White Paper 2025

Roundtable of Longevity Clinics 2024

Buck Institute of Research of Aging | Novato, USA
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Contents

Foreword

In 2024, the popularity of a healthy lifestyle has surged, driven by growing awareness of the link between preventive habits and healthy longevity. As Dr. Eric Verdin said during the Second Roundtable of Longevity Clinics "we are finally seeing an epidemic of health. We are on the verge of a health movement". As personalized health technology advances and wellness programs become more accessible, more people are embracing fitness routines, balanced diets, and stress management techniques to improve their overall quality of life.

The field of longevity focused medicine is expanding rapidly, with a notable increase in the number of clinics dedicated to health optimization and extending healthspan. There is no official count but in the United States, estimates suggest there are approximately 800 longevity clinics in operation. This number is expected to rise as the demand for preventive health and wellness services grows. Globally, the trend mirrors that of the U.S.. Global investment in this sector more than doubled between 2021 and 2022, highlighting the growing demand for longevity-focused healthcare. [1].

As the industry continues to evolve, efforts are underway to develop and disseminate best practices and expertise. There is also a growing need for standardization. Organizations like the International Institute on Longevity (IIOL) [2] aim to address this issue by establishing best practices. In collaboration with organizations such as the Healthy Longevity Medicine Society [3], the Institute actively co-develops and promotes the standards. Additionally, it will provide recommendations on clinic operations, customer service quality, and AI-driven data sharing.

One of the ways that IIOL aims to approach this ambitious task is by organizing an annual conference in collaboration with the scientific partner Buck Institute for Research [4] on Aging called Roundtable of Longevity Clinics. The second International Roundtable of Longevity Clinics, held on the 6-10th of December 2024, built on the success of the event in 2023, and offered an in-depth exploration of the rapidly evolving field of longevity medicine.

The gathering brought together leading longevity clinics and experts from around the globe to discuss emerging trends, share scientific advancements, and address critical challenges in the field. The conference's main objective was to foster collaboration and innovation to shape the future of longevity clinics.

Acknowledgments

Organizers and Advisory Board

International Institute of Longevity (IIOL) and Buck Institute would like to extend our gratitude to the members of the Advisory Board, listed alphabetically.

Eric Verdin, MD, PhD, CEO/President of the Buck Institute for Research on Aging

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David S. Karow, MD, PhD, President and Chief Innovation Officer Human Longevity

Speakers

We express our appreciation to the experts who participated in the Second Longevity Clinics Roundtable Conference, listed alphabetically:

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Chris Hemp, CTO, Fountain Life

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Preface

This year's edition shifted its focus from discussions on standards and regulations to exploring best practices and guidelines for longevity clinics. The event served as a platform for specialists to debate advancements and challenges in this rapidly growing sector.

As in the previous year, the event was organized by the International Institute of Longevity and hosted by its scientific partner Buck Institute for Research on Aging. The International Institute of Longevity is a collaborative platform dedicated to advancing human healthspan, resilience, and flourishing through innovative approaches in longevity science and preventive healthcare. The Institute focuses on system change in healthcare, promoting best practices, and fostering collaboration across clinics, policymakers, and businesses. The Buck Institute, located in Novato, California, is a leading independent biomedical research institution focused on understanding the biology of aging and age-related diseases. Through cutting-edge research and innovation, it aims to extend healthspan and improve quality of life by uncovering strategies to delay or prevent conditions.

This year's Roundtable focused on pivotal topics that shape the longevity clinics landscape, including the current state and future opportunities for longevity clinics, updates on standardization and regulation efforts, and exploration of definitions and perspectives on longevity medicine. Participants discussed new trends and gold standards in diagnostics and biomarkers, as well as innovative and emerging interventions and therapies, and how these advancements could transform clinical practices worldwide. Key discussions also addressed best practices in diagnostics, interventions and the client journey, AI and big data applications, and navigating challenges while embracing opportunities for the future of longevity clinics.

By fostering collaboration and knowledge exchange, the Roundtable continues to advance the establishment of longevity focused medicine as a credible field. Through these recurring forums, the event promotes global collaboration, shares cutting-edge approaches, and identifies effective diagnostics and interventions to support healthspan extension and improve quality of life for individuals worldwide.

Executive Summary

This white paper is based on the presentations and panel discussions from the Second Longevity Clinics Roundtable. Following the conference in 2023, we published a white paper, In Search of Best Practices for Longevity Clinics [5], which served as a landmark document for the industry. That paper outlined foundational standards for defining longevity clinics, examined the status of biological age biomarkers, and proposed strategies for gaining recognition from medical regulatory boards. It also provided a forward-looking perspective on longevity diagnostics and interventions, emphasizing collaboration, regulation, and best practices as essential steps toward establishing credibility in this rapidly growing field.

This new paper builds on the foundations established during the first roundtable but with a focus shifted toward best practices and guidelines for optimizing the client journey and improving care delivery, diagnostics, and intervention tools. We explore the evolving landscape of longevity clinics, highlighting emerging trends, advancements in standardization and regulation, and shifting definitions of longevity medicine.

We also examine the latest developments in biological age biomarkers, which continue to define the unique position of longevity medicine within the broader medical field. Additionally, we discuss progress in leveraging AI and big data for diagnostics and client management and integration of technology into healthy longevity care.

Finally, we provide insights into the future of longevity medicine, addressing innovative interventions, ongoing challenges, emerging opportunities, and the necessary steps to further establish longevity medicine as a globally recognized discipline. While many challenges remain, meaningful progress has been made. This paper explores how the field is actively working to bring the best services to patients and clients and lead longevity medicine closer to mainstream medical approval.

Introduction: What Has Changed Since the Last Conference?

By 2023, when we held our first conference, longevity medicine was already evolving rapidly, driven by the urgent need to address the challenges of aging populations and the increasing burden on traditional healthcare systems. However, several obstacles stood in the way of making longevity medicine widely accessible. The field lacked unified standards, regulatory frameworks, and widespread acceptance from mainstream medical authorities.

Longevity clinics served as a crucial link between scientific research and clinical practice and emerged as critical players in implementing diagnostic tools and interventions aimed at preventing age-related diseases and optimizing overall health. However, translating these discoveries into practical, evidence-based medical applications remained a major challenge.

A key obstacle was the lack of medically validated aging biomarkers, which were essential for reliably measuring the effectiveness of longevity interventions. There was no consensus on biological age clocks, including what they actually measured and how consistently they responded to interventions. Additionally, the field struggled with increased the risk of over-diagnosis and large volumes of diagnostic data, which presented interpretation challenges.

Another pressing issue was the lack of education programs for longevity specialists. High diagnostic and intervention costs limited accessibility, hindering widespread adoption of longevity medicine. Moreover, there was no standardized framework for longevity interventions, leaving clinics without clear guidelines on best practices.

Since then, progress has been made in areas such as biological age biomarkers, personalized health assessments, and innovative therapies. There is a growing body of research exploring the correlation between biological aging clocks and other validated and recognized diagnostic and optimization tools. Innovations in biological age clocks, such as organ-specific aging biomarkers and multi-omics approaches, enhanced the precision of health assessments, providing more actionable insights. AI-driven diagnostics gained momentum, integrating data from wearables, imaging, and blood and DNA biomarkers to deliver personalized health recommendations and improve monitoring of intervention outcomes. Clinics worldwide have begun working towards standardized protocols for assessments and integrating advanced biomarkers. New interventions focused on senolytics, regenerative therapies, and personalized nutrition demonstrated promise in slowing biological aging and mitigating age-related diseases.

Finally, collaboration between researchers, clinicians, and other stakeholders such as public hospitals, insurers, or governmental bodies improved credibility.

Despite these strides, the field is still far from being fully integrated into public healthcare systems. The need for collaboration among researchers, clinicians, and regulators and for clear guidelines to establish credibility and trust are now widely recognized. Events like the Longevity Clinics Roundtable and the work of organizations like IIOL and HLSM reflect growing efforts to address these gaps and shape the future of the longevity industry.

Work on best practices for longevity clinics has been a focal point of recent advancements in the field, with significant strides made in defining the scope and role of these clinics. The white paper, In Search of Best Practices for Longevity Clinics, resulting from the first Longevity Clinics Roundtable, laid a foundation for standardizing nomenclature and practices and creating guidelines to ensure consistency and credibility in the field. The document also explored biological age biomarkers, best practices in diagnostics and interventions, and strategies to enhance cost accessibility in longevity medicine.

Since the previous conference, we have also witnessed a growing public interest in health and longevity, with many seeking solutions beyond traditional healthcare. This surge has fueled a hype cycle in longevity and health optimization, bringing both innovation and exaggerated claims. The challenge is to distinguish evidence-based interventions from pseudoscience, ensuring safety, efficacy, and ethical standards. Clinics must establish best practices to move the field toward a credible, evidence-based discipline. This approach will help transition from the current hype phase to a more mature, credible phase of growth, where longevity medicine is recognized as a legitimate, evidence-based discipline.

One of the issues raised in this year's Roundtable was addressing the gaps in Women's Health, Science, and Practices. Significant gaps exist in understanding and addressing women's health, particularly in areas like ovarian aging, which affects overall health and aging in women. Investment in female-specific health research remains minimal, with less than 2% of therapeutics focused on non-cancer-related female conditions. The field needs to minimize the gap by working towards best practices in treating female patients.

In 2025, longevity clinics face a range of challenges and transformative shifts as they navigate the rapidly evolving field. We hope that this document will bring the longevity medicine field closer to universally approved and standardized best practices. Establishing a framework of regulated guidelines will enhance trust among clients, medical professionals, and regulatory bodies, strengthening the credibility of longevity medicine.

Towards Standarization and Regulatory Approval

Many clinics worldwide identify as longevity clinics, but without regulations or standardization, there are no clear criteria defining them. While many follow similar protocols, these are shaped by collaborations with researchers and specialists rather than formal guidelines. As a result, the field operates on best practices rather than regulated standards.

Understanding these best practices and identifying the most widely used protocols and methodologies is, therefore, essential for advancing the field toward greater standardization and credibility.

In our first white paper [5], we began exploring best practices for longevity clinics, and laid the groundwork for defining what constitutes a true longevity clinic. We outlined the standards followed by established clinics and highlighted key differences between institutions offering similar solutions. In this paper, we aim to expand on these best practices, further refining definitions and advancing the field toward the formal establishment of standardized guidelines.

To assess the level of alignment within the field and identify common protocols, Longevity Technology conducted a global survey of longevity clinics [6]. During the conference, Phil Newman, CEO of Longevity Technology, presented preliminary findings from the ongoing survey. By the time this white paper was published, the survey had been completed. Below, we present the final results.

Responses were received from 82 participants representing clinics across the globe—including the USA, UK, France, Singapore, Australia and Switzerland. Responders ranged from single practitioners to larger clinics with multiple practitioners. The majority of survey participants were representatives of private clinics. The findings provide insight into shared methodologies, emerging trends, and the potential for standardizing longevity clinic practices.

The key Findings from the Longevity Clinics Survey were as follows:

Biological Age & Aging Metrics:	▶ **78%** of clinics help clients identify or manage their biological age, with metabolic age, telomere length and pace of aging (DunedinPACE) being the most commonly used metrics.
	▶ **Nearly 40%** of clinics recommend retesting aging biomarkers after 6 or 12 months.
	▶ **88%** of clinics believe that consumer aging biomarkers contribute to the advancement of longevity medicine.
Pharmaceutical & Medical Interventions:	▶ The majority of clinics prescribe pharmaceutical treatments, with **59%** including the off-label use of rapamycin and metformin.
	▶ **53%** prescribe Ozempic or equivalent drugs for weight management.

Data Sharing & Standardization:
- ▶ **55%** of clinics are willing to safely share anonymized data to help improve client outcomes and industry research.
- ▶ **38%** would adjust their protocols to align with internationally recognized standards for longevity medicine.

Technology & Client Interaction:
- ▶ **49%** of clinics provide client web portals for tracking results.
- ▶ **65%** integrate wearables data into client assessments.

EMR/EHR Integration:
- ▶ **37%** of clinics fully integrate longevity protocols into their electronic medical records (EMR/EHR).
- ▶ **35%** intend to implement EMR/EHR integration in the future.

Longevity Medicine Qualifications & Insurance Coverage:
- ▶ **68%** of respondents agree that longevity-specific medical qualifications should be mandatory for practitioners in longevity clinics.
- ▶ Insurance coverage remains limited—only **34%** of clinics have successfully claimed diagnostics or treatments on their clients' medical insurance.

Financial Sustainability:
- ▶ **37%** of clinics say they are doing okay financially but need more clients.
- ▶ **38%** of clinics operate profitably, while **30%** are nearing breakeven.
- ▶ Despite financial challenges, **77%** of clinics plan to expand and open more facilities based on their current models.

Need for Standardization & Formalization:
- ▶ The most recurring theme in qualitative feedback is the lack of standardization in longevity medicine.
- ▶ Respondents emphasized the need for formalized training programs, standardized longevity medicine protocols, and clear operational guidelines for clinics.

In conclusion, there is a clear trend toward shared approaches among longevity clinics, with many adopting similar client journeys, diagnostics, and interventions. However, there is a strong consensus within the community that the field would greatly benefit from increased standardization, clearer guidelines, formalized education and more information on best practices. Most clinics are committed to providing the best possible solutions to their clients, prioritizing science-backed, evidence-based methods for health optimization and healthspan extension. Therefore, advancing efforts to establish standardization should be a primary focus. Regulatory approval and integration into mainstream medical frameworks remain significant long-term goals. However, on a day-to-day basis, many clinics prioritize enhancing their client journey and delivering effective care. As such, developing practical guidelines and best practices is just as crucial as advancing efforts toward regulatory approval and acceptance within the broader medical field.

Key initiatives working towards standardization:

In longevity medicine, two parallel pathways are emerging toward standardization and the creation of guidelines. The first pathway focuses on achieving regulatory approval and gaining recognition for longevity medicine as a credible medical field. This involves validating diagnostic tools, biological age biomarkers, and longevity medicine interventions. It also includes efforts to define key terms—such as what constitutes longevity medicine—outlining the qualifications required for practitioners, determining allowable practices within the field, and ensuring that only science-backed, evidence-based solutions are utilized. Organizations in this area are also working to establish associations to accredit doctors and other medical professionals in the field.

The second pathway focuses on the operational standardization of longevity clinics and the development of best practices. Practitioners and experts within the clinics are synthesizing their experiences to create a comprehensive framework of diagnostic and interventional tools aimed at optimizing health and extending healthspan for their clients. This pathway emphasizes practical, hands-on guidelines for day-to-day operations in longevity clinics. These guidelines serve as a resource to promote consistency and excellence in clinical practice.

For longevity clinics, this pathway is especially important, as preventative and personalized medicine—when delivered through best practices and standardized protocols—can significantly enhance the client experience and positively influence public perception.

Regulatory Approval

Several key organizations are actively working toward achieving regulatory approval and recognition for longevity medicine. Here are the main ones:

- **The Healthy Longevity Medicine Society (HLMS)** [3] is a global organization dedicated to advancing healthy longevity medicine by promoting evidence-based practices, professional standards, and regulatory engagement. Its goal is to establish healthy longevity medicine as a recognized medical discipline. Through guideline and standards development, clinical trial networks, and education, HLMS works to integrate longevity medicine into mainstream healthcare worldwide. By fostering interdisciplinary partnerships and promoting best practices, the society aims to establish and uphold professional standards, including physician guidelines, in longevity medicine.

- **The International Longevity Institute (IIOL)**[2] aims to advance the longevity clinic sector by establishing best practices in many areas, including operational, management, medical, client experience, data integration, supply chain, collaboration with insurance companies, and PR for the sector. The organization also strives to enhance credibility, ethics, and consumer trust. The Institute will provide training programs and foster a professional network dedicated to best practices. Co-chair Eric Verdin emphasizes that this initiative will help align the industry toward patient safety and proactive preventative medicine, strengthening the reputation and impact of longevity clinics worldwide.

- **The Biomarkers of Aging Consortium** [7] is a collaborative initiative dedicated to developing, validating, and integrating aging biomarkers into clinical practice. Its goal is to establish reliable, standardized measures of biological age to assess aging process and evaluate interventions. By

uniting researchers, clinicians, and regulators, the consortium aims to ensure these biomarkers meet rigorous standards for regulatory approval and widespread adoption.

- **The XPRIZE Healthspan Prize** [8] is a competition designed to accelerate the development of interventions that extend healthspan by restoring muscle, cognitive, and immune function. It incentivizes rigorous scientific research, focusing on measurable health improvements to meet regulatory standards. By promoting evidence-based longevity therapies, the prize aims to drive mainstream acceptance and recognition of longevity medicine.

These various organizations collaborate to bring standardization and regulatory approval to the field of longevity clinics, each focusing on different aspects of the process. The International Institute of Longevity (IIOL) has created a framework that categorizes these stakeholders into three groups based on their areas of expertise and the communities they serve.
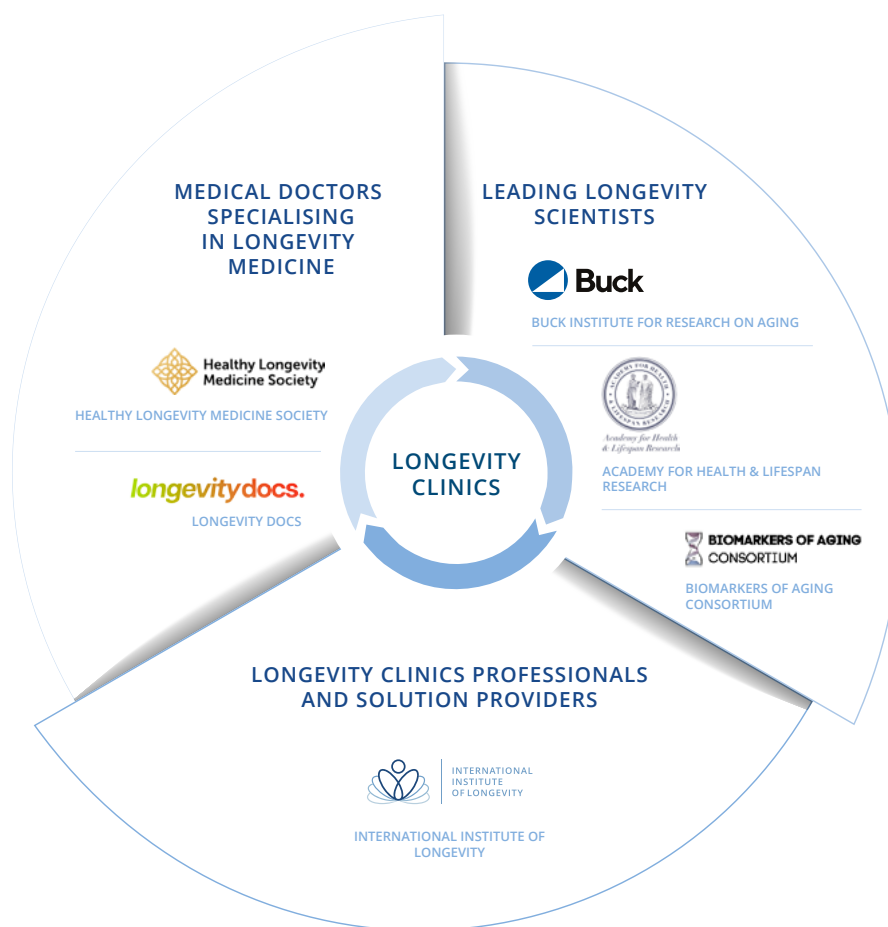
The first category encompasses leading longevity scientists and science organizations, such as the Buck Institute for Research on Aging and the Biomarkers of Aging Consortium, as well as other research institutions.

- **The Buck Institute for Research on Aging** [4] plays a pivotal role in advancing regulatory approval and recognition for longevity medicine. As a leading research institution, it focuses on unravelling the biological mechanisms of aging and translating these findings into evidence-based interventions. The institute actively collaborates with regulatory bodies and industry leaders to validate aging biomarkers and therapeutic approaches, laying the groundwork for their integration into clinical practice.

The groups in this category advance the field by conducting cutting-edge research on aging, developing diagnostic tools and interventions, and educating professionals. They collaborate with industry and clinics to translate scientific discoveries into practice and set the foundation for the field's recognition and credibility.

The second category includes longevity clinic professionals and solution providers, who work to establish best practices with a focus on the effective programs and client journeys of the clinics. The IIOL positions itself within this category, emphasizing collaboration among clinics to enhance their effectiveness. It is building a global association of longevity clinics and a reputable network of diagnostic, product, and intervention providers.

The third category consists of medical doctors specializing in longevity medicine, supported by organizations like the Healthy Longevity Medicine Society (HLMS). HLMS is actively working to standardize practices and establish comprehensive guidelines to support medical professionals in delivering effective longevity medicine services. The organization also concentrates on bringing regulatory approval and eventually leading to accreditation of longevity medicine doctors, gaining recognition for longevity medicine as a credible medical field.

The World's First Licensing Framework for Healthy Longevity Medicine Centres

One of the most significant milestones on the pathway to regulatory approval in longevity medicine came in October 2024, when the Department of Health Abu Dhabi introduced the world's first licensing framework for longevity medicine centers [9]. This groundbreaking initiative set a global precedent for establishing standards in longevity-focused healthcare facilities.

The Healthy Longevity Medicine Centres framework focuses on preventive, personalized, and holistic healthcare, shifting from reactive treatments to proactive strategies. It aims to promote wellness, prevent age-related diseases, and enhance healthspan through individualized care plans that incorporate lifestyle modifications, mental well-being, and environmental factors. In line with these standards, the Department of Health has licensed the Institute for Healthier Living Abu Dhabi (IHLAD) [10] as the world's first specialized longevity medicine Centre. IHLAD aims to set new global benchmarks in longevity medicine by offering services that target the fundamental aging processes and chronic disease progression throughout the lifespan.

Geromedicine vs. Longevity Medicine: Naming Perspectives

We conclude the regulatory section with a discussion on naming perspectives. During the conference, Prof. Meier highlighted that clear differentiation in naming could support broader acceptance of longevity medicine within the wider medical community. According to her the term "longevity medicine" is well-suited for longevity clinics field, however it does not always evoke positive associations in scientific and regulatory contexts. To address this, she proposed a new term "precision geromedicine" that could be used in certain contexts instead of "longevity medicine". "Precision geromedicine" is favored in academic contexts for its scientific rigor, while "longevity medicine" is more relatable to the public and clients. Both terms reflect the same goals of advancing diagnostics and therapeutics to address aging processes, but their use varies depending on the audience and the setting—academic, clinical, or public. How the field will respond to the latest naming proposal by Prof. Maier—and whether dividing it into two distinct categories will prove practical or beneficial—remains to be seen.

The discussion around naming in longevity medicine is not new. Over the years, numerous terms have been proposed to define and describe the field. In our first white paper [11], we initiated a dialogue aimed at establishing consensus on the definitions of key concepts such as longevity, healthy longevity, lifespan, and healthspan.

The field itself has been referred to by a variety of names, including longevity medicine, healthy longevity medicine, healthspan medicine, and longevity-focused medicine. It is also important to acknowledge that longevity medicine integrates principles from several related fields, including lifestyle medicine, integrative medicine, functional medicine, and both preventive and personalized medicine. One of the earliest conceptual frameworks closely aligned with longevity medicine is P4 medicine—predictive, preventive, personalized, and participatory—coined by Dr. Leroy Hood in the late 2000s. Given these overlaps, establishing clear and consistent definitions is essential to distinguish longevity medicine and avoid confusion with adjacent fields. Standardized definitions are also essential for advancing credibility, communication, and integration into the broader| medical landscape.

Best Practices for Longevity Clinics

Summary of the International Institute of Longevity Consultation Results

In order to understand the needs and collaborative capabilities of longevity clinics, the International Longevity Institute conducted a consultation with longevity clinic owners, managers, and experts to identify key priorities for advancing the field. The results highlighted a strong consensus on the need for international standards, best practices, and ethical guidelines, with 80% of respondents supporting efforts to develop standardized operating procedures and best practice frameworks. Collaborative research was another major focus, with 70% expressing interest in participating in studies on biomarker validation and standardization, medical data integration, and the development of personalized health protocols.

Data standardization and anonymized data sharing were identified as significant opportunities for collaboration, with 80% of clinics supporting these initiatives under strict compliance with medical and data safety regulations. Community building and trend sharing were also emphasized, with clinics showing a strong willingness to exchange insights on diagnostics, interventions, and the integration of technology, such as wearable devices and predictive age models.

Building on these findings, the International Institute of Longevity aims to establish itself as the leading professional platform for advancing the longevity sector, with a strong focus on longevity clinics and professional suppliers of services and products. By collaborating with the most reputable longevity clinics worldwide, the Institute is committed to setting gold standards that enhance credibility and uphold ethical conduct. Additionally, it seeks to provide specialized training programs to equip practitioners with the knowledge and skills necessary for excellence in the field. Through these initiatives, the Institute will foster a global network of professionals dedicated to best practices and play a pivotal role in shaping the future of longevity clinics.

Current frameworks

Another step we took in identifying best practices for longevity clinics was examining the operational models documented in scientific literature. Here, we present the most widely recognized models described in scientific journals.

Longevity Pyramid

The concept of the Longevity Pyramid [12] provides a structured framework for understanding and implementing various strategies in longevity medicine. At the foundation lies the emphasis on prevention and diagnostics, including early detection of potential health risks through advanced tools and biomarkers. The next level involves lifestyle modifications, such as exercise, diet, and mental well-being practices, to delay the onset of age-related conditions. As we move up the pyramid, personalized interventions tailored to an individual's genetic, epigenetic, and physiological profile take center stage, aiming to optimize healthspan. At the pinnacle, experimental strategies like gene editing and advanced regenerative therapies represent cutting-edge efforts to push the boundaries of healthy aging.

P4 Healthcare

P4 Healthcare [13] is a transformative medical model built on four principles: Predictive, Preventative, Personalized, and Participatory. The concept was developed and introduced by Dr. Leroy Hood, a pioneer in systems biology, in the late 2000s. Recognizing the limitations of reactive, one-size-fits-all healthcare, Dr. Hood envisioned a model that integrates data-driven insights, systems biology, and patient/client engagement to shift medicine toward proactive health optimization.

P4 focuses on predicting health risks, preventing diseases through early interventions, tailoring care to individual needs, and empowering clients to actively participate in their health management. P4 healthcare offers a framework for standardizing longevity medicine procedures. By adopting predictive tools like biomarkers and AI, longevity clinics can identify risks and tailor preventative strategies to delay aging. Personalized care plans based on individual health profiles ensure targeted and effective interventions, while participatory approaches engage clients as active partners in their health journey.

A model for establishing healthy longevity clinics in public hospitals

The model for establishing longevity clinics in publicly funded hospitals [14] focuses on integrating longevity-focused healthcare into existing medical systems through engaging multidisciplinary teams. It proposes creating specialized teams of physicians, nurses, and allied health professionals who provide personalized diagnostics, including medical history assessments, biomarker evaluations, and functional health screenings. The intervention strategies include lifestyle modifications, tailored supplementation, and repurposed medications to optimize healthspan and delay age-related decline. Additionally, the model emphasizes collaboration with research institutions and industry partners to standardize protocols and advance evidence-based practices. Integrating longevity medicine into public hospitals aims to expand access to preventive, longevity-focused care for a broader population.

The framework for an effective healthy longevity clinic [15] circles around an Analytical Center that drives data-driven decision-making and innovation. The Analytical Center is integrated with the clinical units of a longevity clinic, which are composed of both diagnostic and treatment divisions. The diagnostic units encompass a range of tools, including clinical imaging, functional diagnostics, and, in some clinics, dedicated diagnostic laboratories for in-depth analysis. The treatment units focus on multiple specialized areas, including science-based medicine, longevity medicine, mental

health, and physical therapy interventions, ensuring a holistic approach to patient care. All these components are interconnected through an administrative and IT system, facilitating efficient data management, coordination, and personalized treatment planning. The model prioritizes personalized care plans based on advanced diagnostics and targeted interventions to optimize healthspan. A multidisciplinary approach is key, combining scientific research with real-world clinical applications to enhance patient outcomes.

Clinics' roadmaps

We also conducted an in-depth analysis of the roadmaps of the leading longevity clinics discussed during the conference. This included examining their treatment models, methodologies, and best practices, as well as understanding their client journeys and the strategies they use to optimize client/patient care. Our objective was to identify commonalities among these clinics, assess whether they follow similar methodologies, and extract the best practices currently shaping the field.

A notable distinction between the standard healthcare system and longevity clinics lies in how individuals engaging with care are described. Many longevity clinics deliberately move away from the term "patient," which traditionally implies illness and symptom-driven treatment. In contrast, individuals who seek out longevity services are often not ill but are instead focused on prevention, optimization, and proactive health management. To reflect this shift, many clinics use the term "client," while others—such as Private Medical—prefer "member," highlighting a continuous, personalized relationship. Some clinics also use terms like "guest" or "participant," depending on the nature of their services. The term "patient" tends to be retained primarily by clinics that also provide treatment for existing medical conditions.

Human Longevity's care model is grounded in proactive, precision-based longevity medicine, with the goal of helping individuals live at least 10 years longer in good health. Their approach is structured around a four-step care pathway.

- The first step is to prevent individuals from experiencing a "health iceberg"—serious health issues that remain hidden until they reach an advanced stage—by leveraging precision data to detect conditions like cancer early.

- The second step involves comprehensive data analysis, individualized risk assessments, and root-cause evaluations to identify underlying contributors to disease.

- In the third step, the clinic provides targeted treatments, interventions, and wellness regimens aimed at addressing early-stage disease and reducing biological age.

- The fourth step focuses on continuous monitoring, long-term engagement, and personalized health coaching.

This model is centered on three key goals: the early detection of life-altering, pre-symptomatic conditions; the reduction of biological age; and addressing the root causes of disease rather than just managing symptoms. By integrating cutting-edge diagnostics—including whole genome sequencing, advanced imaging, and functional assessments—Human Longevity creates a detailed personal health baseline to inform a tailored care plan delivered by a multidisciplinary team, supported by ongoing lifestyle and coaching strategies to optimize long-term vitality and healthspan.

Chi Longevity [17]

The Chi Longevity Clinic is dedicated to supporting clients in achieving optimal health through precision medicine. Its model is structured around two key components: assessments and interventions.

- The assessment phase includes biological phenotyping, which involves biological age clocks, genome, epigenome, and microbiome analysis. Additionally, clinical phenotyping is conducted through blood biochemistry, organ function tests, and physiological evaluations, including cardiorespiratory fitness, cognition, metabolism, and immunological resilience. Digital phenotyping integrates continuous monitoring of glucose levels, sleep patterns, physical activity, and vital signs, while psychological and social phenotyping evaluates mental health and social well-being.

- The intervention phase is divided into several categories. Therapeutic interventions include repurposed medications and the use of geroprotective and dietary supplements. Lifestyle interventions focus on precision nutrition, personalized exercise plans, and sleep optimization. Additionally, psychological and social interventions emphasize mental health, stress management, social connection, and overall health behavior improvements.

Longevity Center Europe [18]

The Longevity Center's Client Journey begins with the Longevity Health Check, a comprehensive 360-degree whole-person assessment that culminates in a detailed Longevity Health Check Report. Based on the results, clients receive a Longevity Plan, which includes personalized longevity interventions tailored to their unique needs. After a set period within the program, clients undergo a Longevity Re-check-up to assess progress and refine their interventions.

The Longevity Health Check includes biological age clocks, genetic and epigenetic analysis, blood chemistry panels, cardiovascular and respiratory assessments, ultrasounds, eye health evaluations, metabolic assessment, body composition analysis (including DEXA Scan and 3D Scan), mitochondrial function assessment, cognitive and neurocognitive testing, psychological consultations, dietary monitoring and MRI (as an optional check-up).

The Longevity Center Europe follows its proprietary Longevity Center Method, a systems and science-driven approach. This method incorporates biomarkers of aging, aligns with the hallmarks of aging, and applies gender-specific medicine to ensure personalized care. It also considers environmental health factors, takes an integrative approach by addressing psychological, mental, and emotional well-being, and emphasizes optimized circadian rhythm as a crucial component of health management. At its core, the method is guided by the expertise of the International Consilium of Medical Experts, ensuring that all interventions are grounded in cutting-edge longevity science.

The Fountain Life Program is structured into three key steps aimed at enhancing healthspan through precision diagnostics, performance optimization, and regenerative medicine.

1. **Precision Diagnostics** – This step utilizes AI-powered imaging, including full-body and brain MRI, all-retinal scanning, and AI-assisted skin assessments. The program also incorporates early cancer detection, epigenetics and genome sequencing, advanced blood diagnostics, food intolerance and gut health tests, CCTA with AI-driven coronary scanning, and bone density analysis complemented by metabolic assessments.

2. **Performance Optimization** – Clients receive personalized interventions to enhance overall well-being and vitality. This includes sexual wellness optimization, nutrition-based enhancements, and targeted nutraceutical therapies. The program also offers pain management solutions, therapeutic exercise plans, and athletic performance optimization, ensuring a holistic approach to physical and functional health.

3. **Regenerative Medicine** – The final step includes advanced regenerative therapies, such as therapeutic plasma exchange, customized IV treatments, aesthetic face and hair rejuvenation with regenerative biologics, and adult stem cell banking. Additionally, the program follows FDA Institutional Review Board - approved protocols for regenerative biologics, ensuring compliance with cutting-edge medical research and safety standards.

Hooke's client journey is structured around four key steps, with a strong emphasis on an advanced and comprehensive health assessment process

1. Induction – The journey starts with a pre-assessment call to review medical history, identify health goals and concerns, and explain the upcoming assessments.

2. Assessments and Scanning – Clients undergo a full day of evaluations with Hooke's multidisciplinary team, including specialists in medicine, fitness, nutrition, and cognitive health. The health assessment is an advanced, data-driven health screening that includes MRI scans, ECGs, in-depth blood analysis, genomic sequencing, fitness and physiology evaluations, brain health assessments, and wearable tracking.

3. Multidisciplinary Team Review and Report – The team analyzes all data and delivers a personalized report with key findings and tailored health recommendations in a follow-up consultation.

4. Optional Membership – Clients can continue their care through one of four membership plans offering ongoing, personalized support for longevity and performance.

Best Practices Summary

To consolidate insights from research and real-world longevity clinic models, we have compiled the following list of best practices:

1. Protocols

▶ Longevity clinics establish proprietary clinical protocols that align with scientific research, ethical guidelines, and regulatory standards to ensure credibility and consistency.
▶ They continuously adjust protocols based on data from the patients/clients.
▶ They foster client engagement through remote monitoring and proactive health management tools.
▶ They uphold high ethical standards, transparency, and scientific rigor in diagnostics and treatments.
▶ Clinics bring together experts from various disciplines, such as genetics, mental health, regenerative medicine, or physical therapy, to ensure a systems approach.

2. Diagnostics

▶ Clinics implement advanced diagnostics for early detection of aging-related risks.
▶ They use biomarkers of aging, functional assessments, genetic and epigenetic testing, and AI-driven imaging to create highly personalized longevity plans.
▶ The majority of diagnostic evaluations are selected to target key hallmarks of aging.
▶ Clinics leverage AI-driven health tracking, wearables, and real-time behavior modification strategies to optimize client care.

3. Interventions

▶ Clinics prioritize client-centered, evidence-based approaches to ensure longevity interventions are both safe and effective.
▶ Clinics proactively prevent aging-related diseases through early interventions and lifestyle optimization.
▶ They offer geroprotective therapies, repurposed medications, precision nutrition, mental health support, and personalized wellness programs to maximize healthspan.
▶ Clinics tailor interventions to each client's biological and lifestyle profile, ensuring the most effective, customized treatment plans.
▶ They adjust interventions based on the client's progress and real-time data insights.

4. Collaboration and Activities toward wider recognition

▶ Clinics work closely with researchers, industry leaders and technology providers, healthcare professionals to ensure compliance with medical and ethical standards and refine best practices.
▶ They are open to anonymized data sharing and interoperability to advance longevity research and regulatory collaboration.
▶ Clinics advocate for longevity medicine to be recognized as an official medical discipline and align their work with healthcare regulators and policymakers.
▶ Clinics actively partner with longevity research institutions, biotech companies, and medical organizations to stay at the forefront of innovation.
▶ They participate in observational clinical trials and contribute to cutting-edge longevity research.

Furthermore, current longevity clinics showcase a variety of strengths that set them apart in delivering innovative and effective care. Many clinics leverage advanced technologies, such as the

AI system. For example, Human Longevity [16], utilizes AI and longitudinal data to predict health outcomes. Fountain Life [19] uses Zora AI, a generative system trained in functional and longevity medicine, along with AI-enhanced imaging for early detection and personalized care.

Teams and expert consiliums form the backbone of many clinics, including Longevity Center and Fountain Life, providing multidisciplinary expertise and collaborative care. Clinics like Ornish Lifestyle Medicine [21] stand out for their rigorous scientific foundation, with over 25 years of clinical trials published in medical journals on the effects of lifestyle changes. Clevland Clinic [22] prioritizes outcome-driven, incentive-based approaches, demonstrating measurable healthcare savings and improved longevity for clients. Strong organizational values, such as curiosity, positivity, and empowerment, highlighted by Kate Woolhouse from Hooke [20], further enhance their team dynamics. Some clinics, like Private Medical [23], take a holistic approach by considering family dynamics in care. Others, like the Institute for Healthier Living Abu Dhabi, benefit from governmental support, allowing them to develop robust clinical and research programs. Together, these strengths demonstrate the diversity and innovation driving the field of longevity medicine.

New Trends in Longevity Diagnostics & Biomarkers Development

Since the last conference, the field of longevity diagnostics and biological age biomarkers has made significant strides, driven by advancements in AI, multi-omics research, and non-invasive testing methods. Research has increasingly focused on enhancing the accuracy and accessibility of biological age assessments, moving beyond traditional blood-based biomarkers to explore saliva, skin, facial analysis, and microbiome-based aging metrics. A notable shift has been the development of organ-specific biological age assessments, allowing researchers and clinicians to measure the aging trajectory of individual organs—such as the heart, liver, brain, and lungs—rather than relying on a single composite biological age. AI and machine learning models have been integrated into diagnostics, enabling more dynamic and personalized aging predictions by analyzing data across multiple physiological systems.

Additionally, there has been a push toward standardization and validation of biomarkers of aging to improve their reliability in clinical settings. In February 2024, the Biomarkers of Aging Consortium published a review article [24], emphasizing the need for consensus on validation methods for aging biomarkers. The review proposed systematic validation frameworks to accelerate the clinical translation of these biomarkers and their application in gerotherapeutic trials.

In our previous white paper [5], we outlined best practices in longevity medicine diagnostics, detailing the tools widely used by longevity clinics. Many clinics continue to rely on the diagnostic methods we mapped out in the previous white paper [5]. In this section, we will explore the latest state-of-the-art diagnostic tools presented at this year's conference. These featured tests not only represent cutting-edge advancements in the field but also provide insight into the future direction of longevity diagnostics.

Biological Aging clocks (SymphonyAge)

SYMPHONYAge (System Methylation Proxy of Heterogeneous Organ Years) [25] is an advanced biological aging clock developed by scientists at Yale University and exclusively offered by TruDiagnostic. Unlike traditional aging clocks that provide a single biological age estimate, SYMPHONYAge analyzes DNA methylation patterns across eleven distinct organ systems—including the lungs, heart, brain, and liver—to assess how each system ages both independently and in relation to others. This innovative tool improves our understanding and management of aging, highlighting its variability and supporting customized and targeted interventions for aging individuals.

Epigenetic Biomarker Proxies

Epigenetic biomarker proxies (EBPs) [26] are surrogate measures derived from DNA methylation patterns that reflect various physiological and pathological states. By analyzing specific methylation sites across the genome, EBPs can serve as indicators of aging, disease risk, and environmental exposures. For example, certain DNA methylation signatures have been linked to dementia risk factors, offering insights into an individual's susceptibility to cognitive decline.

One of the primary advantages of EBPs is their ability to provide high-resolution health data at a low cost, with easy collection methods, and using the same dataset that generates biological age estimates. Many EBPs have been shown to outperform traditional biomarkers in predicting disease outcomes and exhibit strong correlations with classical clinical measures. Furthermore, they change longitudinally with interventions, making them valuable for tracking health progress over time.

Beyond aging, EBPs can enhance disease risk stratification and provide deeper insights into disease subtypes. In the future, EBPs may play a crucial role in differentiating between disease progression and the natural aging process, leading to more targeted and personalized healthcare interventions.

Saper Bio cellular senescence test

Sapere Bio offers a unique test **SapereX** [28] that measures cellular senescence—a state where cells cease to divide and adopt altered functions contributing to aging and age-related diseases. This test provides a snapshot of an individual's aging status by assessing the burden of senescent cells and the Immune Longevity Score (ILS). ILS is a proprietary metric designed to assess the functionality of an individual's immune system. By evaluating various immune parameters, the ILS aims to provide insights into one's immune resilience and overall health status. SapereX is a critical tool in longevity medicine because it provides a quantifiable measure of immune system aging. This allows for early intervention, personalized treatments, and long-term monitoring to improve healthspan.

Brain Health Diagnostics

In this round of the Longevity Clinics Roundtable, we placed greater emphasis on brain health, reflecting the growing progress in brain health diagnostics and the increasing availability of commercially accessible tools. Emerging diagnostic techniques offer low-cost, scalable solutions that can be used not only for early prediction but also for evaluating the effectiveness of interventions. As the number of individuals at risk of Alzheimer's disease, dementia, and age-

related cognitive decline continues to rise, prioritizing brain health in longevity medicine becomes essential. Understanding and preserving cognitive function is a crucial component of healthy aging and longevity optimization.

The majority of brain health diagnostic tools in longevity clinics focus on early detection, cognitive function tracking, and neuroprotective interventions. The clinics commonly use advanced neuroimaging technologies, such as MRI and functional MRI (fMRI), to assess brain structure, connectivity, and potential neurodegeneration. Electroencephalography (EEG) and quantitative EEG (qEEG) are employed to evaluate brain wave activity, cognitive processing, and neurological function. Additionally, biomarker analysis through blood or cerebrospinal fluid tests helps identify inflammatory markers, oxidative stress levels, and amyloid or tau proteins, which are linked to cognitive decline. Neuropsychological assessments and AI-driven cognitive testing platforms are used to track memory, processing speed, and executive function over time, allowing for personalized intervention strategies. Many clinics integrate wearable technology and real-time monitoring systems to provide continuous assessment of brain activity, sleep patterns, and stress response, offering a comprehensive approach to brain longevity and cognitive optimization.

One of the notable companies that participated in our 2023 event was **BrainKey** [29]. BrainKey is an AI-driven digital healthcare company dedicated to transforming brain health diagnostics and management. By analyzing brain MRI scans and integrating genetic data, BrainKey provides personalized insights into brain health, enabling early detection of potential issues and facilitating proactive interventions. Users can explore over 25 brain regions in 3D, track changes over time, and receive actionable recommendations tailored to their unique profiles. The platform also calculates a "BrainAge" score, comparing an individual's brain age to their chronological age, offering a comprehensive view of cognitive well-being. BrainKey's mission is to empower individuals and healthcare professionals to prioritize brain health, aiming to reduce the global prevalence of dementia and other neurodegenerative conditions.
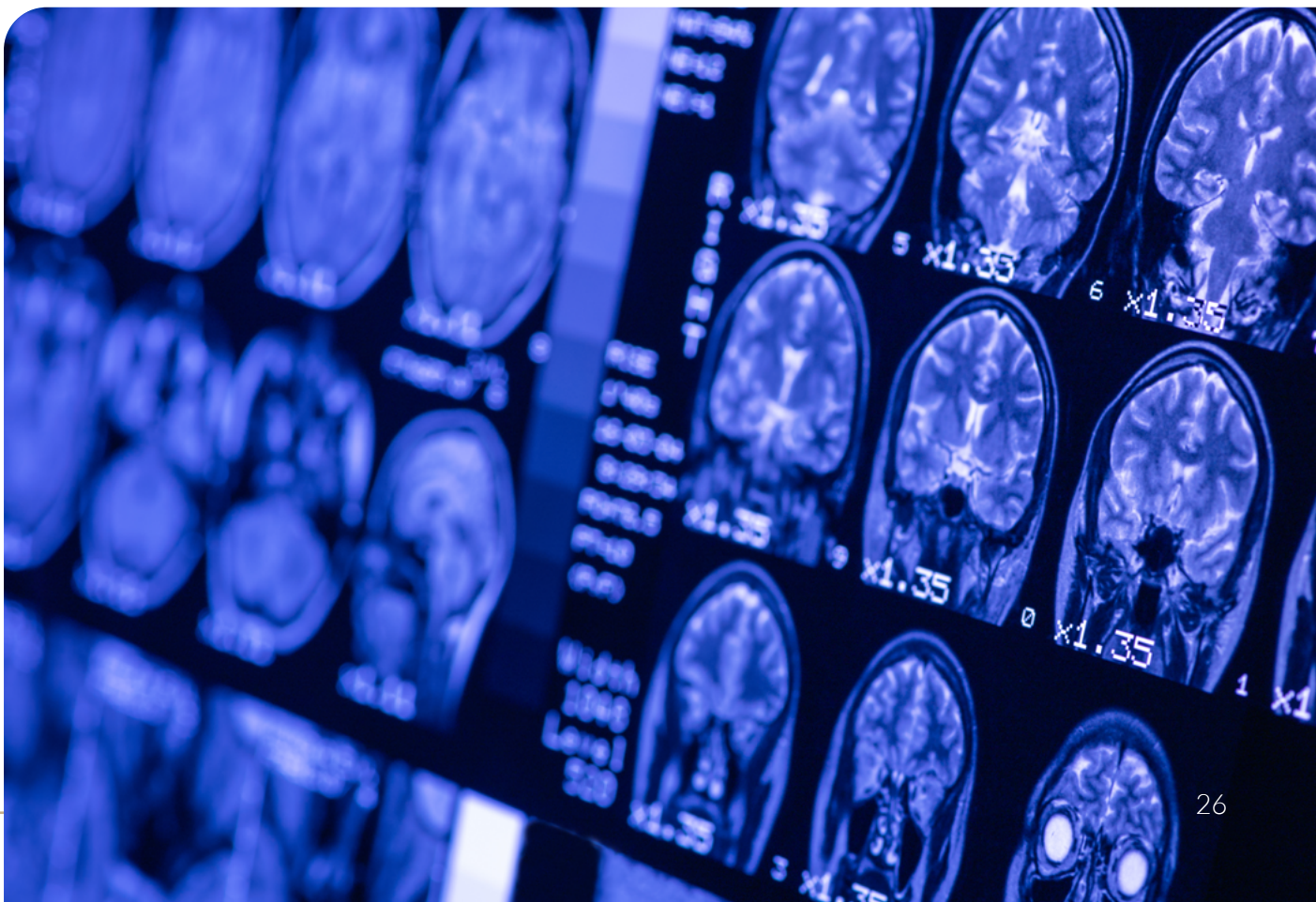
During the Second Longevity Clinics Roundtable, we hosted a panel dedicated to next-generation brain health technologies. This session featured leading companies at the forefront of brain health innovation, each offering cutting-edge approaches to understanding, monitoring, and optimizing cognitive function.

- **Kernel's Flow** [30] is a wearable brain measurement device in form of a helmet, that utilizes time-domain functional near-infrared spectroscopy (TD-fNIRS) to non-invasively monitor cortical hemodynamics, providing insights into brain activity. The system is designed for ease of use and offers full or focused brain coverage options. Unlike traditional bulky and expensive neuroimaging equipment, Kernel Flow is portable and cost-effective, making routine brain health assessments more feasible in various clinical settings.

  Kernel's technology aims to advance precision neuromedicine by providing scalable, data-rich insights into brain function. By providing detailed maps of brain activity, Kernel Flow can identify early signs of neurodegenerative diseases like Alzheimer's and Parkinson's, enabling timely interventions. Additionally, the device allows clinicians to assess the impact of therapeutic interventions on brain function in real-time, facilitating personalized treatment plans. The helmet represents a significant advancement in non-invasive brain monitoring technology, offering valuable applications in the early detection, monitoring, and research of age-related cognitive decline, thereby contributing to the goals of longevity medicine.

- **NeuroAge Test** [31], developed by NeuroAge Therapeutics is a comprehensive brain aging assessment that combines AI, MRI technology, genetic, and cognitive analysis to predict biological brain age and assess dementia risk up to 30 years before symptoms appear. By providing personalized reports and actionable recommendations, it empowers users to optimize brain function and reduce neurodegenerative risk, promoting long-term cognitive health. This early detection and personalized intervention approach enables individuals to take proactive steps to maintain cognitive resilience and overall brain health as they age.

- **Wavi** [32] offers a brain performance assessment platform that utilizes EEG technology to measure and track cognitive function. Their system provides insights into brain health, assisting in early detection of cognitive decline and monitoring the effectiveness of interventions. The WAVi system is a highly user-friendly and accessible EEG platform designed for ease of use and portability. It simplifies electroencephalography (EEG) assessments by requiring only a minimal saline solution, making setup and operation efficient. The system integrates EEG with event-related potentials (ERPs), enhancing its diagnostic capabilities. Additionally, it offers a comprehensive suite of standardized assessments for concussion management, aging, wellness, behavioral health, and mood analysis, making it a versatile tool in both clinical and longevity-focused settings.

Validating Biomarkers: The Latest Scientific Findings

Validating and standardizing biomarkers of aging is a top priority in the field of longevity medicine. Reliable, validated biomarkers are essential for accurately assessing an individual's health status and implementing personalized, evidence-based interventions effectively.

Epigenetic clocks (DNAm aging biomarkers) have long been proposed as surrogate endpoints for longevity interventions, primarily due to their prognostic value in predicting mortality and morbidity.

However, their ability to respond dynamically to interventions has not been systematically tested. Identifying biological age biomarkers that dynamically respond to longevity interventions is crucial for ensuring that the interventions are effective, personalized, and evidence-based.

To answer the question "Are DNAm aging biomarkers responsive" a study [33] has been conducted on a database of 51 longitudinal longevity intervention studies with whole blood DNA methylation (DNAm) data pre- and post-intervention. Results showed that advanced Generation 2+ (Reliable and mortality or rate of aging predictors) DNAm biomarkers —including GrimAgeV2, PCGrimAge, PCPhenoAge, SystemsAge, and DunedinPACE—exhibited substantial responsiveness to the study interventions, regardless of whether interventions were lifestyle- or pharmacology-based. These biomarkers demonstrated significant changes in biological age, reinforcing their potential for monitoring anti-aging strategies, tracking biological age and intervention efficacy in clinical and research settings.

A key finding was that biomarker responsiveness varied by health status. Disease populations showed greater reductions in epigenetic age, suggesting they may benefit more distinctly from longevity treatments. Biomarkers like PCPhenoAge, SystemsAge, and GrimAgeV2 showed greater decreases in epigenetic age in diseased individuals than their healthy counterparts.

Additionally, system-specific Gen X biomarkers like SystemsAge provided insights into targeted effects of interventions on different physiological systems. For example, smoking cessation reduced lung-specific aging, while metformin influenced inflammatory, brain, and metabolic aging scores. Understanding the specific systems affected by various interventions can inform the development of targeted therapies that address the underlying causes of aging in specific organs or tissues. This finding highlights the value of system-specific aging biomarkers in tailoring longevity treatments by targeting therapies to address the underlying causes of aging in specific organs or tissues.

The authors concluded that to serve as effective surrogate endpoints, aging biomarkers must meet two key criteria:

- Reliability – Consistently reproducible across studies.

- Predictive Power – Strong correlation with mortality or the rate of aging.

- Responsiveness to longevity interventions.

Overall, Generation 2+ reliable biomarkers emerged as the leading indicators of biological age response. DunedinPACE was the only biomarker changing unbiasedly in both potentially healthy and disease populations.

The Role of AI and Multi-Modal Data in Longevity Diagnostics

In addition to validation, another important step toward achieving accurate and precise longevity medicine assessments—and enabling personalized, evidence-based interventions—is the integration of multi-modal data with AI-driven analysis.

AI and multi-omics integration helps transform predictive longevity diagnostics by providing a personalized, systems-level understanding of aging. AI-driven algorithms can analyze genomics, epigenomics, proteomics, metabolomics, and microbiomics to detect early aging patterns, predict disease risks, and refine intervention strategies. By integrating multi-modal data, including wearables, medical imaging, and biomarker trends, machine learning enables better biological age estimations, early disease detection, and improved response to longevity interventions. This precision-based approach will shift longevity medicine from generalized recommendations to individualized strategies for optimizing health and delaying aging-related decline.

Aging is a multi-system process, and no single biomarker fully captures an individual's biological trajectory. Employing AI methods to analyze diverse data types, including medical imaging, electronic health records or genetic information enhances diagnosis and enables validation of longevity interventions. AI models can uncover patterns across modalities, leading to more accurate and personalized healthcare solutions.

Key Considerations in Diagnostics for Longevity Medicine

Effective diagnostics in longevity medicine require addressing several challenges to ensure clinical relevance, accuracy, and actionable insights. One of the key challenges in longevity medicine diagnostics is the lack of a clear definition of optimal health. Traditional "normal" reference ranges may not be sufficient; instead, we must define optimal health on the individual level. Without a clear personalized health benchmark, there is no defined goal for interventions.

Without a standardized benchmark for what constitutes optimal health, there may also be a lack of direction for diagnostics. Many longevity clinics still struggle to personalize diagnostic strategies, often relying on standardized test panels or, in some cases, over-testing patients. Excessive testing can generate overwhelming amounts of data, complicating interpretation rather than improving clinical decision-making.

Therefore, effective diagnostics should be focused mainly on clinically relevant, validated tests that provide clear, actionable insights rather than burdening clients with excessive or ambiguous results. Notably, not all diagnostic tests have the same quality, and selecting high-quality, validated tools is essential for meaningful assessments. For instance, as Dr. Yael Raffaele has stressed, not all whole-genome sequencing tests offer the same level of accuracy. Some low-cost options may lack precision, leading to misinterpretation of genetic risk factors. To ensure reliable diagnostics and effective longevity interventions, clinics must prioritize validated, high-quality tests tailored to individual health profiles.

DNA methylation-based biomarkers have a high potential of being reliable and high-quality biomarkers of aging. These biomarkers reflect long-term biological trends rather than short-term fluctuations in biomarker levels that could introduce bias [34]. However, they are not yet fully established as validated diagnostic tools. The standardization and clinical validation of biological age biomarkers remain ongoing challenges, with no consensus on which clocks are most reliable for specific measurements.

While significant progress has been made, identifying the most accurate and clinically relevant DNA methylation-based aging clocks is still an active area of research. The study by Seghal et al. [33] provided valuable insights into aging clocks effectiveness and applicability. Summarizing the study's findings, Ryan Smith—co-author and founder and vice president of TruDiagnostic—identified GrimAgeV2, PCGrimAge, PCPhenoAge, SystemsAge, and DunedinPACE as the most reliable aging clocks tested, noting that these were the most responsive to the interventions examined.

Additionally, newer clocks that were not part of the study, such as SymphonyAge (Yale) and OmicmAge [35] (Harvard), are expected to offer even greater precision than the researched models. However, the journey toward fully validated and universally accepted DNA methylation-based biomarkers of aging is ongoing. Several challenges persist, including the need for large-scale longitudinal studies to confirm their predictive accuracy across diverse populations and conditions. Additionally, distinguishing between normal aging processes and age-related diseases remains complex, as DNA methylation patterns can be influenced by various factors.

The search for a reliable DNA methylation-based biomarker of aging does not imply a quest for a single universal aging marker. Instead, the field is focused on refining multi-omics aging biomarkers that integrate DNA methylation, proteomics, metabolomics, and AI-driven analysis

to enable personalized longevity diagnostics. Aging is a complex, multi-system process involving interconnected biological pathways, making it impractical to define a single molecular measure for aging. Different systems age at varying rates, and inter-system communication deteriorates over time [27]. Instead, comprehensive, multi-modal models are needed to capture the full spectrum of biological aging.

Moreover, for aging biomarkers to be clinically useful, their algorithms must include more explainable features to account for heterogeneous aging trajectories across individuals. The aging clocks need to enable personalized guidance. Simply informing clients whether they are aging faster or slower does not provide actionable insights. Instead, longevity diagnostics must identify where aging occurs (whether in metabolic, immune, neurological, or cardiovascular systems) and why.

To address this need, companies like TruDiagnostics offer personalized recommendations alongside biological age reports. Their SYMPHONYAge score provides insights into the aging processes of eleven different organ systems, helping identify areas where targeted interventions may have the most significant impact. This approach allows for tailoring interventions based on individual aging patterns, providing targeted strategies for those aging slower than their chronological age and those whose biological age is higher than their chronological age.

Biomarkers themselves are not the only challenge. Many doctors struggle with effectively utilizing longevity diagnostic tools. The results can be complex to interpret and challenging to explain to clients. For instance, clients who follow healthy lifestyle practices may still show suboptimal biomarker results due to immune dysfunction, cellular issues, or other underlying factors. Doctors must be able to explain these results effectively and integrate other assessments to provide a clear explanation to the clients. Without clear explanations, clients may lose motivation to maintain lifestyle improvements and follow through with longevity interventions.

Finally, diagnostic tools should be utilized both before and after interventions to assess their impact and ensure treatment effectiveness. Additionally, while gerotherapeutics should be tailored to specific biomarkers, their effects must be monitored across multiple biomarkers to ensure holistic improvements rather than isolated changes.

Emerging interventions used in Longevity Clinics

Over the past year, longevity medicine has seen significant advancements in longevity interventions across various domains, including supplementation, pharmaceuticals, and innovative therapies. At the same time, the demand for validated, science-backed longevity medicine interventions has been rapidly increasing. Moreover, more clinics have been focusing on integrating diagnostics with interventions to deliver precise, data-driven health solutions. The use of technology-driven optimization has been expanding, particularly in areas like brain health, where digital tools and wearables enhance cognitive well-being. At the same time, next-generation interventions targeting the hallmarks of aging have been emerging [27], aiming to deliver systemic, long-term benefits. The field has been increasingly shifting towards personalized medicine, leveraging AI, big data, and multi-omics to tailor interventions to individual needs, ensuring greater precision and efficiency in longevity care.

There has also been a growing need for simpler, more effective interventions that reduce client burden while maintaining effectiveness. Clinics have prioritized accessible, cost-effective solutions including lifestyle modifications, supplementation, and mental and spiritual health support. As Dr. Nicole Mitin remarked "Not every ailment needs drugs or therapies. Lifestyle optimization is often the best choice".

In our previous white paper, we highlighted the significance of lifestyle interventions in healthspan optimization. During this year's conference, in addition to lifestyle optimization, we chose to focus on less commonly utilized yet equally important interventions that enhance healthspan optimization and improve client satisfaction. We will begin by exploring mental and spiritual health interventions, followed by an in-depth discussion on brain health tools and skin aging treatments. Finally, we will explore emerging interventions that may soon become available in longevity clinics.

Mental and spiritual health interventions

Integrating mental and spiritual health practices such as therapy, stress management, music therapy, and meditation plays a crucial role in longevity clinics' programs by enhancing emotional resilience, reducing stress-related inflammation, and supporting overall well-being. Chronic stress and poor mental health contribute to accelerated aging, cognitive decline, and increased disease risk [36, 37] therefore it is essential to include interventions that address these problems.

Therapy can help individuals process emotions and build healthier coping mechanisms [38], while meditation and mindfulness are linked to improved brain plasticity, lower cortisol levels,

and enhanced immune function [39]. Both therapy and mindfulness enhance self-awareness, which in turn can foster a more positive self-identity and a proactive approach to health. Geshe Tenzin Wangyal Rinpoche emphasized the profound impact of self-identity on both mental and physical well-being. He highlighted sleep as a prime example, as sleep is a cornerstone of healthy longevity. By reshaping one's identity and beliefs around sleep—letting go of anxiety and embracing meditation instead of worrying upon waking during the night—one can transform their sleep quality. Dr. Dean Ornish also emphasized a more positive approach to adopting a healthy lifestyle, suggesting that motivation should come not from "the fear of dying, which is unsustainable, but from the joy, pleasure, love, and feeling good".

Moreover, music therapy is especially promising intervention as it is powerful, non-invasive and low-cost. It can support cognitive longevity, reduce anxiety, and enhance mood [40]. It has been shown to minimize pain, stress [41], and side effects of illnesses and treatments, including chemotherapy-induced nausea [42] and surgical recovery [43]. Additionally, music can lower heart rate, blood pressure, and respiratory rates, contributing to better cardiovascular health [41]. In dementia patients, it reduces agitation and enhances cognitive function [44]. Singing has been linked to improved heart [45] and lung function [46].

Several leading universities and medical institutions are actively researching the positive impact of music on health. Harvard Medical School explores how music influences brain function and investigates its therapeutic potential in conditions such as Alzheimer's disease and stroke. Similarly, Johns Hopkins University, through its Center for Music and Medicine [47], is conducting studies on music-based therapies for neurological disorders, including Parkinson's and Alzheimer's disease, highlighting the growing recognition of music as a valuable tool in clinical care.

Brain health

Brain health interventions play a crucial role in longevity medicine by preserving cognitive function, preventing neurodegenerative diseases, and enhancing overall well-being. As longevity increases, maintaining mental clarity, memory, and emotional stability becomes just as important as physical health. Targeted interventions—including neuroprotective nutrients, cognitive training, brain stimulation therapies, and already discussed stress reduction techniques—help optimize brain function, reduce dementia risk, and improve quality of life, ensuring a longer healthspan with sustained mental sharpness [48].

During the conference, we discussed the following brain health interventions:

- **Neuronic** [49] offers pioneering brain health solutions based on the photobiomodulation (PBM) technology. Their non-invasive, near-infrared light helmets are designed to promote cellular energy, reduce inflammation, and support brain vitality, contributing to cognitive longevity.

- **Sens.ai** [50] provides a brain training device that combines multiple technologies, including neurofeedback, transcranial photobiomodulation, and heart rate variability biofeedback. This integrated approach aims to enhance cognitive function, focus, mood, and overall brain health.

- **Ani Biome** [51] is a longevity biotech company that focuses on the intricate relationship between the brain, immune system, and gut microbiome, collectively known as the brain-immune-gut

(BIG) axis. By analyzing data from non-invasive diagnostics, including daily psychobiosocial questionnaires, tongue and skin scans, and wearable devices, Ani Biome aims to optimize and enhance cognitive function and overall well-being. Their approach includes the development of AgeBiotics™, naturally derived molecules tailored to individual needs, which have been linked to improved metabolic and psychological health outcomes.

Skin Aging

Skin longevity is often overlooked in the field of longevity medicine as it is frequently perceived as an aesthetic concern rather than a vital aspect of overall health. However, skin aging is just as important as internal organ aging— the difference is that while internal aging is invisible, skin aging is visibly apparent. Skin can also be seen as a detector of underlying health issues, as it often reflects internal imbalances, nutritional deficiencies [52], and systemic diseases [53]. Changes in skin colour, texture, hydration, and the presence of rashes or lesions can serve as early warning signs of underlying conditions [53].

Despite its significance, effective solutions for skin aging are often misdirected or not properly targeted. Most skincare products focus on treating the visible symptoms of aging rather than addressing its underlying causes. However, ingredients commonly used for skin conditions like acne and rosacea (e.g., AHA, retinol) can also be highly effective for skin aging when used in low concentrations. Additionally, targeting skin health from within, such as modulating the microbiome to reduce redness, is an emerging field in longevity research [54,55]. During the conference, discussions primarily focused on innovative approaches to skin aging, particularly:

- **Red light and near-infrared light** (NIR) therapy, which has shown promise in promoting collagen production and cellular repair [56]. Red and NIR therapy works by activating mitochondria to increase ATP production, which fuels cellular regeneration and improves skin elasticity and resilience [57]. Near-infrared light penetrates deeper, further supporting mitochondrial function and tissue repair [58], making both therapies powerful tools for combating oxidative stress and cellular aging.

- Targeting cellular senescence, specifically by reducing senescent cells in the skin to support regeneration and maintain youthful skin function [59]. At the conference, we hosted OneSkin, whose product features the proprietary OS-01 peptide, designed to target cellular senescence [60], a key driver of skin aging. However, skincare products in the EU must comply with the European Cosmetics Directive [61], which means that they need to be formulated to act on the surface of the skin. This means the current products must remain within the scope of topical skincare, with its primary function being to protect and maintain the skin, rather than serve as a medical treatment. While medical treatments targeting skin cellular senescence are emerging, they are not yet widely available.

Emerging interventions

The field of longevity medicine is rapidly evolving, with new interventions targeting aging at a systemic level. Beyond traditional lifestyle and pharmacological approaches, cutting-edge therapies such as plasmapheresis, OpenWater technology, ExThera blood filtration, and Immunis regenerative treatments are pushing the boundaries of age-related disease prevention and health optimization.

As research progresses, these novel interventions could play a transformative role in extending healthspan, improving systemic function, and redefining longevity care in the years to come. This section explores how these technologies work, their potential benefits, and their future impact on longevity medicine.

- **Plasmapheresis** is a procedure that uses blood separation technology to remove harmful substances, such as inflammatory proteins, from plasma and replace it with physiologic fluids like albumin. A collaborative study [62] conducted by Dobri Kiprov of Circulate Health and Eric Verdin of the Buck Institute investigated the impact of plasmapheresis on aging biomarkers. The study demonstrated a reduction in biological age, as measured by several epigenetic clocks, including GrimAge and SystemsAge. The results suggest that plasmapheresis can help reduce biological age by improving biomarkers related to inflammation, immune function, and cellular environment, supporting healthier aging. While the research findings are promising, the use of plasmapheresis for longevity purposes is still under investigation. Clinical trials are ongoing to better understand its efficacy and safety in the context of aging.

- **The Open Water system** [63] uses AI-enabled infrared and ultrasound technology to treat a variety of medical conditions, such as glioblastoma, depression, long COVID and for stroke detection, offering a non-invasive therapeutic approach. The company is currently accepting order reservations for its Early Access Systems, including a therapeutic ultrasound unit and a blood flow measurement unit. However, the exact timeline for widespread official usage of this technology will depend on ongoing clinical trials, regulatory approvals, and successful integration into medical practice.

- **The ExThera blood filter** [64], originally developed for bio-warfare scenarios, filters the blood through a large glycocalyx surface to remove pathogens, including metastatic cancer cells and viruses like those causing long COVID. The device is commercially available in Europe for treating bloodstream infections. It has not been approved by the U.S. Food and Drug Administration (FDA) but has been granted multiple Breakthrough Device Designations and has been used under Emergency Use Authorization (EUA) for treating COVID-19 patients.

- **Immunis' IMM01-STEM** [65] focuses on stem cell secretomes, delivering 440 bioactive factors to rejuvenate immune function, reduce inflammation, and enhance muscle mass, showcasing promising results in treating osteoarthritis and other age-related conditions. Currently, IMM01-STEM remains an investigational therapy and is not yet available for general patient use. Its availability will depend on the successful completion of ongoing clinical trials and subsequent regulatory approvals.

More novel interventions are on the horizon. As of early 2025, there are over 85 clinical studies underway focusing on gerotherapeutic interventions [66] —strategies aimed at targeting the biological mechanisms of aging to prevent or delay age-related diseases and extend healthspan.

These trials encompass a range of approaches, including pharmaceutical agents like metformin and rapamycin, lifestyle modifications, and novel therapies targeting specific aging pathways. The National Institute on Aging's Translational Geroscience Network has been instrumental in facilitating these studies, providing infrastructure and support to translate potential gerotherapeutics into clinical applications.

Challenges in development of new interventions

We will conclude this section by exploring the key challenges in developing new longevity and anti-aging interventions.

One of the major challenges in the development and utilization of longevity interventions is the lack of proper validation and evaluation methods. Biological age clocks, the primary diagnostic tools used to measure aging, remain unvalidated, and there is no standardized framework to accurately assess the effectiveness of these interventions.

A notable step toward addressing this issue was a study by Sehgal et al. [33], which evaluated 51 longevity interventions using 16 biological age clocks. The study examined interventions such as metformin, gastric bypass, caloric restriction, and anti-TNF therapies, offering insights into how these treatments influence biological aging markers.

The study found that pharmacological interventions had the most pronounced effects on DNA methylation-based biological age biomarkers, compared to lifestyle changes, supplements, and medical procedures. Among them, anti-TNF therapies and metformin consistently influenced biological aging markers, highlighting their potential as longevity therapies. Future research should further investigate the mechanisms behind these therapies to optimize clinical applications of pharmacological longevity interventions.

The study [33] also revealed that DNA methylation biomarkers were significantly more responsive in disease populations than in healthy individuals. This suggests that those with pre-existing health conditions may benefit the most from targeted anti-aging interventions. The heightened response in disease populations could be due to the accelerated biological aging processes linked to chronic conditions, making them more susceptible to interventions that slow or reverse aging pathways.

These findings emphasize the importance of tailoring longevity interventions to individual health profiles, optimizing therapeutic outcomes, and ensuring greater applicability across diverse populations.

One of the other major challenges in longevity medicine is the translation of evidence from animal studies to human models. Many longevity clinics seek to offer cutting-edge interventions as early as possible, often before they become available in conventional medical systems. Because aging is not officially classified as a disease, there is currently no established regulatory framework for approved longevity interventions. It remains uncertain if or when longevity therapies will be formally integrated into public healthcare systems.

As a result, many longevity clinics explore experimental interventions that lack formal regulatory approval. While this allows for innovation and early adoption, it also carries risks, particularly when relying on findings from animal studies without sufficient human validation. Clinics must exercise extreme caution in selecting interventions, ensuring that their efficacy is supported by robust human data rather than solely by preclinical animal models.

For example, as Dr. Natalia Mitin highlighted, senolytic drugs targeting senescent cells have shown promise in mice but have often been toxic in humans. Therapies targeting high levels of cellular senescence can offer significant benefits, but they must be carefully selected and tailored to each patient. Proper diagnosis and thorough evaluation are essential to ensure that these interventions are both effective and appropriate for individual health profiles.

Dr. Mitin cautioned that senolytic therapies may not be universally beneficial across all age groups and, in some cases, could even be harmful. Low levels of cellular senescence are not inherently beneficial, and reducing cellular senescence may, in some cases, be harmful [67]. Given the uncertainties, harnessing the body's own immune system to clear senescent cells may be a safer and more effective approach than direct senolytic therapies. Restoring immune function is emerging as a more promising strategy than conventional senolytic treatments.

Additionally, while senolytics alleviate physical dysfunction in all tested mice, studies have identified gender-specific effects—female mice primarily experience muscle mass improvement [68], whereas male mice show enhanced metabolic function [69]. It is highly likely that similar gender differences exist in humans.

Cellular senescence treatments serve as a critical example of why precision, personalization and caution are essential in longevity medicine. Before implementing any intervention, it is crucial to thoroughly assess each individual, ensuring that treatments are tailored to their unique biological profile through comprehensive testing and analysis. Finally, as Joseph Raffaelle emphasized *"When we consider interventions, we need to consider that this is all systems biology and there is no simple answer."*

Democratizing Longevity Medicine

Democratizing longevity medicine is crucial for making it accessible, affordable, and scalable across diverse populations. This involves improving outcomes, controlling costs, and integrating longevity-focused interventions into public healthcare systems.

Prof. Andrea Maier advised that the field needs to form a network to set protocols that are affordable and can be incorporated into the public healthcare systems. With the Healthy Longevity Medicine Society, she is actively working towards integrating healthy longevity diagnostics into public hospitals [14]. Integrating longevity clinics into publicly funded hospitals would make preventive and longevity-focused healthcare accessible to a broader population, particularly those who might not afford private longevity services. By embedding biological age assessments, personalized interventions, and early detection of aging-related diseases into existing healthcare systems, these clinics could help shift the focus from reactive treatment to proactive healthspan optimization.

Integrating longevity medicine protocols into public hospitals is a crucial first step toward full adoption within public healthcare. However, achieving complete integration requires developing a scalable blueprint model that ensures effective implementation across diverse healthcare systems. Additionally, we need to start creating more educational programs for medical professionals, expanding their training in preventive and longevity-focused medical models. Scaling up longevity clinics will require a well-trained workforce equipped to implement these approaches effectively. Doctors adopting a preventive approach need the necessary skills and knowledge to integrate proactive, science-backed diagnostics and interventions into clinical practice.

We also need to address the high cost of aging biomarkers as it remains a major barrier to their integration into public healthcare and the democratization of longevity medicine. The cost of biomarkers of aging could be reduced in the future through advancements in high-throughput sequencing, AI-driven biomarker analysis, and standardized testing protocols. Automation and large-scale data integration will lower processing costs, while increased research funding and commercialization will drive competition, making tests more affordable. Additionally, regulatory approval could lead to insurance coverage and subsidized screening programs, further improving accessibility.

As stressed by Joanna Bensz, integration of longevity medicine with health insurance coverage could be a significant step towards democratizing access to preventative and longevity-focused healthcare. By recognizing aging as a modifiable risk factor, insurance companies could integrate biomarker-based health assessments, preventive therapies, and personalized lifestyle interventions into standard coverage plans. Some health insurance companies are already adopting a more preventive approach, offering incentive programs to encourage healthier lifestyles among their clients.

Incentive programs can also play a key role in public policy change. Dr. Michael Roizen suggested that introducing such programs could effectively encourage the public to adopt healthier lifestyles. Therefore, longevity medicine field needs to actively engage governments and policymakers to drive meaningful change. This involves campaigning for incentive programs but also demonstrating

the long-term economic and public health benefits of longevity-focused interventions and advocating for policy reforms that integrate longevity medicine into mainstream healthcare. Policymakers should be encouraged to collaborate with experts to implement evidence-based strategies, such as nationwide campaigns promoting healthier lifestyles and preventive health initiatives. Employers could also play a key role in promoting health and well-being. They can implement incentive programs to encourage healthier lifestyles and offer benefits such as gym memberships, nutritious meal options, and partnerships with longevity clinics.

To make longevity medicine more appealing to stakeholders embracing such preventative and proactive approach, we should develop standardized, easy-to-implement programs based on best practices. Dr. Dean Ornish emphasized such need for simple, accessible lifestyle programs to drive meaningful change and discussed his clinic's model focused on healthy eating, regular walking, and quality time with family. Such a framework could serve as a blueprint for a standardized longevity medicine program to be promoted to the public.

Finally, integrating AI-driven analysis with advanced diagnostics can lower diagnostic costs while enabling personalized, precision-based interventions tailored to individual health needs. Collecting and analysing patient data from advanced diagnostics, such as AI-driven MRI scans, or multi-omic tests could help establish formalized and uniform set of biomarkers that could serve as industry-wide standards. One such effort is the Human Phenome Initiative [70], led by Dr. Leroy Hood. This research-driven initiative aims to systematically map and understand the phenome—the complete set of observable traits and characteristics of an individual, shaped by genetics, environment, and lifestyle choices. By bridging the gap between genomics (the study of genes) and phenomics (the study of traits), the initiative seeks to advance personalized medicine, improve diagnostics, and develop targeted treatments, ultimately transforming healthcare through a deeper understanding of human biology.

Addressing the gap in women's health

A discussion on democratizing longevity medicine is incomplete without addressing the significant gap in our understanding of women's health. Despite significant advancements in medicine, women's health remains widely under-researched and poorly understood. Historically, clinical studies have been male-dominated, leading to gaps in knowledge about how aging, metabolism, and disease progression differ between men and women. Key aspects of women's longevity, such as the impact of hormonal shifts (e.g., menopause), sex-specific aging biomarkers, and the role of reproductive history in long-term health, remain underexplored.

One area currently being explored to bridge this knowledge gap is ovarian aging. Ovaries show signs of aging decades before other

tissues. As an endocrine organ, the ovaries regulate multiple health systems, but the full extent of these interactions and communication pathways is still unclear. Alarmingly, increasing number of women experience health conditions linked to poor ovarian function [71], underscoring the urgent need for research and targeted interventions.

While preventive therapies that support overall health may also benefit ovarian aging, current treatment options remain limited. At present, lifestyle improvements are among the most effective interventions, and for women approaching menopause, hormone replacement therapy (HRT) remains the gold standard.

Recognizing this gap, the Center for Healthy Aging in Women [72] at the Buck Institute launched the first dedicated research center for ovarian health and aging in 2019. In just five years, the center has made a major impact, publishing over 50 studies and advancing efforts to develop new solutions for women's health. Hormone replacement therapy is expected to be a key area of innovation in the coming years, with new therapies on the horizon to optimize ovarian function and extend women's healthspan.

In the next edition of the Roundtable of Longevity Clinics conference, the organizers plan to expand the discussion on gender-specific medicine and female longevity. In the meantime, the longevity medicine field must take steps to promote lifestyle interventions specifically tailored for women. It is also crucial to educate medical professionals on the effective use of hormone replacement therapy (HRT) and other evidence-based interventions. Additionally, longevity experts should raise public awareness, ensuring that women are informed about the available treatments and personalized health strategies that can support their long-term well-being.

Major challenges for the Healthy Longevity Field

The longevity medicine field faces several major challenges that hinder its progress and widespread implementation. One of the primary obstacles is the absence of validated biological age biomarkers, which limits the ability to reliably measure and track the effects of interventions.

Regulatory barriers further impede progress, with regulatory bodies like the FDA not recognizing aging as a disease. The lack of standardized guidelines is another major obstacle to advancing longevity medicine. Establishing national policies, licensing standards, and certification frameworks is essential to positioning longevity medicine as a credible, regulated, and impactful medical discipline.

Finally, we need a deeper understanding of longevity interventions and how to tailor them to specific health and aging challenges, including the hallmarks of aging. We must advance our knowledge of personalized interventions and refine the integration of AI-driven and data-driven diagnostics with targeted treatments to enhance precision and effectiveness.

Challenges of Longevity Medicine Clinic Leaders

Leaders of longevity clinics face unique challenges inherent to managing and operating a longevity-focused healthcare practice. Advancing this movement requires strategic efforts across multiple domains, including specialist training, creation of standards and best practices, public education, data utilization, and policy engagement.

The lack of established best practices, standards, and guidelines is a major challenge in longevity medicine. Most clinics develop proprietary methods, refining them through trial and error, which carries significant risks. As clinics work to improve their approaches, there is a danger that clients may not receive the most effective treatments, potentially compromising outcomes and satisfaction.

The lack of standards impacts both diagnostics and interventions. In diagnostics, this often results in an overwhelming volume of data generated by longevity assessments due to no clear guidelines on which tests to prioritize. Without standardized protocols, longevity physicians frequently over-test to minimize errors, leading to unnecessary costs and complexity. Additionally, current diagnostic tools produce vast datasets, yet there are no established best practices for analyzing this amount of data and making meaningful predictions.

Even when doctors fully understand diagnostic results, effectively communicating findings in a clear, persuasive, and actionable way remains a challenge. Physicians must not only interpret data but also motivate behavior change, empowering clients to take control of their biological aging. Longevity interventions demand significant lifestyle adjustments, which can feel overwhelming for many clients. To ensure long-term success, individuals must be actively engaged in their health journey, yet there are currently no standardized guidelines or best practices on how to facilitate this process effectively.

Due to a lack of standards, guidelines, and best practices, there is a shortage of longevity medicine educational programs. As the field expands, finding adequately trained medical professionals is becoming a challenge. Many longevity clinics struggle to hire forward-thinking physicians, as most

conventionally trained doctors lack expertise in preventive and precision-based medicine. Dr. William Kapp emphasized that while longevity medicine is growing, there are not enough medical professionals thinking outside of the box. Joanna Bensz highlighted the urgent need for longevity-specific training programs to accelerate the education of specialists and meet the rising demand for expertise in this field.

Educational programs must be flexible and continuously evolving to keep pace with emerging technologies, advancing diagnostic tools, and ever-changing intervention protocols. This rapid evolution presents a significant challenge not only for those developing training materials but also for longevity specialists, who must stay at the cutting edge of science while simultaneously caring for clients and driving innovation.

Moreover, longevity leaders are expected to push global standards forward, engage policymakers, collaborate with insurance providers, and implement new programs both within their clinics and in the public healthcare system. These demands far exceed those of traditional healthcare, requiring a multidisciplinary approach that blends medical expertise, policy advocacy, and strategic innovation. Therefore, longevity education should accommodate these multidisciplinary demands.

The lack of guidelines, standards, and best practices in longevity medicine also affects its nomenclature, as there is no widely accepted definition of what constitutes an longevity medicine clinic. Without clear standards, there is no consensus on the services these clinics should offer, leading to significant variation in practices. Some clinics branding themselves as longevity services provide experimental treatments that lack scientific backing and sufficient validation.

This lack of regulation raises serious ethical concerns, highlighting the need for a measured, evidence-driven approach. As Dr. Jordan Shlain emphasized, caution is essential when considering experimental treatments, as many remain unproven and carry significant risks. He further noted, *"The art of longevity medicine is to keep ourselves young while persuading our minds to be patient enough to wait for the science and research to catch up to our aspirations."*

Without clear regulations and standards, the public struggles to distinguish between evidence-based longevity clinics and those offering experimental treatments. Therefore, longevity medicine professionals should actively combat misinformation by establishing credible, transparent communication both in the clinics and on social media. Effective public education and responsible messaging will be key to ensuring that longevity medicine remains credible field grounded in science, ethics, and patient safety.

In conclusion, to advance longevity medicine, strategic efforts must focus on establishing evidence-based standards and guidelines, enhancing physician training, improving public communication, and integrating longevity-focused care into healthcare systems. Additionally, combating misinformation and unproven interventions is crucial to maintaining credibility and ensuring patient safety. As longevity medicine grows, fostering a balanced, ethical, and science-driven approach will be key to its successful integration into both clinical practice and public health policy.

The Future of Longevity Medicine and Longevity Clinics

The future of longevity medicine and longevity clinics lies in the convergence of innovation, collaboration, and system-level transformation. Establishing longevity medicine as a credible, recognized field within global healthcare frameworks requires a multifaceted approach involving scientific validation, regulatory integration, standardized nomenclature and protocols, medical education, and public trust. Additionally, protocols of longevity clinics must be rooted in scientific evidence, backed by regulatory frameworks, standardized in clinical practice, and supported by medical education. Longevity professionals must also work on public engagement, misinformation control, and global policy advocacy to advance its integration into mainstream healthcare.

Significant strides are already being made to establish longevity medicine as a credible field within global healthcare frameworks. Notably, Abu Dhabi's Department of Health has introduced a pioneering licensing framework to establish Healthy Longevity Medicine Centres, aiming to promote wellness, longevity, and disease prevention. Additionally, the Healthy Longevity Medicine Society is actively working to establish standards and guidelines for longevity medicine practitioners while advancing longevity medicine as a recognized and respected medical specialty. Finally, the International Institute of Longevity (IIOL) is actively working towards broader public acceptance of longevity clinics by developing and promoting best practices.

In this final section, we will explore what the near future holds for longevity clinics.

The long-term goal of the longevity medicine field is to achieve integration into public healthcare systems and reimbursement models. To make this a reality, efforts are underway to establish validated biomarkers of aging, standardized practices, regulations, and scalable, equitable protocols. The field is also working toward expanding educational training and certification programs, with the ultimate aim of incorporating them into university curricula. Ideally, longevity medicine will become a formal part of medical education, ensuring that preventive and longevity-focused methods are taught in medical programs worldwide.

Future advancements in longevity medicine will be driven by cutting-edge research and global collaboration. One initiative driving the advancement of longevity medicine through research and global collaboration is IIOL's effort to establish a cooperative platform for clinics to conduct joint research using anonymized data. Since the longevity clinics utilize similar biomarkers, this initiative offers an opportunity for large-scale data collection. By harnessing this data, we can deepen our understanding of longevity medicine diagnostics and interventions, paving the way for more evidence-based approaches.

Future advancements in longevity medicine will also be increasingly driven by artificial intelligence and big data, which are poised to revolutionize the field. Multi-agent AI systems, digital twins, and large language models (LLMs) will enable personalized, proactive, and efficient healthcare solutions. These technologies can analyze individual client data, creating actionable insights for physicians and patients/clients. As AI democratizes healthcare, it will shift the focus from disease management to wellness and prevention, bringing the Fourth Industrial Revolution's promise of data-driven health. By reducing the complexity of what needs to be treated, multi-omics and systems-driven data health will streamline diagnostics and interventions, making them more precise and effective.

A year ago, we identified multi-omics and digital twins as key emerging innovations in the space of longevity medicine. While these solutions are still in their early stages and not yet widely adopted, a growing number of longevity clinics are beginning to integrate them into personalized care strategies.

The adoption of multi-omics diagnostics is expected to become more prevalent in longevity clinics. The integration of genomics, transcriptomics, proteomics, and metabolomics will provide deeper insights into aging biology, enabling more precise and personalized interventions. Multi-omics is also a crucial component of digital twin technology in healthcare and longevity medicine. Multi-omics by integrating data from various biological layers is an important component in comprehensive digital representation of an individual's health.

One of the pioneers in digital twin technology is Fountain Life [19], co-founded by Dr. Peter Diamandis and Tony Robbins. By utilizing digital twin models, Fountain Life can simulate client care pathways, optimize resource allocation, and predict health outcomes, ultimately improving diagnostics and treatment precision. As this technology proves its value, it is highly likely that more clinics will adopt digital twin models, leveraging advanced simulations to revolutionize diagnostics, treatment planning, and longevity strategies.

Key Learnings

1. Standardization and Regulation

- Longevity Medicine is based on preventive medicine but is lacking formal standards for diagnostics, interventions, and qualifications.

- IIOL and HLM are currently developing recommendations to support the establishment of such standards.

- There is a need for standardized biomarkers, protocols, and formalized training.

- Abu Dhabi launched the world's first licensing framework for longevity clinics, setting a precedent for regulatory approval.

2. Best Practices Implemented by the Majority of Longevity Clinics

- Longevity clinics develop and continuously refine evidence-based protocols that align with scientific research, ethical standards, and regulatory guidelines, integrating multidisciplinary expertise, remote monitoring, and client-centered care to ensure credibility and effectiveness.

- Longevity clinics utilize advanced diagnostics, including biomarkers, genetic testing, AI-driven imaging, and wearables, to enable early detection of aging-related risks and develop highly personalized health optimization plans.

- Longevity clinics implement personalized, evidence-based interventions, including early prevention, geroprotective therapies, precision nutrition, and lifestyle optimization, continuously adjusting treatment plans based on real-time data and client progress.

- Longevity clinics collaborate with researchers, industry leaders, and regulators, engaging in data sharing, clinical trials, and policy advocacy to advance best practices, drive innovation, and establish longevity medicine as a recognized medical discipline.

- As the number of clinics offering longevity-focused services continues to grow, there is an increasing need for global best practices and standardization. This is essential to minimize reputational risks posed by unqualified or fringe operators entering the market. A survey conducted by International Institute of Longevity (IIOL) prior to the roundtable with leading clinics found the following:

  - 57% of respondents consider the development of international industry standards and best practices for longevity clinics very important, and 43% consider it important.

    - ▷ Top priorities identified:
      - ▶ Patient/client care and safety protocols
      - ▶ Ethical principles and guidelines
      - ▶ Business model innovation
      - ▶ Technology standards

- 85% agree on the need for internationally recognized policies and regulations to support the growth of longevity clinics.

  ▷ Top 3 priority areas:
    ▶ Systemic shift toward prevention, including business model innovation
    ▶ Government regulation, e.g., data standards harmonization and anti-aging therapeutics
    ▶ Medical training and certification

- 71% are interested in participating in collaborative research projects facilitated by the IIOL.

  ▷ Top research priorities:
    ▶ Biomarker prioritization, validation, and consensus
    ▶ Development of personalized health and medicine protocols
    ▶ Design and implementation of human clinical trials, including decentralized digital trials

- 100% of respondents find internationally certified training programs valuable

  ▷ Key training needs:
    ▶ Operational excellence in longevity clinic management
    ▶ Personalized medicine approaches
    ▶ Advanced diagnostics and biomarker analysis
    ▶ Integration of data, AI, and genomics/omics into clinical practice

3. Longevity Diagnostics and Interventions

- The field needs a clear definition of optimal health to establish a personalized health benchmark; without it, there is no well-defined goal for interventions.

- Longevity diagnostics should be able to determine where aging occurs and its underlying causes.

- Biological age biomarkers, AI-driven diagnostics, and multi-omics approaches are improving personalized longevity care.

- Diagnostics and interventions should incorporate brain health. There is growing interest in brain health and mental and emotional resilience. Many clinics now offer some of the latest technologies in brain imaging and stimulation to enhance cognitive function and reduce the risk of neurodegenerative conditions. During the conference, emerging trends and research on the impact of music, vibration technologies, light therapies, and lifestyle interventions on the hallmarks of aging were explored.

- Spiritual practices such as meditation and emotional regulation techniques can help embrace a positive outlook on one's health.

- Skin longevity is often overlooked in longevity medicine, yet it should be integrated into both diagnostics and interventions.

- AI and digital twin models are emerging as powerful tools for predicting health outcomes and optimizing treatment pathways.

- New longevity interventions such as senolytics, regenerative therapies, and AI-driven precision

medicine are being tested for clinical applications.

- Numerous novel interventions are emerging, with over 85 clinical studies on gerotherapeutic interventions underway as of early 2025.

4. Challenges in Longevity Medicine Implementation

- Lack of validated biomarkers hinders accurate assessment, makes it difficult to measure intervention effectiveness and gain regulatory approval.

- High diagnostic and intervention costs limit accessibility, with only 30% of clinics able to claim insurance for longevity treatments.

- The absence of established best practices, standards, and guidelines results in a lack of clear definition for longevity clinics, leading to lower credibility and public confusion about their offerings.

- There is a lack of standardized protocols for longevity clinics to follow.

- There is a shortage of trained longevity medicine specialists and a limited availability of educational programs in the field.

5. Female Longevity

- Women's health is significantly under-researched, particularly in areas like ovarian aging, which affects overall aging processes.

- Less than 2% of therapeutics research focuses on non-cancer-related female health conditions, highlighting a critical gap in longevity science.

6. The Future of Longevity Medicine Is Tied to AI, Big Data, and Public Health Integration

- Democratizing longevity medicine will require insurance coverage, integration into public healthcare, and cost-effective diagnostic solutions.

- Public and workplace incentive programs may contribute to driving policy change.

- Public engagement, misinformation control, and government collaboration are necessary to legitimize longevity medicine as a medical field.

- The field is actively working to develop educational training and certification programs and integrate them into university curricula.

- AI and multi-omics-driven longevity diagnostics will be essential for personalizing treatments and reducing costs in longevity medicine.

Key Recommendations

1. Development and Implementation of Standardized Guidelines for Longevity Clinics

- Longevity clinics should collaborate to develop standardized best practices and clinical protocols to ensure consistency and credibility.

- Longevity medicine professionals should co-create structured training programs to equip longevity medicine practitioners with evidence-based knowledge and address knowledge gaps.

- Longevity clinics should use science-backed, high-quality diagnostic tools and evidence-based interventions.

2. Collaboration and Data Sharing

- Anonymized data sharing among longevity clinics should be promoted to accelerate research and improve client outcomes.

- The integration of AI-powered diagnostics and client monitoring should be encouraged for precision interventions.

- Partnerships with research institutions, regulators, and biotech firms should be strengthened to advance longevity-focused healthcare.

3. Access and Cost of Longevity Medicine Services

- The field should explore innovative approaches to integrating longevity medicine into public healthcare systems, such as implementing longevity diagnostics in public hospitals.

- The field should collaborate with key stakeholders, including policymakers and insurance companies, to facilitate regulatory approval and integration into public healthcare systems.

- Affordable, scalable interventions should be developed, prioritizing lifestyle-based, cost-effective solutions over expensive treatments.

- Longevity programs tailored to women's unique aging trajectories and health needs should be developed.

4. AI, Big Data, and Digital Twin Technology

- The adoption of AI-driven diagnostics, digital twins, and predictive health modeling in longevity clinics should be encouraged.

- Multi-omics data integration should be used to create highly personalized health optimization plans.

5. Public Awareness and Policy Change

- Clinics should advocate for aging to be recognized by regulatory bodies as the primary modifiable risk factor for most chronic diseases.

- Governments, insurers, and employers should be engaged to support longevity-focused healthcare incentives.

- Science-backed public education should be promoted to counter misinformation and establish longevity medicine as a credible field.

6. Incorporate a Customer Experience Approach

- As the marketplace becomes crowded and clinics compete for 'clients' (as opposed to 'patients'), there is growing attention to the best models for client engagement and long-term motivation. Sustained behavior change and consistent adoption of clinical recommendations are essential for the success of longevity programs. Motivation strategies and incentive models could be the key to maintaining long-term client commitment, ensuring adherence to personalized protocols, and supporting lasting health outcomes.

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