

The Immortality Update: Deep Research on Longevity (Nov 18–25, 2025)

Introduction

Researchers emphasize the urgent need to find interventions that can broadly counteract aging and its disorders ¹. In the past week, multiple studies have reported advances in extending *functional* lifespan – not just living longer, but staying healthier longer. Highlights include novel senolytic drugs that clear aging cells, metabolic therapies (e.g. anti-diabetes drugs repurposed for aging), and emerging “omic” and AI tools to track biological age. Together these findings suggest new avenues toward healthier ageing, although all remain early-stage and will need human testing.

Key Findings

- **Senolytic drugs:** A Chinese-led team developed a β -galactosidase-activated prodrug (SSK1) that selectively kills senescent (aging) cells. In a mouse model of osteoarthritis, intra-joint SSK1 cleared senescent chondrocytes, reduced inflammation, and improved cartilage and bone health ². The authors report that SSK1 produced less fibrosis and pain and enabled joint remodeling in both young and old mice ² ³. They conclude SSK1 is a promising senolytic candidate for age-related joint degeneration ³.
- **Metabolic regulators (GLP-1 drugs):** A *Cell Metabolism* study found that treating middle-aged mice with a low dose of a GLP-1 receptor agonist (an FDA-approved diabetes drug) produced broad anti-aging effects across multiple tissues. After 30 weeks of treatment starting at 11 months, mice showed strong “age-reversal” changes at the molecular level and improved physical strength ¹. The effects were specific to older mice, and a shorter 13-week treatment at 18 months yielded even stronger benefits via a brain (hypothalamus) mechanism ⁴. Remarkably, these multi-organ effects closely resembled those of rapamycin (a known lifespan-extender) ⁵, suggesting GLP-1 drugs may be repurposed for healthspan extension.
- **Cell/organelle therapies:** A U.S.-Israeli collaboration is advancing *mitochondrial transplantation* as a therapy. Cellergy Therapeutics has isolated healthy mitochondria from donor cells and infuses them intravenously (therapy CLG-001) to boost cellular energy. This approach targets conditions of mitochondrial dysfunction, including metabolic and neurodegenerative diseases as well as age-related decline ⁶. In late November, Cellergy partnered with a CDMO to produce clinical-grade CLG-001 for first-in-human use ⁷. (It will initially be tested under Israel’s compassionate-use program and an FDA Phase I trial ⁷.) If safe, this “metabolic cell therapy” could re-energize aging tissues by restoring healthy mitochondria.
- **Other interventions:** Although not yet in trials, several creative strategies are being explored. For example, researchers are beginning to manipulate the gut microbiome: a study (PLOS Biology, Nov

11, 2025) showed that a low dose of the antibiotic cephaloridine caused gut bacteria to overproduce colanic acid, extending lifespan in worms and mice. (*Note: that study falls just outside this week's window, but it illustrates how even microbial metabolites are emerging as targets.*) Additionally, rare "longevity genes" from centenarians continue to attract interest: a published study (Nov 3, 2025) showed one such gene (LAV-BPIFB4) can reverse heart aging in progeria models – hinting gene therapies may one day leverage supercentenarian biology.

Basic Research vs. Clinical Trials

- **Preclinical (lab) findings:** Most breakthroughs reported this week are in animal or cell models. For example, the GLP-1 agonist study was done entirely in aged mice ¹, and the SSK1 senolytic was tested in mouse joints ². These provide proof-of-concept but are far from human therapies. Similarly, gut microbiome and other experimental approaches have so far only been demonstrated in worms or rodents.
- **Moving toward humans:** Some strategies are entering clinical translation. Notably, the CLG-001 mitochondrial therapy is being prepared for **first-in-human** trials ⁷. In other words, donor mitochondria infusions will soon be tested under strict protocols in people with metabolic or age-related conditions. Likewise, GLP-1R drugs are already FDA-approved (for diabetes/weight-loss) and are now prime candidates for repurposing; the new study's authors explicitly note their findings "guide clinical trials" of these drugs for aging ⁵. In short, next steps include human trials of repurposed metabolic drugs and of new cell-based therapies like CLG-001.
- **Trials needed:** Importantly, none of the above interventions is yet proven in healthy humans for longevity. Published studies caution that all findings are preliminary. For example, the GLP-1 study showed benefits only in older mice, with no effect in young adults ⁴, and the SSK1 work has so far only been in rodents. Large, controlled human trials will be needed to test safety and efficacy. In some cases (e.g. senolytic drugs or mitochondrial infusions) on-target/off-target effects must be carefully monitored before these can be widely applied.

Technological Tools

- **Big-data biomarkers:** The **Precision Aging Network** at the University of Arizona released a massive public dataset (~300 terabytes) of multi-omic data on normal cognitive aging ⁸. This open-access resource includes genomics, transcriptomics, imaging and clinical data from healthy adults over time. It is designed to fuel AI and machine-learning discovery of new aging markers. Indeed, the portal uses cloud-based AI search tools so researchers worldwide can mine patterns that predict cognitive resilience or decline ⁹. Such data-driven tools should accelerate the identification of novel longevity targets and biomarkers.
- **AI-driven digital biomarkers:** New AI tools are also emerging for noninvasive aging assessment. A *Communications Medicine* study (Nov 19, 2025) introduced an **AI-PPG age**: a deep-learning algorithm that estimates a person's "vascular age" from raw photoplethysmography (PPG) signals (the pulses in wearable devices) ¹⁰. They found that a higher AI-PPG age (above calendar age) strongly predicted future heart attacks, strokes and mortality ¹⁰, while a lower PPG-age predicted health. In short, this wearable-based aging clock is a scalable biomarker for cardiovascular health ¹¹. Integrating such

AI-derived age metrics into health monitors could enable personalized prevention and early intervention.

- **Imaging & sensors:** Beyond AI clocks, novel imaging markers continue to appear. For instance, new retinal imaging techniques (scanning blood vessel patterns) and 7T MRI methods are being studied as windows into systemic aging (see related work at McMaster and Rosalind Franklin University). While not reported this week, the trend is clear: noninvasive imaging (eye scans, brain scans) combined with AI analysis is maturing as a way to monitor the pace of aging in specific organs.

Ethical & Practical Considerations

- **Equity vs. Elitism:** Many commentators caution that longevity research must focus on **quality of life and broad health** rather than only extending maximum lifespan for the privileged few. Lifespan inequality is already enormous: for example, a recent analysis notes that a child born in Norway can expect ~83 years of life versus ~52 years in Chad ¹². In wealthier countries there is also a large gap between total lifespan and healthy, active years – about a 12-year “frailty gap” in the U.S. ¹³. Experts argue it’s more impactful (and ethical) to invest in interventions that raise the average healthspan for all, rather than pouring resources into high-tech fixes that only the rich can afford ¹² ¹³.
- **Safety and long-term effects:** Cutting-edge therapies carry unknown risks. Drugs that clear cells (senolytics) or overhaul metabolism (gene and cell therapies) might have side effects not seen yet. Long-term surveillance will be needed. For example, widespread clearance of senescent cells might impair wound healing or immunity; the mitochondrial transplant approach could induce immune reactions to foreign organelles. Until large trials confirm safety, these remain experimental. Regulators and clinicians will require robust evidence that benefits (e.g. increased vigor) outweigh any harm.
- **Cost and access:** Even if effective, many anti-aging treatments will be expensive. Novel cell and gene therapies often cost hundreds of thousands per patient today. Chronic use of expensive drugs (GLP-1 agonists or rapalogs) also poses affordability challenges. This raises practical questions: who will pay for extended “healthspan therapies,” and how to ensure access beyond affluent patients? Strategies under discussion include repurposing generic drugs (for example, metformin or rapamycin analogs) and developing affordable biomarkers to target treatments only to those who need them. Public-private partnerships and value-based pricing may also be needed to make future longevity treatments equitable.

Future Directions

- **Clinical trials and translation:** Based on recent findings, we can expect several studies in the near future. For example, the GLP-1 agonist results encourage trials of these drugs in elderly populations (possibly in Alzheimer’s or frailty contexts) ⁵. Likewise, Cellergy’s CLG-001 is moving into Phase I trials for patients with metabolic or degenerative diseases ⁷. Senolytic compounds like SSK1 will likely be tested in non-human primates soon, and if safe, may enter human trials for diseases like osteoarthritis. Overall, many lab discoveries are now “Phase 0” (planning for human work) – the next several years should see actual longevity-focused trials for some of these interventions.

- **Mechanistic discoveries:** Open-data initiatives and AI tools will drive new target discovery. Scientists will mine the Precision Aging data and other omics datasets to find molecular signals of “healthy agers.” For example, the retinal/imaging study cited several inflammatory proteins (like MMP12) as aging clues ¹⁴, pointing to new drug targets. We anticipate more such multi-organ analyses identifying drivers of aging (inflammation, senescence markers, metabolic regulators) that can be tested in animals and cells. Integrating genetics from long-lived humans (centenarian gene variants) with these networks may yield novel therapies.
- **Digital and preventive health:** Wearable and digital biomarkers (PPG-age, facial aging AI, epigenetic clocks from blood) will become more accurate and widely used. As shown by the new AI-PPG study ¹¹, simple home devices may soon flag biological aging acceleration before symptoms arise. Combined with smartphone/AI health apps, this could shift longevity from the lab to the clinic and home: people could track their personal “age rate” and modify diet, exercise or medication accordingly. Such tools also enable remote monitoring of trial outcomes, reducing costs.
- **Emerging technologies:** Beyond this week’s news, other advances loom: partial cellular reprogramming (Yamanaka factors), advanced gene editing (base editing of aging genes), and senolytic antibodies are all under development. We expect cross-fertilization: for instance, AI screening may speed discovery of new senolytic compounds, while imaging may reveal which organ systems benefit most from a given therapy.

In sum, the past week’s research underscores that longevity science is rapidly evolving on multiple fronts. Nearly all interventions still require translation to humans, but the convergence of drug repurposing (GLP-1 and others), targeted cell therapies (mitochondria, senolytics), and powerful data/AI tools is charting a clear path toward extending healthy human lifespan. The coming months will tell which leads hold up under the scrutiny of clinical research.

Sources: Recent peer-reviewed studies and institutional releases (2025) on senolytics ² ³, metabolic therapies ¹ ⁵, cell therapies ⁷, and biomarker tech ⁸ ¹⁰ ¹¹; and expert commentary on longevity ethics ¹² ¹³.

¹ ⁴ ⁵ Body-wide multi-omic counteraction of aging with GLP-1R agonism - PubMed
<https://pubmed.ncbi.nlm.nih.gov/41265449/>

² ³ β -galactosidase-targeted senolytic prodrug ameliorates preclinical models of post-traumatic osteoarthritis - ScienceDirect
<https://www.sciencedirect.com/science/article/pii/S2352396425004591>

⁶ ⁷ Made Scientific Announces Manufacturing Partnership with Cellergy Therapeutics for CLG-001 - PharmaSource
<https://pharmasource.global/content/news/cdmo-news/made-scientific-announces-manufacturing-partnership-with-cellergy-therapeutics-for-clg-001/>

⁸ ⁹ Precision Aging Network data release opens new pathways for healthy aging research | University of Arizona News
<https://news.arizona.edu/news/precision-aging-network-data-release-opens-new-pathways-healthy-aging-research>

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<https://www.statnews.com/2025/11/20/longevity-economy-lifespan-life-expectancy/>

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