Thermal Health Resorts as Settings for Early Frailty Detection and Healthy Longevity in water to data

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UNIVERSIDAD COMPLUTENSE DE MADRID

THE 77TH ANNUAL FEMTEC SCIENTIFIC CONGRESS AND GENERAL ASSEMBLY

Balneology and Cutting-Edge Technologies: Shaping the Road to 2034

Why Thermal Health Resorts?

The strategic opportunity for preventive healthcare in independent older adults.



The Population

Target audience consists of functionally independent older adults who remain active but may harbour hidden early signs of functional vulnerability and physiological decline.



The Environment

Immersive, residential stays of 10–15 days provide an unparalleled window for continuous observation, controlled routines, and active participation compared to standard outpatient visits.



The Opportunity

Integration of balneotherapy, therapeutic exercise, and nutrition allows for comprehensive multidisciplinary functional screening and immediate personalized intervention.

Frailty: The Hidden Clinical Challenge

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The Reversible Window

Optimal stage for multicomponent interventions to prevent disability.



Robust

0 Fried Criteria.
High physiological reserve.

Pre-Frail

1–2 Fried Criteria.
Early loss of physiological reserve.

Frail

≥3 Fried Criteria.
High vulnerability to stressors, increased risk of falls, dependency, and mortality.

Balneario de Cofrentes: A Clinical & Research Ecosystem

Valencia, Spain



Clinical Assessment
(Medical Hydrology & Gerontology)

Therapeutic Exercise
(Dry and Aquatic)

Balneotherapy
(Mineral-medicinal waters)

Scientific Research & Innovation

Nutrition & Lifestyle

Four Projects, One Shared Vision

Advancing from traditional assessment to AI-driven personalization.

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Focus: Current Baseline → Future Capability

Domain: Clinical Assessment ↔ Technological Innovation

INSIDE U

Identifying baseline functional vulnerability and fall risk in active populations.

SALUD SENIOR 6P

Characterizing multidimensional frailty and sex-specific biological factors.

AQUAFRAIL

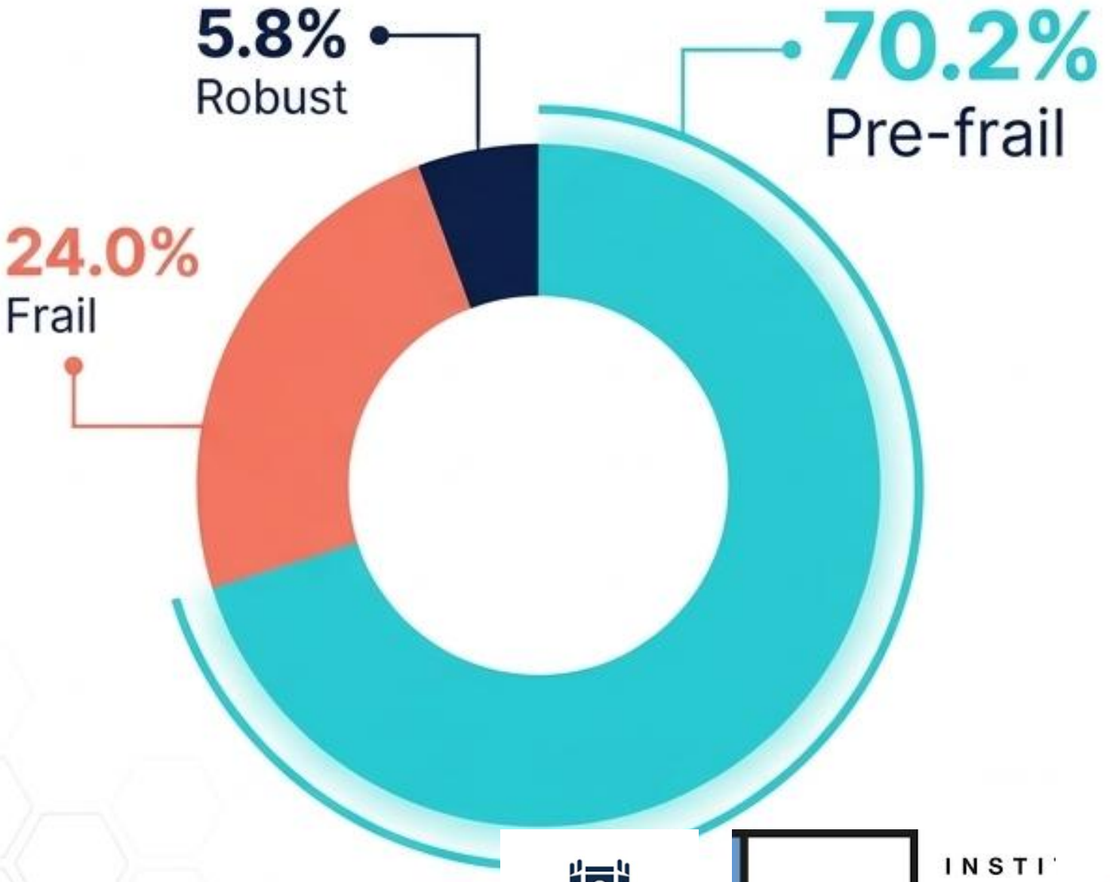
Investigating artificial intelligence-based aquatic gait as a digital biomarker.

LONGEV.IA

Developing AI decision-support systems to optimize personalized longevity protocols.

INSIDE U: Detecting Hidden Vulnerability

Observational research | n = 104 adults (≥60 years)



48.1%
Gait speed below 0.8 m/s (Slowness).

42.3%
Timed Up and Go > 12 seconds (Mobility limitation).



98.1%
Below reference values in Sit-to-Stand Test (Lower limb weakness).

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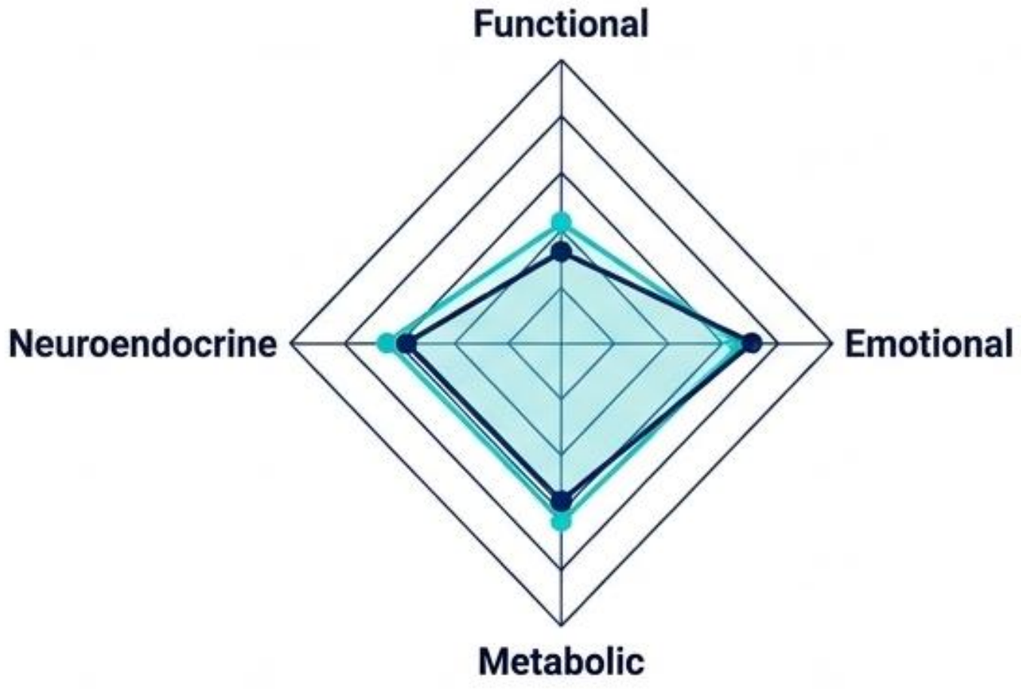
IVACE
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Key Insight: Even older adults participating in active health programmes harbour substantial, undetected functional vulnerabi

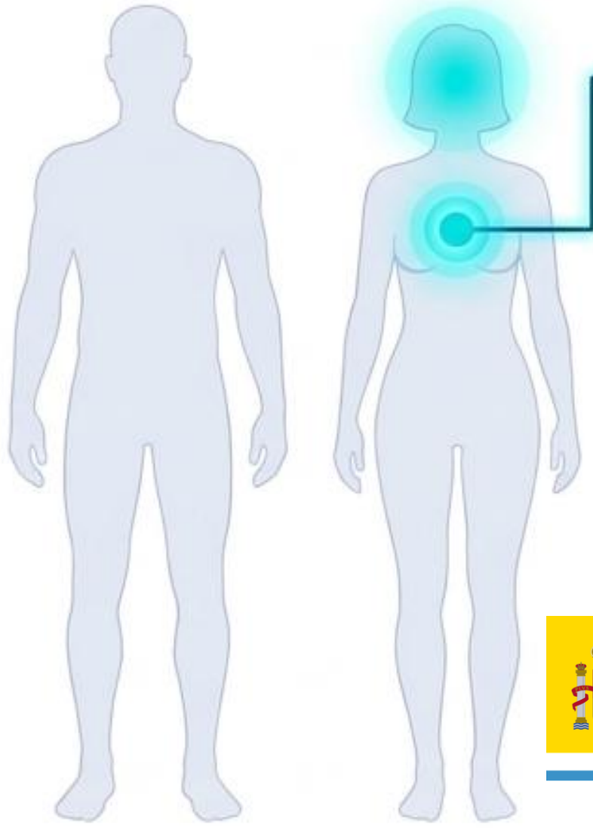
Salud Senior 6P: Multidimensional Assessment

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CDTI-funded Science & Innovation Missions (MIG-20241038) | Observational cohort | n = 286 adults (≥65 years). Overall Prevalence: **64.3% Pre-frail** | **6.6% Frail.**



Functional: Reduced upper- and lower-limb strength endurance strongly associated with frailty status (OR=0.52).



Sex-Specific Patterns (Female): Exhaustion significantly more frequent (31.1% vs 12.3%, OR=3.22); higher capillary cortisol concentrations.

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CDTI

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Key Insight: Frailty requires a multidimensional assessment considering functional, emotional, metabolic, and neuroendocrine factors, with distinct expressions based on sex.

Observational findings. Causality not claimed.

AQUAFRAIL: From Aquatic Movement to Digital Biomarkers

Collaborative research protocol with Complutense University of Madrid.



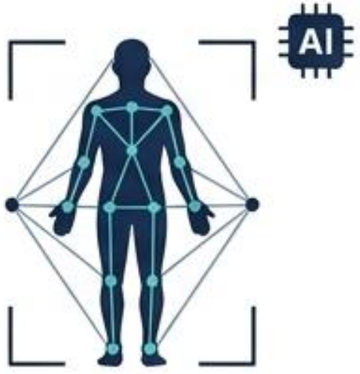
1. Aquatic Gait

Functional assessment of adults ≥65 walking in thermal water (vs. land-based comparison).



2. Video Capture

Standardized recording analyzing speed, cadence, step length, joint movement, stability, and symmetry.



3. AI Processing

Computer vision translates kinematics into data without wearable sensors.



4. Clinical Output

Proposed development of AquaGait-65 model and Aqua-Frailty Score, correlating with Fried phenotype, SPPB, and TUG.

Research protocol in development. Proposed AI models and scores are exploratory and not yet validated diagnostic instruments.

LONGEV.IA: AI for Personalized Longevity

Optimizing 10–15 day immersive healthcare environments.

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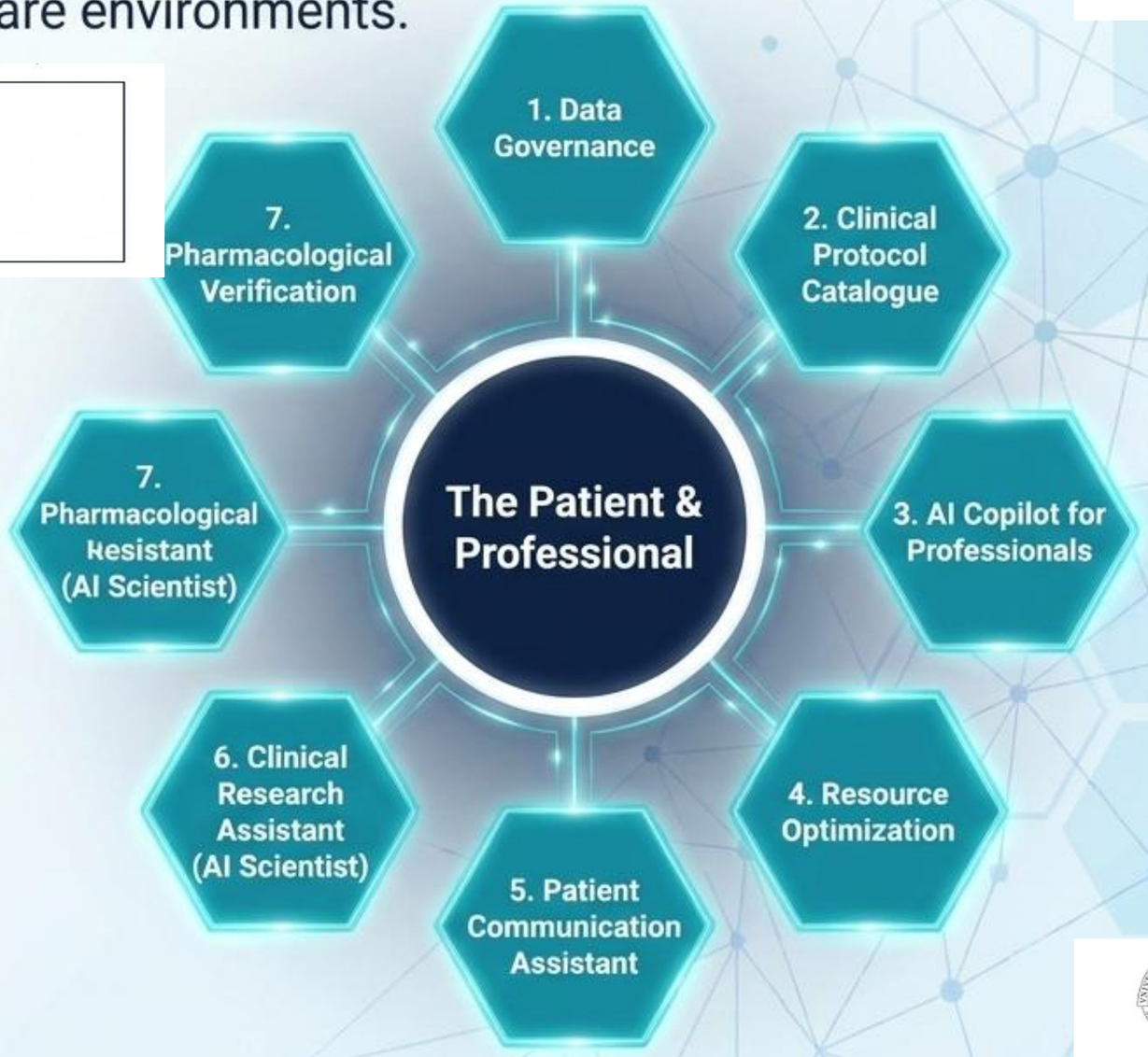
LONGEV.IA Project Funding (Ref: 2025/0625/00297084)

FEDER Fondo Europeo de Desarrollo Regional · European Union · Gobierno de España · Ministerio de Asuntos Económicos y Transformación Digital · red.es · RedIA Salud

Project Meta-Data:
Red.es (RedSaludAI 2025) co-funded by FEDER
Budget: €1,125,195 | Duration: 24 months

UCM Role:
Study design, analysis validation, protocol review, scientific publication.

Project systems represent developmental objectives, not fully validated clinical outcomes.



Four Complementary Projects, One Clinical Vision

Proposing a unified pathway for healthy longevity.

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Screening (INSIDE U)

Identifying baseline functional vulnerability.

Multidimensional Assessment (Salud Senior 6P)

Characterizing biological, emotional, and sex-specific frailty.

Digital Biomarkers (AQUAFRAIL)

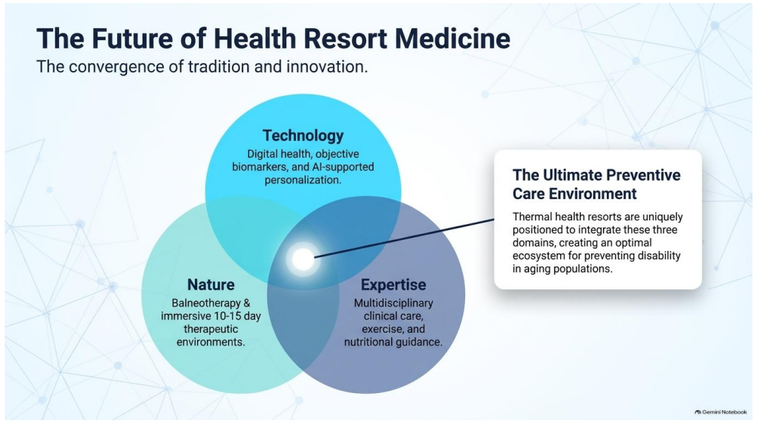
Utilizing AI aquatic gait analysis for objective measurement.

Personalized Intervention (LONGEV.IA)

Deploying AI decision-support for optimized follow-up and care.

Note: This represents a proposed integrated clinical vision, not an already validated unified system.

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Scientific Conclusions

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1

Thermal health resorts offer high-value, immersive opportunities for the early detection of pre-frailty in independent older adults.

2

Integrating comprehensive functional assessment and clinical research fundamentally strengthens preventive longevity programmes.

3

Artificial Intelligence can support future care personalization, provided these technological tools undergo rigorous clinical validation.

"Thermal health resorts can evolve from therapeutic destinations into integrated environments for early frailty detection, preventive care, clinical research and AI-supported healthy longevity."

Merci Beaucoup

Thank you very much