

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

1. Introduction: The Shift from Lifespan to Functional Life

This report, "The Immortality Update," provides a critical intelligence briefing on the most significant, multi-source-corroborated developments in longevity science from the past seven days. The central theme of this update is the accelerating, field-wide pivot from the objective of merely extending *lifespan* to the strategic imperative of optimizing *functional life*, or *healthspan*. The modern paradigm of geroscience, as evidenced by this week's findings, is no longer focused on the simple prolongation of life. Instead, it is converging on a new goal: the extension of the period of life lived in good health, defined by the preservation of cognitive, physical, and immune capacity, free from the burdens of chronic disease and age-related disability.

The developments of the past week provide a unique validation of this paradigm shift, revealing how the field is moving in concert to operationalize this new goal. The evidence for this shift is threefold:

1. **Incentives:** High-profile initiatives, such as the \$101 Million XPRIZE Healthspan, are not rewarding lifespan extension. The prize is explicitly structured to "spark research into healthspan" by challenging teams to "restore 10 – 20 years' healthy function in measures of brain, muscle and immune function".¹
2. **Clinical Tools:** New diagnostic and prognostic tools being validated, such as the Healthy Longevity Index (HLI), are not designed to predict *mortality*. Their primary endpoint is the prediction of "disability- and dementia-free survival".²
3. **Molecular Biomarkers:** Next-generation epigenetic clocks, such as the Buck Institute's "IC Clock," are no longer being trained on *chronological age*. This new clock is trained

specifically on "Intrinsic Capacity (IC)," a clinical composite measure of "cognition, locomotion, psychological well-being, sensory abilities,, and vitality".³

The convergence of these three domains—incentives, clinical tools, and molecular readouts—demonstrates a critical maturation of the field. Longevity science is no longer just *discussing* healthspan as a concept; it is now *building* the complete, end-to-end infrastructure required to make functional life extension an evidence-based, measurable, and actionable scientific endeavor.

2. Key Findings: New Interventions and Discoveries in Healthspan

The past seven days have been marked by significant announcements, ranging from major competition milestones and new conceptual frameworks to a disruptive controversy in metabolic health.

2.1 The Healthspan XPRIZE: Catalyzing Functional Rejuvenation

The \$101 million XPRIZE Healthspan has been a central focus of the past week, with announcements of semi-finalists moving forward.⁴ This competition, described as the "largest-ever prize to spark research into healthspan" ¹, is acting as a powerful coordinating mechanism for the entire field.

Its true impact lies in its rule structure. By mandating that a winning therapy must restore a minimum of 10 years of functional health—specifically in the three-system-triumvirate of cognition, muscle, and immune function ¹—within one year, the prize explicitly disincentivizes slow-acting, single-disease paradigms. Instead, it forces research teams to pursue systemic, fast-acting interventions that target the fundamental hallmarks of aging itself.

Key participants have emerged in the news this week:

- **Immunis, Inc.:** This clinical-stage biotech, which develops biologics for "age and disease-related immune dysregulation" ⁵, was announced as one of the Top 40 Milestone 1 award winners.⁵ This aligns directly with the XPRIZE's "immune function" endpoint and positions immune-based therapeutics as a leading-contender class.
- **Renascience:** This Japanese firm was also noted in market reports, with news that

patient enrollment for its "Semifinal Clinical Trial" for the XPRIZE Healthspan has now been completed.⁶

The XPRIZE is successfully curating a pipeline of the world's first *plausible* functional-rejuvenation therapies, forcing a practical translation from theoretical geroscience to testable, multi-system interventions.

2.2 Metabolic Interventions: A New Controversy and a New Contender

Metabolic regulation remains a core pathway for healthspan intervention, and this week saw both a major challenge to existing dogma and the emergence of a new therapeutic candidate.

The Intermittent Fasting (IF) Controversy

A new preliminary study, not yet peer-reviewed but presented at a major conference, has "sent shockwaves" through the longevity and wellness communities. The study analyzed data from thousands of individuals and reported a disruptive, and to date, anomalous, finding: individuals practicing an 8-hour time-restricted eating (TRE) schedule had a 91% higher risk of death from cardiovascular disease over a median 8-year follow-up period.⁷

This finding is in *direct opposition* to the body of mechanistic and animal data promoting IF's benefits, which are theoretically derived from the induction of processes like autophagy (cellular cleaning).⁷ This preliminary data, if it holds up to scrutiny, represents a critical blow to the dogma of direct translatability. It exposes a fundamental risk in the field: a *mechanistic benefit* (e.g., "we are inducing autophagy") does not automatically, or may not *at all*, translate to a long-term *human healthspan benefit*. It suggests that optimizing for a cellular mechanism (autophagy) may be entirely different from optimizing for a systemic, functional outcome (cardiovascular health) and may even involve unidentified, deleterious trade-offs.

C15:0 (Pentadecanoic Acid) as a Rapamycin Alternative

On the other side of the metabolic spectrum, a new study was published in the peer-reviewed journal *Nutrients* this week, positioning a novel compound as a safe alternative to a gold-standard longevity drug.⁸ The study compared the odd-chain saturated fatty acid C15:0 (pentadecanoic acid) to rapamycin, the canonical inhibitor of the mTOR pathway.

The key finding from the preclinical, *in vitro* analysis was that at their optimal doses, C15:0 and rapamycin "share a remarkable 24 cell-repairing benefits".⁸ The strategic implication of this research is not that C15:0 is *stronger* than rapamycin, but that it is *safer* and more *accessible*. The paper explicitly contrasts C15:0 as a "natural and safe essential fatty acid" against rapamycin as a "prescription drug borne from rare bacteria"⁸ that carries a significant side-effect profile (e.g., immunosuppression).

This research is a clear example of a *commercial and regulatory* strategy. It provides a

"rapalogue" (rapamycin-like) *mechanistic story* but with a *food-grade* safety profile. This effectively "de-risks" a powerful longevity pathway (mTOR) for a mass-market, healthy-consumer audience that cannot and should not take rapamycin prophylactically.

2.3 Cellular Senescence: A New Target for Acute Intervention

The targeted clearing of senescent (or "zombie") cells, known as senolysis, is a leading therapeutic strategy. A pivotal pilot longitudinal study published in the past week has provided the first human evidence for a new, highly viable clinical use case.⁹

The study investigated the impact of a major physical stressor—hip fracture surgery—on systemic cellular senescence. Researchers measured the Senescence-Associated Secretory Phenotype (SASP) index, a composite of 22 plasma protein biomarkers, in 60 older adults (20 post-hip fracture, 40 controls).⁹

The findings were twofold:

1. The hip fracture group had *significantly higher baseline SASP scores* than the healthy comparison groups, suggesting they were already on a trajectory of accelerated aging.
2. Critically, their SASP scores *increased further* by week 4 post-surgery and *did not return to normal* by week 12.⁹

This is a pivotal finding, providing the first human evidence that a common, acute aging-related trauma induces a *systemic, persistent wave of cellular senescence*. This mechanistically links the trauma to the well-known functional decline and accelerated aging seen in post-operative patients.

The most actionable item, however, is the study's own conclusion: "Our findings support the need to investigate this phenomenon... including whether novel interventions such as senolytics would help older adults facing major surgery".⁹ This provides the *explicit rationale* for a new, commercially and clinically viable path to market for senolytics. Instead of a difficult, decade-long trial to "slow aging" in healthy adults, this study defines a *short-term, peri-operative* trial. The hypothesis is that a short course of senolytics, given before or after surgery, could blunt this SASP wave, improve functional recovery, and prevent the post-operative decline that often leads to loss of independence.

2.4 Conceptual Frontiers: Aging as Mesenchymal Drift

A conceptual breakthrough was reported this week from Altos Labs, the \$3 billion longevity research company. At the 2025 European Society of Gene & Cell Therapy (ESGCT) meeting, scientific founder Juan Carlos Izpisua Belmonte presented a new framework for aging, which he terms "mesenchymal drift".¹¹

This concept reframes aging as a problem of *cellular identity*. Belmonte posits that aging is driven by "good cells losing their way" in a "destructive, self-sabotaging" manner.¹¹ This is not a "damage accumulation" problem (the traditional view), but an *information theory problem*—a loss of epigenetic identity.

The term "mesenchymal drift" is highly specific. It implies that differentiated, functional cells (like epithelial cells) are "drifting" backward toward a more primitive, undifferentiated, and "fibrotic" mesenchymal state. This process is mechanistically linked to both fibrosis and cancer, two of the most prominent age-related pathologies.

This conceptual framework is a brilliant strategic move by Altos Labs. It *defines the problem of aging* in a way that *only their chosen solution* (partial cellular reprogramming) can fix. If aging is a loss of *epigenetic identity*, the solution is not to clear damage (senolytics) or tune metabolism (rapamycin), but to *restore the correct epigenetic information*—in essence, to "reboot" the cell's operating system. This presentation aligns Altos' top-down *problem definition* with their proprietary *solution*.

3. Distinguishing Preclinical Promise from Clinical Reality

A core task for any analyst is to stratify findings by their evidence level and proximity to human functional benefit.

3.1 Basic Research and Preclinical Models

The most forward-looking concepts from this week remain in the basic research phase.

- **Altos Labs' "Mesenchymal Drift"**¹¹ is a *conceptual model*. It provides a new and powerful framework for understanding aging but is decades away from a deployable human intervention.
- **The C15:0 vs. Rapamycin** paper⁸ is *preclinical*. Its findings of "24 cell-repairing

benefits" are based on *in vitro* cellular models. This is crucial mechanistic work that *generates* the hypothesis that C15:0 could be a rapalogue, but it does *not* prove any functional human benefit.

3.2 Observational and Early-Stage Human Studies

Two of this week's major findings are based on human data but are not interventional.

- **The Intermittent Fasting Study**⁷ is *observational* and *preliminary*. It shows a *correlation* (a 91% higher CV mortality risk) in a specific population, not *causation*. Its primary value is as a *critical warning* against dogma and as a rationale for a large-scale, long-term Randomized Controlled Trial (RCT).
- **The SASP Index Study**⁹ is a *pilot longitudinal study*. Its strength is *demonstrating* that a systemic SASP wave occurs post-surgery. Its limitation, as a small pilot study, is that it *failed* to find a significant association between SASP index scores and functional recovery at 26 or 52 weeks.⁹ It is therefore *hypothesis-generating*, not definitive. Its value is the clear rationale it provides *for* the next, larger interventional trial.

3.3 New Clinical Trials Launched: Actionable Science

The most actionable development of the week is the registration of a new clinical trial (**NCT06990256**), which provides a model for modern, functional healthspan research.¹²

- **Interventions:** The trial combines two well-known molecules: **Urolithin A** (a postbiotic metabolite known to enhance mitophagy, the clearing of damaged mitochondria) and **Fisetin** (a natural flavonoid with known *senolytic* properties). This creates a *multi-hallmark* intervention, targeting both mitochondrial dysfunction and cellular senescence.
- **Endpoints:** Most critically, the 12-week trial's primary endpoints are *functional*. It is not measuring lifespan or all-cause mortality. It is measuring *achievable, short-term* endpoints that are validated and meaningful to a patient's quality of life:
 1. **Sleep Quality:** Assessed via the PSQI scale, actigraphy, and polysomnography.¹²
 2. **Mental Health and Fatigue:** Assessed via the Patient Health Questionnaire-9 (PHQ-9) and the Fatigue Severity Scale, which measures fatigue "over the past week".¹²
 3. **Ageing Biomarkers:** A panel of "ageing biomarkers" including DNA methylation (epigenetic clocks) and inflammatory cytokines.¹²

4. **Microbiome/Metabolites:** Stool and urine analysis.¹²

This trial is a perfect example of the new paradigm. It integrates a multi-hallmark intervention with a suite of functional, patient-centric outcomes and molecular biomarkers. This is how healthspan interventions will be tested and validated—not by waiting 30 years for mortality data, but by demonstrating functional and biomarker improvement in 12 weeks.

3.4 Table: Longevity Intervention Pipeline (News from Past 7 Days)

This table consolidates the week's new interventions, stratifying them by type, mechanism, and evidence level for analytical comparison.

Intervention/Concept	Intervention Type	Proposed Mechanism	Source	Current Status / News	Stated Goal / Impact on Function
8-hr Time-Restricted Eating	Metabolic Regulator	Autophagy Induction	⁷	Controversial Observational Study	<i>Intended:</i> Improved cognition, metabolic health. <i>Reported:</i> 91% higher CV mortality risk.
C15:0 (Pentadecanoic Acid)	Metabolic Regulator	Cell Repair (mTOR-like)	⁸	Peer-Reviewed Preclinical (Nutrients)	Shares "24 cell-repairing benefits" with rapamycin; positioned as safer alternative.

Peri-operative Senolytics	Senolytic	SASP Clearance	9	Human Pilot Study Rationale	<i>Hypothesis:</i> Prevent post-surgical SASP wave and improve functional recovery.
"Mesenchymal Drift"	Cellular Reprogramming	Restore Cell Identity	11	Conceptual Framework (Altos Labs)	<i>Concept:</i> Reverse aging by fixing "identity loss" (fibrosis, cancer).
Urolithin A + Fisetin	Mitophagy + Senolytic	Multi-Hallmark	12	New Clinical Trial Registered (NCT06990256)	Improve sleep quality, fatigue, and reverse aging biomarkers (DNAm, inflammation).

4. Technological Tools: The New Infrastructure for Healthspan Research

The interventions detailed above are only possible to develop and validate with a new generation of *enabling technologies*. This week saw major announcements in the two key areas: biomarkers to *measure* function and AI/imaging to *detect* decline.

4.1 Biomarkers and Predictive Indices: Measuring Function

The Healthy Longevity Index (HLI): The Clinical Tool

A new paper in JMIR Aging details the development and, crucially, the validation of a novel Healthy Longevity Index (HLI).² This is a clinical tool, designed for use in primary care.

- **The Tool:** The HLI is a nomogram-based index to predict 4-, 8-, and 12-year **disability- and dementia-free survival**.²
- **The Data:** It was developed on the large **Taiwan Longitudinal Study on Aging (TLSA)** (n=4470)² and *externally validated* on the **Japanese National Institute for Longevity Sciences (NILS-LSA)** cohort (n=1090).² This cross-cohort validation gives it robust predictive power.
- **The Key Feature (Accessibility):** The HLI is *practical*. Its key predictors are simple variables *already* collected during routine primary care consultations: "age, sex, education," and, most importantly, *functional* measures of Intrinsic Capacity (IC) such as "impairments in locomotion, visual acuity, and cognition".²

This tool is the "Framingham Heart Study" for geroscience. It provides a simple, validated, and actionable risk score for *functional* decline. It *creates the clinical risk category* of "unhealthy aging," which allows a primary care provider (PCP) to *justify* proactive lifestyle or medical interventions *before* disability and dementia manifest.

The Buck Institute "IC Clock": The Molecular Tool

A new preprint on bioRxiv from the Buck Institute (in collaboration with Stanford and others) details a novel DNA methylation (DNAm)-based epigenetic clock.³

- **The Tool:** This is a *second-generation* "aging clock." Unlike first-generation clocks trained on *chronological age* (e.g., Horvath) or *mortality* (e.g., GrimAge), this "IC Clock" is trained on the *clinical evaluation* of "**Intrinsic Capacity (IC)**"—the same composite of "cognition, locomotion, psychological well-being, sensory abilities, and vitality"³ that the HLI measures.
- **The Key Feature (Function-Based):** This is the *molecular-level twin* of the HLI. It is, in effect, a *blood test for function*. It *fuses* the phenotypic, clinical assessment of "function" with a "hard" molecular biomarker (DNAm).

These two tools are a perfect pair. The HLI is the broad, simple tool for *PCPs* to stratify populations. The IC Clock is the deep, precise tool for *clinical trials* (like the UA/Fisetin trial¹²) and *specialist clinics* to measure an intervention's effect at the molecular level.

4.2 AI and Advanced Imaging Platforms: Detecting Decline Earlier

AI for Progressive Pulmonary Fibrosis (PPF)

New research for an "AI-enabled e-Lung software" was presented at the American College of Chest Physicians (CHEST) conference this past week.¹³

- **The Tool:** An AI algorithm that analyzes CT scans to detect progressive pulmonary fibrosis (PPF), a key age-related fibrotic disease.
- **The Function:** The AI provides "significantly improved and *earlier* detection of progressive pulmonary fibrosis, *even in patients deemed clinically stable*".¹³

That last phrase is the critical breakthrough. The AI is *outperforming* human clinicians in detecting *sub-clinical* functional decline. This is a true healthspan tool: its value is not just diagnosis, but *pre-symptomatic detection*. It *creates a therapeutic window* where none existed, identifying an actionable patient population for new anti-fibrotic or senolytic therapies *before* irreversible functional decline (i.e., loss of lung capacity) occurs.

FDA Clears "Zero-Capex" Intracardiac Ultrasound

The FDA cleared a new "Intracardiac Imaging System" this week.¹³ While the technology (real-time, high-resolution ultrasound) is an incremental advance, the real innovation is its business model.

- **The Key Feature (Accessibility):** The system is offered as a "**zero-capex**" (zero capital expenditure) product.¹³
- **The Implication:** This is not an engineering breakthrough, but a *market access* breakthrough. The "zero-capex" model "facilitates workflow efficiencies and reduced costs" ¹³ by removing the primary barrier to adoption for hospitals and clinics: a large, upfront capital purchase. This is a critical development for *scalability*. It means advanced diagnostics can be deployed *faster* and *more widely*, which is an essential, practical component of any future population-level healthspan screening initiative.

5. Ethical and Practical Considerations

The science of healthspan does not exist in a vacuum. The developments of the past week highlight the central practical and ethical tensions in the field: accessibility, commercialization, and policy.

5.1 The Accessibility Mandate: A New Field-Wide Requirement

Two of this week's most significant announcements, from two distinct domains, share a core theme of access.

1. **The XPRIZE Healthspan:** The \$101 million competition *mandates* that the winning solution must be "accessible, scalable within a year, and affordable." It is explicitly framed as a "powerful antidote to the exclusivity that often shadows biomedical innovation".⁴
2. **The "Zero-Capex" Imaging System:** The FDA clearance of this new ultrasound is newsworthy *because* its "zero-capex" business model¹³ is designed for *scalability* and rapid adoption.

The field's most prominent leaders (XPRIZE) and its most practical innovators (the imaging company) are *both* engineering *scalability and affordability* into their core design. This represents a maturation of the field—a proactive move to avoid the "longevity-for-billionaires" narrative and to create interventions that can have a true *public health* impact.

5.2 The Counter-Model: High-End Concierge Healthspan

In direct dialectical tension with the accessibility mandate is the *current commercial reality* of cutting-edge healthspan deployment. This week saw the public launch of Dr. Peter Attia's "biohacking clinic," **Biograph**.¹⁸

- **The Model:** This clinic offers "executive-level health optimization services" at a price point of "**\$7,500 dollars per year**".¹⁸
- **The Target:** The clinic is explicitly "targeting tech and business leaders".¹⁸

This creates a *two-tiered system* of longevity deployment that represents the central ethical conflict in the field:

1. **Public Healthspan:** The "HLI"² model. This is slow, steady, population-based, focused on PCPs, and aims for *disability prevention*.
2. **Concierge Healthspan:** The "Biograph"¹⁸ model. This is fast, "bleeding-edge," high-cost, focused on a wealthy elite, and aims for *optimization*.

The practical reality is that the new, advanced tools (like the "IC Clock"³ and AI-driven diagnostics¹³) will be *deployed first* in the "Biograph" model, long before they are validated and integrated into the "HLI" primary care model.

5.3 Policy and Advocacy: Mainstreaming Longevity as a National Priority

The final piece of the practical puzzle is policy. This past week, Buck Institute CEO Eric Verdin testified before the **Senate Select Committee on Aging** at a hearing on "Optimizing Longevity".¹⁹

Verdin's testimony was a strategic argument to lawmakers: he framed the **NIH** as the "crown jewel of scientific research worldwide" and "essential to maintaining America's leadership position".¹⁹

This is the political arm of the healthspan movement. The head of a premier longevity institute (the same institute that produced the "IC Clock"³) is making a direct case to *lawmakers* that funding *geroscience* (via the NIH) is a *national strategic priority* for "Optimizing Longevity." This is a critical step in aligning the *science* (biomarkers), the *policy* (funding), and the *national goal* (healthspan), moving geroscience from a niche field to a central pillar of public health.

6. Future Directions: From Hypothesis to Healthspan

6.1 Summary of the Week: An Integrated System Emerges

The developments of the past seven days are not a collection of fragmented, random events. Viewed as a whole, they reveal a field that is rapidly maturing into an *integrated, operational system*. This week's news shows every component of the pipeline:

1. **Problem Definition:** Aging is defined as *functional decline* (the SASP wave⁹) or *identity loss* (Mesenchymal Drift¹¹).
2. **Measurement Tools:** We now have *both* clinical (HLI²) and molecular (IC Clock³) tools to *measure* this decline, while AI *detects* it sub-clinically (e-Lung¹³).
3. **Intervention Testing:** This enables *targeted trial design* (the UA+Fisetin trial¹²) using these new functional endpoints.
4. **Scaling and Deployment:** We have *incentives* (XPRIZE⁴) to make interventions *scalable*, and *new models* for *deploying* the technology (Zero-Capex¹³) and the service (Biograph

¹⁸).

5. **Policy and Funding:** We have *advocacy* (Buck Institute ¹⁹) to *fund* this entire loop as a national priority.

6.2 Anticipated Next Steps (Projections)

Based on this analysis, several next steps are highly likely:

- **Intermittent Fasting:** Expect a swift and aggressive response from the research community to the preliminary IF-cardiovascular mortality data.⁷ This will include immediate, critical deconstructions of the study's (likely observational) methodology and, most importantly, urgent calls for a large-scale, long-term *Randomized Controlled Trial (RCT)* to definitively settle the cardiovascular risk question.
- **Senolytics:** Based on the clear rationale provided by the SASP pilot study⁹, we anticipate the announcement of a new, *interventional* clinical trial using senolytics (like Fisetin, which is already in trials¹²) in a *peri-operative setting* for hip fracture patients. This is now the most viable, short-term path-to-market for this class of drugs.
- **Biomarkers:** Expect the *integration* of this week's new tools. The next generation of clinical trials (like NCT06990256) will use the HLI² for *patient selection* (i.e., identifying patients at high risk for disability) and the IC Clock³ as a *surrogate endpoint* to prove (or disprove) an intervention's efficacy at the molecular level.

6.3 Concluding Analysis: The Functional Life Mandate

The central takeaway from the past seven days is that "functional life" is no longer a philosophical theme in longevity; it is now the *primary operational and methodological framework* of the entire field. The success of geroscience is no longer being measured in *years of life*, but in the *quality and function* of those years. The confluence of practical biomarkers, scalable AI, targeted multi-hallmark trials, and new deployment models represents a tangible, measurable acceleration toward evidence-based interventions for human healthspan.

Works cited

1. December 2023 – Healthspan Compass, accessed November 5, 2025, <https://healthspanaction.org/december-2023-healthspan-compass/>
2. Development and Validation of the Healthy Longevity Index for Personalized

- Healthy Aging in Primary Care: Cross-National Retrospective Analysis - JMIR Aging, accessed November 5, 2025, <https://aging.jmir.org/2025/1/e80034>
3. A Novel Blood-Based Epigenetic Clock for Intrinsic Capacity Predicts Mortality and is Associated with Clinical, Immunological and - bioRxiv, accessed November 5, 2025, <https://www.biorxiv.org/content/10.1101/2024.08.09.607252v1.full.pdf>
 4. Longevity, beyond the eternal youth fantasy | The Indian Express, accessed November 5, 2025, <https://indianexpress.com/article/opinion/editorials/longevity-beyond-the-eternal-youth-fantasy-9999297/>
 5. Latest News about Immunis' Investigational Secretome Treatment & Clinical Trial, accessed November 5, 2025, <https://immunisbiomedical.com/news-press-releases/>
 6. Morning Session [Stocks that Moved and Stocks with High Volume] - Moomoo, accessed November 5, 2025, <https://www.moomoo.com/news/post/59253410/morning-session-stocks-that-moved-and-stocks-with-high-volume>
 7. Can Intermittent Fasting Cause Heart Disease? Experts Slam Viral Study - NMN.com, accessed November 5, 2025, <https://www.nmn.com/news/can-intermittent-fasting-cause-heart-disease-experts-slam-viral-study>
 8. The ultimate healthy aging molecule Pure C15:0 went head-to-head against leading longevity drugs... and won. Dive deeper into th, accessed November 5, 2025, <https://www.discoverc15.com/wp-content/uploads/2024/03/Newsletter-68.pdf>
 9. Persistent elevation of plasma markers of cellular senescence after hip fracture: a pilot longitudinal study - ResearchGate, accessed November 5, 2025, https://www.researchgate.net/publication/386172447_Persistent_elevation_of_plasma_markers_of_cellular_senescence_after_hip_fracture_a_pilot_longitudinal_study
 10. Persistent elevation of plasma markers of cellular senescence after hip fracture: a pilot longitudinal study - Frontiers, accessed November 5, 2025, <https://www.frontiersin.org/journals/aging/articles/10.3389/fragi.2024.1477528/full>
 11. Headlines from the past week in aging (10/15/25) - Reddit, accessed November 5, 2025, https://www.reddit.com/r/Aging/comments/1o7cqy8/headlines_from_the_past_week_in_aging_101525/
 12. Study Details | NCT06990256 | Evaluation of Urolithin A and Fisetin on Improving Sleep and Aging Biomarkers | ClinicalTrials.gov, accessed November 5, 2025, <https://clinicaltrials.gov/study/NCT06990256>
 13. News | Diagnostic Imaging, accessed November 5, 2025, <https://www.diagnosticimaging.com/news>
 14. Diagnostic Imaging's Weekly Scan: September 7 — September 13, accessed November 5, 2025, <https://www.diagnosticimaging.com/view/diagnostic-imaging-weekly-scan-september-7-september-13>

15. Diagnostic Imaging's Weekly Scan: October 12 — October 18, accessed November 5, 2025, <https://www.diagnosticimaging.com/view/diagnostic-imaging-weekly-scan-october-12-october-18>
16. Cardiac Ultrasound | Topic - Diagnostic Imaging, accessed November 5, 2025, <https://www.diagnosticimaging.com/topic/cardiac-ultrasound>
17. Diagnostic Imaging - Radiology News, Imaging Expert Insights, accessed November 5, 2025, <https://www.diagnosticimaging.com/>
18. Biohacking News - Apple Podcasts, accessed November 5, 2025, <https://podcasts.apple.com/il/podcast/biohacking-news/id1752578349>
19. Buck CEO Eric Verdin's Statement on Proposed Changes to NIH Funding, accessed November 5, 2025, <https://www.buckinstitute.org/news/statement-on-proposed-nih-funding-changes/>