

# Live Long and Prosper: Navigating the Hope and Hype of Extended Longevity



**Kenneth Pelletier R\***

*Vice President, American Specialty Health (ASH), Clinical Professor of Medicine, University of California School of Medicine (UCSF), USA*

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**\*Corresponding author:** Kenneth Pelletier R, Vice President, American Specialty Health (ASH), Clinical Professor of Medicine, University of California School of Medicine (UCSF), USA

## Abstract

Predicting the future of human longevity with any degree of certainty is virtually impossible. However, it is reasonable to highlight some trends that have been emerging in the practical applications of human longevity research in recent years. These trends will continue to evolve over the next five years. Most importantly, these breakthroughs will form the basis for the international development of longevity clinics or centers to transfer these discoveries to extend, healthy, highly functional human longevity well beyond the “Hayflick Limit” of 120 years. Keep in mind that the field of longevity research is rapidly evolving, so these trends may change or become more refined. One major influence is the \$100 Million dollar prize announced by Peter Diamandis of the X Prize in Qatar at the end of November 2023. That prize is focused on the global challenge to all researchers/clinicians to develop an intervention that has a positive impact on the three dimensions of psychological/mental, immunological and physical functioning that produces a measurable and sustainable impact on human longevity. That prize will be awarded in Qatar in 2030 and with literally thousands of competing group, results are a virtual certainty. It is also also a certainty that we will be bombarded with both hope and hype that will be tantamount to isolating one snowflake in a blizzard from less reputable, competing sources between now and 2030. There is no panacea or quick fix in the infinite media stream of junk science ... it is a matter of “steady as she goes” to use a nautical term!

**Keywords:** Longevity; Anti-Aging Therapies; Senolytic drugs; Bio Printig of 3D organs; Biohacking

**Abbreviations:** EGCG: Epigallocatechin Gallate; NAD: Nicotinamide Adenine Dinucleotide; NR: Nicotinamide Riboside; AI: Artificial Intelligence

## Introduction

### Data Background and PPTs of Global Longevity (@ 3 - 4 Inserts)

Here are eight (8) major trends in the practical applications of longevity research in longevity clinics and centers:

#### Personalized Longevity Plans

Longevity clinics or “Centers” (not “spas”) are likely to increasingly focus on personalized health plans tailored to an individual’s genetic makeup, lifestyle, and specific health risks. This will involve ongoing, comprehensive genetic testing, epigenetic analysis, and advanced biomarker assessments to create customized longevity strategies [1]. There are literally hundreds of Longevity Centers around the globe. Among the more well known and long standing Centers are the Longevity Health and Wellness Hotel in Alvor, Portugal; Ikaria Longevity Retreat in Ikaria, Greece which is a Blue Zone; Clinique la Prairie on the Swiss Riviera; Six Senses in Ibiza, Spain; Borgo Egnazia in Puglia, Italy and is an official Blue Zones partner; Rancho la Puerta which

is the oldest spa in North America in Tecate, Mexico; the Farm at San Benito in the Philippines; Chiva-Som in two locations in Thailand and the other in Qatar; Ananda in the Himalayan foothills in northern India; and, one recent example is the international Fountain Life Clinics developed by Bill Kapp. Several of these are detailed as examples of this burgeoning trend later in this chapter. Advances in medical imaging technologies, biomarker identification, and noninvasive diagnostic tools will enable early detection and intervention for age related diseases [2-4]. Also, vaccines will continue to play a vital role in preventing infectious diseases that can be particularly dangerous to the very young and the very old. It is vital to remember that human aging is not a disease to be cured but a focus on a “healthspan” of vital living versus life expectancy at all costs.

#### Senolytics and Anti-Aging Therapies

Pharmacology is increasingly moving towards personalized medicine, where treatments are tailored to an individual’s genetic makeup and health profile. This allows for more precise

and effective interventions. As research into senescence and senolytics (drugs that target and remove senescent cells) advances, longevity clinics will offer more therapies aimed at slowing down or reversing the aging process. These treatments could include senolytic and nootropic drugs as well as indigenous herbals/mushrooms, regenerative therapies, and CRISPR gene editing interventions to address age-related diseases. Senolytic drugs are being investigated for their potential to extend healthy lifespan. Among these are various senolytic pharmacologies include Metformin (French Lilac); Rapamycin - Slows cell growth and reproduction; Resveratrol - Inflammation and blood sugar regulation; mTOR inhibition which increases lifespan and regulates autophagy through fasting, rapamycin, and urolithin A (pomegranate); NAD (Nicotinamide Adenine Dinucleotide) derived from the precursors (NR - Nicotinamide Riboside NWN and Nicotinamide Mononucleotide); Omega-3 Fatty Acids (DHA and EPA); Fisetin (A plant flavanol with laboratory animals found to increase lifespan and reduce senescence; AMPK activated protein which improves mitochondrial energy production and reverses insulin resistance; Curcumin; EGCG (Epigallocatechin Gallate = Green Tea) which is a polyphenol which reduces inflammation, weight loss, and CHD prevention; sirtuins which are proteins that reduce inflammation, reduce cancer via activation of the p53 tumor suppressor gene; Astragalus; Microbiome with pre and post biotics (Emeran Mayer); and Taurine. Anti-aging drugs are ones that target the biological processes of aging, such as senescence and cellular damage, has gained momentum [5-8].

## Nutrigenomics and Dietary Interventions

Longevity centers will increasingly incorporate nutrigenomics, the study of how diet interacts with genetics, to develop personalized nutrition plans. Individuals would receive specific recommendations based on their genetic predispositions to optimize their diets for longevity and disease prevention. Dietary recommendations move from “one size fits all” to tailored choices according to genetic profiles. To be sure, the endless flood of “diet of the day fads” will continue including Keto, Paleo, low carb, high carb, Vegan, low fat, pescetarian, non-fat, and every conceivable magic bullet recommendation. However, the gyroscope to orient ourselves is that there is only one diet that has the longest history of evidence-based health and longevity outcomes for the largest number of people, for the most conditions and that is the Mediterranean diet (Willett, ) [9-10]. In the near future, it will be possible to identify certain medical conditions and make specific dietary choices to mitigate the genetic risks. Foods such as antioxidants, cruciferous vegetables, or specific supplements can protect against cellular aging, maintain telomere length, or support mitochondrial functioning. All of which contribute to longevity [11].

## Telomere Regeneration

Research on telomeres, the protective caps on the ends of chromosomes implicated in aging, continues to be a prominent

area in longevity research. Longevity clinics will offer therapies, hormones such as telomerase, and/or other interventions to maintain or lengthen telomeres, potentially slowing the cellular aging process. Drugs that target telomere maintenance are under study for their anti-aging effects. Among the potential strategies are:

- 1) Telomerase activation by stimulating the activity of the telomerase in cells;
- 2) Cell based therapies involve the introduction of new, younger cells with longer telomeres into the body; and,
- 3) Telomere lengthening drugs are experimental but aim to influence the pathways involved in telomere maintenance and elongation.

There are extensive potential benefits of these bio hacks to slow cellular aging, reduce the risk of age related diseases such as Alzheimer's, improve tissue regeneration through inducing longer telomeres to enhance their regenerative capacity, and contribute to a longer health span with an enhanced capacity for physical and cognitive functions. Such efforts are designed to achieve the “longevity escape velocity” (LEV) cited by George Church and Aubrey de Grey [12-15].

## Digital Health and AI/GPT Driven Healthcare

Longevity centers are likely to leverage digital health technologies and artificial intelligence (AI) for early disease detection, continuous health monitoring, and treatment optimization. Wearable devices, health apps, and AI driven analytics can provide real-time data and insights for proactive health management. Wearable technology allows for continuous monitoring of vital signs, physical activity, and sleep patterns enabling individuals to proactively manage their health. Additionally, the advances in telemedicine will make it easier to access medical care, receive clinical advice, and manage chronic diseases while remaining in at home. Bio trackers will be common with emerging over the counter devices such as the Apple Watch, Fitbits, and Continuous Glucose Monitors (CGMs) [16]. While such ongoing biomonitoring is potentially beneficial, caution needs to be exercised so we do not become generations of data fixated (ie, “orthosomia” or the obsessive pursuit of optimal sleep metrics) hypochondriacs! There is also the “Bio Printig of 3D organs” and the new “Longevity Collective” collaboration between Stanford Medical School, Estee Lauder, the Buck Center in Marin, and the Weill Cornell Medical School [17-20].

## Genetics and Genomics

Genetic Insights have generated advances in genetics and genomics have provided valuable insights into the genetic factors that influence longevity. Researchers are studying centenarians and their genetic makeup to identify longevity-associated genes. Gene editing technologies such as CRISPR-Cas9 offer the potential to edit genes associated with aging and age-related diseases, although ethical and safety concerns need to be addressed. There are a growing number of reliable, accurately predictive, evidence based epigenetic assays [21-24]. Among these are assays by George

Church at Harvard; David Sinclair also at Harvard with a “Chemical Cocktail” that rejuvenates senescent cells; Viome - Partnership with CVS; Horvath’s Clock - UCLA; Huberman – a focus on sunlight exposure and optimal sleep (Stanford); Hyman - “Function Health” with over 100 Lab Tests; Thorne’s “OneGevery” program; Elizabeth Blackburn who won the Nobel Prize for telomeres in 2009 (UCSF Med); Bryan Johnson’s quest to “live forever” with a regimented protocol including a “Do Not Die” T-Shirt; regulating the gene FOXO3 which is one of the most prominent genes associated with human longevity; and, nanobots, xenobots, and regeneration technologies which will enable the growth of tissues, limbs, and internal organs [25].

## Social, Lifestyle, and Environmental Factors

Social support refers to the strong social networks and community engagement which are associated with increased longevity since they provide emotional support and promote healthy behaviors. Environmental factors are vital in reducing exposure to environmental toxins and promoting clean air and water can contribute to better health and longevity [26]. Diets such as the Mediterranean diet and caloric restriction have been associated with increased longevity. Nutritional supplements and interventions like the many variants of intermittent fasting (Longo, 2024) are also being explored. Regular physical activity has a significant impact on longevity by reducing the risk of chronic diseases, maintaining muscle mass, and improving overall health [27-29]. Also, stress management and meditation provide practical means of managing stress through practices like meditation, mindfulness, yoga, and relaxation techniques which can have a positive influence on longevity [30].

## Biohacking

There are many forms of “Biohacking” which is a term, minted by Dave Asprey in 2004. Among the more common hacks are: the Mediterranean diet; Alzheimer’s Halting/Reversing clinical interventions (Bredesen); Intermittent Fasting (Jack Dorsey); “Young Blood” Transfusions (Thiel); Stem Cells - “Banking”; Medical Grade Hyperbaric Oxygen (Aviv Clinic c Shai Efrati in Israel); Cryonic freezing - Cold Water Immersion (Wim Hof); DNA Repair; Peptides and Exosomes; Immuno-Stabilization; Klotho (Platelet Factor 4 - PF 4) - Antiaging hormone injections; GLP Inhibitors - Ozempic, Wegovy; Red Light Therapy Beds; Hormone Therapies; and, Bio Trackers such as Apple Watches, Fitbits, and CGMs [31-33].

## Blue Zones

Almost NONE of the above are derived from or used by the longest-lived communities and people! Analyzing the Blue Zone communities, there are a “Divine Dozen” (Pelletier, 1980) characteristics that are common to virtually all of them:

- i. A Mediterranean diet with fish but little or no red meat or poultry with a plant-based diet;
- ii. Smoking is common but it is in the form of locally raised

tobacco with no petrochemicals in processing and is puffed rather than inhaled [34];

- iii. Physical activity is part of their lives with daily farming or fishing since they do not have fitness facilities or personal trainers;

- iv. Strong psychosocial bonds recognize that no person is an island and it “takes a village” to raise a centenarian. Also, they all have domestic pets and/or farm animals and having animals is correlated with longer, healthier life expectancies;

- v. Advanced age is respected. Elders are the head of the family and make major decisions on finances and marriages;

- vi. They are sexually active are with a great deal of touching, hugging, and intercourse into their 80s and 90s;

- vii. They do not have a “fear of death” but are concerned about disability or becoming a burden to their family. There is a “squaring of the curve” (Fries, 1995) where they usually die very quickly in a matter of hours or days;

- viii. There is frequent alcohol consumption with breakfast, lunch, dinner, and evenings but it is usually beer or wine, consumed with friends and with meals. Actual amounts exceed the usual “standard/average” recommended consumption;

- ix. They live in a sound/clear/“organic” environment with little or no petrochemical or herbicidal pollution and toxins;

- x. Appropriate, quality medical care includes “alternative” therapies such as herbals and is usually free to all in need;

- xi. Clearly there are genetic and epigenetic influences evolved over many generations leading to their 100+ health spans;

- xii. There is always a “spiritual” dimension which is not usually an orthodox religion. Most often there are periods of prayer, meditation, and introspection resulting in a true wisdom [35-38].

Surely it is not possible to overlook the low-tech, simple longevity approaches identified by the Blue Zones project. Blue Zones, those five places around the world identified by National Geographic fellow and author Dan Buettner, where more people live to 100. This is not because of pharmacology, epigenetic biohacking treatments, or self-optimization, but because their lifestyles and environment result in extended lifespans. With the new Netflix docuseries, *Live to 100: Secrets of the Blue Zones*, the conversation around the physical and psychosocial environment as the lynchpin of longevity has been reignited. This series focuses on the original five Blue Zones of Sardinia, Italy; Okinawa, Japan; Nicoya, Costa Rica; Ikaria, Greece; and Loma Linda, California to illustrate how these places, in quite different ways, all share the “Divine Dozen” principles stated above. Most recently, Singapore has been added to that list since the number of centenarians has doubled over the last decade and life expectancy has grown by 20 years since 1960. This is due to a concerted effort to maximize the

Divine Dozen variables and serves as a potential model for all future communities and countries [39]. In the Blue Zones documentary, Buettner drives home the watershed mindset difference between the new high-tech, high-cost, and essentially fear-based longevity approaches and the Blue Zones approach. According to Buettner, the Blue Zones life “is not about trying to prevent death, it’s about learning how to live ... not about test-tubes but living well without trying.” It’s about things that feel good like having a glass of wine with friends and having purpose. If wellness is all about personal agency, we need “to stop beating the dead horse of personal responsibility” in order to create effective longevity communities [40-43].

### Longevity Centers Exist Now

Hypotheses and research focused on human longevity of 120-150 years is not speculation but rapidly becoming a deliverable scientific reality. In 1981, I wrote a book entitled “Longevity: Fulfilling Our Biological Potential” and cited a great deal of the research cited in this chapter including the “centenarian communities” which were discovered in the 1970s by Alexander Leaf of the Harvard Medical School. Over the course of the intervening 50 years, many sites of applied longevity have emerged in research VC firms, clinics, hospitals, schools of medicine, and laboratories worldwide [44].

#### Among the instances are:

**Fountain Life:** The company’s focus is AI-powered precision diagnostics to identify and predict illnesses such as cancer, heart disease, metabolic disorders, and neurodegenerative diseases, at the earliest stages. Founded by high-profile doctors (Robert Hariri, Bill Kapp, and Peter Diamandis), and mega-entrepreneur, Tony Robbins, their clinics offer non-invasive MRI and CT scans; comprehensive biological age, blood and microbiome testing; and DEXA bone density scans—all reviewed by a physician [45]. Their clinics are on the global march: Now open in Naples, FL; White Plains, NY; Dallas, TX; and at Lake Nona in Orlando, FL—and coming soon to Dubai, Toronto, New Delhi, and Santa Monica, CA. In 2025, a 10,000-square-foot Fountain Life Center will open in the new wellness residences community of Velvaeare in Park City, UT—the first time a medical-grade longevity clinic gets “brought home.”

**Healthy Longevity Clinic:** With locations in Prague and Boca Raton, FL, they offer programs in brain, heart and immune health, and cellular regeneration and regenerative aesthetics. Diagnostics span everything from genetic risk testing to full-body MRIs to hormone analysis and treatments range from therapeutic plasma exchange and cell therapy to IV and hyperbaric oxygen therapies.

**Human Longevity Inc.:** With clinics in Beijing, San Francisco and San Diego, HLI (with \$340 million in funding) calls its genomics-based program “100+”-and uses genotypic and phenotypic data, blood biomarker testing, and in-depth imaging to prevent disease and lower healthcare costs [46].

**Hooke:** This swanky, spa-like longevity clinic in London focuses on advanced preventative health screenings-20+ tests, from whole genomic sequencing to a four-part MRI to cognitive assessments, to create a full ‘BioPortrait’ and ‘BioScore’ that can minutely track your health over time and prescribe and deliver lifestyle and medical interventions. The prices could cause heart problems: one popular membership plan costs \$40,000 a year, and includes the extensive battery of tests, custom nutrition plans, meetings with the scientific advisory board, and an Oura ring—while the \$76,000 annual plan includes everything from unlimited expert consultations to weekly training [47-49].

**Liv Lounge:** Coming to Switzerland and Germany in 2024 (with plans for Dubai and Saudi Arabia), this new “health span clinic” brand is the brainchild of Maximon, a company that builds diverse companies in the longevity market. Notably, this global longevity clinic concept is aimed not at the 1%, but the upper-middle class, with average monthly member fees expected at around \$500, which includes quarterly diagnostics and multiple treatments per week. They will take a holistic approach, mixing the new (testing, drugs, supplements) with the old, from exercise to mental wellness [50].

**Doctor-led programs:** More high-profile, longevity-focused, integrative physicians are opening their own clinics and virtual clinics. For instance, Peter Attia, MD, of the wildly-popular podcast, *The Drive*, and book “*Outlive: The Science & Art of Longevity*,” spins out the longevity approaches from his wait-listed medical practice through Early Medical, a virtual (you don’t interact with Attia or his clinical staff) “medical practice” that takes subscribers over a year through 12 longevity modules—from diagnostics to nutrition to emotional wellness. Integrative longevity expert Frank Lipman, MD, runs his own comprehensive NY longevity clinic, and as co-founder of *Hearty*, he’s created the first tech platform that trains the next generation of doctors in longevity medicine—and with biomarker testing, wearables and diagnostic tools under one virtual roof.

**New longevity clinics in hospitals bring much-needed access:** With private longevity clinics costing up to \$100,000 a year, a welcome trend is public hospitals starting to open sophisticated part-research- lab, part-longevity-clinic, centers, bringing far greater access to regular people (with some treatments covered by insurance). Singapore’s Alexandra Hospital recently opened the first public longevity clinic to increase Singaporeans health span by three years within the next decade [51-53]. It will use aging biomarkers specific to Singapore’s population, have a multidisciplinary team dive deep into a patient’s biomarkers and data, to set personalized health plans, with patients able to participate in longevity clinical trials. Sheba Medical Center, Israel’s top healthcare institution, recently opened the Sheba Longevity Medicine Center, and because Israel’s healthcare system is excellent and highly digitized, it can amass data on aging and run effective human clinical trials. It is focused on “the four A’s”:

accessibility, affordability, academic research and AI. The welcome, public longevity centers—Sheba Longevity, Singapore’s Alexandra Hospital and Mayo Clinic, are all teaming up to run homogenous clinical trials and share research.

So much global action with longevity clinics lies ahead. The longevity-focused VC firm Apollo Health (offices in Germany and the UK) is expected to roll out its own global clinics in 2024. The Longevity Suite (with roughly 20 clinics more focused on biohacking and anti-aging esthetics in Italy, Spain and Switzerland plans to expand in the Middle East and Portugal. Saudi Arabia’s mind-boggling, new smart, sustainable city NEOM is essentially an entire city programmed as a longevity clinic and may mark the first government-led city that makes longevity an overt goal [54]. Technology will play a huge role: AI, data science, genetics, genomics—and with its “Dr. NEOM” system offering residents “digital twins” to track and improve their health.

## Caveats, Cautions, and Limitations

While there are many potential benefits associated with increased longevity, there are also several potential negatives or challenges to consider:

**Financial Implications - Outliving Retirement Savings:** One of the major concerns is that people may outlive their retirement savings. If individuals live significantly longer, they may need more financial resources to sustain their lifestyles in retirement. This could result in financial insecurity for many people, particularly those who haven’t adequately saved for retirement.

**Social Security and Pension Systems:** Strain on Social Security and Pension Systems: Longer lifespans can place strain on government social security and pension systems. With more people drawing benefits for longer periods, these systems may require significant adjustments to remain sustainable.

**Inequality and Access:** Accessibility and Affordability: Longevity-enhancing interventions and treatments are often costly, making them accessible primarily to those with significant financial means. This can exacerbate existing inequalities in healthcare and longevity.

**Medical care Costs:** Increased Medical care Costs: An aging population with longer lifespans may drive up medical care costs. Treating age-related diseases and providing care for an older population can strain medical care systems and increase overall healthcare expenditures.

**Ethical and Social Considerations - Ethical Dilemmas:** Prolonging life raises ethical questions about quality of life, end-of-life care decisions, and the potential for societal pressure to pursue longevity at any cost [55]. There may also be debates about the allocation of limited healthcare resources. Regarding the affordability and funding of longevity interventions:

**Affordability:** Currently, many longevity-enhancing interventions are expensive and often not covered by insurance. This can create disparities in access, where only the wealthy can afford these treatments. However, as technology advances and research progresses, there may be efforts to make these interventions more accessible and affordable to a broader range of people.

**Insurance Coverage:** The coverage of longevity interventions by insurance companies would depend on several factors, including the effectiveness and safety of the interventions, regulatory approvals, and insurance policies. In some cases, insurance companies may cover certain preventive measures that promote longevity, such as regular health check-ups or lifestyle interventions. However, coverage for more experimental or unproven longevity treatments may be limited. It’s important to note that the field of longevity is still evolving, and many of these challenges are subjects of ongoing research, policy discussions, and ethical debates. As longevity science advances, addressing these challenges will be essential to ensure that the benefits of increased longevity are equitably distributed and do not lead to unintended negative consequences [56]. Overall, the pursuit of human longevity involves a multifaceted approach that combines advances in pharmacology, genetics, lifestyle modifications, and healthcare delivery to enhance not only lifespan but also the quality of life in old age. It’s important to note that while significant progress has been made, many challenges and ethical considerations remain in the quest for extended human longevity. Clearly, the field of longevity research is highly dynamic, and new breakthroughs and trends will surely emerge in the coming years. Additionally, the ethical and regulatory aspects of these trends will need to be carefully considered as longevity clinics and centers integrate these innovations into their practice. Always consult with healthcare professionals and stay updated on the latest research when considering any longevity-related treatments or interventions.

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