Application of Emerging Pharmaceutical Technologies for Therapeutic Challenges of Space Exploration missions

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An important requirement of therapeutics for extended duration exploration missions beyond low Earth orbit will be the development of pharmaceutical technologies suitable for sustained and preventive health care in remote and adverse environmental conditions. Availability of sustained, stable and targeted delivery pharmaceuticals for preventive health of major organ systems including gastrointestinal, hepato-renal, musculo-skeletal and immune function are essential to offset adverse effects of space environment beyond low Earth orbit. Specifically, medical needs may include multi-drug combinations for hormone replacement, radiation protection, immune enhancement and organ function restoration. Additionally, extended stability of pharmaceuticals dispensed in space must be also considered in future drug development. Emerging technologies that can deliver stable and multi-therapy pharmaceutical preparations and delivery systems include nanotechnology based drug delivery platforms, targeted-delivery systems in non-oral and non-parenteral formulation matrices. Synthetic nanomaterials designed with molecular precision offer defined structures, electronics, and chemistries to be efficient drug carriers with clear advantages over conventional materials of drug delivery matricies. Nano-carrier materials like the bottle brush polymers may be suitable for systemic delivery of drug cocktails while Superparamagnetic Iron Oxide Nanoparticles or (SPIONS) have great potential to serve as carriers for targeted drug delivery to a specific site. These and other emerging concepts of drug delivery and extended shelf-life technologies will be reviewed in light of their application to address health-care challenges of exploration missions. Innovations in alternate treatments for sustained immune enhancement and infection control will be also discussed.