The 2019 WACEM and Academic College of Emergency Experts India Position Paper on Developing the Academic Department of Space Medicine in India – The Time Has Come!

The Prime Minister of India in August 2019 announced that India will send astronauts into the space by 2022 in its indigenous spacecraft “Gaganyaan” and also that India will have its own Space Station by 2030.[1,2] Ever since Indian Space Research Organization (ISRO) built its first satellite Aryabhatta in 1975, ISRO has come a long way and has successfully sent Chandrayaan-1 and Mangalyaan to the Lunar and Mars orbits, respectively. The Chandrayaan-2 has met with huge success although there were uncertainties about the last touchdown of Vikram rover. There are no doubts on ISRO’s technological capabilities in sending successful missions including Gaganyaan and Space Station to the space in the future.

Space stations are satellites that remain in low earth orbit and are used to study the effects of long-term space travel on the human body. Varied types of research activities are being carried out by countries to prepare humans for deep space travel. Space Medicine (SM) is the science that deals with the effects of space travel on the human body and includes all aspects of connected sciences.

Success of India’s human mission in the space depends heavily on a legitimate SM research powered by an Academic Department of SM. The whole world is trying to solve the puzzle of long-distance space travel and its ill effects on various domains of human life. Indians are good at space technology, and they have shown their mettle to the world repeatedly, but now the time has come to send humans into the space, and we need dedicated researchers and SM specialists to cover all aspects of space travel and safe return for the Indian crew.

The efforts of the Institute of Aerospace Medicine (IAM) are worth mentioning here. The selection procedure and physiological recording of our space crew Squadron Leader Rakesh Sharma were carried out by IAM in 1984.

While India is looking to send first of its four-member crew into the space that will be selected from 200 fittest of Air Force pilots, the world has already moved into an era of space tourism. At least seven self-funded space tourists have now spent time in the International Space Station (ISS). The space tourists were older than routine astronauts, and three of them had multiple medical problems that were adequately covered by the SM doctors on the ground.[3,4] The medical community of the ISS has published medical standards for self-paid space tourists and used by the ISS medical certification board to determine medical eligibility of individuals other than professional astronauts (cosmonauts) for short-duration space flight to the ISS.[5]

The space travel for the purpose of tourism is going to open up for more and more civilians with all types of diseases. The impact of space travel, including microgravity on these populations, is yet to be seen.[6] One of the civilian space travelers had moderately severe bullous emphysema, previous spontaneous pneumothorax with talc pleurodesis, a lung parenchymal mass, and ventricular and atrial ectopy. For certification, his medical evaluation required monitoring conducted in analog spaceflight environments, including altitude chambers, high altitude mixed-gas simulation, Zero-G aircraft, and high-G centrifuge. To prevent the recurrence of pneumothorax, he underwent video-assisted thoracoscopic pleurodesis and to assess the lung masses, several percutaneous, or direct biopsies. The candidate’s 10-day mission to ISS was without incident.[6] More and more such travel by human travelers with compromised physiology is foreseeable in far future. The studies done on extremely fit astronauts may not apply to these individuals.

As of now, the ISRO has signed a memorandum of understanding with the IAM to conduct preliminary research on the needs of the crew and the development of training facilities.[7] The IAM has been running a Medical Council of India (now National Medical Commission) recognized MD course primarily dealing with the aeronautics, suborbital flights, and aviation-related health issues.[8] The IAM has now been entrusted to deal with the effects of microgravity and time spent in space on the human body. Now IAM is planning research in several aspects of Space Physiology including cardiovascular physiology and SM in India.[9] For ≥5 years, the Department of Physiology, All India Institute of Medical Sciences (AIIMS), New Delhi, has been conducting research in space physiology-related topics such as effect of lower body negative pressure (LBPN, a countermeasure of microgravity) on cardiovascular physiology and brain autoregulation, as well as developing gravitational loading and unloading protocols in humans and microgravity simulation in rodents.

India needs to develop an advanced research and teaching facility in the field of SM. Further, it will be worthwhile to develop advanced courses in Space Biology and SM in the form of PhD and DM courses at its Apex Institute, the AIIMS, New Delhi. The demand for physician’s expert in the field of SM is going to increase in the near future in India, not just for the certification of astronauts but also to cater the needs of space tourism that has now become inevitable. It is high time that
ISRO, AIIMS, Indian Council of Medical Research (ICMR), Department of Science and Technology (DST), Department of Biotechnology (DBT), Indian Air Force, and the Academic College of Emergency Experts (ACEE) India join hands to develop SM course at AIIMS, New Delhi.

These specialists must be given exposure at international level in the established field of SM, the certification pathways for space travelers and must be involved in collaborative research and publications on SM. Countries such as United States (US) and Russia have been active in this specialty for long. In 1990s, Russian cosmonauts performed 312–438-day mission on Mir Space Station.\[10\] The only operational crew space station currently in the orbit is the ISS launched in 1998 with a total 226 visitors till date, including 149 from the US, 47 from Russia, 9 from Japan, 8 from Canada, and 23 from 14 other countries having a cumulative space-time of 6808 days till date.\[11\] The stay on ISS and research being carried out, there is considered an important step toward interplanetary missions being planned in the future.

Environmental challenges to humans during space travel depend on whether the type of spaceflight is suborbital, low earth orbit (<48 h or >48 h), or beyond earth’s orbit (lunar and interplanetary).\[6\] Since the crew members ought to have truly normal (desirably superior to normal) physiology, the changes envisaged will be falling in the range of “Physiological Reserve.” The prominent medical challenges include neurovestibular dysfunction, anxiety and psychological problems, plasma volume shifts, cardiovascular deconditioning, bone and muscle loss, renal stone formation, spaceflight associated neuro-ocular syndrome, and renal and other changes.\[6\] The environmental challenges such as confinement, noise, acceleration, vibration, microgravity, radiation, and isolation are equally important considerations for space travelers.\[6\]

SM research includes effects of microgravity, cosmic radiation, and prolonged duration in space on not only on physiology but also at genetic level, microbiota, nutrition, and psychology of humans. Another exciting area of research to enable long-duration space flights includes suspended animation and synthetic torpor. In nature, many animals naturally and reversibly exploit an analogous hypometabolic state, torpor, to save energy. The term synthetic torpor was introduced recently to describe the artificial induction of torpor in species that do not normally use it.\[12\] The country that is able to develop this technology of suspended animation or torpor will be the undisputed leader in future space travel.

The US Government has announced its plans of a crewed mission to Mars in 2030s, and a private company in the US by the name SpaceX is planning to establish a base on Mars in 2020s.\[13\] Interplanetary missions have their own medical challenges. For the lower orbit or suborbital mission, remote emergency medical help can be provided through telemedicine. Evacuation is also possible from the ISS in case of a medical emergency. Unfortunately, these options do not work for an interplanetary mission like Mars. The delay in communication time from Mars to earth is in several minutes, and thus neither telemedicine nor evacuation to earth would be a viable option for people traveling to Mars. Ideally speaking, it would thus be prudent to have an onboard doctor, and the natural choice for type of medical professional for these missions is an Emergency Medicine (EM) specialist. EM specialists are trained in working on almost all types of emergencies and can handle life-threatening emergencies better than any other specialist working alone. EM physician can be supplemented by a general surgeon, in case, a life-saving surgery is needed onboard (both have to serve as astronauts as well).

India is planning to send its first batch of cosmonauts to the space in 2022, and it is logical to think that soon it will be followed by more people from India going to space as a part of tourism. With its space station in place by 2030, space travel to low earth orbit will become a regular feature for Indians.\[1,2\]

Now is the time when the Indian Government should be planning a dedicated Department of SM, giving out DM and PhD degree in SM. The eligible candidates should be the MD EM, MD Medicine, MD Pulmonary Medicine, MD Aerospace Medicine (from IAM), and MD Physiology. Furthermore, the department needs to be housed in a medical institute that has the capability to do high-quality research in human physiology, psychology, pathology, genetics, immunology, microbiology, nutrition, EM, microgravity, ophthalmology, cardiology, neurology, telemedicine, simulation, sonography, and artificial intelligence. These varied specialties and capability to do research under one roof are available at AIIMS, New Delhi; thus it is the right place for starting DM/PhD in SM in India.

To conclude, SM is an integral part of any space exploratory program where humans are being sent out into the space. Space tourism is now a reality, and more and more people who have multiple diseases are willing to pay to enter the space. India is soon going to have its own space station and thus development of an Academic Department of SM is the need of the time. High-quality research is the key to become a leader in space travel. AIIMS, New Delhi, in association with ISRO, Indian Air Force, ICMR, DBT, DST, and ACEE, India, should jointly develop this highly needed specialty of DM/PhD SM for Indian space travel needs.

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