recommended: it might have adverse effect, diminishing G (acceleration) tolerance.

As a flight surgeon (and not a psychologist) I see the necessity for the future a very widely used combined psychological test battery, continously improving their predictivity, validity. Scientific, validated methods could guarantee only to find the balance between candidate number „offer" and military pilot „demand".

2. In the **Second Chapter** I go into details in Aeromedical STANAGs, analysing the standardization process as a general model, then going through all the 26 Agreements. I specially highlight the STANAG 3114, („Aeromedical training of flight personnel"), evaluate its introduction in our Institute. Analysing the experience and data of MiG 29 (Fulcrum) and JAS 39 (GRIPEN) pilots in barochamber at 7600 and 8000 meter altitude I compare our practice with other NATO countries' protocol.

Focusing on technical protection and training against hypoxia and acceleration (G-loads) I overview all the actually valid Agreements. I conclude, that while emphasis on the training against physiological stressors, I can not identify aspiration for standardizing selection process (neither on physical, nor on psychical side): it remains national responsibility.

Other Agreements deal with fatigue management, temporary flying restrictions due to exogenous factors affecting aircrew efficiency, medications. Our Aeromedical Manual, selection and qualification policy is well accepted in NFTC (NATO Flight Training in Canada) programme and in Sweden as well: so practically our qualification principles and

examinations are compatible with other NATO (and non-NATO) countries' standards and expectation.

We should further approach in standardization process: regular overview of aeromedical training of aircrew is a warrant. We should put greater emphasis on practical demonstrations. The present is the hypoxic training for GRIPEN, next step would be a disorientation training (GYRO) lab and NVG (Night Vision Goggles) table exercise. Centrifuge training is highly dependent on establishment: at the moment in Sweden for Gripen pilots it is correctly solved, later perhaps in Poland can be arranged. .

The cooperation with other NATO countries is a must (not only for centrifuge, NVG, but for dunken, practice for underwater breathing apparatus), otherwise we can ratificate these Agreements without implementation only. Closing this Dissertation the Hungarian Home Defence Forces have made ratification steps in 13 cases of the 26 STANAGs: in 5 cases full ratification, in 3 cases with reservation, in 5 cases ratification without implementation. We need stronger and continous cooperation and information exchange with flight engineers, pilots, aviation specialists of Joint Service Command (ÖHP) in order to plan the further steps (on-board oxygene system, CBRN (Chemical, Biological, Radiological-Nuclear) protection, NVG) in NATO compatibility improvements.

3. In the **Third Chapter** adopting and further developing the functional diagnostic view of my professors I have analysed the results of Impedance Cardiograph measurements registered in hypobaric/low pressure chamber and during pressure breathing test as well. I have investigated the extension of fitness for flight at pilot population with higher cardiovascular risk profile, with special regards on medication. For this purpose I have utilized the NATO RTO Research and Technological Organization database (Medication for Military Aircrew. RTO-TR-014 AC/323 (HFM-014)TP/14), the STANAG 3474 (Temporary flying restrictions), and STANAG 3526 (Interchangeability of NATO aircrew medical categories) dispositions and instructions.

I prove that in Aviation Medicine the preventive medicine aspect and the diagnostic – therapeutic intentions are simultaneously enforceable. As the discipline has developed over the decades, the utilization of the new measuring instruments, diagnostic tools could be justified in a very early stage, ready to validate, establish the indication. The final aim is to get the most information about the humans' performance in extreme environment, with their limiting factors, mental stress level.

From this viewpoint the organs of senses are especially important, the successfull information aquisition is fundamental for the safe flight mission. The other system of organs is the circulation, where the short term reflex responses and the long term adaptation are under investigation: different tools (longitudinal ECG, ambulatory blood pressure monitoring, tilting table test) are dedicated to monitorize reaction in hypoxia, during G-loads or microgravity.

A non-invasive method, the Impedance Cardiography can be used perfectly in two extreme (but in emergency flight situation easily occuring) situation: in hypoxia and during pressure breathing. The analysis of the highlighted parameters demonstrate the cardiovascular adaptation at reflex /response level.

At the same time for the initiative of the NATO RTO Working Group 26 our intention has been reinforced to overview the possibility of medication in pilot population and to wok out an algorithm for practical introduction.

Evaluating all the active ingredients against hypertonia and high blood lipids I compared with my own experience (as a specialist in internal medicine). I also took into account the possible interference with aeromedical physiological processes, which might downgrade performance, diminishing G and hypoxia tolerance. I also considered the possible side effects (drowsiness, nausea) which might reduce mental performance, deteriorating reaction times. My suggestions, recommendations were built in the directive of the Chief Air Surgeon, harmonised with clinical guidelines of Evidence Based Medicine.

It provides a firm base to start the medical treatment at special cases (pilots with higher cardiovascular risk profile, but otherwise in compensated state) and later to reinstate them in flying service (in Waiver status). Closing this Dissertation more than 13 pilots and other flying personnel have received their medication (antihypertenzives and lipid lowering agents) with close monitoring but restoring flying status.

CONCLUSIONS

The main points of the thesis

1. In the future warfare the combat aircrafts will have the highest priority, so the maintain and development of manoeuvreability (providing high speed, acceleration and altitude) is mandatory. The improvement of technical performance of fast jets is much faster than the

development of life support systems, including anti-G suits and altitude protective garments. The training methods are also lagged behind the technical requirements.
I summarized the main effects of altitude (hypoxia, decompression sickness), acceleration (G-loads), spatial disorientation. I listed the possible technical development trends and their physiological backgrounds, in order to prevent the incapacity of the weakest link of chain.

2. Based on the flight safety sstatistics I put in wider context the causes of incapacitation in emergency situation, analysing the different physiological and psycical aspects of pilot error.
   Demonstrating the dynamic course I have stated, that **the deficit of the human operator is attributed not only to the individual limiting factors** (like circulatory reflexes or time constraint) just before the disaster: **other training, methodological, organizational and interpersonal (socialpsychological) factors can be involved** as well quite easily, accidentally. The retrospective analysis of this process (as a re-active, objective investigation) is fundamental, involving the flight surgeon into the air accident investigation committee.

3. As the pro-active, preventive component of the accident process can be the development of selection criteria. From this aspect both the somatic (physical) aptitudes and limits, and the psychical capacity, the overall and momentary (emergency) stress tolerance should be thoroughly evaluated. I have analysed historically the evolution of selection criteria, I have compared the present physical and mental capacity requirements in different countries. I established, that for the appropriate physical endurance and **stamina against aeromedical physiological stressors the high (but not excessive) level of aerob capacity is general requirement.** In the objective evaluation of stress tolerance both the combined psychological tests and simulator practical trainings (overlearning) might be helpful.

4. The Air Force deployment missions and the military technical developments require integration and standardization in my specialization as well. I stated that the **Aeromedical STANAGs largely cover the methods related to training and protection of aircrew against physiological stressors**. They provide a common base for the pilot to prevent and react for the potential challenges, stress situation consciously, his/her mental and physical

performance would be adequate. These Agreements also define the common basic level of technical establishments, instruments, life support systems, CBRN and laser protection devices. The ratification of common principles of fatigue management, temporary grounding, interchangeability of aircrew, mutual acknowledgement of aeromedical national competencies can provide the pilot uniform qualification, continous medical control during deployments**. This step forward makes possible the participation in joint missions, integration of Hungarian pilots into Joint Task Forces, at the level of interoperability.** We have made some successful steps in NATO Flying Training in Canada programme and Gripen Transition Programme as well.

5. Regarding the Life Support systems the continous active technical development is a must, during which the study of physiological reactions in extreme conditions is necessary. New functional diagnostic methods like Impedance Cardiography (ICG) **could measure the most circulatory parameters in non-invasive method**, with external measuring and reference electrodes. By means of ICG it can be proved, that during hypoxia the absolute change in cardiac output and heart workload alone is not at extreme high level comparing to the bicycle exercise. **In the background of the potential collapse of circulation we could identify an adaptation disorder on reflex level.**

6. In order to provide a long successfull flight career we should be ready to diagnose and treat the pilots with higher cardiovascular risk profile, even in the early, symptom free phase. (They are not sick, it is a premorbid state.) By the adaptation of NATO medication principles, monitorizing the drug effects in flight stress situation, screening out the potential side effects which are incompatible with flying status **we can solve that medically treated pilots in waiver status can fly.** The **application of ICG for such monitoring purpose in simulated stress situation is also very useful** and informative.

NEW SCIENTIFIC RESULTS

Aviation Medicine as an independent discipline and important branch of military medicine has a definitely positive booster role in the dynamic relationship of military tehnical-structural-organizational spiral. For my activity I assess as new result the followings:

1. In the Hungarian military aviation medicine **for the first time I made an attempt** to summarize and explain the new challenges (stressors, technical solutions and training requirements) of the new generation of fighter aircrafts.
2. On the other hand **I have made efforts to harmonize the legal background** (Aeromedical Manual) with NATO principles as well **by the ratification of aeromedical STANAGs**. I have executed a huge analytical work and promoted the standardization process by substantial recommendations. With the ratifications of half of the Aeromedical STANAGs my contribution to the improvement of NATO interchangeability and interoperability of Hungarian aircrew is unquestionable.
3. I have suggested specific concrete steps to bring up-to-date the aeromedical practice and theoretical education, responsing for the high altitude physiological challenges: **the introduction of new barochamber profiles (at 7600 meter and 8000 meter high) is mainly attributable to my research and consultative work**. I have developed a safe and organized method to perform these protocols under close medical supervision in Hungary, till now free of adverse effects and events.
4. **By adaptation of the Impedance Cardiography in a new stress situation I have investigated the effects of hypoxia and pressure breathing on circulatory system.** I have proved the benefit (and long term applicability) of ICG and longitudinal ECG in evaluation of vegetative dystonia (instability), even after starting medication.
5. I have studied in details the possibility of medication of high blood pressure and blood lipids. Based on my experience in internal medicine and aeromedical physiology **I have put forward concrete proposals for starting the medication of pilots with high risk profile**, restoring their fitness for flight after a certain period of grounding. For the better characterization of possible vegetative instability in hypoxia after drug administration I have made proposals to utilize the Impedance Cardiography and longitudinal (24-48 hours) ECG monitoring systems.

PRACTICAL AVAILABILITY OF THE NEW SCIENTIFIC RESULTS, RECOMMENDATIONS

By the leadership of Chief Air Surgeon my proposals are the followings:

1., Broaden the spectrum of the functional diagnostic tests and aeromedical physiological demonstrations, despite of the financial burden. The new barochamber protocols can be extended for new military aircrew categories like on-board personnel of AWACS (Airborne Early Warning and Control aircraft) aircrew and SAR/CSAR (Combat Search

and Rescue) flight personnel, including basic theoretical lectures about aeromedical topics. Taking into account of spatial disorientation as a leading cause of air accidents I suggested the GYRO simulator trainings as well.

2., I strongly support the gradual and cautious broaden of medication for more aircraft types and aircrew categories, according with clinical guidelines and morbidity statistics.

3., I have specific recommendations for step forward in standardization agreements related to hypoxic and centrifuge trainings, preparation for NVG use, NBC and laser protection.

4., I would like to share my research results and personal experiences with the pilots as well in order to demonstrate the aeromedical stressors more efficiently, improving further the flight statistics.

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23. S. A. Szabó, J. Hornyik, A. Grósz, E. Tóth, Zs. Tótka, Zs. Szamek: *Life science and human performance – research activity in space medicine* . ESA Workshop Kecskemét, 2004. szeptember 28.

24. S.A. Szabó, A. Grósz, Zs. Tótka, E. Tóth, Z. Vámosi, S. Kada: *Diagnostic and Therapeutic Possibilities in Cardiovascular Risk Management of Flight Personnel*

International Conference on Aerospace Medicine and 1st Annual International Forum on Disaster Medicine . Kassa, 2004. június 15-18.

25. Szabó S.A.: *Negyedik generációs vadászgépek; új követelmények az eü. minősítés, a kiképzés és az életfenntartó rendszerek vonatkozásában.*
„Válogatott fejezetek a repülő- és űrorvostanból (haladó szintű repülőorvosi tanfolyam a JAA előírásai szerint repülő-szakorvosok számára) „
Kecskemét-Budapest, 2003. október 13-22.

26. S. Szabó, Zs. Tótka, A Grósz, E. Tóth, J. Hornyik, M. Dudás, Zs. Szamek: *Evaluation of Autonomous Dystonia And Assessment of Endothel Dysfuncion In The Aeromedical Evaluation Process: Possibilities of Drug Treatment*
(Conference) 51st International Congress of Aviation and Space Medicine (ICASM) Madrid, 2003. október 5-9. (Poster)

27. S. Szabó, Zs. Tótka, E. Tóth, J. Hornyik, Zs. Szamek: *Assessment of Endothelia Dysfunction in the Aeromedical Evaluation Process, Possibilities of Drug Treatment.*
(Conference) 50th Anniversary of the Foundation of Institute of Aviation Medicine, Prague, 2003. május 26-28. (Poster)

28. Szabó S. A., Pászti Zs., Hornyik J.: *Különleges repülési módok pszichofiziológiai vonatkozásai.* Magyar Repülő- és Űrorvosi Társaság és a SZTE ÁOK Repülő- és Űrorvosi Tanszék közös tudományos konferenciája, Kecskemét, 2003. ápr. 25.

29. Szabó S.A., Tótka Zs., Szamek Zs., Dudás M.: *Az endothel diszfunkció értékelése a repülőalkalmasság elbírálásakor, gyógyszeres befolyásolásának lehetőségei*
MH OTT 2003. évi Tudományos Konferenciája Budapest, 2003. március 12.

ASPIRANT'S SCIENTIFIC- PROFESSIONAL CV

1962: I was born in Debrecen.

1981–1987: University of Medicine, Debrecen, graduation with „summa cum laude" qualification. Degree issued on 19th September, 1987.

1987-1990: Regimental flight surgeon at the Medical Center of the Air Force Base Kecskemét. I was responsible for the medical care of the special flying personnel, and the whole regiment as well.

1987–1991: Institute of Aviation Medicine, Kecskemét, Specialist in Aviation Medicine Degree issued on19th November, 1991.

1991-1997: Aeromedical Hospital, Kecskemét, University of Medicine, Debrecen, Specialist in Internal Medicine, Degree issued on 27th November, 1997.

1998–2000: Semmelweis University of Medicine, Budapest, Specialist in Military and Disaster Medicine, Degree issued on 24th May, 2000.

1999: King's College London, Faculty of Occupational Medicine, Royal Air Force Henlow, Centre of Aviation Medicine, Diploma in Aviation Medicine. Degree issued on 7th July, 1999, and honoured by Barbara Harrison Memorial Prize.

1997-2005: Experience in performing cardiovascular exercise tests, including treadmill and bicycle ergometry tests, HOLTER longitudinal ECG examinations, evaluating of tolerance to hypoxia in barochamber. Duty at the Emergency Care Department of the Aeromedical Hospital.

2000- 2003: Correspondence student at PhD Education and Training programme at Zrínyi Miklós National Defence University.

2001-to date: Research in aviation physiology and aeromedical cardiovascular aptitude tests. As a senior lecturer of the Faculty of Aviation and Space Medicine, Medical University Szeged: lectures on special (graduate and postgraduate) courses for medical students and doctors preparing for special diploma in Aviation Medicine. Participation in Examination Board activity.

2005- to date: as the head physician of Aeromedical Research Department (from 1st of July, 2008 as the deputy director of the Aeromedical Screening and Research Institute of the „Dr. Radó György" Military Healtcare Center) Participation in clinical diagnostic examinations and scientific research work as well.

Other Courses & Meetings: Standing representative of Hungary in NATO Aeromedical Working Group and Panel (regular participant at meetings in NATO HQ Brussels and other conferences hosted by member nations.) Participant and lecturer on Military and Aviation Medicine Conferences in Beijing 1996, Vienna 2000, Warsaw 2005, Vienna 2007.

Languages and Certificates: Upper level State Certificate in English (1993), Intermediate level State Certificate in German (1996), High Intermediate level State Certificate in Russian (1985), STANAG (military English) 3.3.3.3. (2005).

Professional Memberships: Member of the Medical Association of Cardiology, Member of the Medical Association of Aviation Medicine, Member of the Aeronautical Society, Member of Hungarian Chamber of Medical Doctors.

Computer Skills: Microsoft Word, Excel, Power Point, MARS/Burdick Vision/Hellige Longitudinal ECG programs, Hellige/Marquette exercise test computer systems.

25. August, 2008.

(Lt.Col. Alexander SZABÓ, M.D.)

aspirant

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