From space to ICU:

The expanding role of human hypometabolism

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Across time and culture, the idea of a healing sleep, where the body endures without ageing, starving, or dying, has captured the human imagination. But in the animal kingdom, it's not fantasy. Each year, millions of creatures enter torpor, surviving bitter seasons by pressing pause on life. Now, this strategy is being studied not as a metaphor, but as a method.

Hibernation, once relegated to science fiction, is increasingly grounded in scientific fact. The ability to deliberately slow human metabolism, known as induced hypometabolism, is advancing through experimental research and early human applications. From hospital ICUs to astronaut training centres, scientists are exploring how to apply the biology of hibernation to human care. It's a kind of time travel, not through space, but through danger, buying precious time to intervene, heal, and survive. From trauma medicine to organ transplantation, from mass casualty response to long-duration spaceflight, the controlled slowing of metabolism could become one of the most consequential biotechnologies of the century.

There is growing urgency at institutions worldwide to translate the biology of hibernation into viable human applications. Researchers at the Translational Research Institute for Space Health (Trish) and the University of Pittsburgh are pioneering the use of controlled metabolic suppression in human subjects through gradual strategies referred to as 'shallow torpor.' These efforts build on established practices such as therapeutic hypothermia and anaesthesia, alongside insights from naturally hibernating species.

Picture this

Government agencies are recognising the operational value of metabolic suppression and accelerating investment in this area. National Aeronautics and Space Administration (NASA) has identified hypometabolic states as a promising countermeasure for four of the five greatest health hazards of long-duration spaceflight, including radiation exposure, metabolic strain, muscle and bone degeneration, and psychological stress. Making it no longer a cinematic concept but a necessary tool for enabling human survival in deep space. The European Space Agency has launched its own parallel research efforts, and military programmes such as the US Defense Advanced Research Projects Agency (DARPA)'s Biostasis initiative are investigating how to extend the "Golden Hour" after trauma by temporarily slowing biological time through non-temperature-dependent hypometabolism. Whether in orbit, in combat, or in disaster zones, the strategic value of metabolic control is becoming clear.

The alarm blares in the control module. A systems failure has triggered a cascade: oxygen levels are falling, carbon dioxide is rising, and the return path is cut off. There's no immediate rescue, just calculations, dwindling resources, and time running out. For astronauts aboard a damaged space station, miners trapped deep underground, or a submariner sealed beneath the sea, survival becomes a race not against the environment, but against their own biology. In these moments, one radical possibility emerges: what if we could slow the body itself, reduce its need for oxygen, pause cellular damage, and stretch life long enough for help to arrive? This is no longer the premise of a sci-fi thriller. It is becoming a real-world response strategy, as research transitions from theoretical models and animal studies into human-centred design. A stepwise emergency protocol is now in development to apply hypometabolism as a practical intervention for critical situations where oxygen is limited and time is scarce. These include spacecraft and space stations like the ISS, future lunar or Martian habitats, submarines and underwater facilities, mining collapses, and other closed systems where oxygen is limited and evacuation is difficult.

Combining pharmacological agents with environmental and physiological cues, the protocol is engineered to safely induce a reversible low-metabolism state. It represents a turning point where decades of foundational science converge into a usable tool for crisis survival. Whether in orbit, under the sea, or deep below the Earth's surface, hypometabolism may soon offer a new kind of first aid. One that preserves life not by acting faster but by slowing it down.

While scenarios involving spaceflight, deep-sea missions, or underground entrapment are high-stakes and compelling, they remain relatively rare. The number of lives directly affected by such emergencies is limited. Yet the potential of hypometabolism extends far beyond these isolated crises. The same physiological principles that could preserve an astronaut or a trapped miner also offer powerful tools for mainstream medicine. Slowing metabolism has the potential to benefit millions by extending the window for trauma care, improving

outcomes in cardiac arrest or stroke, enhancing organ and tissue preservation through improved cold storage and metabolic stabilisation, and reducing damage from ischaemia-reperfusion injury and post-resuscitation inflammation. In surgical contexts, it may offer intraoperative protection during procedures that require circulatory arrest or limited perfusion.

Hypometabolism is also being explored as a protective strategy against radiation, both in the context of accidental or acute exposure and as an adjunct to cancer treatment, where it could help mitigate the side effects of radiotherapy by reducing tissue vulnerability. Beyond acute care, metabolic adaptations observed in hibernating species may inform new therapies for chronic conditions such as diabetes, kidney disease, and neurodegenerative disorders. What began as a strategy for survival in extreme conditions is now being explored as a platform for transforming care across the entire medical spectrum, fuelling the interest of researchers around the world and drawing increasing support from competitive grant programmes from the military and health sectors.

Recognising the growing momentum of this field, Hiberia was established to bridge the critical gaps in communication, collaboration, and knowledge integration across disciplines. While interest in hypometabolism is expanding, much of the research remains siloed, spread across molecular biology, neuroscience, aerospace medicine, critical care, and pharmacology, with no common infrastructure to co-ordinate progress. It was created to meet that need. It is an open-science platform supported by artificial intelligence and designed to unify and amplify global efforts in hibernation research. Its goal is to empower scientists and clinicians to share knowledge, integrate findings, and collectively accelerate the transition from scattered innovation to co-ordinated advancement, bringing the promise of human hibernation technology closer to reality.

The concept took shape during a deep literature review that began with a simple question: how close are we to making hibernation a reality for humans? What emerged was not only the breadth of scientific progress but also the need for a structured environment where that knowledge could be made actionable. Inspired by the collaborative spirit that defined the global scientific response to the Covid-19 pandemic, and modelled after the co-ordination strategies of international space agencies such as NASA's Open and Citizen Science models, the platform seeks to cultivate a similar ecosystem for hibernation science.

Its foundation rests on three pillars. First, a structured, open-access textbook distils the current state of knowledge across disciplines in a format designed for clarity, accessibility, and cognitive efficiency. Second, an AI-powered assistant allows researchers to query this body of knowledge and receive multilingual, evidence-based responses drawn from curated literature. Third, the platform serves as a digital meeting ground, fostering international collaboration through shared protocols, community peer review, and modern communication tools, fuelled by the collective energy that brings humans together around a common goal, where the outcome is greater than the sum of its parts.

By improving accessibility and enabling cross-sector collaboration, this platform is helping transform isolated discoveries into unified scientific momentum, like individual fuel cells aligning to launch a single rocket. When co-ordinated with purpose, even scattered breakthroughs across unrelated disciplines can generate the thrust needed to propel humanity into a new era of medicine. The future of hypometabolism hinges not just on scientific discovery, but on our ability to co-ordinate it.

For scientists exploring cellular pathways, clinicians innovating in emergency care, or institutions funding the next frontier of medicine, Hiberia is an open invitation to join a growing movement. In an era of converging crises and technological acceleration, the question is no longer whether human hibernation is possible, but how we make it real, safe, and ready when it's needed most.

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