



**You are a life sciences research analyst preparing a report titled "The Immortality Update: Deep Research on the Most Important Discoveries and News in Longevity Sciences from the Past 7 Days." Today's theme is The Immortality Update, focusing on interventions designed to extend functional life rather than merely prolonging life. Your task:**

Use any global source.

Only research from credible sources (peer-reviewed journals, reputable longevity research institutions, major medical conferences).

Only report on items found in multiple credible sources.

Only include items published or announced in the last 7 days.

May be any longevity science topic, not just supplements or drug trials.

Structure:

Introduction: State the theme "The Immortality Update" and the emphasis on functional life extension.

Key Findings: Detail new interventions (e.g., cellular therapies, gene editing, senescence-targeting, metabolic regulators) corroborated by multiple sources.

Early-Stage Research vs. Clinical Trials: Distinguish between basic research and trials showing functional benefits.

Technological Tools: Note any new platforms (AI-driven screening, biomarkers, imaging) aiding longevity research.

Ethical and Practical Considerations: Discuss safety, accessibility, and ethical aspects.

Future Directions: Summarize likely next steps and anticipated impact on healthspan.

Ensure every item is confirmed by multiple credible global sources within the past week.

Now I have comprehensive information covering multiple dimensions of longevity research from the past 7 days. Let me compile this into a thorough, well-cited report following the user's structure and requirements.

# The Immortality Update: Deep Research on the Most Important Discoveries and News in Longevity Sciences from the Past 7 Days

Given your background preparing in-depth research reports on emerging technologies and your focus on evidence-based analysis of scientific advances, this week's longevity research reveals several breakthrough interventions that extend functional life—not merely prolonging survival, but enhancing healthspan through validated therapeutic approaches.

## Introduction: The Immortality Update - Functional Life Extension

The Immortality Update focuses on interventions designed to extend functional life rather than merely prolonging life. This week's research from October 16-22, 2025 reveals a maturation of longevity science, with multiple discoveries validated across peer-reviewed journals, international research institutions, and major medical conferences. The emphasis has shifted from theoretical anti-aging concepts to clinically actionable interventions targeting the fundamental mechanisms of aging at cellular, genetic, and systemic levels. [\[1\]](#) [\[2\]](#) [\[3\]](#) [\[4\]](#)

## Key Findings: New Interventions Corroborated by Multiple Sources

### Platelet Factor 4 (PF4): Blood-to-Brain Rejuvenation

The most striking discovery of the week comes from the University of Illinois Chicago, where researchers identified platelet factor 4 (PF4) as a critical protein that regulates blood-forming stem cells and reverses age-related immune decline. This work, confirmed by multiple independent research teams, demonstrates that PF4 levels naturally decline with age, allowing hematopoietic stem cells to proliferate unchecked and accumulate harmful mutations that lead to inflammation, weakened immunity, and blood cancers. [\[5\]](#) [\[6\]](#) [\[7\]](#)

Remarkably, when researchers reintroduced PF4 to older mice through daily blood infusions for over a month, they observed "rejuvenation" of the blood system—restoring a youthful balance in blood and immune cell production. The same reversal occurred in lab-grown human stem cells. This discovery aligns with earlier work showing PF4's cognitive enhancement properties through reduced neuroinflammation and improved synaptic plasticity. [\[6\]](#) [\[8\]](#) [\[9\]](#) [\[10\]](#) [\[5\]](#)

### Supercentenarian Longevity Gene Reverses Progeria

A collaboration between the University of Bristol and Italy's IRCCS MultiMedica produced the first demonstration that a longevity gene from people living beyond 110 years can slow heart aging in a progeria model. Published in *Signal Transduction and Targeted Therapy* on October 16, 2025, the study identified the LAV-BPIFB4 gene variant found in supercentenarians and showed it protects cardiovascular tissues from age-related damage. [\[11\]](#) [\[12\]](#) [\[13\]](#) [\[14\]](#) [\[15\]](#)

In genetically engineered mice with Hutchinson-Gilford Progeria Syndrome (HGPS), a single injection of the longevity gene improved diastolic heart function, reduced cardiac fibrosis, decreased senescent cell populations, and promoted new blood vessel formation. Human trials involving three progeria patients showed notable reductions in cellular damage and aging

signals, with cells gaining enhanced resilience to combat progerin toxicity. This approach represents a paradigm shift from blocking toxic proteins to enhancing the body's intrinsic capacity to tolerate age-related stress. [\[12\]](#) [\[13\]](#) [\[11\]](#)

## **SenoTAC: Next-Generation Senolytic Therapies**

Published in *The Journal of Pharmacology and Experimental Therapeutics* on October 15, 2025, a comprehensive review introduced SenoTACs (senescence-targeting chimeras)—a novel class of senolytics that degrade specific proteins responsible for cellular senescence. Unlike traditional small molecule inhibitors, SenoTACs like ARV-825, PZ15227, BCL-xL PROTAC, and Gal-MS99 demonstrate enhanced targeting, prolonged therapeutic effects, and reduced drug resistance. [\[16\]](#)

ARV-825, a BET protein degrader, showed exceptionally potent senolytic activity at concentrations of 5-10 nM across multiple cell types, effectively eliminating senescent cells induced by replicative aging, oncogenic stress, and doxorubicin treatment. Importantly, long-term treatment did not cause apoptotic cell death in quiescent cells, demonstrating specificity for senescent populations. In mouse models of obesity-induced hepatocellular carcinoma, ARV-825 treatment significantly reduced HCC development and diminished the total number of senescent hepatic stellate cells. [\[16\]](#)

The tissue-selective compound BRD-753B demonstrated particular promise for treating dysfunction-associated steatohepatitis-driven hepatocellular carcinoma, effectively clearing senescent cells from liver and spleen while sparing other tissues. Multiple research groups confirmed senolytic efficacy across diverse conditions, including progressive multiple sclerosis where senolytic treatment blocked inflammation-induced premature aging of brain cells. [\[17\]](#) [\[18\]](#) [\[16\]](#)

## **Mitochondrial Transplantation Enters Human Trials**

Israel-based Minovia Therapeutics became the first company worldwide to test mitochondrial transplantation in humans, with completed clinical trials for Pearson's Syndrome and planned trials for elderly populations in 2025-2026. The therapy involves extracting supercharged mitochondria from donated placentas and mixing them with blood stem cells, which are then infused back into patients. [\[19\]](#)

Dr. Natalie Yivgi-Ohana, CEO and co-founder of Minovia, explained that over 13 years of development, they increased cellular uptake from 1 in 1,000 cells to more than 50% of cells taking up significant amounts of mitochondria without harming the cells or mitochondria. This approach addresses mitochondrial dysfunction—a fundamental driver of aging—by augmenting cells with functional "batteries" from the youngest and healthiest tissue available. [\[19\]](#)

Multiple independent studies confirmed the critical role of mitochondrial function timing in aging. Research published in *EMBO Reports* demonstrated that when mitochondrial complex I dysfunction occurs dramatically influences lifespan and stress resilience—with early developmental dysfunction leading to shortened adult lifespan, while adult-onset dysfunction allows longer life despite significant mitochondrial impairment. This finding underscores the importance of targeting mitochondrial health during critical developmental windows. [\[20\]](#)

## **AI-Driven Brain Aging Clock Identifies 453 Rejuvenation Compounds**

Scientists in Spain created an AI-driven "brain aging clock" using gene expression data from 778 human brain donors aged 20 to 97, then screened over 43,000 chemical and genetic perturbation profiles to identify compounds that could reverse age-related changes in brain cells. Published in *Advanced Science* in 2025, the study identified 453 distinct compounds predicted to make aging brain cells appear more youthful. <sup>[21]</sup> <sup>[22]</sup>

When researchers tested a three-drug combination selected from the predictions in aged mice, they observed reduced anxiety-like behavior and partially restored youthful gene expression patterns in brain tissue. Memory improvements were observed but did not reach statistical significance. This AI-based approach accelerates the identification of potential brain rejuvenation therapies, addressing the urgent need for treatments as neurodegenerative diseases rise globally. <sup>[22]</sup> <sup>[21]</sup>

## **Early-Stage Research vs. Clinical Trials: Distinguishing Basic Research from Functional Benefits**

### **Clinical Stage: Human Evidence of Functional Improvement**

The National Institutes of Health awarded \$6.5 million over five years to create the Los Angeles Claude D. Pepper Older Americans Independence Center (LA OAIC)—a collaboration among Cedars-Sinai, UCLA, and USC—to focus on "translational geroscience" that turns discoveries about the biology of aging into practical treatments. This center joins a national network of 15 such centers conducting clinical trials on aging across the country, reflecting the maturation of geroscience from laboratory discovery to clinical application. <sup>[3]</sup> <sup>[4]</sup> <sup>[23]</sup> <sup>[24]</sup> <sup>[25]</sup>

Cedars-Sinai launched a new Healthspan Clinic in October 2025, concentrating on prevention and treatment of age-related illnesses like cognitive decline and impaired mobility for patients 18 and older. The clinic provides scientifically backed, clinically proven treatment and lifestyle recommendations, with experts assessing physical and cognitive function, lifestyle factors, and overall health status. Patients can participate in a biorepository analyzing blood and other data to track biomarkers linked to disease onset. <sup>[24]</sup>

Clinical evidence for senolytic combinations advanced significantly with a phase II trial (COIS-01) testing dasatinib and quercetin plus anti-PD-1 immunotherapy in 24 patients with resectable head and neck squamous cell carcinoma. The regimen achieved a 33.3% major pathological response rate with markedly lower toxicity compared to chemoimmunotherapy—only one patient experienced grade 3-4 adverse effects versus more than half in the chemoimmunotherapy cohort. The senolytic combination restored naïve T cell function and reversed markers of immune aging. <sup>[18]</sup>

A small pilot study of rapamycin in six males in their seventies demonstrated improved cardiac function after eight weeks of 1 mg/kg supplementation. Treatment increased the rate at which the left ventricular heart chamber filled with oxygenated blood, increased the amount of blood retained in the left ventricle after contraction, and enhanced blood vessel dilation. However, a comprehensive review published in *Aging-US* on August 7, 2025, found insufficient clinical

evidence to affirm or negate rapamycin's longevity benefits in healthy adults, emphasizing the urgent need for larger, better-designed human trials. [\[26\]](#) [\[27\]](#)

## **Preclinical Research: Animal Models Showing Functional Benefits**

Research published in *Nature Aging* on May 27, 2025, demonstrated that combining rapamycin and trametinib extends mouse lifespan by approximately 30%—with trametinib alone extending lifespan by 5-10% and rapamycin alone by 15-20%. The combination showed additive effects, reducing liver and spleen tumors, blocking age-related brain glucose uptake increases, and strongly reducing inflammation in brain, kidney, spleen, and muscle. [\[28\]](#) [\[29\]](#) [\[30\]](#)

Gene therapy using Klotho protein demonstrated remarkable effects in aged mice, with a single treatment extending lifespan by 15-20%. Animals treated with the secreted form of Klotho (s-KL) lived 15-20% longer, exhibited better physical performance, larger muscle fibers, less fibrosis, and improvements in bone health, particularly in females. Clinical trials in humans are planned for 2025-2026, representing one of the most exciting developments in longevity medicine. [\[31\]](#) [\[32\]](#)

Chinese Academy of Sciences researchers developed senescence-resistant stem cells (SRCs) by genetically engineering stem cells to withstand age-related inflammation and cellular senescence. In aged macaques, SRC treatment reduced senescent cells in multiple organs (brain, heart, lungs), decreased markers of inflammation and DNA damage, and improved cognitive function. The SRCs possess tumor suppression properties, suggesting they may not induce tumor growth—a primary safety concern with stem cell therapies. [\[33\]](#)

## **Technological Tools: AI-Driven Screening, Biomarkers, and Imaging Platforms**

### **AI-Powered Drug Discovery and Screening**

Multiple pharmaceutical companies and research institutions deployed AI platforms specifically for longevity drug discovery in October 2025. Eli Lilly launched TuneLab, an AI/ML platform providing biotech companies access to drug discovery models trained on decades of Lilly's proprietary research data, representing over \$1 billion in investment. The platform uses federated learning—a privacy-preserving approach allowing biotechs to use Lilly's models without sharing their own data. [\[22\]](#)

M42, a global health leader, announced a strategic investment and partnership with Juvenescence during Abu Dhabi Global Health Week (April 15-17, 2025) to advance AI-powered drug discovery and longevity science. The collaboration leverages M42's capabilities in genomics, biobanking, and clinical trial infrastructure alongside Juvenescence's discovery technology and drug development experience. This partnership supports Abu Dhabi's vision of becoming a global hub for longevity science and next-generation drug development. [\[34\]](#)

Alex Zhavoronkov, CEO of Insilico Medicine, discussed how AI accelerates drug discovery in the longevity field, arguing that AI is a "force multiplier for drug hunters," allowing focus on high-level strategy and scientific questions. He highlighted the shift as major pharmaceutical companies begin embracing aging as a disease, with AI validation through clinical trial advancements. [\[35\]](#) [\[22\]](#)

## **Biomarkers of Aging: Moving Toward Clinical Integration**

The Biomarkers of Aging Conference 2025, held October 20-21 at Harvard Medical School, brought together leading researchers, clinicians, and industry experts to advance development and validation of aging biomarkers. Now in its third year, the conference expanded from a one-day kickoff to a major international fixture reflecting momentum in biomarker science and urgency of establishing standards for trials, practice, and regulatory pathways. [\[2\]](#) [\[36\]](#) [\[37\]](#) [\[38\]](#) [\[39\]](#)

Dr. Jesse Poganik emphasized that "biomarkers of aging are moving closer and closer to the clinic," noting that clinician perspectives are essential because they think differently than researchers—their priorities differ and how they explain biomarkers to patients differs from research audiences. Dr. Andrea Cipriano highlighted the challenge of reaching consensus on biomarkers when every organ has a different aging base, requiring decipherment of different dimensions of aging that may lead to developing different biomarker types. [\[36\]](#)

Research published in *Aging Cell* unveiled new DNA markers associated with retroelements—remnants of ancient viral genetic material—that act as highly accurate epigenetic clocks for predicting chronological age. The retroelement-based "Retro-Age clock" remained accurate across various human tissue types and complemented conventional methylation-based aging clocks by capturing unique aging signals not recognized by traditional approaches. [\[40\]](#)

A meta-analysis of epigenetic changes in 17 types of human tissue throughout the entire adult lifespan provided the most comprehensive picture to date of how aging modifies genes. The study assessed DNA methylation patterns in over 15,000 samples from adults aged 18 to 100+ years, revealing that some tissues age faster than others—retina and stomach accumulate more aging-related methylation changes than cervix or skin. The analysis identified universal epigenetic markers of aging across different organs, creating an open-access atlas. [\[41\]](#)

## **Advanced Delivery Systems and Precision Medicine**

CRISPR gene editing technologies advanced toward clinical application despite challenges. Research published in *Cell Reports Medicine* in June 2025 found that gene editing using CRISPR-Cas9 in combination with AAV6 vectors can trigger inflammatory and senescence-like responses in blood stem cells, compromising long-term regenerative ability. However, the study outlined strategies to overcome this hurdle—transient p53 inhibition and anti-inflammatory agents like Anakinra significantly reduced senescence markers and improved stem cell regenerative capacity. [\[42\]](#)

A landmark case in June 2025 delivered the world's first personalized CRISPR therapy to an infant, developed and delivered in just six months by a team including five researchers from the Innovative Genomics Institute. This breakthrough paved the way for on-demand gene-editing therapies for individuals with rare genetic diseases and set precedent for a regulatory pathway for rapid approval of platform therapies in the United States. [\[43\]](#) [\[44\]](#)

Avant Technologies and Austrianova announced the launch of Klothonova on October 21, 2025, beginning development of age-related cellular therapies using the longevity protein Klotho. The initiative aims to engineer a genetically modified cell line that overexpresses Klotho protein, paving the way for innovative cell-based therapies targeting age-related diseases. [\[45\]](#) [\[46\]](#)

## Ethical and Practical Considerations: Safety, Accessibility, and Ethics

### Longevity Clinics: Promise and Peril

An editorial published in *Aging-US* on October 13, 2025, reviewed the rapid rise of longevity clinics worldwide, highlighting both opportunities and serious concerns. Longevity clinics have emerged globally offering advanced diagnostics including genomic testing, advanced imaging, and multi-omics profiling, with costs ranging from €10,000 to over €100,000 per year.<sup>[47] [48] [1]</sup>

Marco Demaria, Editor-in-Chief of *Aging-US*, emphasized that "the major issue is that longevity clinics not yet embedded within mainstream medical practice". Many operate outside conventional medical systems and lack connections to academic geroscience, allowing them to market expensive interventions without sufficient clinical validation. This disconnection creates barriers limiting access to wealthy individuals while leaving out populations most at risk for premature aging.<sup>[1] [47]</sup>

However, Demaria notes potential benefits: by collecting extensive, long-term health data from clients, these clinics could identify early biomarkers of aging and detect signs of age-related diseases. Unlike traditional clinical trials limited in scope and duration, longevity clinics track wide-ranging health data over time that, when paired with AI tools, could advance healthy aging science.<sup>[1]</sup>

To ensure positive contributions to health innovation, the editorial outlined key steps: greater collaboration with academic researchers, adoption of standardized protocols, increased transparency, regulatory clarity, and development of scalable, more affordable models through partnerships with public health systems.<sup>[47] [1]</sup>

### Safety Considerations and Side Effects

The rapamycin review in *Aging-US* raised important safety concerns, with some studies reporting increases in blood lipids and inflammation markers. Research on muscle health produced contradictory findings, with some suggesting rapamycin might reduce the body's ability to build muscle. Mental health impacts remain unclear, with a few participants reporting increased anxiety during treatment.<sup>[26]</sup>

The CRISPR gene editing research highlighted unintended consequences, demonstrating that editing can trigger inflammatory and senescence-like responses in blood stem cells. However, the development of mitigation strategies—particularly the clinically approved IL-1 receptor antagonist Anakinra—offers safer approaches by reducing both senescence markers and potential genotoxic events.<sup>[42]</sup>

For mitochondrial transplantation, the primary concern involves triggering cancer spread, as injecting stem cells into the bloodstream can potentially promote tumor growth anywhere in the body. However, the SRCs' tumor suppression properties suggest they may not induce tumor growth, though long-term effects require further evaluation.<sup>[33]</sup>

## Health Equity and Access

The cost barriers of longevity interventions pose significant ethical challenges. Program fees exceeding €100,000 annually render these innovations inaccessible to most populations, particularly those disproportionately affected by premature aging and chronic diseases. This creates a two-tiered system where life-extending therapies benefit only the wealthy. <sup>[47]</sup> <sup>[1]</sup>

The Healthspan Action Coalition emphasizes that "it's time for healthspan to be recognized as a fundamental human right, thereby assuring that discoveries in healthy longevity will be delivered to all populations, sooner rather than later". The organization advocates for addressing disparities in drivers of health and structural flaws in the health system, ensuring all people have fair and just opportunity to achieve full potential in health, longevity, and well-being. <sup>[49]</sup>

The Claude D. Pepper Older Americans Independence Center network represents a model addressing this challenge by conducting clinical trials across diverse populations and integrating discoveries into mainstream medical care rather than exclusive private clinics. <sup>[23]</sup> <sup>[25]</sup> <sup>[3]</sup> <sup>[24]</sup>

## Future Directions: Next Steps and Anticipated Impact on Healthspan

### Immediate Clinical Translation Opportunities

The National Institute on Aging's renewal of the Translational Geroscience Network grant, awarding nearly \$3 million over four years, enables continued study of conditions accelerating aging, including long COVID, obesity, and Alzheimer's disease. This network comprises 90 clinical trials across the U.S. and northern Europe, finding new ways to help people age in better health. <sup>[24]</sup>

The combination therapy of rapamycin and trametinib represents a promising candidate for human trials, with trametinib already approved for human use and demonstrating geroprotective effects in mice. Researchers plan to determine optimal dosing and administration routes to maximize health and life-prolonging effects while minimizing side effects. <sup>[29]</sup> <sup>[28]</sup>

Gene therapy for Klotho protein, with clinical trials planned for 2025-2026, represents one of the most exciting near-term developments. Previous work demonstrated safety and efficacy in animal models, with translation to human trials poised to determine whether similar lifespan extension and health improvements occur in people. <sup>[32]</sup> <sup>[31]</sup>

### Emerging Therapeutic Strategies

The SenoTAC approach offers a more effective solution for treating aging-associated diseases compared to traditional senolytic inhibitors. By degrading specific proteins responsible for senescence in a substoichiometric manner, SenoTACs provide enhanced targeting, prolonged therapeutic effects, expanded target range, and reduced drug resistance. Development of tissue-selective SenoTACs like BRD-753B demonstrates the potential for treating specific age-related diseases without affecting protective senescent cells in other tissues. <sup>[16]</sup>

The AI-driven brain aging clock approach enables rapid screening of vast compound libraries to identify brain rejuvenation therapies. With 453 compounds already identified and initial

validation in mice showing behavioral and molecular improvements, this platform accelerates the traditionally lengthy drug discovery process.<sup>[21] [22]</sup>

Mitochondrial transplantation's progression to human trials marks a watershed moment in regenerative medicine. If the treatment proves safe and effective in elderly populations starting in 2025-2026, it could provide a direct method to combat mitochondrial dysfunction—one of the fundamental drivers of aging.<sup>[19]</sup>

## **Systemic Integration and Regulatory Pathways**

The Biomarkers of Aging Consortium's work toward consensus, standardization, and real-world applications of aging biomarkers supports development of longevity interventions by providing validated tools to measure therapeutic efficacy. Without standardized, validated tools to measure aging, progress in bringing anti-aging therapies to clinic stalls.<sup>[38] [2] [36]</sup>

The establishment of the LA OAIC and similar centers creates infrastructure for conducting rigorous clinical trials of gerotherapeutics, with protocols designed to assess functional outcomes—mobility, cognitive function, independence—rather than merely disease-specific endpoints. This shift toward healthspan-focused outcomes aligns with the goal of extending functional life.<sup>[25] [3] [23] [24]</sup>

The precedent set by the personalized CRISPR therapy for the infant establishes a regulatory pathway for rapid approval of platform therapies addressing rare genetic diseases. This framework could accelerate approval of gene therapies targeting age-related genetic dysfunction.<sup>[43]</sup>

## **Convergence of Multiple Interventions**

The most promising future direction involves combining multiple interventions targeting different aging mechanisms. The additive effects of rapamycin and trametinib demonstrate that simultaneous inhibition of mTOR and Ras-Mek-ERK pathways provides greater benefits than either alone. Similarly, pairing senolytic therapies with immunotherapy shows enhanced efficacy with reduced toxicity.<sup>[30] [18] [28] [29]</sup>

The integration of AI-driven drug discovery, validated biomarkers, precision delivery systems, and standardized clinical trial infrastructure creates an ecosystem capable of accelerating translation from laboratory discovery to clinical application. This convergence, combined with growing pharmaceutical industry interest in aging as a therapeutic target, suggests the next decade will see significant advances in interventions extending functional human healthspan.<sup>[36] [34] [35] [22]</sup>

The emphasis on functional life extension—maintaining cognitive function, physical mobility, metabolic health, and independence—rather than merely extending lifespan represents a maturation of the field. As Dr. Sara Espinoza stated, "This unique clinic offers scientifically backed science with clinically proven treatment and lifestyle recommendations that can improve health and wellbeing—now—and as individuals age".<sup>[3] [24] [1]</sup>

The discoveries of the past week demonstrate that longevity science has moved beyond speculative anti-aging claims to validated interventions with measurable functional benefits,

supported by rigorous research across multiple credible institutions globally. The convergence of cellular therapies, gene editing, AI-driven discovery, validated biomarkers, and clinical trial infrastructure positions the field for significant advances in extending human healthspan in the coming years.



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