

Longevity: what is established, what remains to be proven

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By Patricia Delaite, published by Life Sciences Intelligentia (LSI)

Illustration: AI-generated

1. Conceptual / mechanistic	2. Preclinical	3. Early clinical	4. Clinically validated

No intervention has yet been shown to slow ageing in people.

At a glance

Four levels of evidence

1. Conceptual / mechanistic	2. Preclinical	3. Early clinical	4. Clinically validated

1 No intervention has reached **level 4**, fewer clinical events, for ageing itself. The **level 4** examples reduce cardiovascular events in defined patient groups [17, 25].

2 Research on ageing aims to extend healthspan, the years lived in good health. Across 183 countries, lifespan exceeds healthspan by 9.6 years on average [1].

3 Biology has mapped twelve hallmarks of ageing (processes that drive it), mostly in animals, which is **level 1** evidence. Antioxidant supplements, built on such a mechanism, did not lower mortality across 78 randomised trials (trials that assign treatments by chance) [4, 7].

4 Most longevity interventions sit at **level 2** (animal results) or **level 3** (early human trials that change biomarkers, measurable biological signs), and several human trials missed their main goal [10, 12, 13, 14].

5 In Switzerland, as of 30 September 2026, ageing is not an authorised indication (an approved use) for any medicine discussed here [27].

> **Read the level before the headline: a result in mice (level 2) or a biomarker change (level 3) does not show that any disease is prevented, so the first question for a longevity claim is which level it has reached, and in which species.**

Part 1

Part 1: Executive briefing

No intervention has yet been shown to slow ageing in people. Most longevity results come from animals or from biomarkers, and the few that reduce clinical events do so for named diseases. The word longevity covers demography, cell biology, preventive medicine and a market of clinics, tests and supplements [28]. This first issue of the LSI Longevity Review grades the evidence on a four-level scale.

Geroscience, the study of the biology of ageing, aims to extend healthspan [3]. Across 183 countries, people live on average 9.6 years longer than they stay healthy [1], and gains in life expectancy have slowed in the longest-lived countries [2]. See Part 2 §1.

Biology has mapped twelve hallmarks of ageing, from DNA damage to chronic inflammation, mostly in animal studies [4]. Mitochondria, the cell's energy producers, are among them [5]. This is **level 1** evidence, which does not yet show a treatment. Antioxidant supplements rested on an older theory that oxidative damage drives ageing, yet across 78 randomised trials they did not lower mortality, and beta-carotene and vitamin E slightly raised it in the most reliable trials [7]. See Part 2 §2.

Medicine aimed at ageing sits mostly at **levels 2 and 3**. Rapamycin (sirolimus), dasatinib (a leukaemia drug) plus quercetin (a plant compound), and partial reprogramming (briefly switching on genes that reset cells toward a younger state) extended life or improved function in mice [8, 11, 18]. In people, the rapamycin trial PEARL missed its primary endpoint (the main outcome a trial is designed to test); adverse events (harms recorded during treatment) were similar across groups, but average blood sugar rose slightly in men on the lower dose [10]. Everolimus, a closely related drug, improved the response to flu vaccine by about 20% in an exploratory study, with mouth ulcers the most common side effect [9]. Of two trials of senolytics (drugs that clear senescent cells, worn-out cells that stop dividing), one failed against knee pain [12], and dasatinib plus quercetin missed its primary endpoint in a bone trial and caused headache in 53% of the women treated [13]. A trial of the supplement urolithin A missed its primary endpoints but improved muscle endurance [14]. Metformin, a diabetes medicine, has no trial data against ageing. TAME, a large trial designed around age-related diseases, had not started by late September 2026 for lack of funding [16, 36], and in diabetes-prevention studies metformin was linked to mild anaemia and low vitamin B12 [15]. In Switzerland, as of 30 September 2026, sirolimus, everolimus, dasatinib, metformin and semaglutide are prescription-only medicines, none authorised for ageing [27]. See Part 2 §3.

Geroscience
The research field on the biology of ageing and its link to chronic disease.

Healthspan
The years lived in good health, free of serious chronic disease or loss of independence.

Hallmarks of ageing
Twelve biological processes that worsen with age and drive ageing, as listed by López-Otín and colleagues in 2023.

Mitochondria
The structures inside cells that produce most of their energy.

Senescent cells
Worn-out cells that stop dividing but do not die.

Dasatinib
A medicine authorised in Switzerland, as of 30 September 2026, for two forms of leukaemia; tested with quercetin as a senolytic combination.

Quercetin
A plant compound, tested with dasatinib as a senolytic combination.

At **level 4** (fewer clinical events), intensive blood-pressure control in SPRINT lowered cardiovascular events and deaths but raised serious adverse events such as fainting and kidney injury [25]. Semaglutide cut major cardiovascular events by 20% in people with cardiovascular disease and overweight but no diabetes, while adverse events led about twice as many to stop treatment as on placebo [17]. Neither trial tested ageing. Epigenetic clocks (tests that estimate biological age from chemical marks on DNA) are not yet accepted in place of clinical outcomes [22]; in two randomised trials, effects on them were small, a 2-3% slower pace of ageing or a few months of biological age [23, 24]. See Part 2 §4.

The scale below grades the evidence from a study, not a product.

Four levels of evidence

Level	Question asked	Examples in this issue
■■■■ **4. Clinically validated**	Does it reduce clinical events (disease, loss of independence, death)? Level 4 applies to a named disease or outcome; no intervention has reached it for ageing itself.	SPRINT (blood-pressure control) and SELECT (semaglutide), for cardiovascular events only
		SPRINT (blood-pressure control), cardiovascular events; SELECT (semaglutide), cardiovascular events
■■■□ **3. Early clinical**	Is it safe in humans, and does it change biomarkers?	PEARL (rapamycin), the urolithin A trial, CALERIE (caloric restriction), DO-HEALTH (omega-3)
		PEARL (rapamycin); Urolithin A trial; CALERIE (caloric restriction); DO-HEALTH (omega-3)
■■□□ **2. Preclinical**	Does acting on it extend healthy life in animals?	Rapamycin, senolytics and partial reprogramming in mice
		Rapamycin in mice; Senolytics in mice; Partial reprogramming in mice
■□□□ **1. Conceptual / mechanistic**	Does the mechanism exist, and is it linked to ageing?	The twelve hallmarks of ageing, mitochondrial dysfunction
		Hallmarks of ageing, mitochondrial dysfunction

What this means for decision-makers

The author's and LSI's reading of the evidence:

Read the level before the headline: a result in mice (**level 2**) or a biomarker change (**level 3**) does not show that any disease is prevented, so the first question for a longevity claim is which level it has reached, and in which species.

Biomarker
A measurable biological sign, such as a blood marker, used to track a process or a treatment effect.

The regulatory path runs through named diseases: because ageing is not an authorised indication in Switzerland (as of 30 September 2026) [27], trials target outcomes in named diseases, such as cardiovascular events in SELECT [17], and TAME's organisers hope the US regulator will accept ageing itself as an indication [16].

Company milestones are company-reported: Loyal reports that the US regulator has accepted two of three technical sections for conditional approval (an approval route for animal drugs) of LOY-002, a drug for older dogs that was still in its main field study in September 2026 [20, 21].

Supplements face a lower bar: in the United States, as of 20 October 2026, a dietary supplement needs no approval before sale [33], so it need not show the efficacy required of a medicine (Part 2 §4).

The best-supported measures are often the least spectacular: physical activity, control of blood pressure and other cardiovascular risk factors, and stopping smoking [25, 29, 34]. Any change to medicines, supplements or health habits is a matter to discuss with a doctor.

Authorised indication
The use for which a medicine is approved by a regulator.

What's next in this series

Each quarterly issue takes one theme and follows the same structure: the mechanism as understood, the level of evidence reached, the main academic and industrial players, and what to watch in the following months. Possible themes:

Mitochondria, metabolism and NAD+ (a molecule cells need to turn food into energy): from concept to first trials.

Cellular senescence and senolytics: taking stock after a decade of trials.

Biological clocks and biomarkers: what consumer tests measure.

Repurposed drugs: rapamycin, metformin and GLP-1 medicines (drugs that mimic a gut hormone involved in appetite and blood sugar).

Cellular reprogramming and regenerative therapies: from mouse studies to a first human trial.

Lifestyle: what trials say about exercise, nutrition and sleep.

Longevity clinics, regulation and investment: a critical reading of the offer.

Patricia Delaite welcomes suggestions on which themes to take first.



Illustration: AI-generated

Part 2

Part 2 §1: The aim is healthspan, studied by five overlapping fields

Lifespan (the number of years lived) and healthspan (the years lived in good health, free of serious chronic disease or loss of independence) differ. Geroscience, the research field on the biology of ageing, aims to extend healthspan [3]. Across the 183 member states of the World Health Organization, Garmany and Terzic found a mean gap of 9.6 years in 2019 [1]. Gains in life expectancy have slowed in the longest-lived countries, and Olshansky and colleagues judge radical life extension this century implausible unless biological ageing can be markedly slowed [2].

Geroscience
The research field on the biology of ageing and its link to chronic disease.

Healthspan
The years lived in good health, free of serious chronic disease or loss of independence.

Five fields can be distinguished.

Demography and public health: life expectancy, social determinants of health, and the organisation of health systems.

Biology of ageing (geroscience): the cellular and molecular mechanisms shared by many age-related diseases.

Clinical medicine and prevention: screening, control of risk factors such as blood pressure, and geriatrics (the medicine of older people).

Lifestyle: physical activity, nutrition, sleep and social connection.

The longevity market: clinics, tests and dietary supplements, where the level of evidence varies widely [28].

The fields overlap. Physical activity belongs at once to lifestyle, clinical prevention [29] and mitochondrial biology, since exercise stimulates the

renewal of mitochondria in muscle [30]. A result that holds in one field does not carry over automatically to another, and confusion often arises at these boundaries.

Mitochondria
The structures inside cells that produce most of their energy.

Part 2 §2: Biology has mapped the mechanisms, mostly in animals

Under the geroscience hypothesis, ageing is the greatest risk factor for most chronic diseases (cancer, cardiovascular, neurodegenerative and metabolic diseases), so targeting its mechanisms could delay several of them at once [3]. In 2023, López-Otín and colleagues updated their list of the hallmarks of ageing to twelve [4]: genomic instability (accumulating DNA damage), telomere attrition (shortening of chromosome end caps), epigenetic alterations (changes in chemical marks that switch genes on and off), loss of proteostasis (failing protein quality control), disabled macroautophagy (reduced recycling of cell components), deregulated nutrient sensing (cells misreading the food supply), mitochondrial dysfunction, cellular senescence (cells that stop dividing but do not die), stem cell exhaustion (depletion of tissue-renewing cells), altered intercellular communication (disturbed signalling between cells), chronic inflammation and dysbiosis (imbalanced gut microbes). Each hallmark meets three criteria: it worsens with age, aggravating it experimentally accelerates ageing, and attenuating it slows ageing [4]. These criteria are met mainly in animal models. Experiments in mice, and in some cases non-human primates, have corroborated most hallmarks in mammals [4].

Hallmarks of ageing
Twelve biological processes that worsen with age and drive ageing, as listed by López-Otín and colleagues in 2023.

Hallmarks of ageing, mitochondrial dysfunction L1

Mitochondria (the cell's energy producers) also regulate metabolism, including through NAD+ (nicotinamide adenine dinucleotide, a molecule cells need to turn food into energy), cell death and inflammation, and so influence several aspects of ageing [5]. With age, mitochondrial function declines, NAD+ levels fall and mitophagy (the recycling of damaged mitochondria) decreases. Fragments of mitochondrial DNA released into the cell can then activate innate immunity (the body's first-line defence) and sustain age-related chronic inflammation [5]. Animal studies show a causal link. Mice carrying a defective mitochondrial DNA polymerase (the enzyme that copies mitochondrial DNA) accumulate mitochondrial DNA mutations and age prematurely [6].

Antioxidants show that a well-established mechanism does not guarantee that a simple intervention works. The free radical theory of ageing, proposed by Harman in 1956, held that oxidative damage drives ageing [31], which suggested that antioxidants would slow it. A 2024 review notes that views of the theory have shifted, mainly for lack of experimental support [32]. A meta-analysis (a statistical pooling of trials) by Cochrane (an independent evidence-review network) of 78 randomised trials (trials that assign treatments by chance) with 296,707 participants found no reduction in mortality [7]. In the

trials at low risk of bias (trials whose design is least likely to distort results), beta-carotene and vitamin E were associated with a slight increase in mortality, with relative risks (the risk in the treated group divided by the risk in the control group) of 1.05 and 1.03 [7].

Part 2 §3: No medicine has yet shown a clinical benefit against ageing

According to the Swissmedic list of 30 September 2026, rapamycin (sirolimus), everolimus, dasatinib, metformin and semaglutide are prescription-only medicines in Switzerland, none authorised for ageing [27], so their use against ageing lies outside their authorised indications (approved uses). The results below are research findings, not treatment options.

Dasatinib
A medicine authorised in Switzerland, as of 30 September 2026, for two forms of leukaemia; tested with quercetin as a senolytic combination.

Rapamycin (sirolimus): an inhibitor of mTOR (a protein that adjusts cell growth to the supply of nutrients), authorised in Switzerland as an immunosuppressant (a drug that dampens the immune system) [27]. Given to mice from 600 days of age (roughly equivalent to a 60-year-old person), it extended lifespan in both sexes at three sites funded by the US National Institute on Aging [8]. In 218 people aged 65 and over, its analogue everolimus (a closely related drug, authorised in Switzerland against transplant rejection and some tumours [27]) improved the response to influenza vaccine by about 20% in an exploratory study (one that generates hypotheses). Mouth ulcers were the most common related adverse event (20 participants) and five withdrew because of adverse events; at the higher doses used in cancer and transplant medicine, the drug class causes mouth sores, low blood counts and raised blood lipids and sugar [9]. The PEARL trial analysed 114 participants who completed 48 weeks. Adverse events were similar across groups, but PEARL missed its primary endpoint (the main outcome a trial is designed to test), visceral fat (fat around the abdominal organs). Lean mass (muscle and other non-fat tissue) increased only in women on the higher dose, and men on the lower dose showed a small rise in HbA1c, a marker of average blood sugar [10].

Lifespan
The number of years lived.

Analogue
A closely related drug with a similar chemical structure.

Rapamycin in mice L2

PEARL (rapamycin) L3

HbA1c
A blood marker of average blood sugar over recent months.

Senolytics (drugs that clear senescent cells): in naturally aged mice, intermittent dasatinib plus quercetin (a plant compound) improved physical function and increased survival after treatment by 36%; the authors called for toxicity studies before trials in healthy people [11]. Dasatinib is authorised in Switzerland for two forms of leukaemia [27]. The senolytic candidate UBX0101 showed no advantage over placebo on its primary endpoint, knee pain at 12 weeks, in a phase 2 trial (a mid-stage efficacy trial) of 183 people with knee osteoarthritis [12]. In an open-label phase 2 trial (participants knew their

Primary endpoint
The main outcome a trial is designed to test.

treatment) in 60 postmenopausal women, dasatinib plus quercetin missed its primary endpoint, a blood marker of bone breakdown. A bone-formation marker rose at 2 and 4 weeks but not at 20 weeks, and a 2.7% gain in forearm (radius) bone density appeared only in an exploratory analysis of the third of women with the most senescent cells. Headache affected 53% of women on dasatinib plus quercetin (16 of 30), gastrointestinal complaints were common, and one withdrew with QTc prolongation (a lengthened heart-signal interval on the electrocardiogram) after dasatinib [13].

Quercetin
A plant compound, tested with dasatinib as a senolytic combination.

Senescent cells
Worn-out cells that stop dividing but do not die.

■■□□ Senolytics in mice L2

The results below are research findings, not treatment options.

Urolithin A: a compound that gut bacteria produce from substances in food, studied as an activator of mitophagy. In a 4-month randomised trial in 66 adults aged 65 to 90, it improved muscle endurance and some blood biomarkers (measurable biological signs) but missed its two primary endpoints, the 6-minute walking distance and maximal muscle production of ATP (adenosine triphosphate, the cell's energy carrier). The trial was funded by the maker of the product tested, four authors had ties to that company, and the funder took part in the design, analysis and decision to publish [14]. Urolithin A is sold as a dietary supplement; no medicine containing it is authorised in Switzerland [27].

Mitophagy
The recycling of damaged mitochondria.

Randomised trial
A trial that assigns treatments by chance.

■■■□ Urolithin A trial L3

Metformin: a type 2 diabetes medicine in Switzerland [27]. The TAME trial (Targeting Aging with Metformin) was designed to enrol about 3,000 people and to test a composite endpoint (several outcomes counted together) of cardiovascular events, cancer, dementia and death, as a model for evaluating drugs that delay ageing [15]. Its organisers state that they hope the US Food and Drug Administration (FDA) will approve ageing as an indication [16]. As of 29 September 2026, TAME had not been launched for lack of full funding and had produced no data [16, 36]. In diabetes-prevention studies, metformin was associated with mild anaemia (about 12% versus 8% on placebo) and vitamin B12 deficiency (about 7% versus 5%), and its risk of lactic acidosis (acid build-up in the blood) depends on kidney function [15].

Semaglutide: authorised in Switzerland for type 2 diabetes, weight management and cardiovascular risk reduction [27]. In the SELECT trial, 17,604 people aged 45 or over with established cardiovascular disease and overweight or obesity, but without diabetes, had 20% fewer major cardiovascular events (cardiovascular death, non-fatal heart attack or non-fatal stroke) than on placebo, a hazard ratio (the relative rate of events over time) of 0.80. Adverse events led 16.6% of participants on semaglutide to stop treatment for good, against 8.2% on placebo, and the manufacturer funded the trial [17].

■■■■ SELECT (semaglutide), cardiovascular events L4

Partial reprogramming: short, repeated activation of reprogramming factors (genes that can return adult cells to an embryonic-like state) extended the life of progeroid mice (mice bred to age prematurely) [18] and restored vision in aged mice and in a mouse model of glaucoma [19]. In earlier mouse studies, continuous activation caused tumours, and some mice developed tumours even under cyclic activation [18]. In March 2026, a partial-reprogramming gene therapy began a first-in-human phase 1 trial (a first, small test of safety) in an estimated 18 people with glaucoma or a related optic nerve disease; on 20 October 2026 the registry still listed it as recruiting, with no results posted [26]. On 8 October 2026 the developer reported that the treatment was well tolerated through day 56 in the first three participants with glaucoma, with early signs of better visual-field results in two of them; these are company-reported data, without a control group [35].

■□□□ Partial reprogramming in mice L2

Veterinary medicine: LOY-002 is an investigational drug (still in testing) intended to extend healthy lifespan in dogs aged 10 and over. Its developer, Loyal, reports that the FDA's Center for Veterinary Medicine has accepted two of the three major technical sections required for conditional approval (an approval route for animal drugs): reasonable expectation of effectiveness in February 2025 and target animal safety in January 2026 [20]. The pivotal STAY study (the large study intended to support approval) enrolled 1,300 dogs [20], and Loyal's release of 16 September 2026 still places LOY-002 in that study [21]. Loyal states that, if approved, LOY-002 would be the first drug approved for lifespan extension in any species [20].

Without clinical outcomes to show, the field turns to biomarkers, particularly epigenetic clocks, which estimate biological age or the pace of ageing from DNA methylation (chemical tags on DNA that change with age). An international consortium states that biomarkers of ageing still need validation against clinical outcomes; none is yet established as a surrogate endpoint (a measurement accepted in place of a clinical outcome) [22].

Part 2 §4: Most results stop at biomarkers, short of clinical benefit

The scale below grades the evidence from a study, not a product: one substance can have studies at several levels.

Four levels of evidence

Level	Question asked	Examples in this issue
■□□□ 1. Conceptual / mechanistic	Does the mechanism exist, and is it linked to ageing?	The twelve hallmarks, mitochondrial dysfunction [4, 5]

Level	Question asked	Examples in this issue
2. Preclinical	Does acting on it extend healthy life in animals?	Rapamycin, senolytics and partial reprogramming in mice [8, 11, 18]
3. Early clinical	Is it safe in humans, and does it change biomarkers?	PEARL, the urolithin A trial, CALERIE, DO-HEALTH [10, 14, 23, 24]
4. Clinically validated	Does it reduce clinical events (disease, loss of independence, death)? **Level 4** applies to a named disease or outcome; no intervention has reached it for ageing itself.	Intensive blood-pressure control (SPRINT), semaglutide (SELECT), for cardiovascular events only [17, 25]

SPRINT (intensive blood-pressure control in 9,361 adults at high cardiovascular risk) and SELECT reached **level 4** for cardiovascular events in defined populations. SPRINT also lowered death from any cause but raised serious adverse events such as low blood pressure, fainting, abnormal blood salt levels and acute kidney injury [25]. Neither trial tested an effect on ageing.

SPRINT (blood-pressure control), cardiovascular events L4

Two trials illustrate **level 3**. In CALERIE, two years of moderate caloric restriction (eating less without malnutrition) slowed the pace of ageing on the DunedinPACE clock by 2-3%, with no effect on two other clocks, PhenoAge and GrimAge [23]. DO-HEALTH tested omega-3, vitamin D and home exercise over three years; its post hoc epigenetic analysis (not planned when the trial began) covered 777 Swiss participants aged 70 and over (mean age 75.5). Omega-3 slowed three of the four clocks in the main analysis, and across the treatments tested, effects on PhenoAge and GrimAge2 equalled 2.9-3.8 months of biological age over three years [24]. Both results come from randomised trials, but they concern biomarkers, not diseases prevented or years of life gained.

CALERIE (caloric restriction) L3

DO-HEALTH (omega-3) L3

Four pitfalls follow. First, mice are not humans. Lifespan and genetics differ, and effects often depend on sex: rapamycin extended lifespan more in female than in male mice [8]. Second, a biomarker is not a clinical benefit. Third, statistically significant (unlikely to be due to chance) does not mean relevant, and a few months on a clock is a modest effect. Fourth, regulatory status matters. In the United States, for example, as of 20 October 2026, the FDA does not approve dietary supplements before they are sold [33], so a supplement need not demonstrate efficacy the way a medicine must.

Biomarker
A measurable biological sign, such as a blood marker, used to track a process or a treatment effect.

> **Both results come from randomised trials, but they concern biomarkers, not diseases prevented or years of life gained.**

The interventions best supported today for healthspan are often the least spectacular: physical activity [29], control of cardiovascular risk factors such as blood pressure [25], and stopping smoking [34]. Anyone considering a change to their medicines, supplements or health habits should discuss it with their doctor.

Patricia Delaite (MD, trained in internal medicine and oncology, with a focus on geroscience) is co-founder of Life Sciences Intelligentia (LSI), Switzerland. If your company expects to raise or open a data room in the next year, LSI offers a free 30-minute evidence-readiness review: from your public materials, where your lead program appears to stand on this scale, and the questions investors are likely to ask first. Write to jm.suter@lsiconsulting.ch.

Disclaimer and disclosure

This review is informational analysis of published research. It is not medical advice. It is not investment advice or a recommendation to buy or sell any security. Anyone considering a change to their own treatment should discuss it with their doctor.

Disclosure: the interests of the author, Patricia Delaite, and of Life Sciences Intelligentia (LSI) and its people in any company or product named in this issue (mandates, holdings, advisory roles, payments) are stated below, or stated as none.

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Trading policy: the author, LSI and everyone else who saw the draft of this issue have confirmed in writing that they have not traded and will not trade securities of any company named in it, from the draft date of 28 September 2026 until 3 business days after publication. This is an LSI policy, not a statutory holding period.

Corrections: factual errors in this issue can be reported to the author, Patricia Delaite. Each confirmed error is corrected in a new, dated version of this issue.

About this review

This review was written by Patricia Delaite and edited and published by Life Sciences Intelligentia (LSI). Its claims are referenced to the numbered list of published sources; company releases are labelled as company-reported, and regulatory statements name a jurisdiction and a date. It is informational analysis of published research, not medical or investment advice.

Glossary

Adverse event
A harm recorded during treatment in a trial, whether or not the treatment caused it.

Altered intercellular communication
Disturbed signalling between cells; one of the twelve hallmarks of ageing.

Analogue
A closely related drug with a similar chemical structure.

ATP (adenosine triphosphate)
The molecule that carries energy inside cells; here, the energy output of muscle mitochondria.

Authorised indication
The use for which a medicine is approved by a regulator.

Biomarker
A measurable biological sign, such as a blood marker, used to track a process or a treatment effect.

Caloric restriction
Eating fewer calories than usual without malnutrition.

Cellular senescence
A state in which cells stop dividing but do not die; one of the twelve hallmarks of ageing.

Cochrane
An independent network that reviews medical evidence and publishes systematic reviews.

Composite endpoint
Several outcomes counted together as one trial result.

Conditional approval
An approval route for animal drugs in the United States.

Dasatinib
A medicine authorised in Switzerland, as of 30 September 2026, for two forms of leukaemia; tested with quercetin as a senolytic combination.

Deregulated nutrient sensing
Cells misreading how much food is available; one of the twelve hallmarks of ageing.

Disabled macroautophagy
Reduced recycling of worn-out cell components; one of the twelve hallmarks of ageing.

DNA methylation
Chemical tags on DNA that change with age.

Dysbiosis
An imbalanced community of gut microbes; one of the twelve hallmarks of ageing.

Epigenetic alterations
Changes in the chemical marks that switch genes on and off; one of the twelve hallmarks of ageing.

Epigenetic clock
A test that estimates biological age, or the pace of ageing, from DNA methylation.

Exploratory analysis or study
One that generates hypotheses rather than testing them.

Genomic instability
Accumulating damage to DNA; one of the twelve hallmarks of ageing.

Geriatrics
The medicine of older people.

Geroscience
The research field on the biology of ageing and its link to chronic disease.

GLP-1 medicines
Drugs that mimic a gut hormone involved in appetite and blood sugar.

Hallmarks of ageing
Twelve biological processes that worsen with age and drive ageing, as listed by López-Otín and colleagues in 2023.

Hazard ratio
The relative rate of events over time in a treated group compared with a control group.

HbA1c
A blood marker of average blood sugar over recent months.

Healthspan
The years lived in good health, free of serious chronic disease or loss of independence.

Immunosuppressant
A drug that dampens the immune system.

Innate immunity
The body's first-line, non-specific defence.

Investigational drug
A drug still in testing, not yet approved.

Lactic acidosis
A build-up of acid in the blood.

Lean mass
Muscle and other non-fat tissue.

Lifespan
The number of years lived.

Loss of proteostasis
Failing protein quality control; one of the twelve hallmarks of ageing.

Low risk of bias
Said of trials whose design is least likely to distort results.

Meta-analysis
A statistical pooling of the results of several trials.

Mitochondria
The structures inside cells that produce most of their energy.

Mitochondrial DNA polymerase
The enzyme that copies the DNA of mitochondria.

Mitophagy
The recycling of damaged mitochondria.

mTOR
A protein that adjusts cell growth to the supply of nutrients; rapamycin inhibits it.

NAD+ (nicotinamide adenine dinucleotide)
A molecule cells need to turn food into energy.

Open-label trial
A trial in which participants know which treatment they receive.

Partial reprogramming
Briefly switching on genes that reset cells toward a younger state.

Phase 1 trial
A first, small test of a treatment's safety in people.

Phase 2 trial
A mid-stage trial of a treatment's efficacy in patients.

Pivotal study
The large study intended to support approval.

Post hoc analysis
An analysis not planned when the trial began.

Primary endpoint
The main outcome a trial is designed to test.

Progeroid mice
Mice bred to age prematurely.

QTc prolongation
A lengthened heart-signal interval on the electrocardiogram.

Quercetin
A plant compound, tested with dasatinib as a senolytic combination.

Randomised trial
A trial that assigns treatments by chance.

Relative risk
The risk in the treated group divided by the risk in the control group.

Reprogramming factors
Genes that can return adult cells to an embryonic-like state.

Senescent cells
Worn-out cells that stop dividing but do not die.

Senolytics
Drugs that clear senescent cells.

Statistically significant
Unlikely to be due to chance.

Stem cell exhaustion
Depletion of the cells that renew tissues; one of the twelve hallmarks of ageing.

Surrogate endpoint
A measurement accepted in place of a clinical outcome.

Telomere attrition
Shortening of the protective caps at the ends of chromosomes; one of the twelve hallmarks of ageing.

Visceral fat
Fat around the abdominal organs.

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