XVIII CURSO ALMA PARA DOCENTES UNIVERSITARIOS DE GERIATRÍA

"GERONTOTECNOLOGÍA"

RÍO DE JANEIRO, BRASIL

Del 31 de octubre al 3 de noviembre de 2019

La atención a las personas mayores: ¿cuál es el rol de las nuevas tecnologías?

Prof. Leocadio Rodríguez-Mañas
Jefe del Servicio de Geriatría
Hospital Universitario de Getafe, Madrid-España
Director Científico de CIBERfes

FUNDING

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AGEING-LAB
"Salgado Alba"

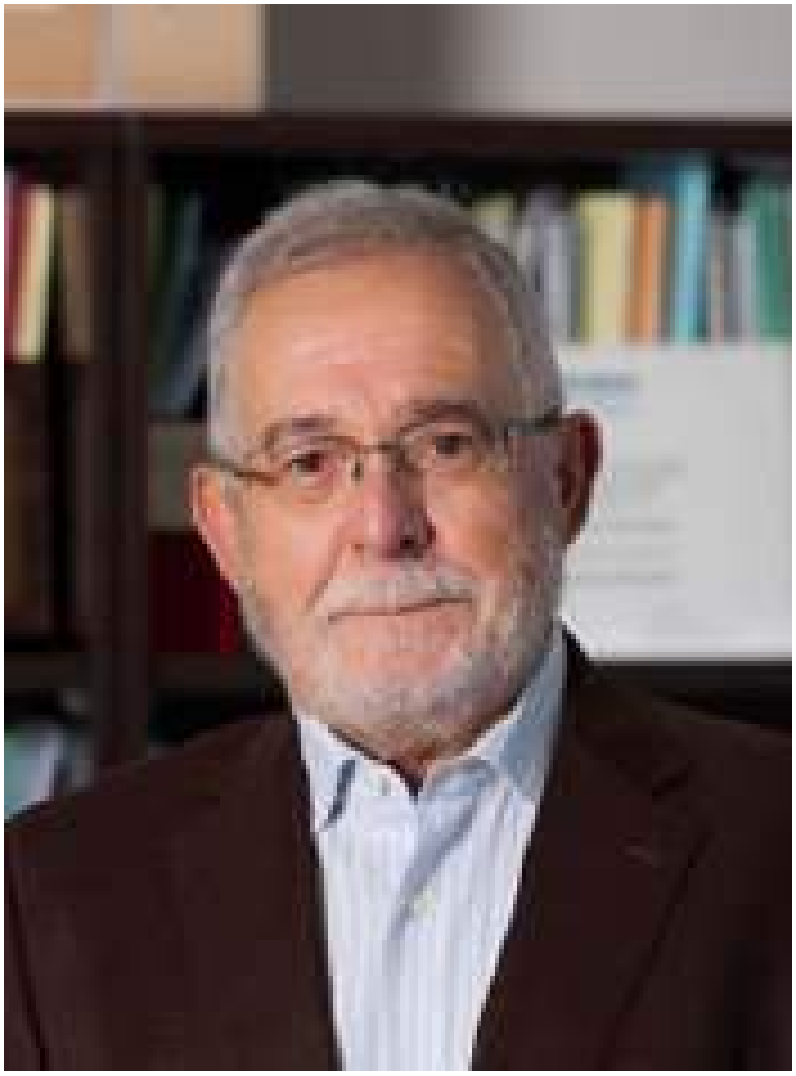
CTB center for biomedical technology

IN MEMORIAM

POLITÉCNICA "Engineering the future"

INTERNATIONAL CAMPUS OF EXCELLENCE





Prof. Francisco del Pozo

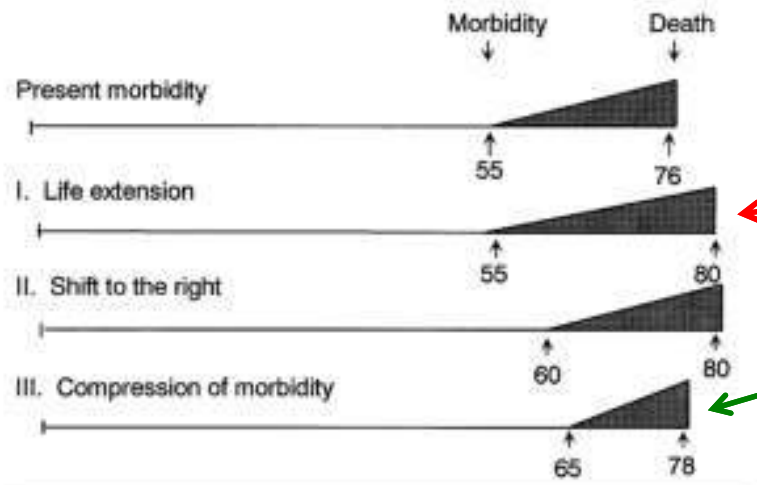


Figure 1. Possible scenarios for future morbidity and longevity. Present lifetime morbidity, portrayed as the shaded area, contrasted with three possible future scenarios. See text for discussion.

Fries JF. Ann Intern Med 2003:139: 455-459

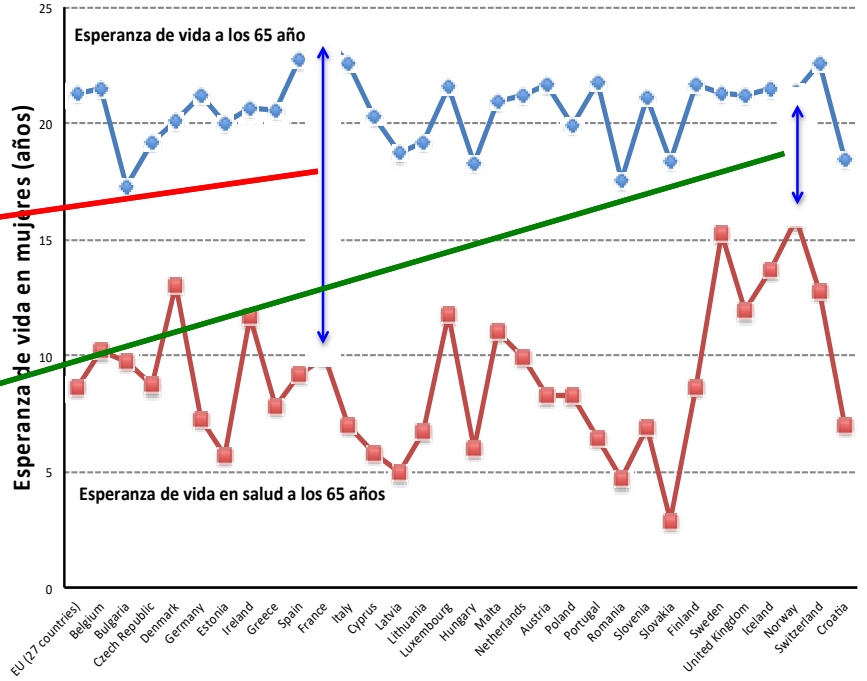


Fig 7

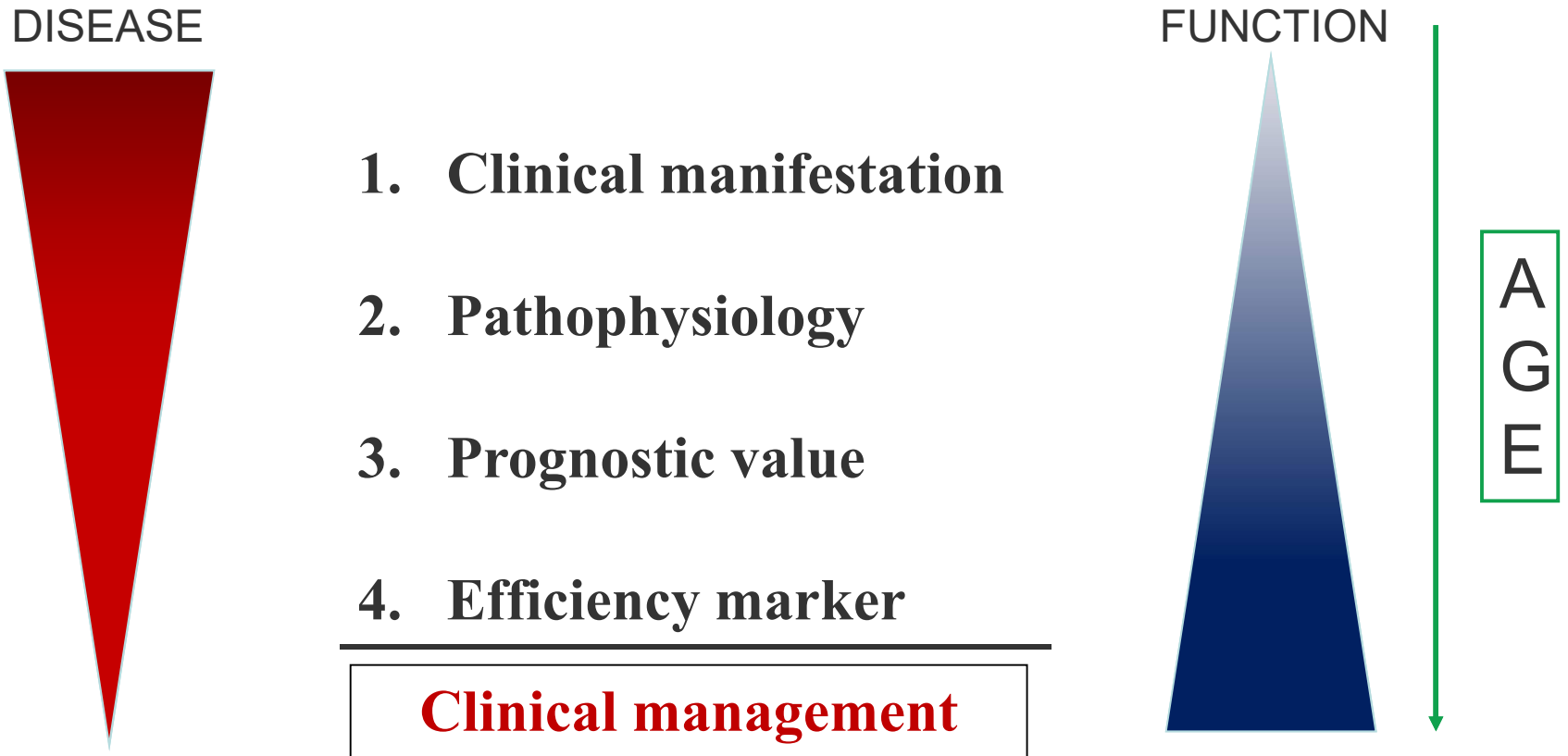
Fuente:Jagger y cols (EHLEIS team) 2008

The challenge for modern societies

Hospital Universitario de Getafe
Comunidad de Madrid

fundación para la Investigación Biomédica Hospital Universitario de Getafe

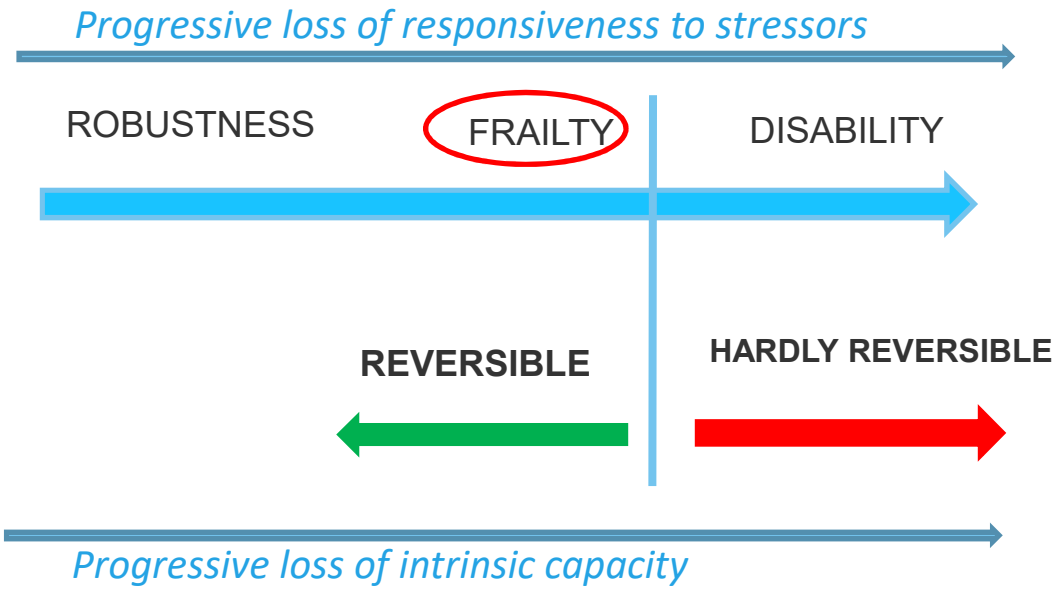
From disease to function



1. **Clinical manifestation**
2. **Pathophysiology**
3. **Prognostic value**
4. **Efficiency marker**

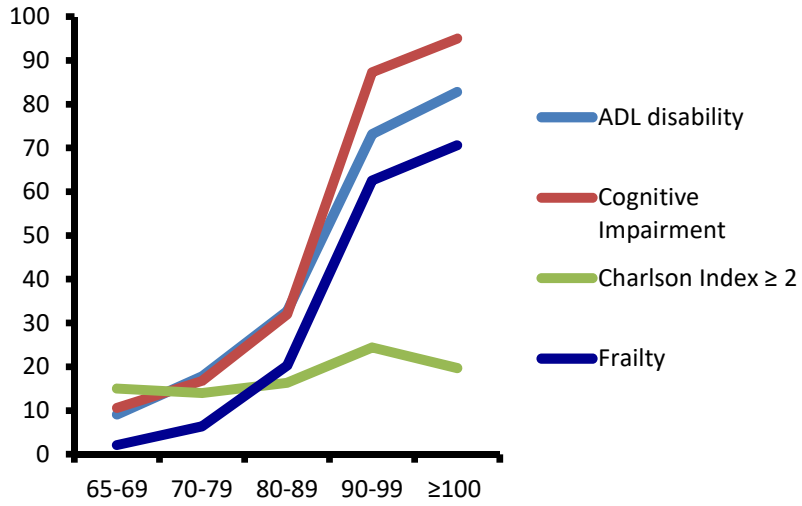
Clinical management
TOTALLY DIFFERENT

FRAILTY SYNDROME

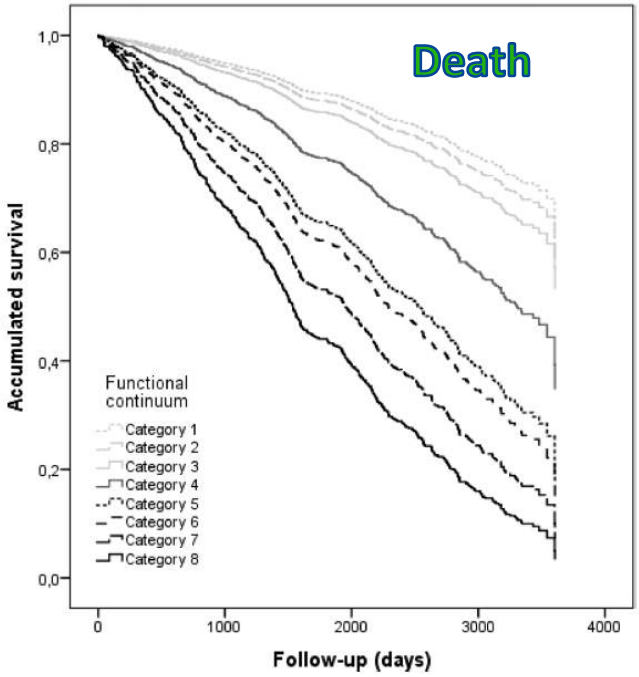


Ferrucci et al., 2002; Gill, Gahbauer, Allore, & Han, 2006; Strandberg & Pitkala, 2007; Xue, 2011; Pahor et al., 2014, Rodriguez-Mañas & Fried., 2015, WHO, 2015

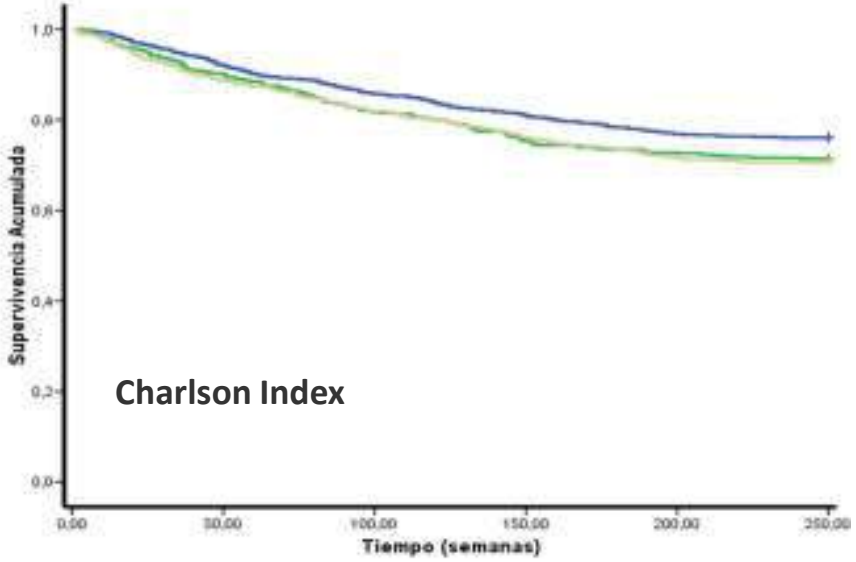
Toledo Study for Healthy Aging

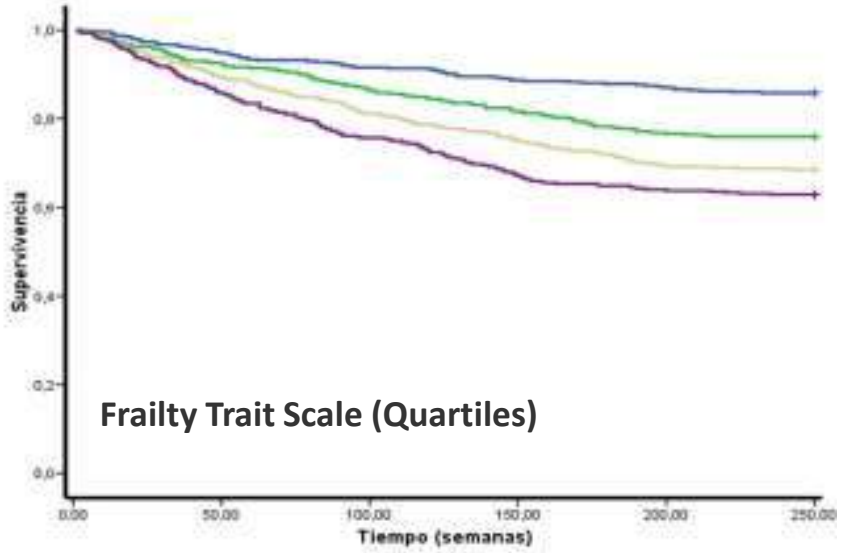


Hoogendijk et al 2019

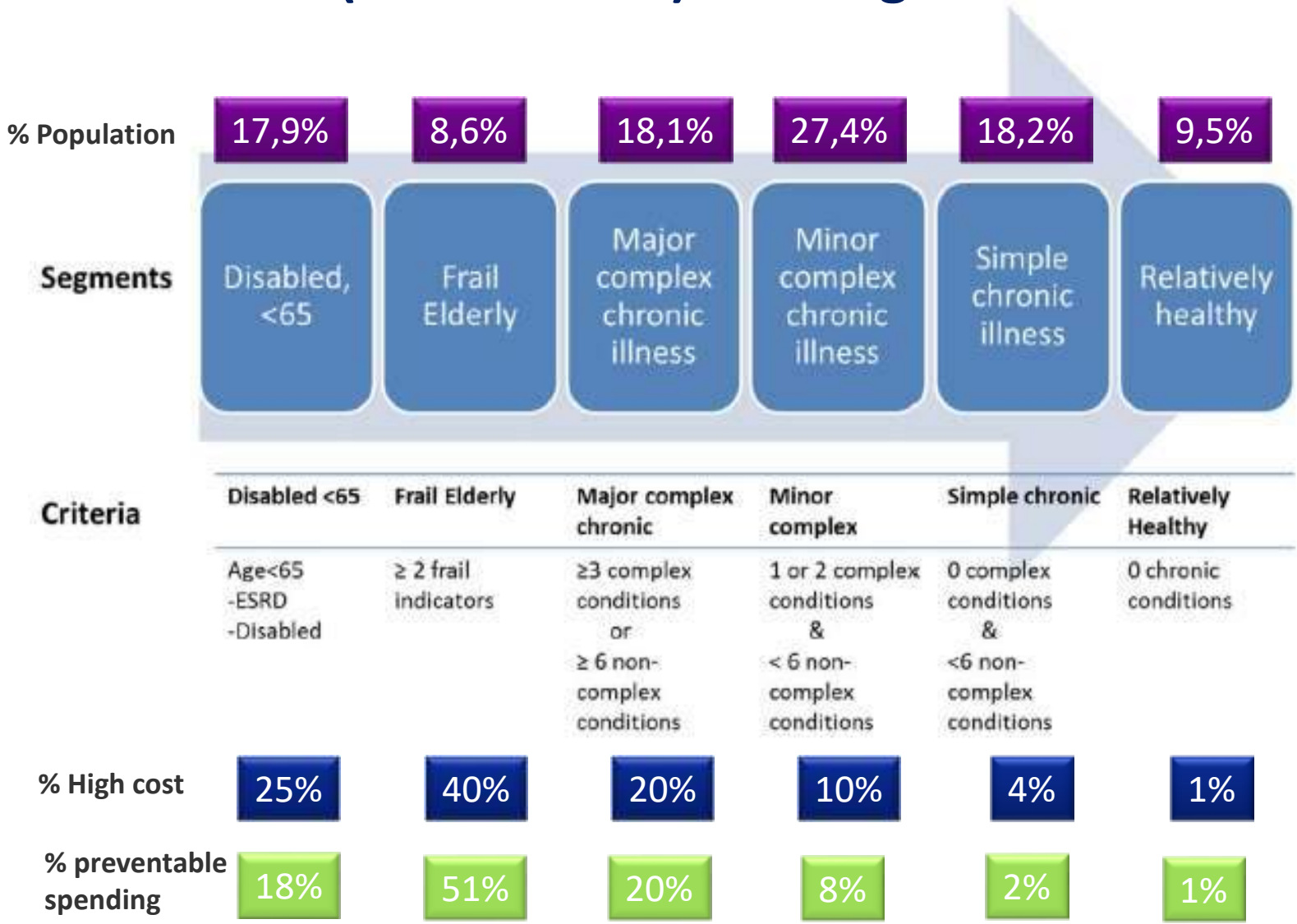


Toledo Study for Healthy Aging– First hospitalization





Health-care costs 2012: Medicare (n=6.112.450) 10% Higher cost



Joint KE. BMC Healthcare 2017; 5: 62-7

Figueroa JF. Ann Intern Med 2017; 167: 706-13

TITLE: THE THIRD TRANSITION – the Clinical Evolution oriented to the Contemporary Older Patient



Authors and affiliation

Leocadio Rodriguez-Mañas, MD, PhD
Service of Geriatrics, Getafe University Hospital, Madrid, Spain

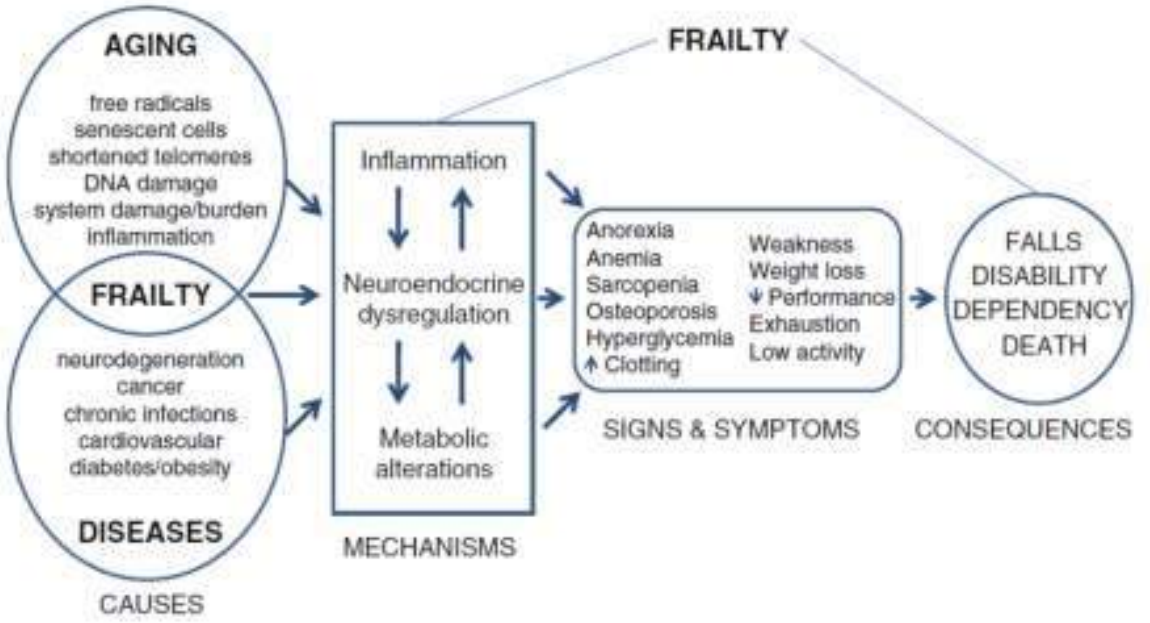
Fernando Rodríguez-Artalejo, MD, PhD
Department of Preventive Medicine and Public Health, Universidad Autónoma de Madrid/IdiPaz and CIBERESP, Madrid, Spain.

Alan J Sinclair, MD, PhD
Diabetes Frail Ltd, UK and University of Aston, UK

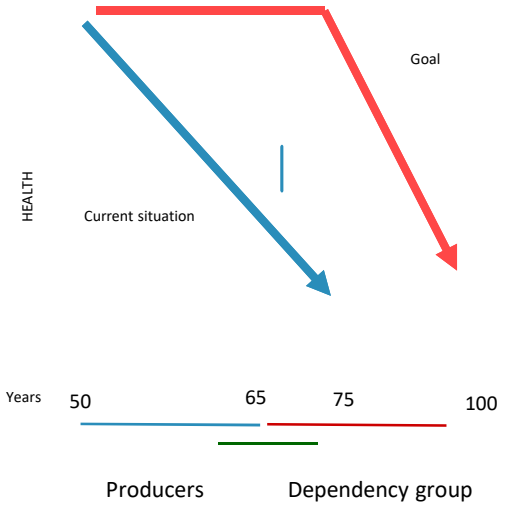
JAMDA, 2017

DEMOGRAPHIC TRANSITION → **EPIDEMIOLOGIC TRANSITION** → **CLINICAL TRANSITION**

Frailty: an age associated, biological syndrome characterized by decreased biological reserves, due to deregulation of several physiological systems, which puts an individual at risk when facing minor stressors, and is associated with poor outcomes.

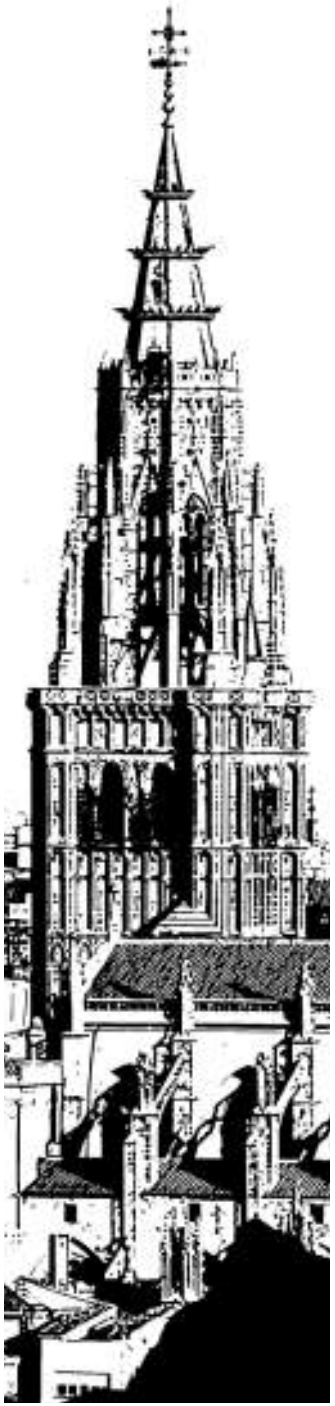


Source: Fulop et al., 2010

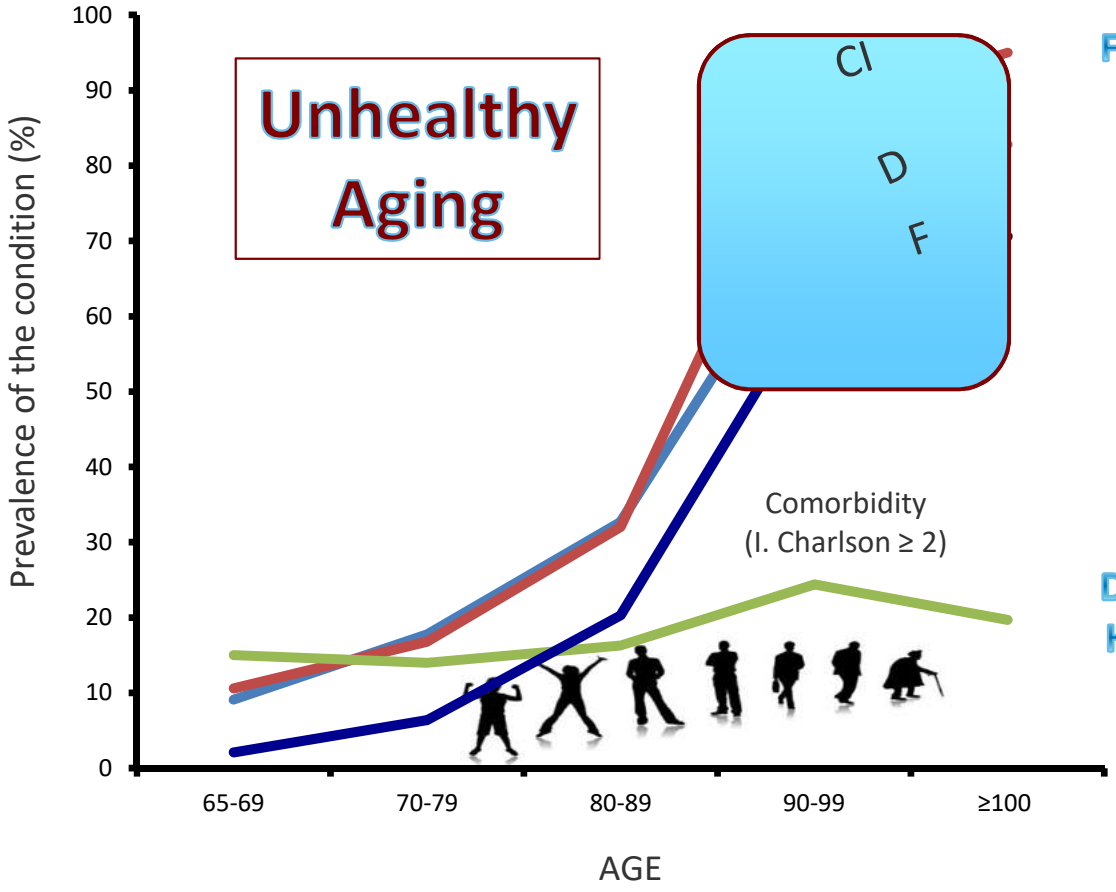


Reducing the gap between living longer and live healthy

Frailty: A socio-economic challenge in need of efficient technology solutions



TSHA
TSHA-Plus



Function-centered Health programs

Disease-centered Health programs

ESTUDIO TOLEDO ENVEJECIMIENTO SALUDABLE

TOLEDO STUDY FOR HEALTHY AGING

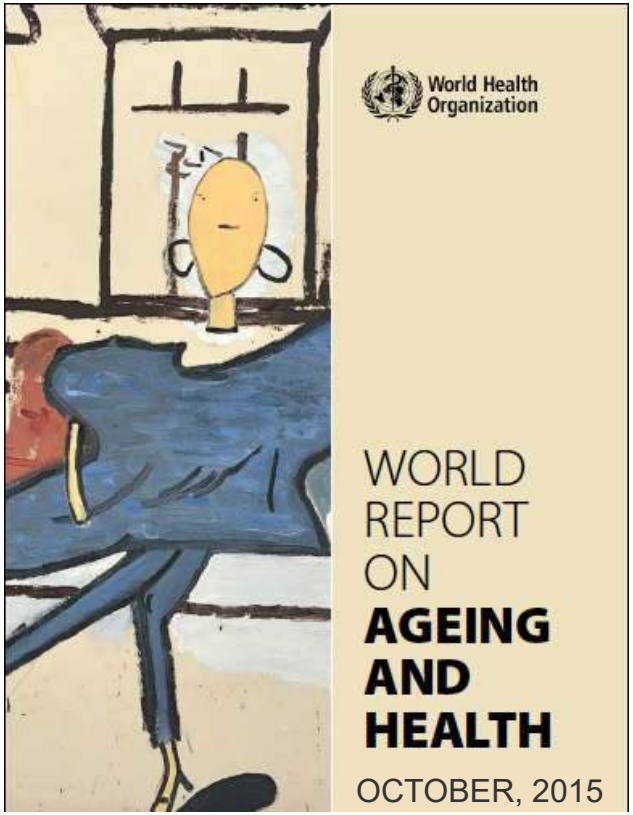


Fig. 2.1. *Healthy Ageing*

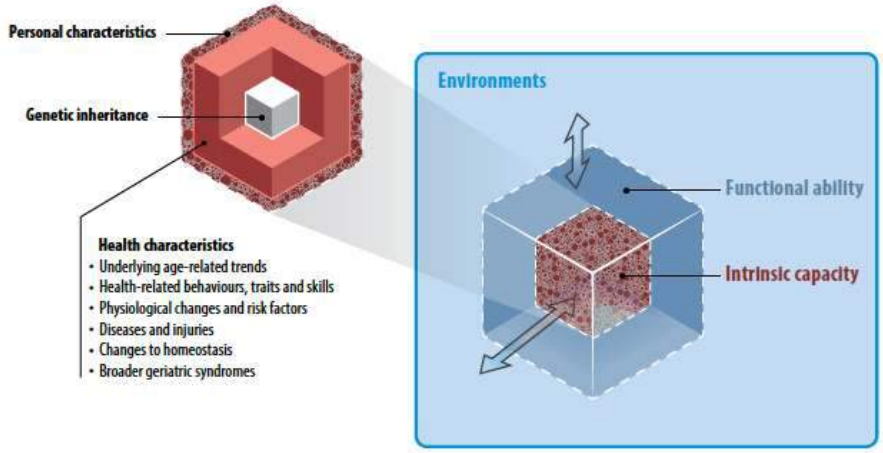


Fig. 2.4. **A public-health framework for *Healthy Ageing*: opportunities for public-health action across the life course**

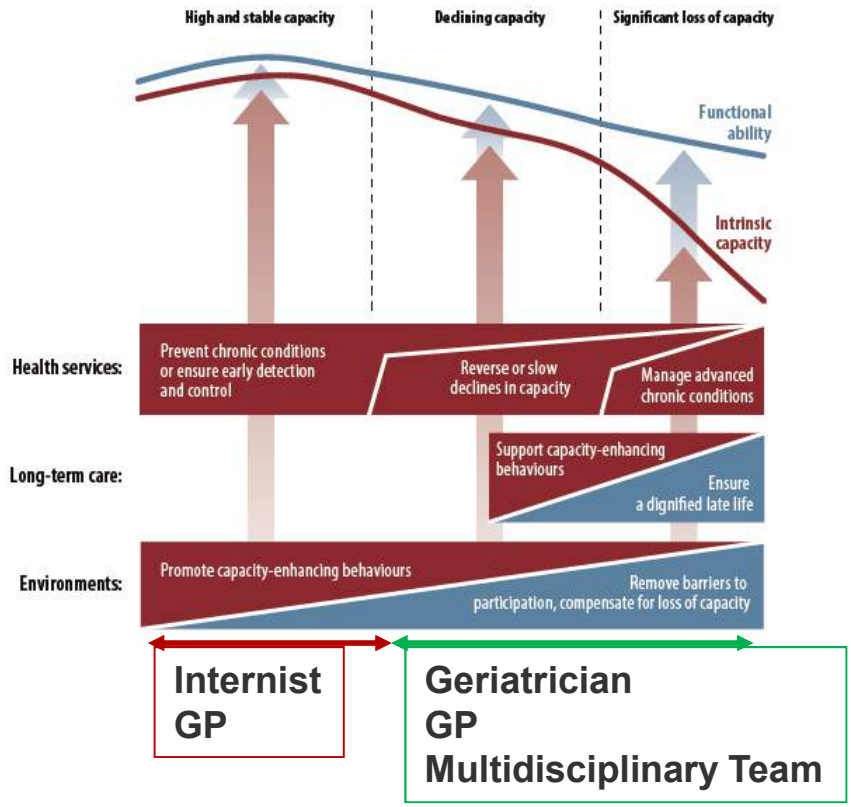
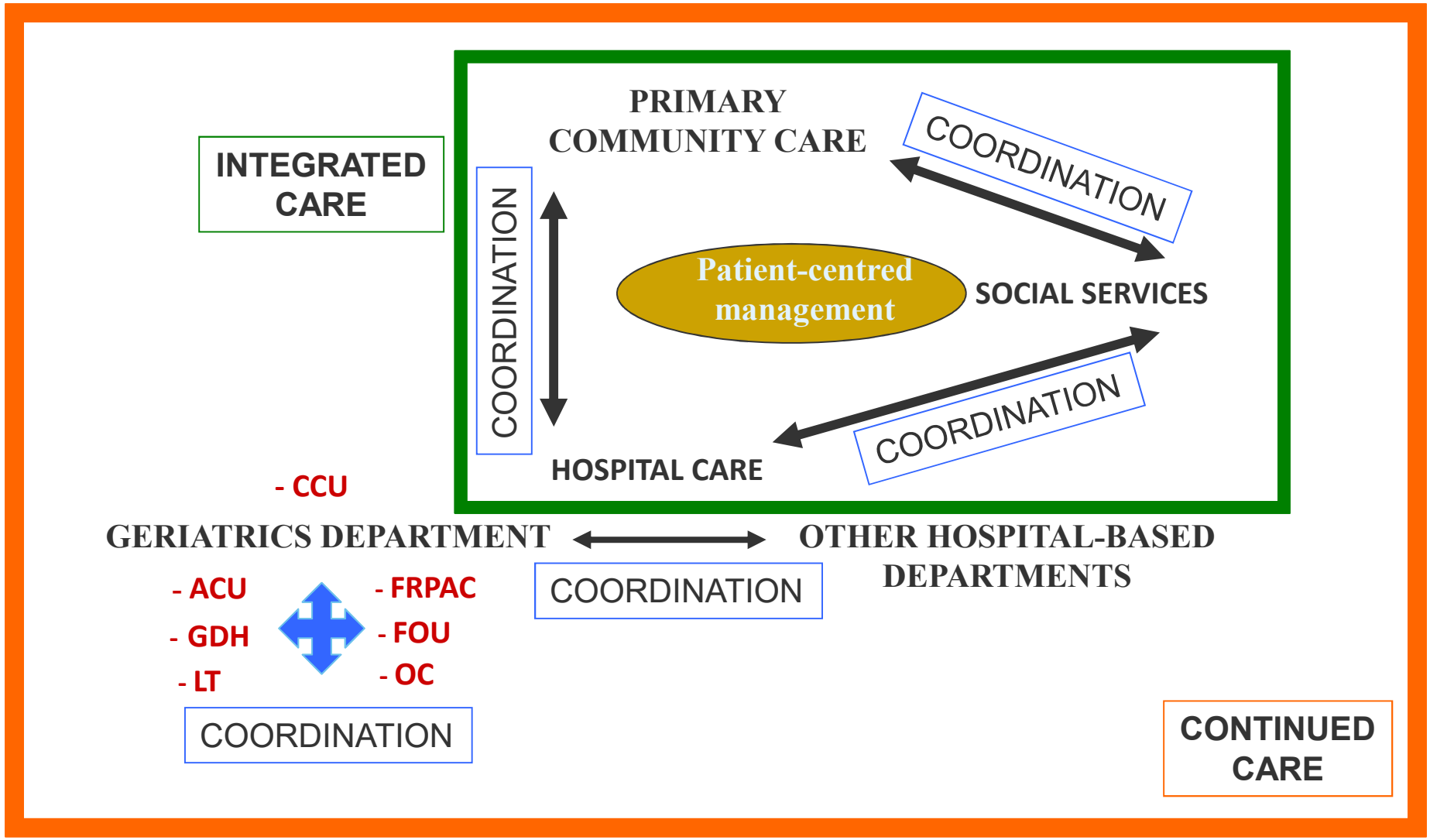


Table 4.3. **Conventional care versus older-person-centred and integrated care**

Conventional care	Older-person-centred and integrated care
Focuses on a health condition (or conditions)	Focuses on people and their goals
Goal is disease management or cure	Goal is maximizing intrinsic capacity
Older person is regarded as a passive recipient of care	Older person is an active participant in care planning and self-management
Care is fragmented across conditions, health workers, settings and life course	Care is integrated across conditions, health workers, settings and life course
Links with health care and long-term care are limited or non-existent	Links with health care and long-term care exist and are strong
Ageing is considered to be a pathological state	Ageing is considered to be a normal and valued part of the life course



ACU: Acue Care Unit ; FRPAC: Functional Recovery Post-Acute Care; FOU: Falls and Orthogeriatric Unit; GDH: Geriatric Day Hospital; LT: Liaision Team; OC: Outpatien Clinic; CCU: Community Care Unit

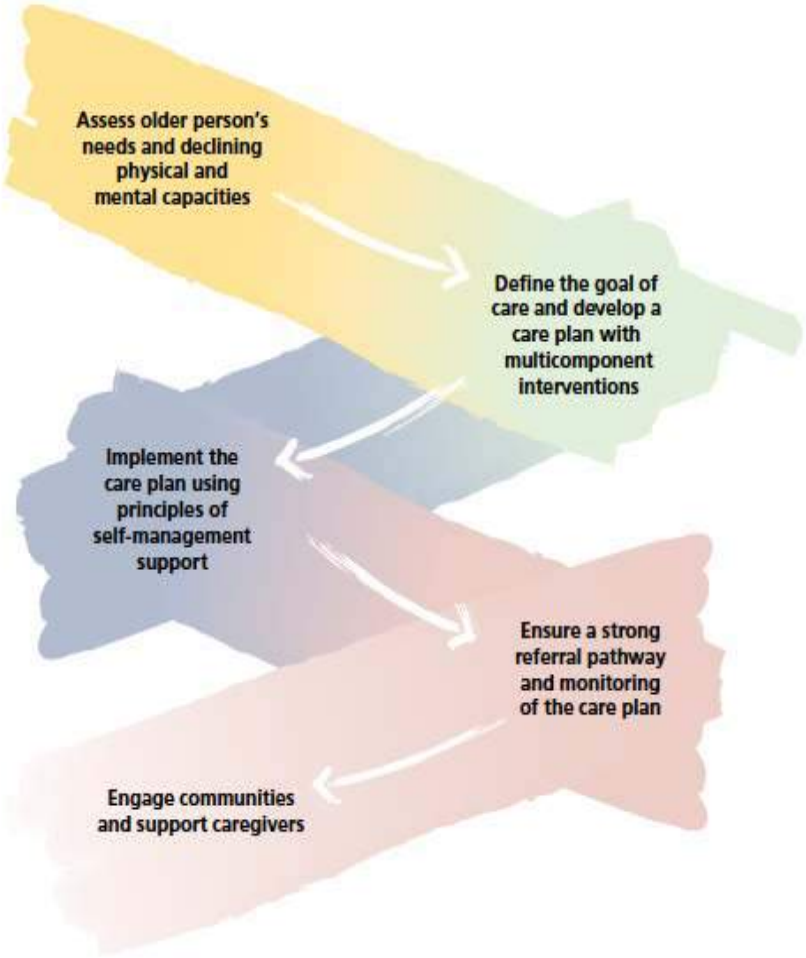
OCTOBER, 2017

Integrated care for older people

Guidelines on community-level interventions to manage declines in intrinsic capacity

World Health Organization

Fig. 2: Delivering ICOPE in an integrated way



Some general objectives of the technology to care of frailty people

Ubiquitous and continuous management of frail older adults and older at risk as well, their chronic diseases and their changing needs, promoting their empowerment and autonomy preservation

Provide the artificial intelligence tools (big data and analytics) to achieve personalized care and aggregated-data-based clinical guides and diagnostic aids

Optimize the cooperative work of health professionals, within the coordination network with patients, informal careers and related services, providing the communication, information processing, education, motivation and change management services

Contribute to the definition of cost-efficient and sustainable care models for this large and rapidly increasing frail community

Avoid well documented past mistakes: I. the Telemedicine (e-Health, TIC-health) nightmare

After many decades and thousand of experiences in the world we can not speak of a significant impact of this technologies in the health care models, away from administrative services

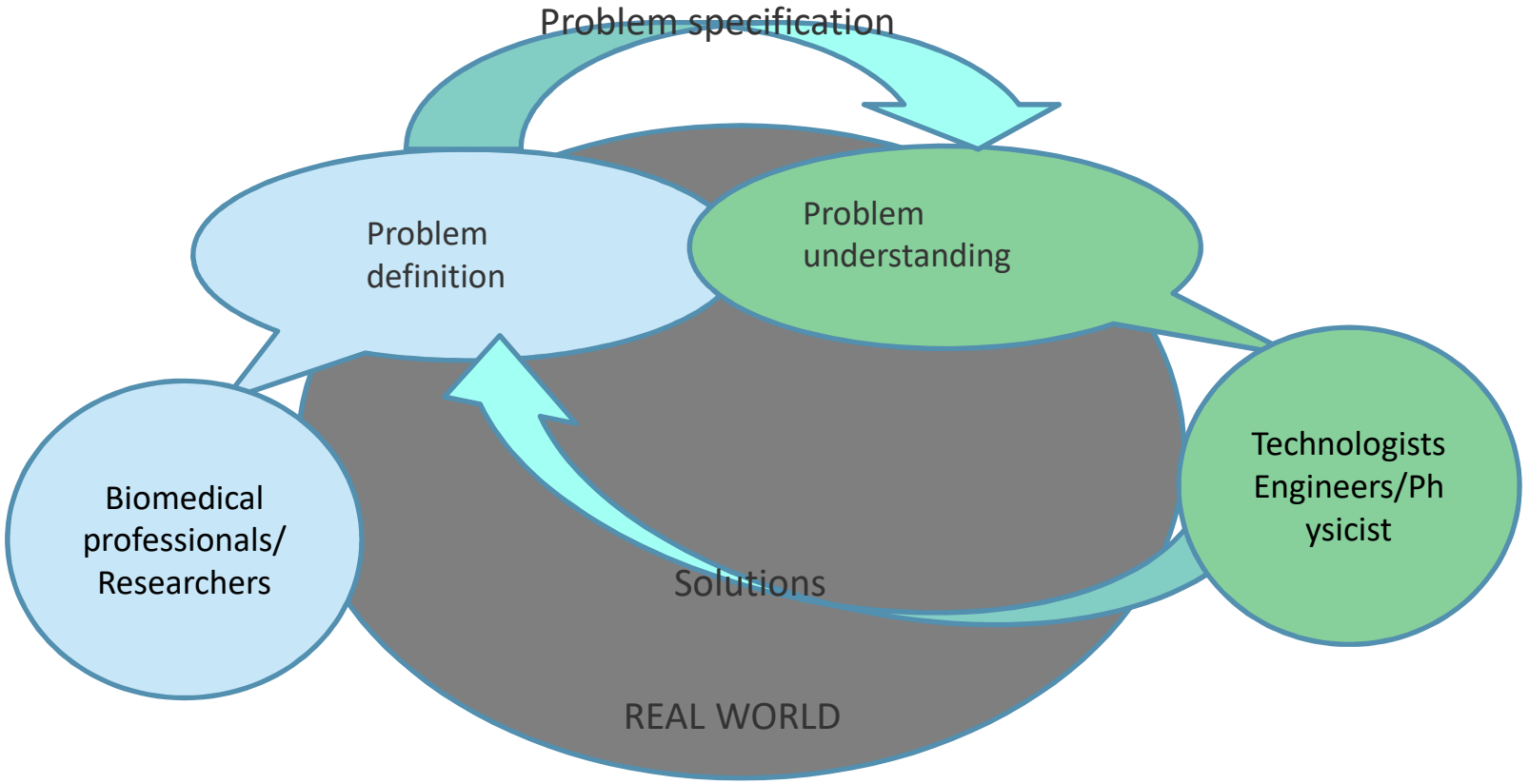
What we do have today:

- A huge amount of pilots that remain while the public funding
- Some experiences in exploitation with limited coverage, normally away from the wide health care systems
- A impact in the medical industry as sort as that of clinical translation

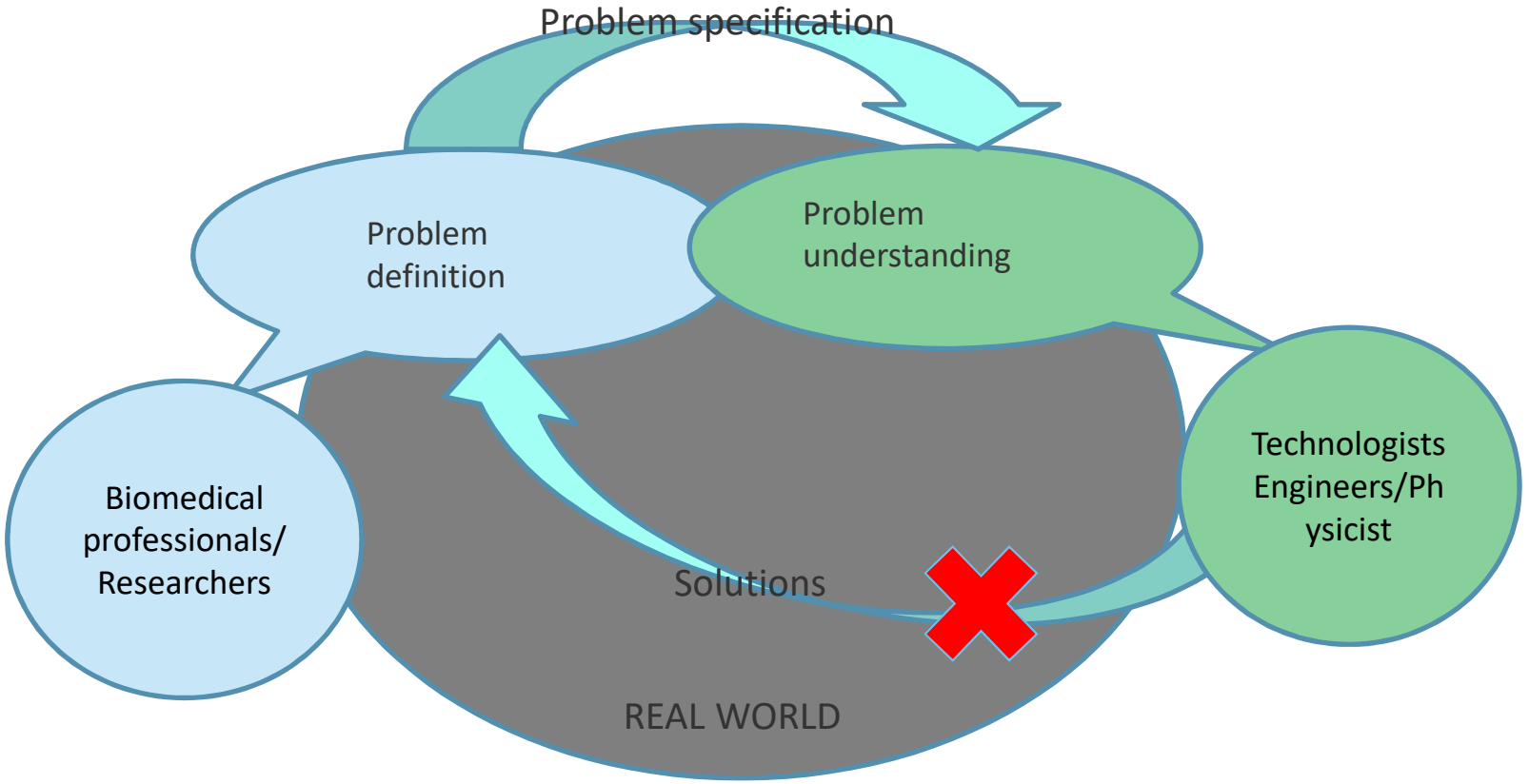
The value of technology to manage frailty will be only real if it moves from being a simple application of technologies to significant transform the care services

Only then the health care administration, the users, the clinical professionals and the industry will perceive its clinical, social and economic values

Avoid well documented past mistakes:
II. beware of Complexity and Multidisciplinarity



Avoid well documented past mistakes:
II. beware of Complexity and Multidisciplnarity



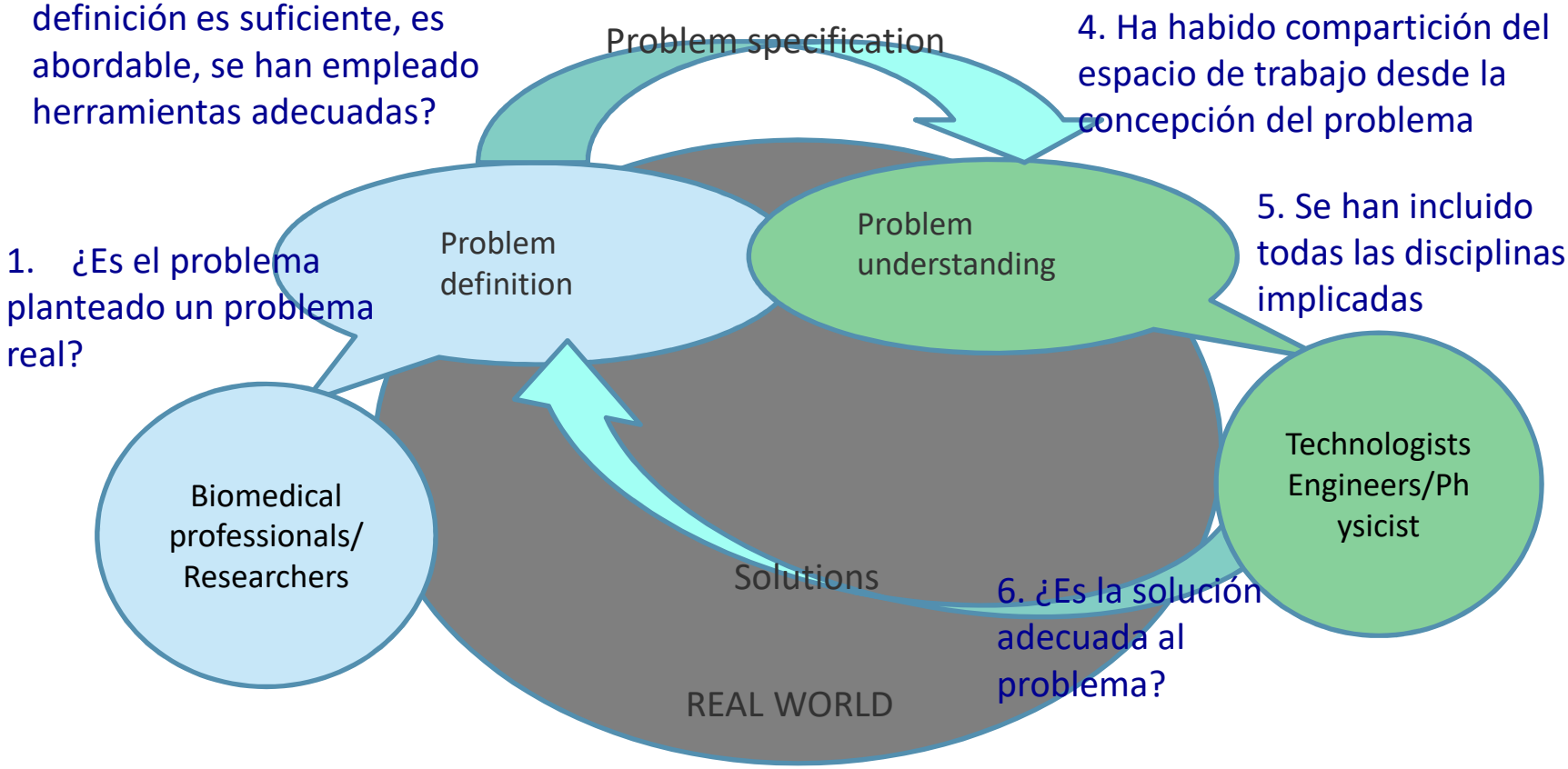
3. Los problemas complejos no permiten actitudes reduccionistas.

2. ¿Está bien planteado: la definición es suficiente, es abordable, se han empleado herramientas adecuadas?

4. Ha habido compartición del espacio de trabajo desde la concepción del problema

5. Se han incluido todas las disciplinas implicadas

1. ¿Es el problema planteado un problema real?



6. ¿Es la solución adecuada al problema?

TECHNOLOGY & FRAILTY includes a large variety of things

SENSORS:
- Lab on a chip.
- Inertial.
- Frailty Assessment.
- Activity recognition.
- Behavioral pattern assessment.

WSN(wireless sensor networks) / IoT
- Wearable, portable, and environment.

DIAGNOSTIC/RISK ASSESSMENT TOOLS
- "OMICS" BASED
- Functional criteria
- Image

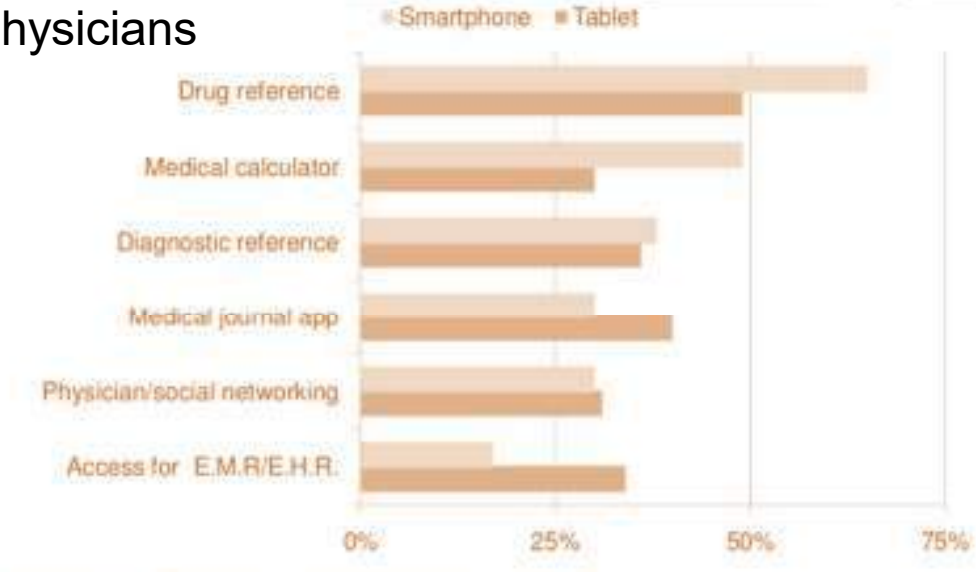
Virtual assistants
- Embedded in smartphones, set-top-boxes, or robotic companions.
- Activity recognition + behavioral pattern analysis.
- Emotion recognition (facial expressions, gestures, speech)

UI
- Multimodal (speech interaction)
- Graphic and tactile
- Voice recognition & speech synthesis.
- TV-based interfaces
- VR and virtual words

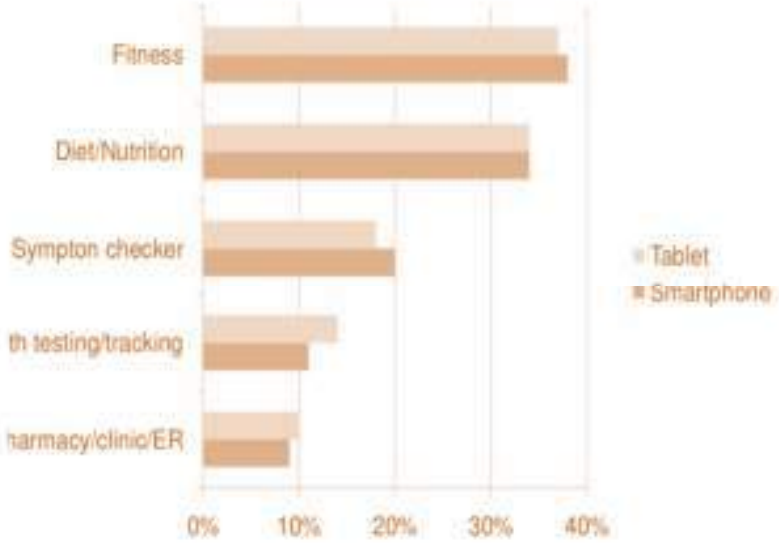
- TREATMENT
  - New drugs
  - Technical devices for exercise
  - Treatment adherence
  - Nutritional assessment and intervention
- Personal assistants
  - Reminders
  - Locating personal objects.
- Social networks (connecting with)
  - Family and friends
  - Caregivers.
- Serious gaming
- New technologies in traditional telemedicine architectures
- Smart devices:
  - cWalker.
- Care models and ICT platforms.
  - Architecture models. SOA infrastructure
  - Middleware platforms. Implementation of particular architectures
- Robotic companions.
  - Mutual care.
  - Automated or tele-presence.



physicians

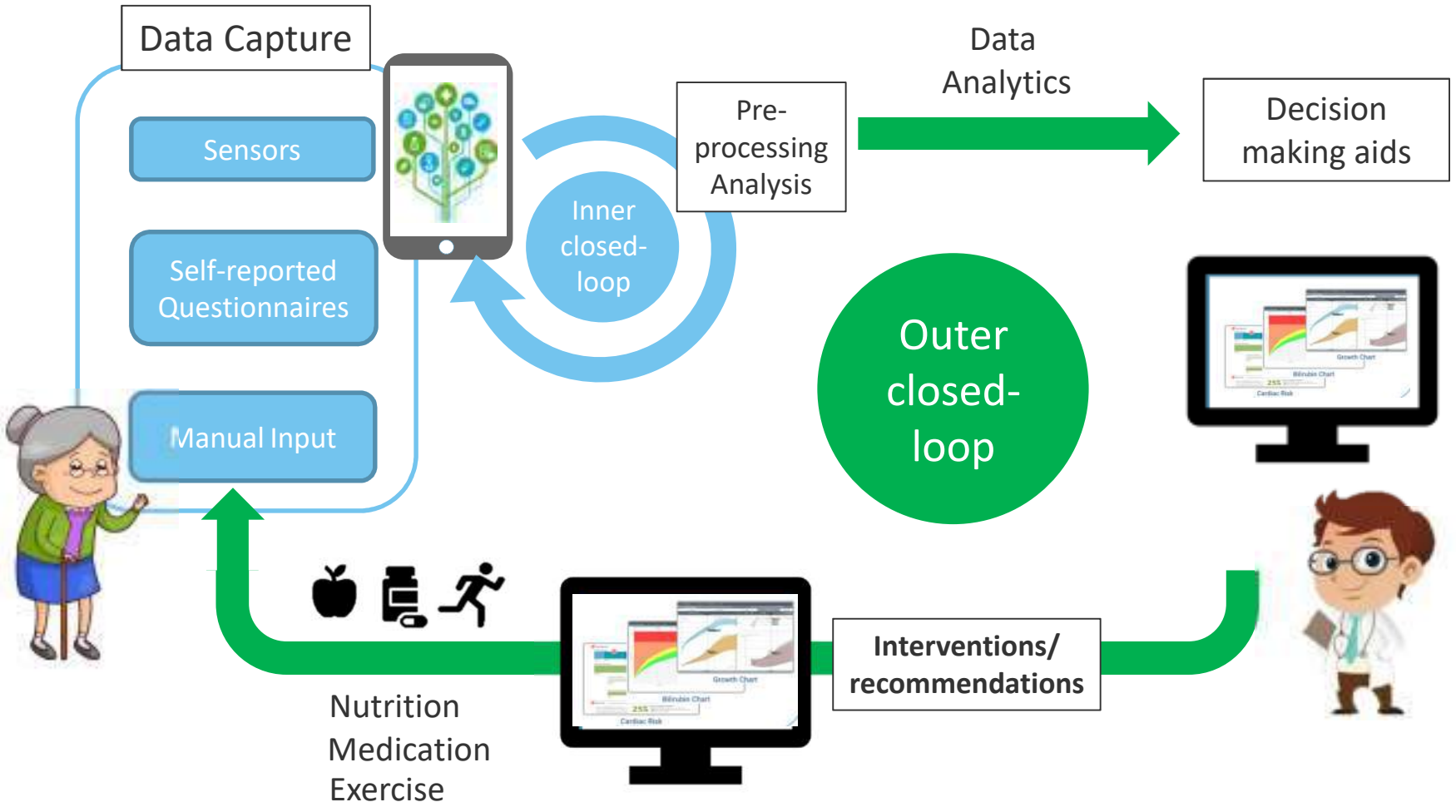


patients

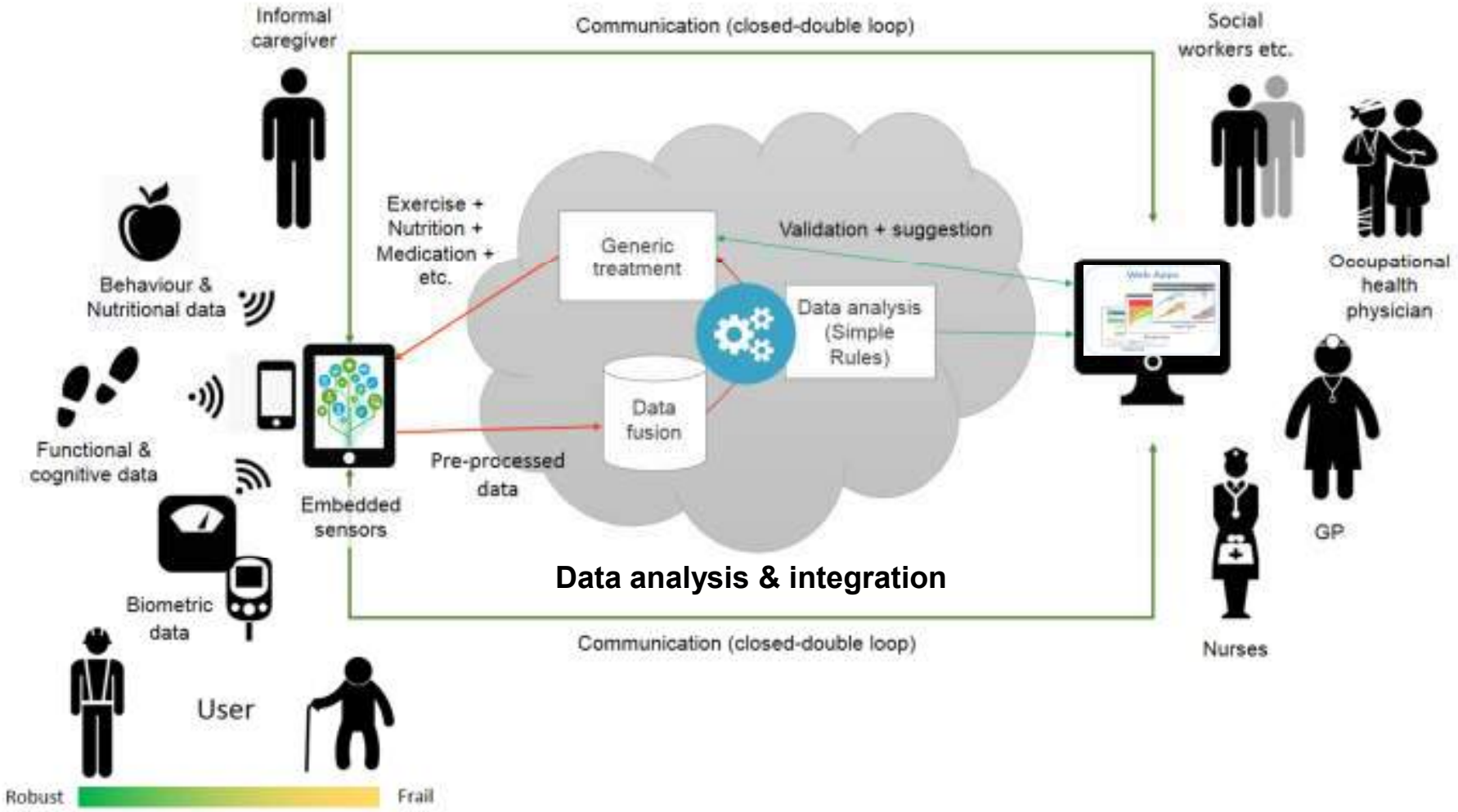


- The global mobile Health and Wellness market is estimated to reach $58,8 billion by the end of 2020 with a growth of 32,3% between 2013 and 2020

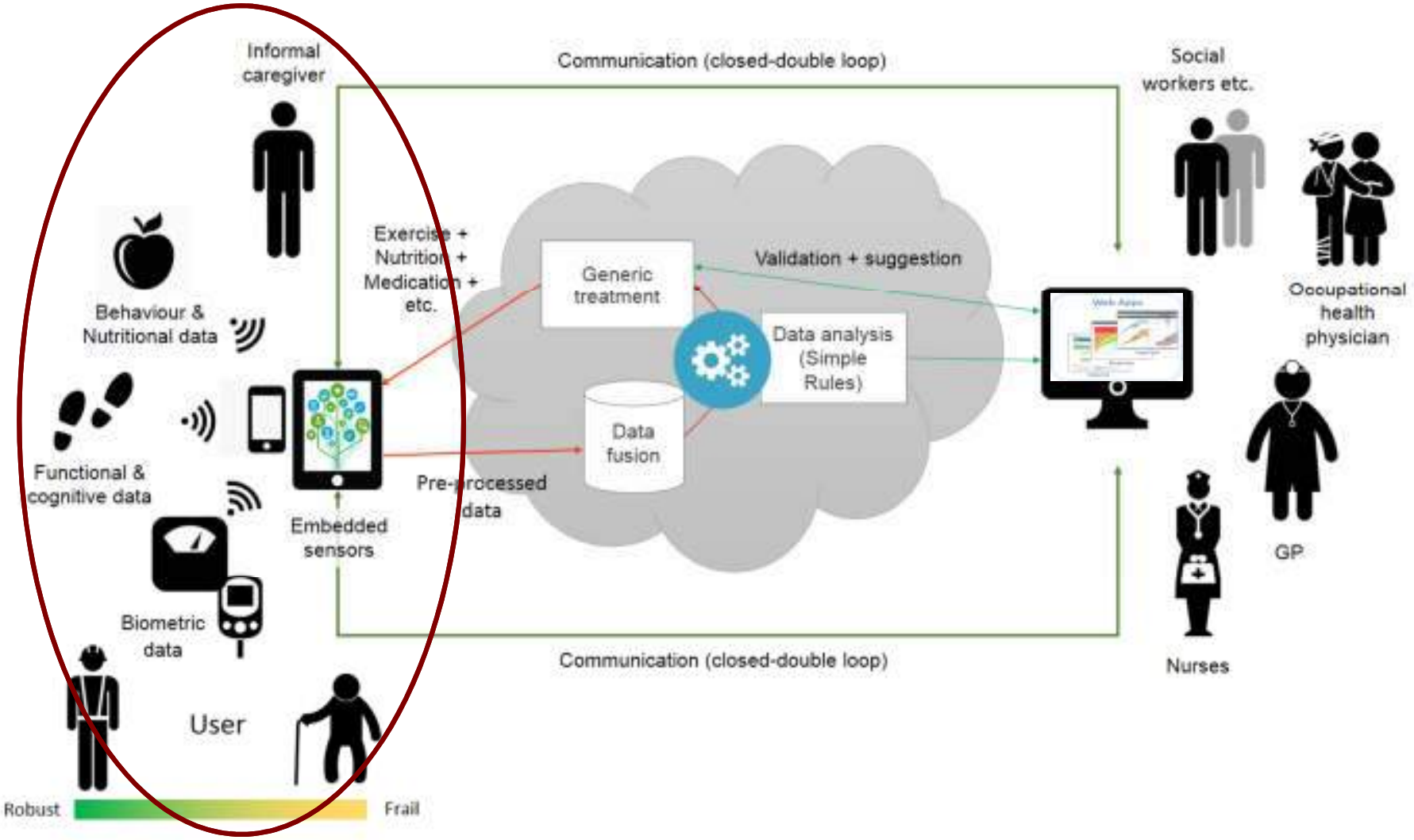
Frailty Personal Platform Architecture:
The double closed-loop strategy



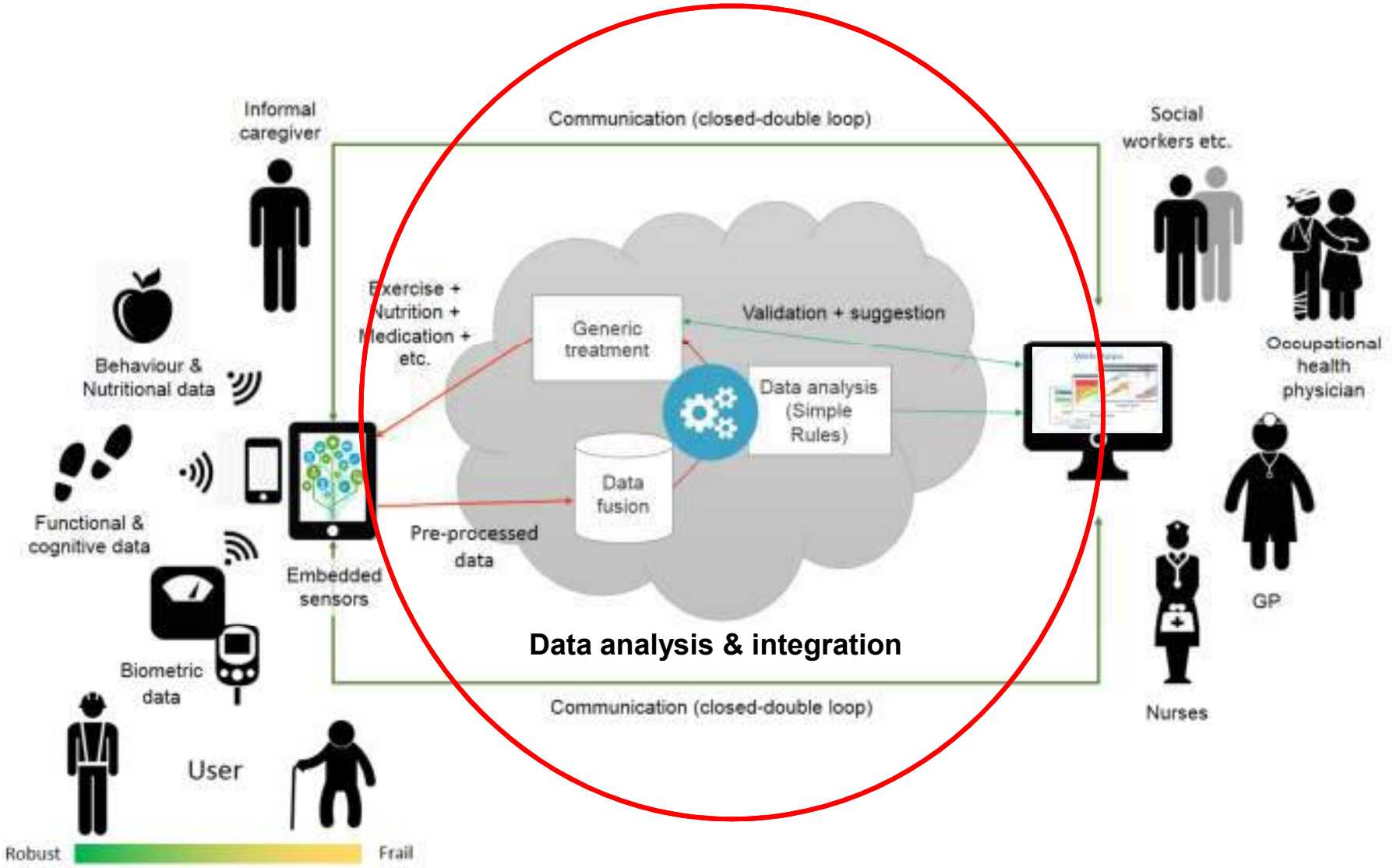
Three main environment for technology



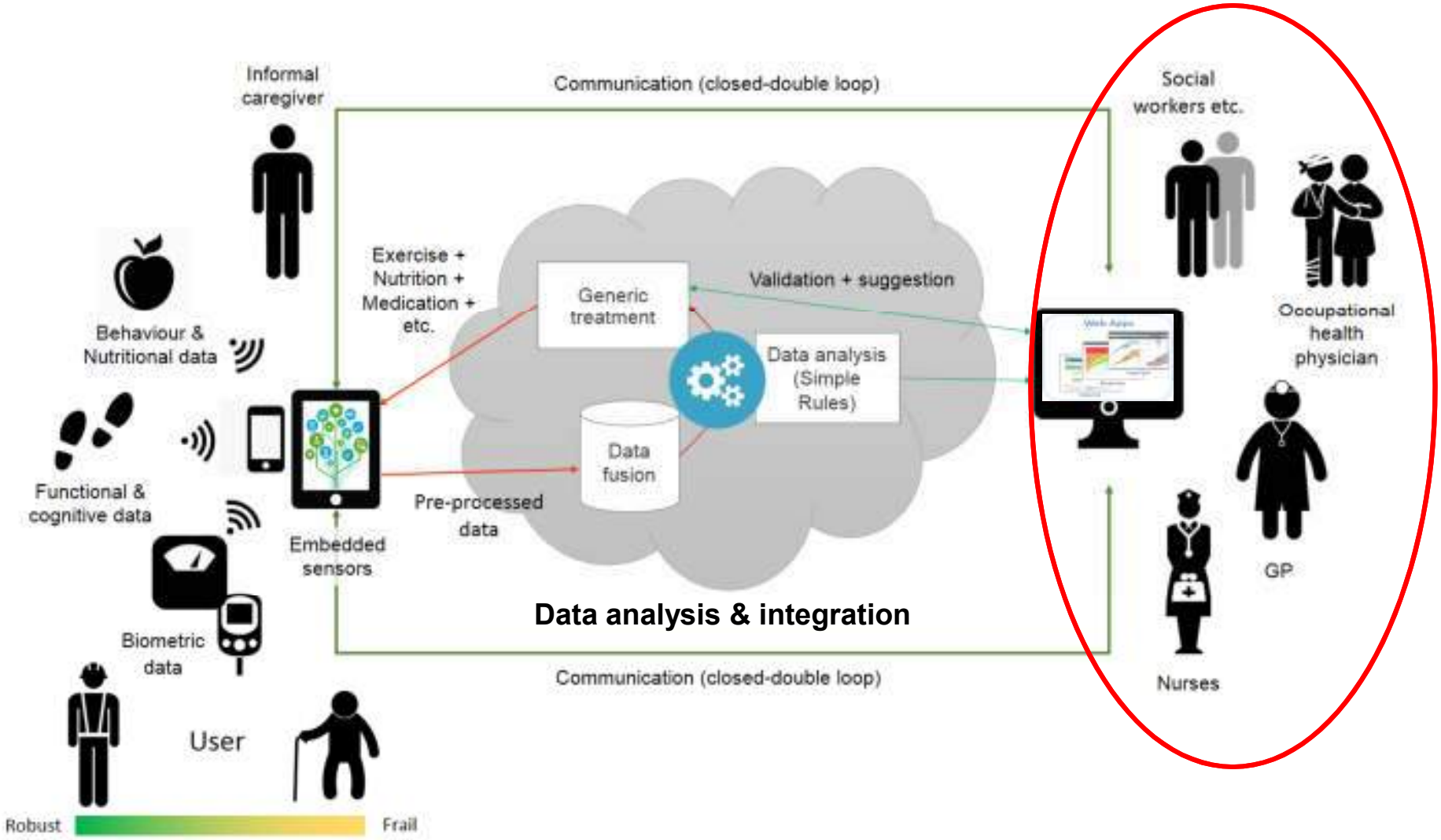
SENSORS. Data gathering



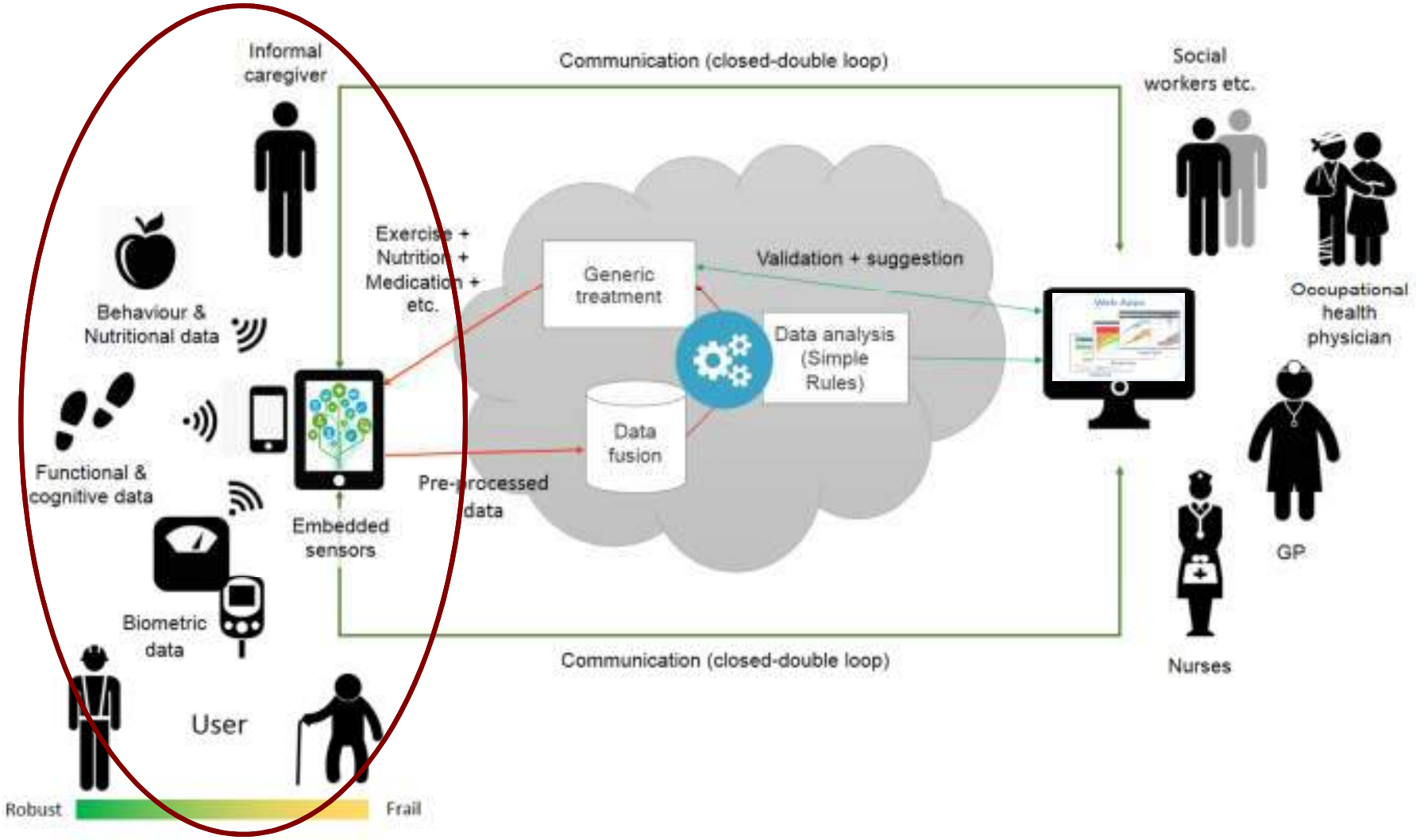
Analytics - AI



Care Network



SENSORS. Data gathering



Change frailty comprehensive assessment

Current clinical scenario:

Fixed picture of the functional decline status. A single or very few samples available to make decisions

- SPPB. Short Physical Performance Battery
  - Balance test
  - Gait speed test
  - Chair stand test
- Linda Fried Physical Frailty Phenotype
  - Gait speed tests
  - Weight loss test
  - Grip strength
  - Exhaustion test
  - Activity level test

Target scenario:

To move frailty tests outside the clinical premises (Telemedicine). Dense and continuous follow-up sampling

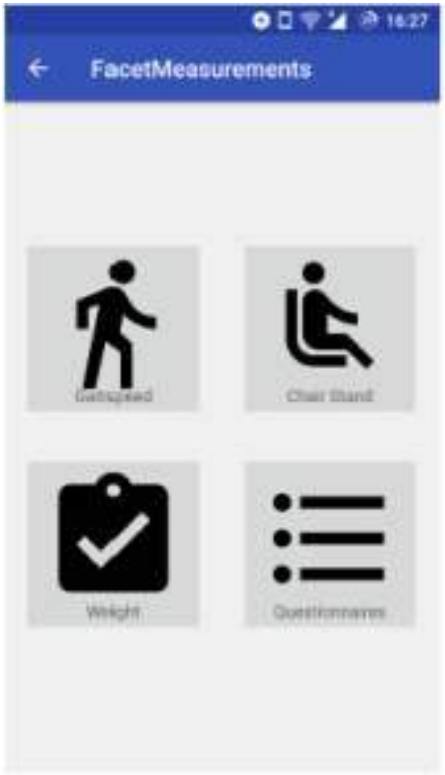
- Continuous – ubiquitous assessment of functional decline in the patient's usual (and diverse) environment.
- Both sensor-base data gathering systems, and human-operated mobile applications.
- Evaluation against gold standards (actual clinical tests)
- Future: Search for new criteria to assess functional status and its evolution and to evaluate interventions

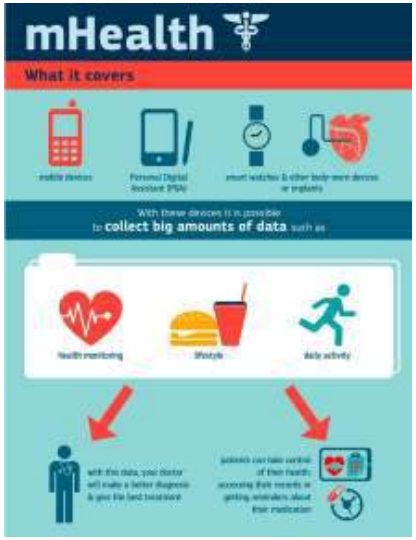
Data capture

- Gait speed
  - Infrared sensor Arduino-based device
- Chair stand (strength)
  - Infrared sensor Arduino-based device
- Weight
  - Smart weight scale
- Frailty questionnaires
  - Mobile app
- …

•SPPB (Short Physical Performance Battery) tests: Gait speed, Chair stand, Balance

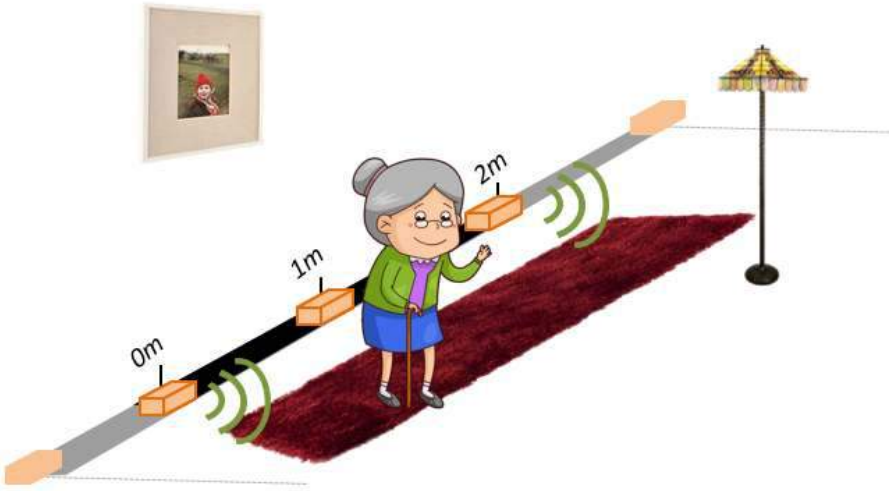
•Linda Fried Physical Frailty Phenotype

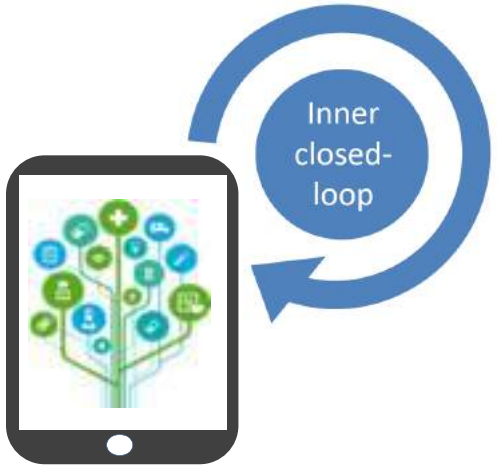




259,000 applications currently available on major app stores (Research2Guidance, 2016)

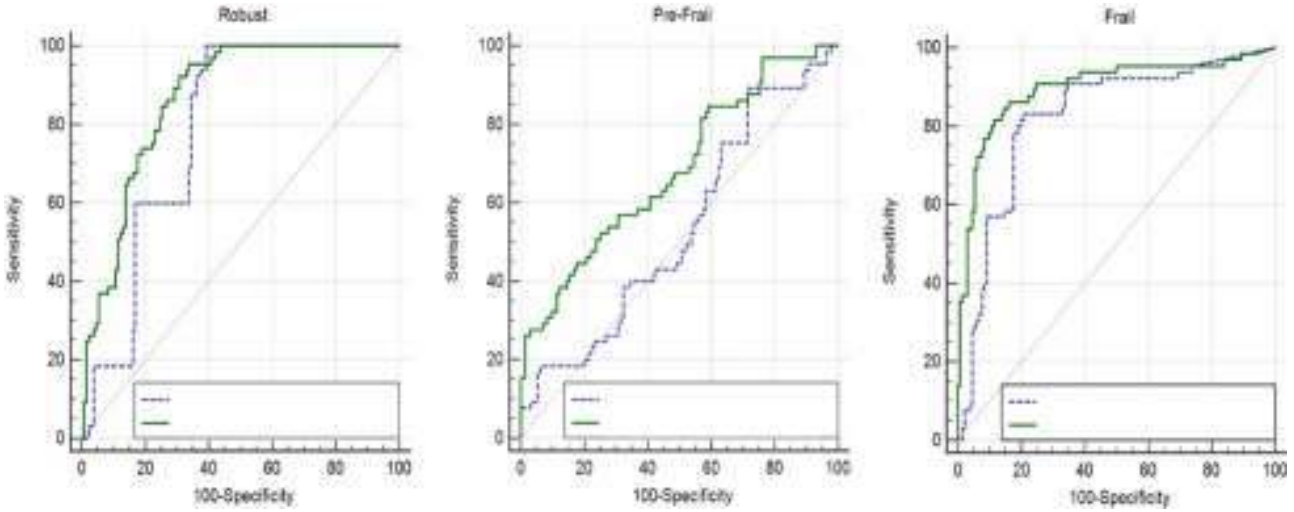
Gait analysis in the community





Inner loop feedback
Direct feedback to patients
Visualization of results
Trends

Gait parameters simultaneously used with gait velocity are able to provide useful information for a more accurate frailty classification and improve the early detection of pre-frail status (outside of a laboratory envirommment)



ROC curves of the two classificatory performance

JNER JOURNAL OF NEUROENGINEERING AND REHABILITATION

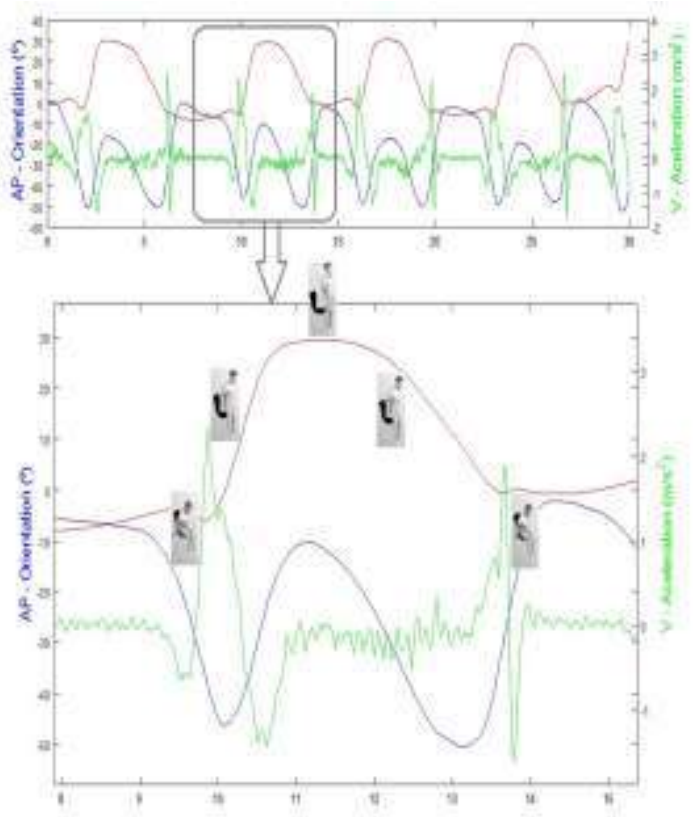
RESEARCH Open Access

Frailty assessment based on trunk kinematic parameters during walking

MIKEL IZQUIERDO
Department of Health Sciences, Public
University of Navarra, Pamplona, Spain

ACELEROMETRY (Mikel Izquierdo)

Individual example of the 30-s CST performance.
Up- an entire test waveform Down- selection of a single sit-stand-sit cycle. V-acceleration (green-line) V-position (red-line)

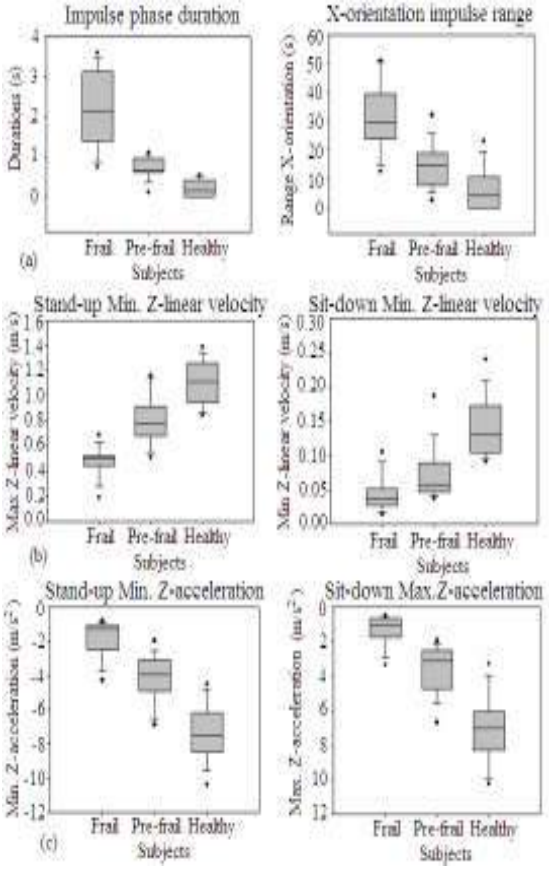


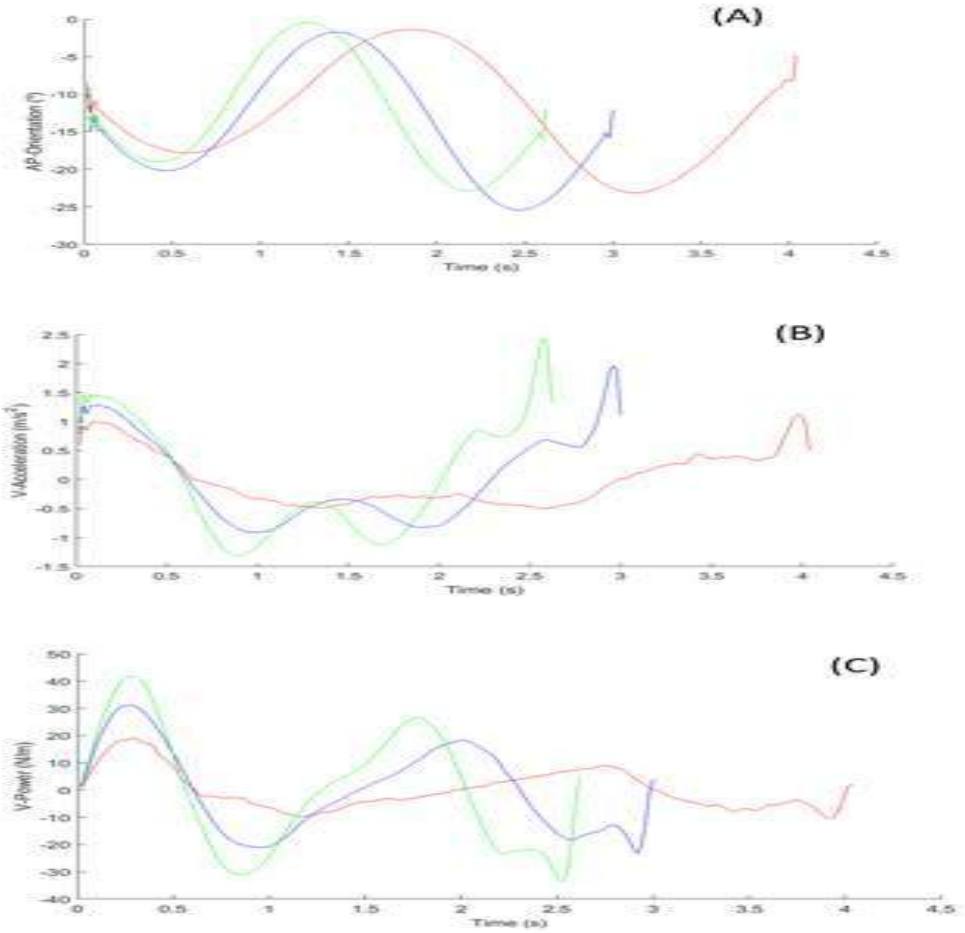
Journal of Biomechanics
journal homepage: www.elsevier.com/locate/jbiomech
www.JBiomech.com

Frailty assessment based on wavelet analysis during quiet standing balance test

A. Martínez-Ramírez[a], P. Lecumberri[a], M. Gómez[a], L. Rodríguez-Mañas[b], F.J. García[c], M. Izquierdo[d,*]

Sit to Stand parameters are able to provid useful information for a more accurate frailty classification

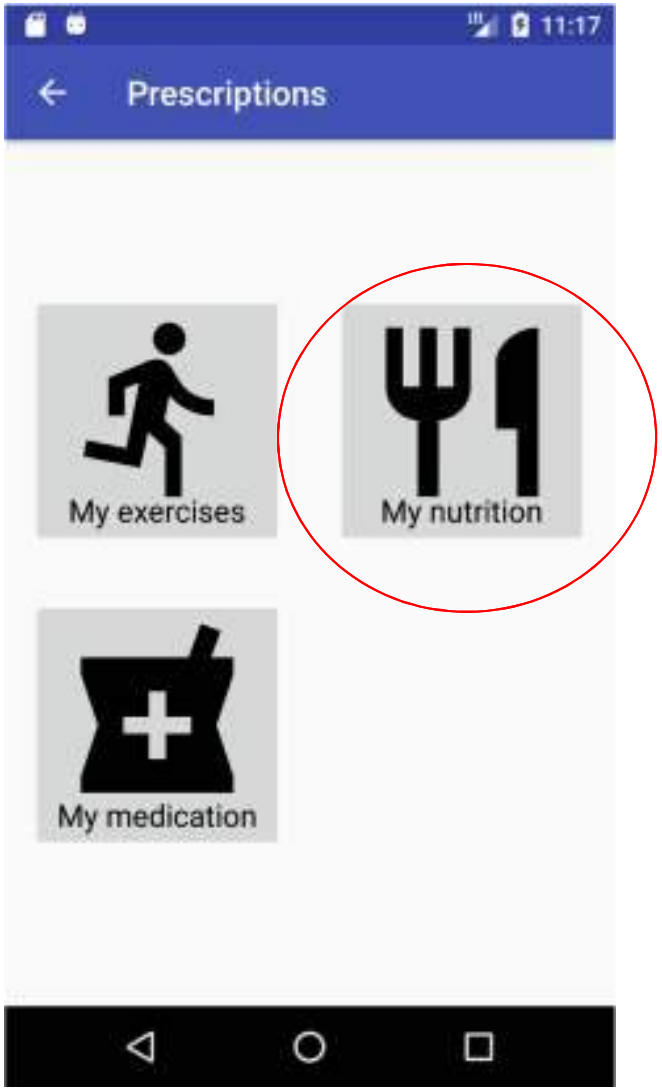


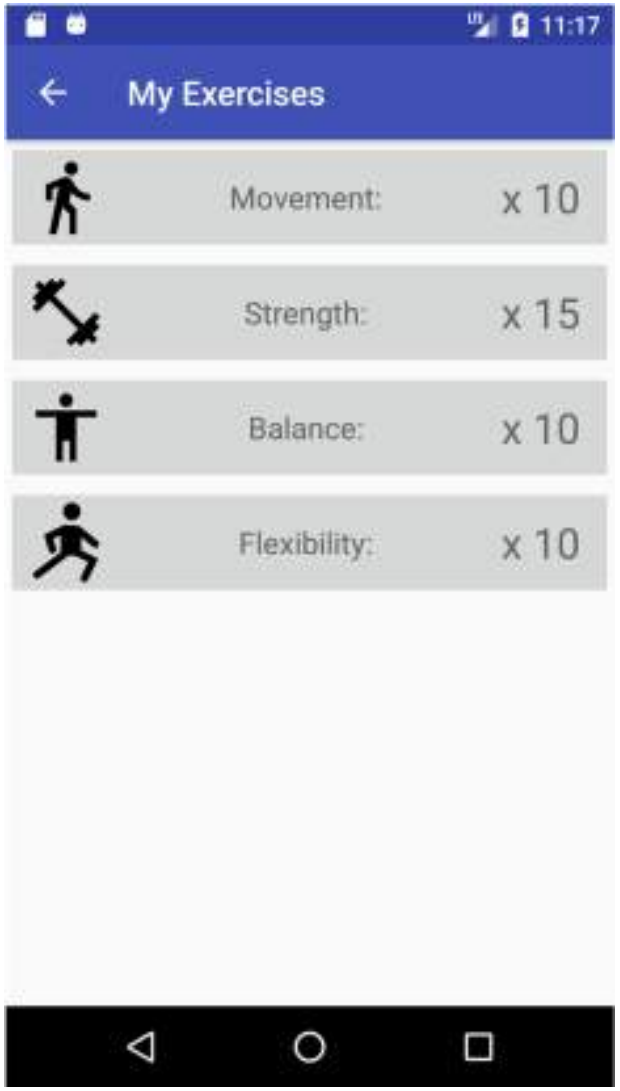


Cycle's performance pattern. Representation of the average performance of a single cycle of the different frailty groups: frail one (red-line), pre-frail one (blue-line) and robust one (green-line). First figure embodies AP-orientation, while second one is the V-acceleration and the third one is the V-velocity.

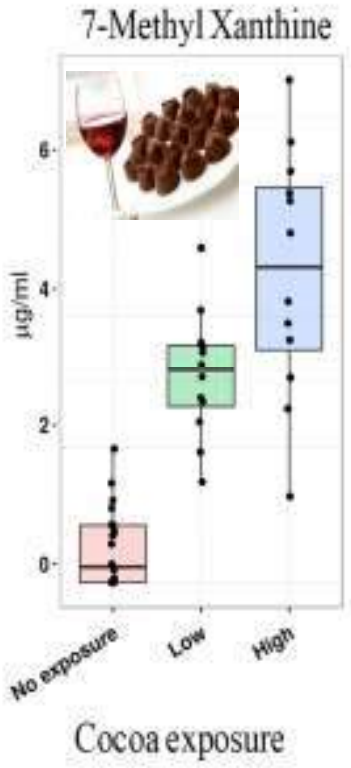
MIKEL IZQUIERDO
Department of Health Sciences,
Public University of Navarra,
Pamplona, Spain

Frailty assessment: Food intake

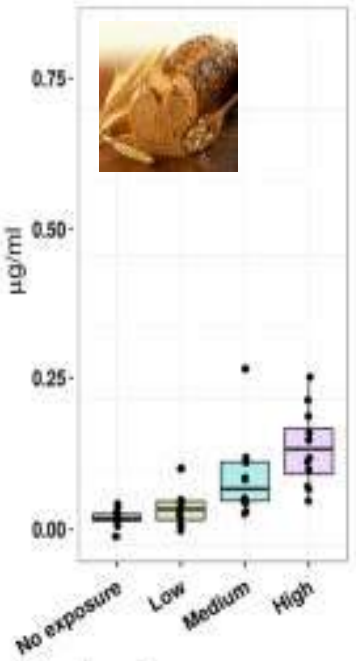




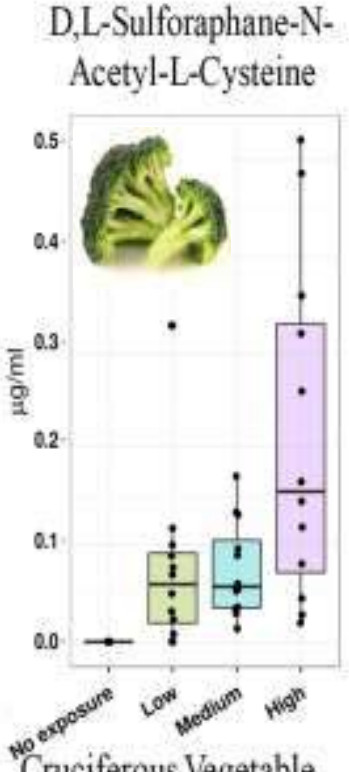
Quantitation of exposure to foods high in anti-oxidants



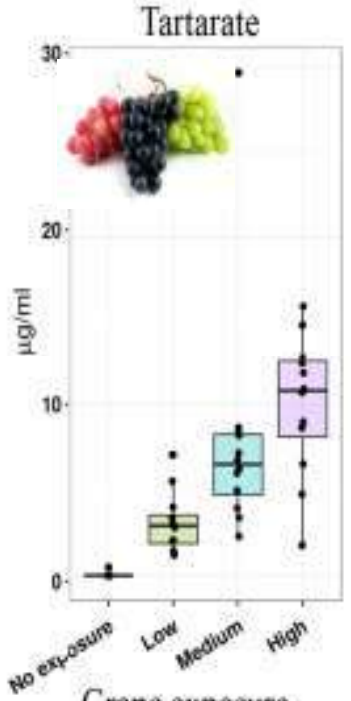
Cocoa exposure



Wholegrain exposure

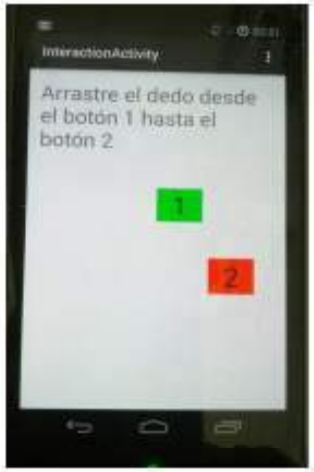


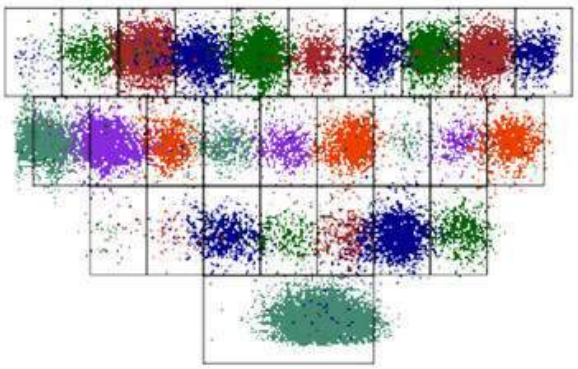
Cruciferous Vegetable exposure

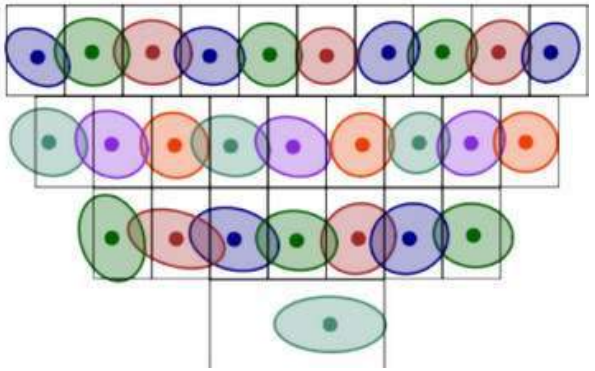


Grape exposure

Touch Dynamics

		
Prueba de teclear. Teclado software propio. Aplicación auxiliar.	Prueba escritura gestual. Teclado de Google. Aplicación auxiliar	Prueba gestos guiados. Aplicación auxiliar.





TOUCH DYNAMICS: monitoring signs of suboptimal ageing

Unobtrusive interactions

Gaming interactions



Normal ageing

Frailty

Stress

...

Hospital Universitario de Getafe
SaludMadrid
Comunidad de Madrid

Servicio de Geriatría

Valoración geriátrica

Servicio de Geriatría
Hospital Universitario de Getafe

Número de identificación

Contraseña

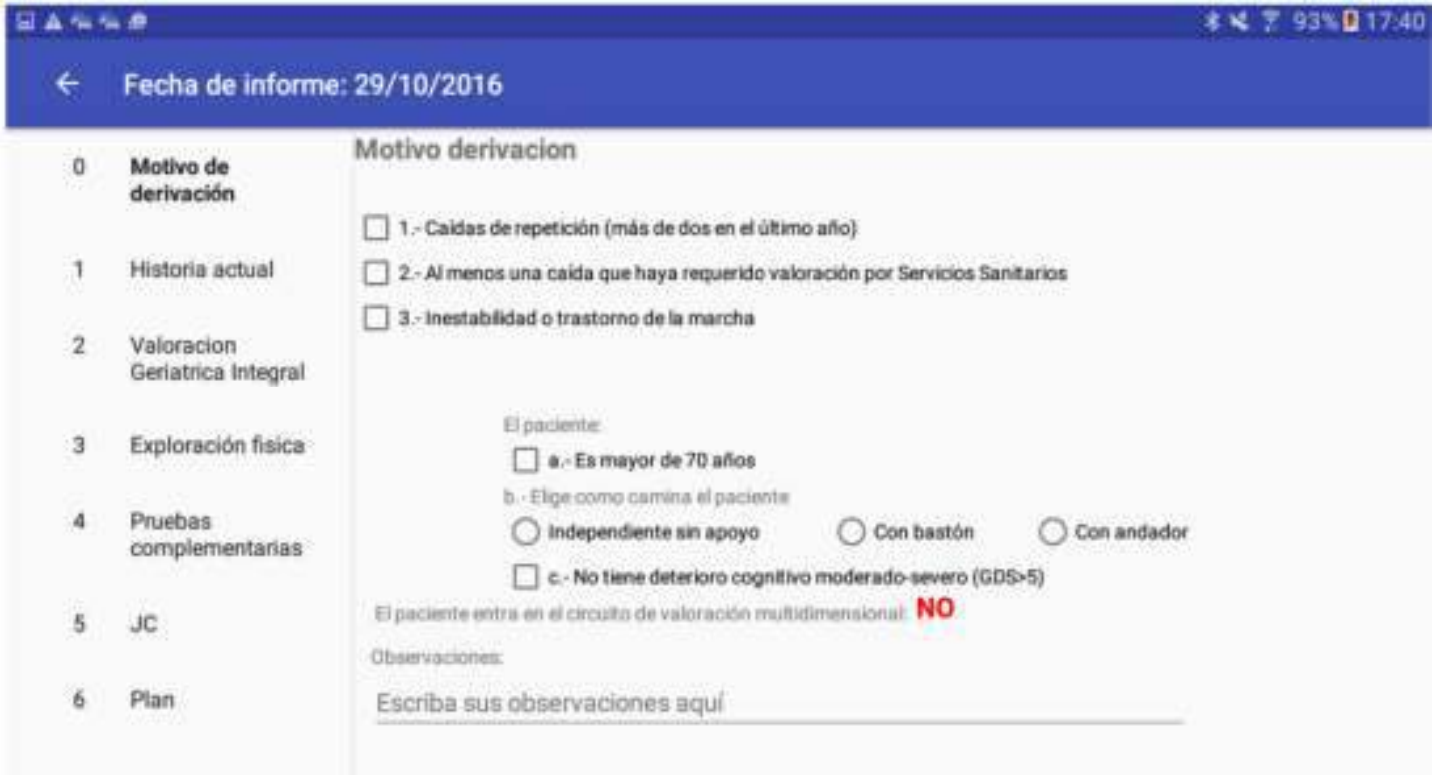
¿Has olvidado tu contraseña?

Entrar

APP: FALLS UNIT

MULTIFACTORIAL ASSESSMENT TOOL

- Android app.
- Digitalization of assessment process.
- Digitalization of existing data.
- Automatic feed of data analytics with clinical data.



3.- Actividad física

¿El paciente ha realizado menor o igual actividad física que lo indicado cada semana?

Hombres: < 383 kcal/semana (caminar ≤ 2 horas y 30 minutos / semana)

Mujeres: < 270 kcal / semana (caminar ≤ 2 horas / semana)

◯ Si

◯ No

4.- Velocidad de la marcha

Medimos la lentitud como el tiempo que toma un paciente en recorrer 4,6 metros andando a su velocidad habitual

Le pedimos al paciente que se coloque justo detrás de la línea de salida, y le pedimos que camine de manera normal y pare en la línea de meta.

Presiona el botón comenzar para realizar este test.

COMENZAR | FINALIZAR PRUEBA | REINICIAR

Primera prueba: 00:00 segundos

Segunda prueba: 00:00 segundos

Altura del paciente (cm):

175

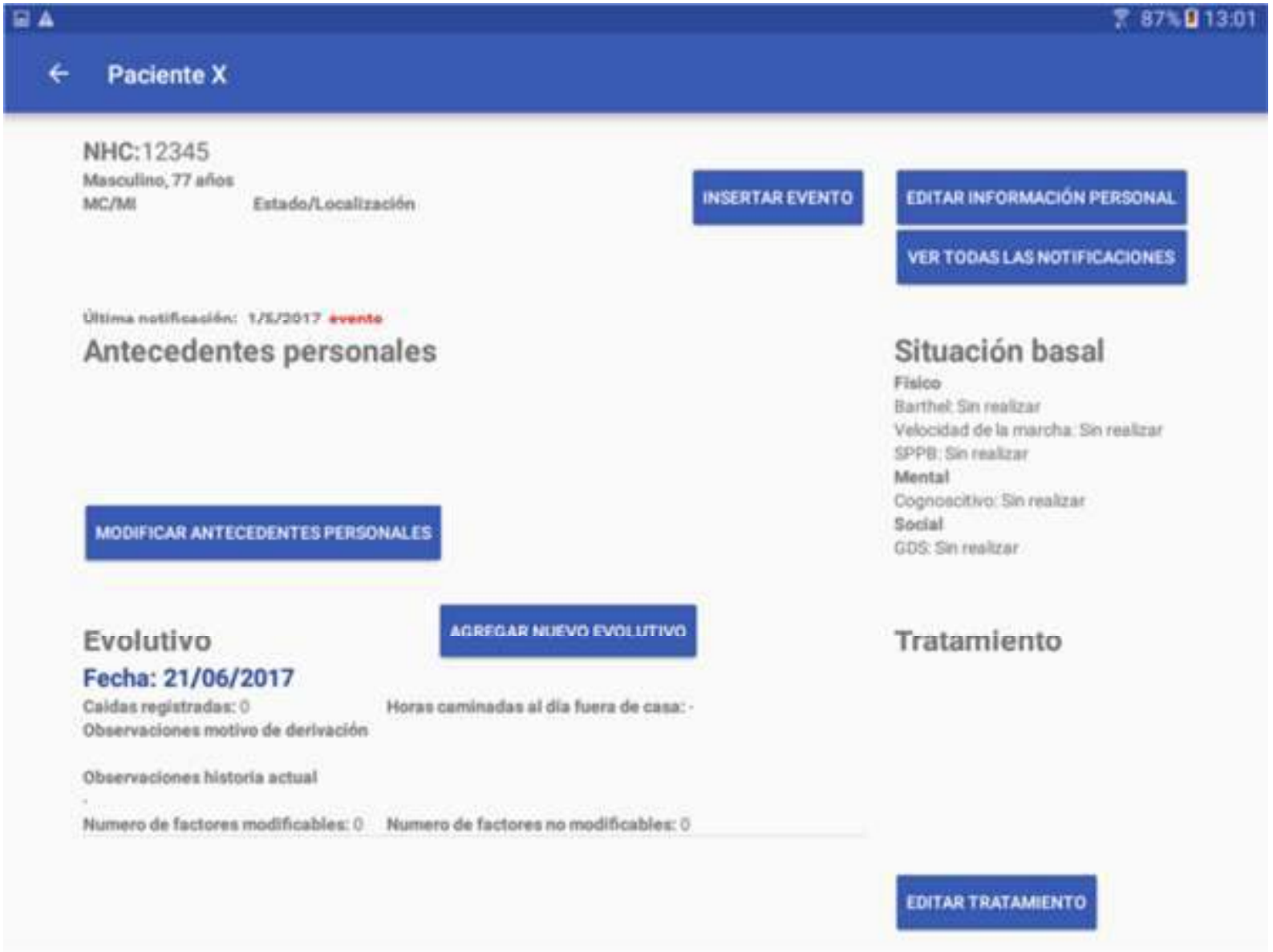
Genero	Altura	Tiempo
Hombre	≤ 173 cm	≥ 7 s
	> 173 cm	≥ 6 s
Mujer	≤ 159 cm	≥ 7 s
	> 159 cm	≥ 6 s

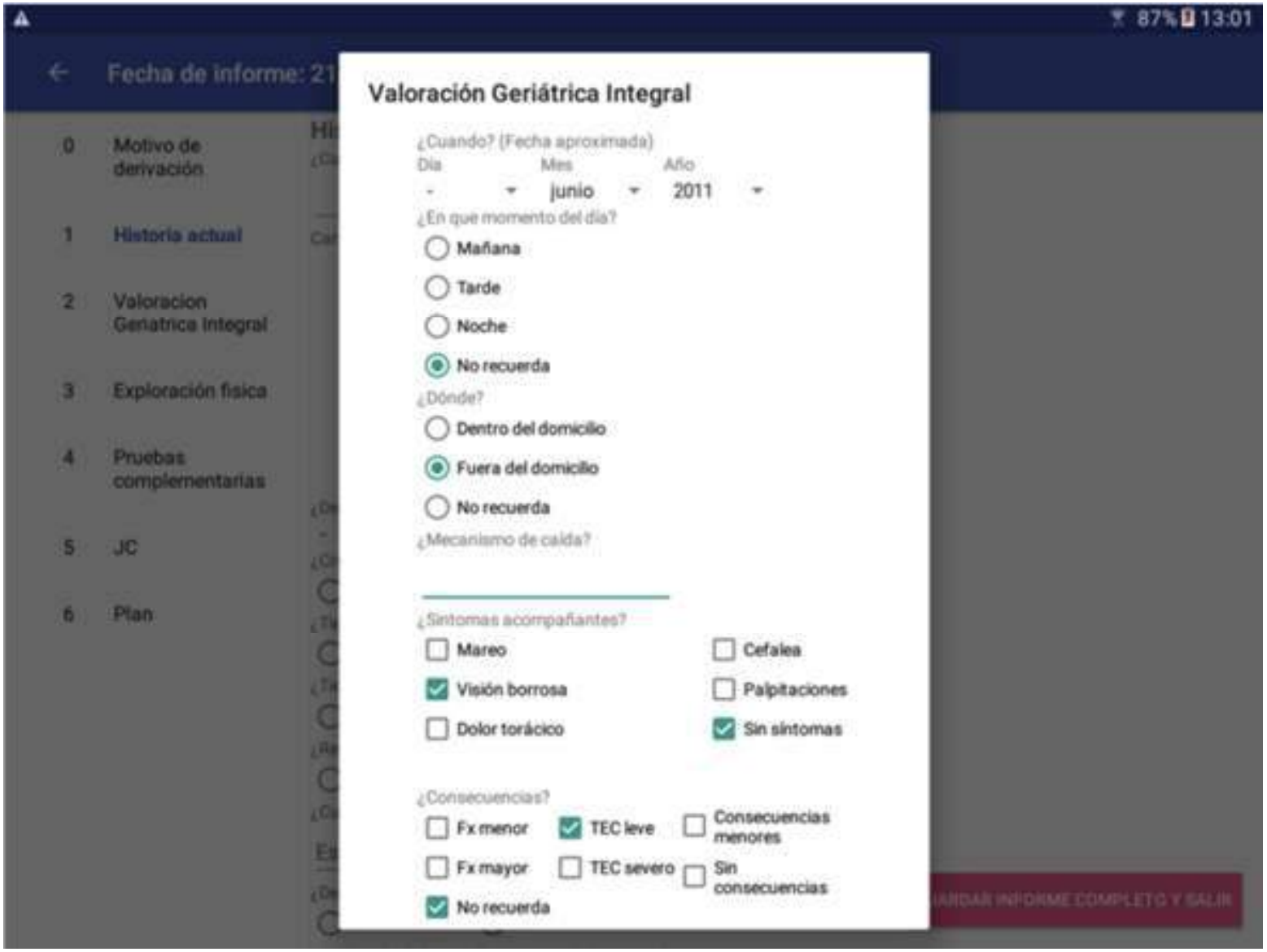
◯ Si ◯ No

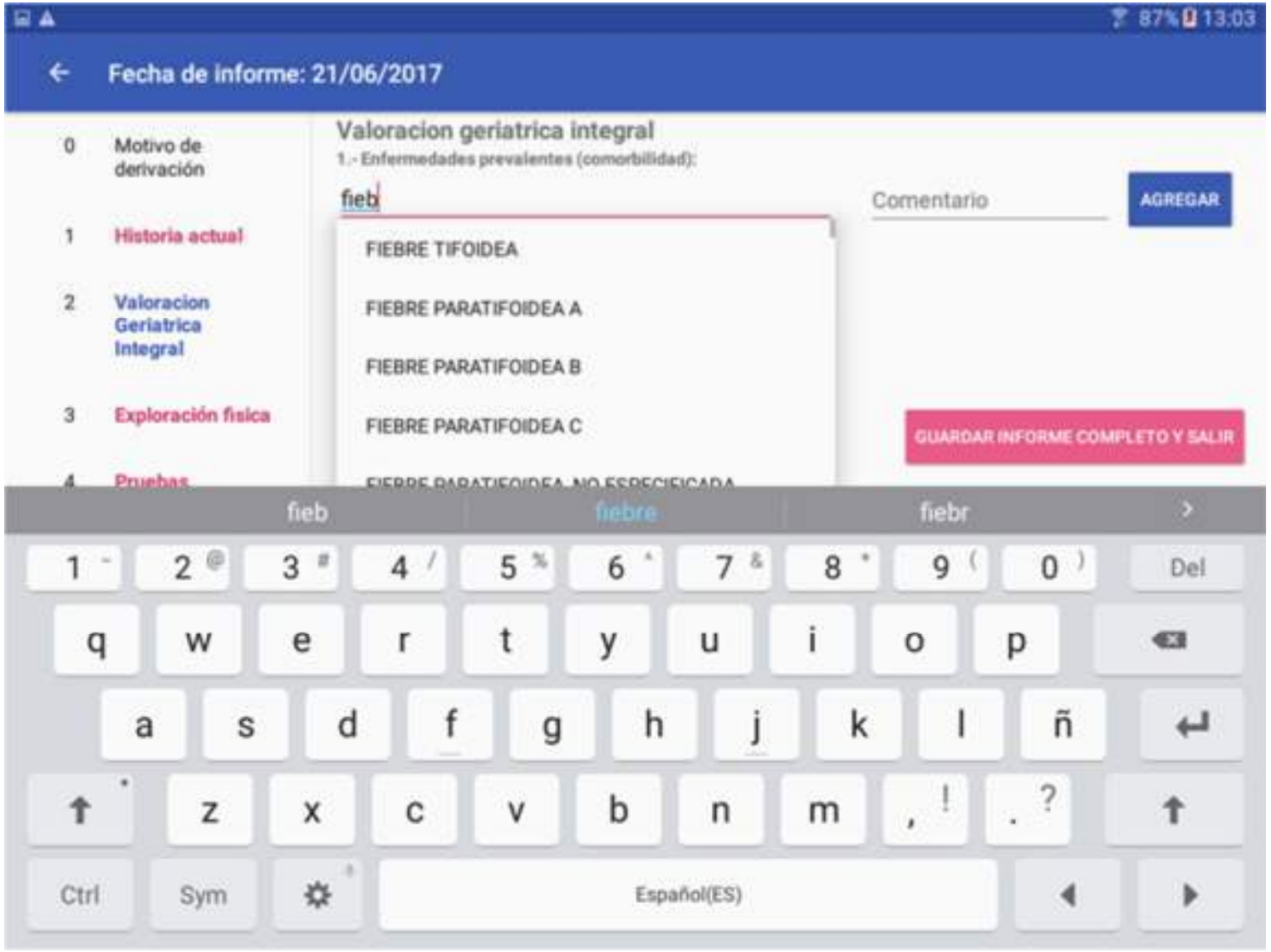
Según el índice de masa corporal y sexo ¿la fuerza de prensión de la mano es menor o igual a la indicada?

IMC	HOMBRE	DIM	IMC	MUJER	DIM
< 24		≤ 29 kg	< 23		≤ 17 kg
24.1-26		≤ 30 kg	23.1-26		≤ 17.3 kg

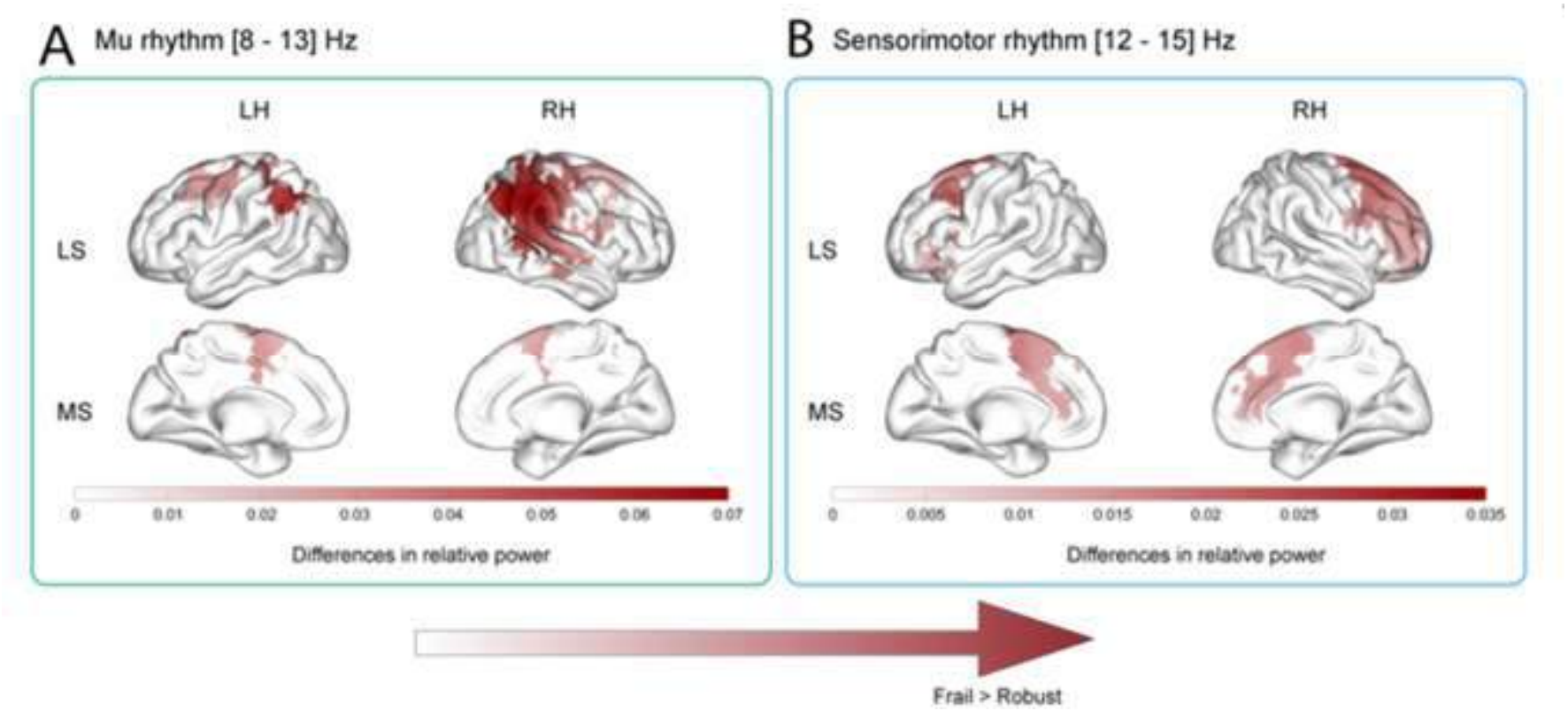
◯ Si ◯ No


87% 13:01
Paciente X
NHC:12345
Masculino, 77 años
MC/MI
Estado/Localización
INSERTAR EVENTO
EDITAR INFORMACIÓN PERSONAL
VER TODAS LAS NOTIFICACIONES
Última notificación: 1/5/2017 evento
Antecedentes personales
MODIFICAR ANTECEDENTES PERSONALES
Situación basal
Físico
Barthel: Sin realizar
Velocidad de la marcha: Sin realizar
SPPB: Sin realizar
Mental
Cognoscitivo: Sin realizar
Social
GDS: Sin realizar
Evolutivo
AGREGAR NUEVO EVOLUTIVO
Fecha: 21/06/2017
Caidas registradas: 0
Horas caminadas al día fuera de casa: -
Observaciones motivo de derivación
Observaciones historia actual
Numero de factores modificables: 0
Numero de factores no modificables: 0
Tratamiento
EDITAR TRATAMIENTO


87% 13:01
Fecha de informe: 21
0 Motivo de derivación
1 Historia actual
2 Valoracion Geriatrica Integral
3 Exploración fisica
4 Pruebas complementarias
5 JC
6 Plan
Valoración Geriátrica Integral
¿Cuando? (Fecha aproximada)
Dia
Mes
Año
junio
2011
¿En que momento del dia?
Mañana
Tarde
Noche
No recuerda
¿Dónde?
Dentro del domicilio
Fuera del domicilio
No recuerda
¿Mecanismo de caida?
¿Síntomas acompañantes?
Mareo
Visión borrosa
Dolor torácico
Cefalea
Palpitaciones
Sin síntomas
¿Consecuencias?
Fx menor
Fx mayor
No recuerda
TEC leve
TEC severo
Consecuencias menores
Sin consecuencias

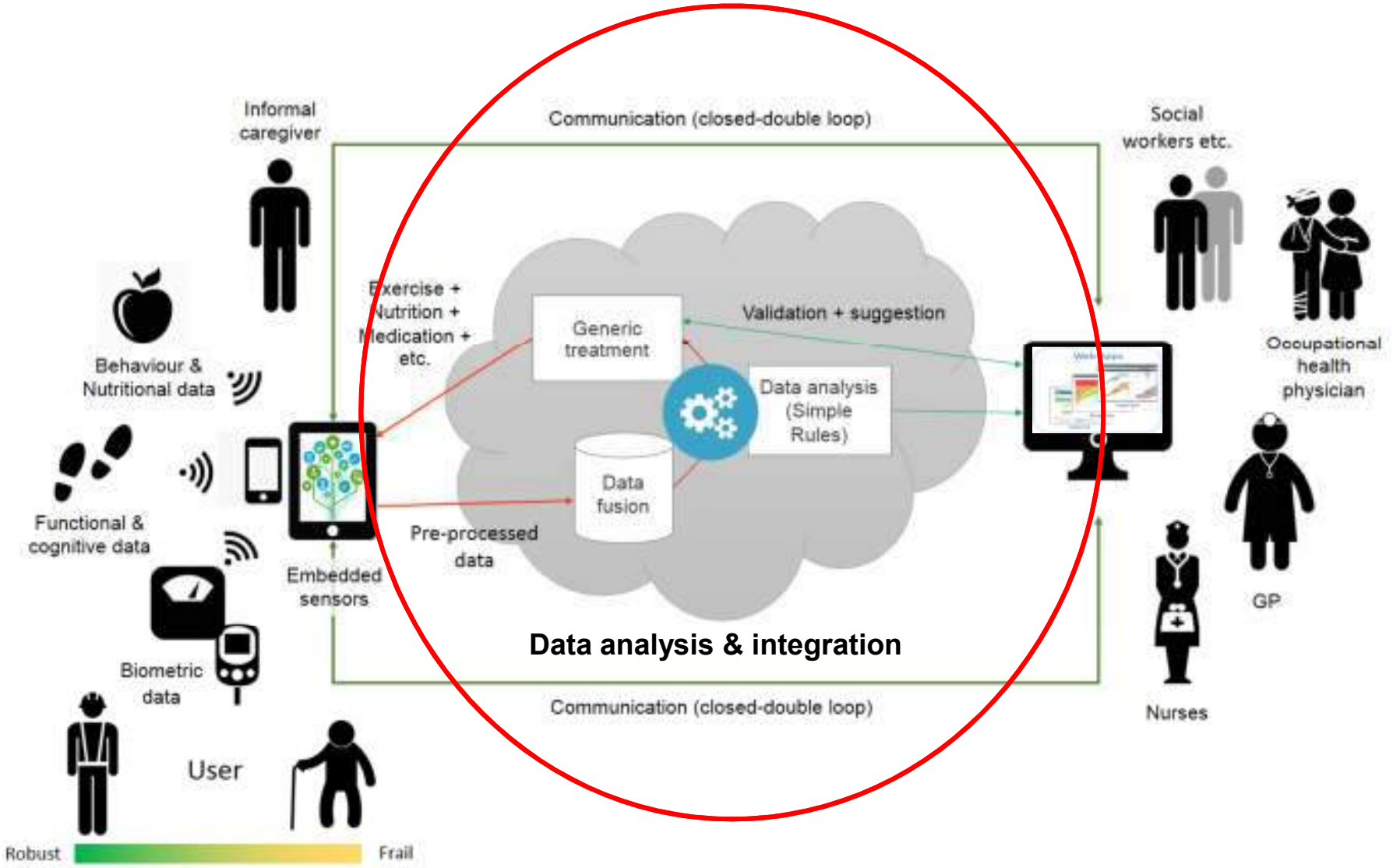

87% 13:03
Fecha de informe: 21/06/2017
0 Motivo de derivación
1 Historia actual
2 Valoracion Geriatrica Integral
3 Exploración fisica
4 Pruebas
Valoracion geriatrica integral
1.- Enfermedades prevalentes (comorbilidad):
fieb
FIEBRE TIFOIDEA
FIEBRE PARATIFOIDEA A
FIEBRE PARATIFOIDEA B
FIEBRE PARATIFOIDEA C
Comentario
AGREGAR
GUARDAR INFORME COMPLETO Y SALIR
fieb
fiebre
fiebr
Del
Ctrl
Sym
Español(ES)

MEG findings in frail people without global cognitive impairment

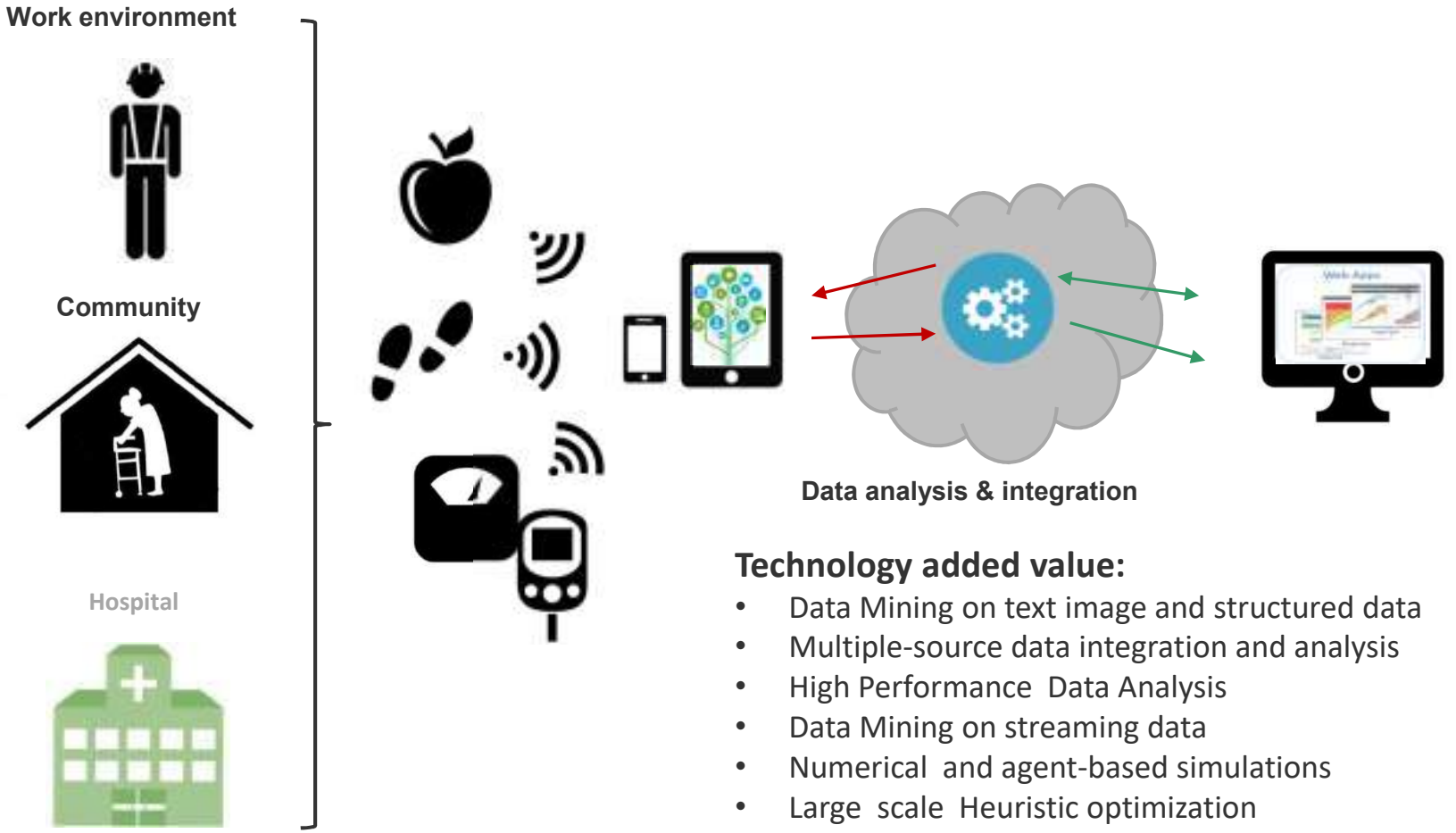


Rodriguez-Mañas et al (unpublished)

Analytics - AI



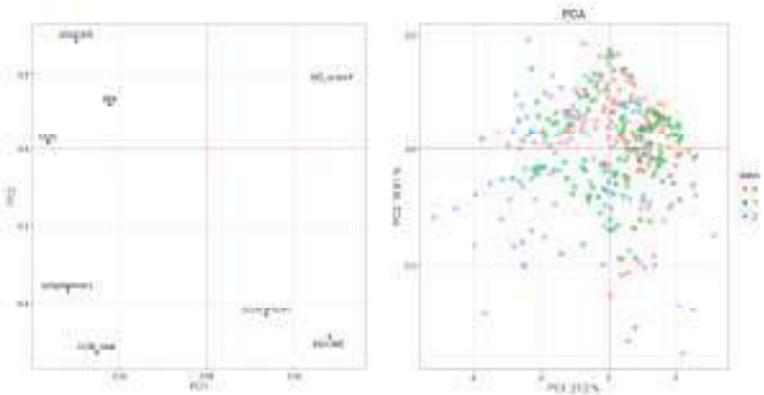
Data aggregation: Big Data & Analytics

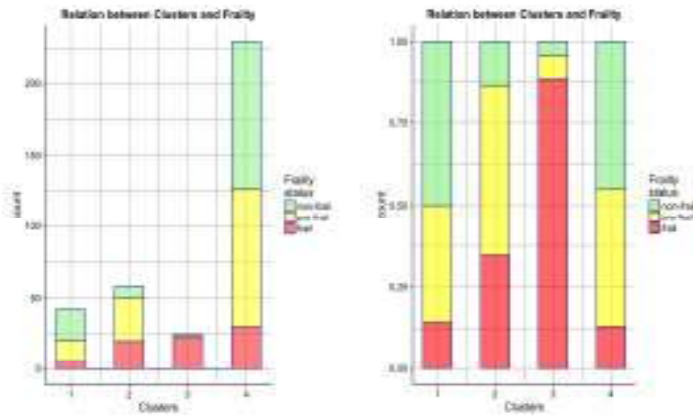


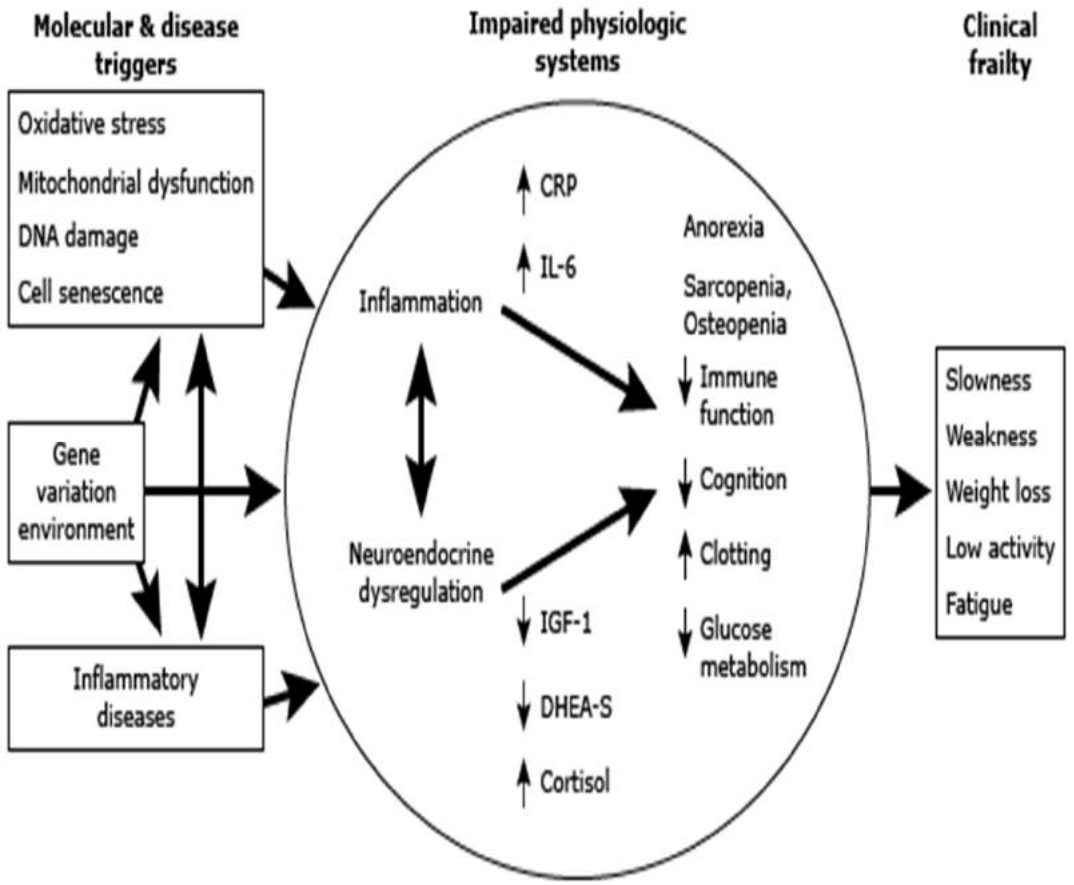
Technology added value:

- Data Mining on text image and structured data
- Multiple-source data integration and analysis
- High Performance Data Analysis
- Data Mining on streaming data
- Numerical and agent-based simulations
- Large scale Heuristic optimization
- Complex data interaction and visualization
- MEG data analysis
- Early detection of markers
- Cloud computing

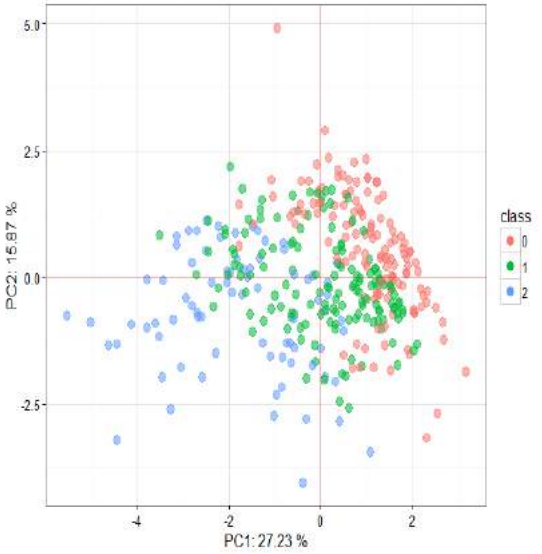
Frailty criteria and modulators

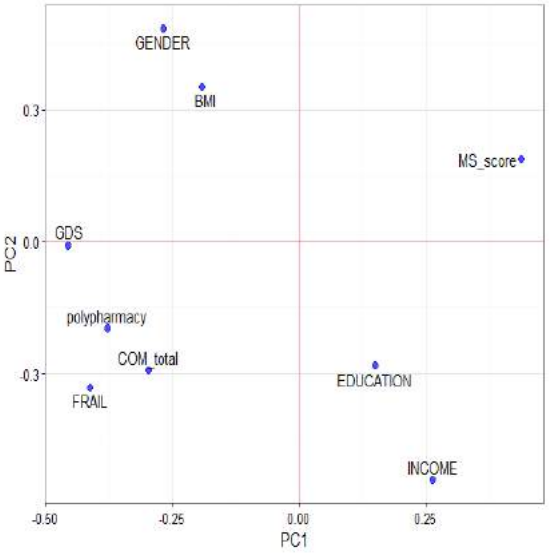




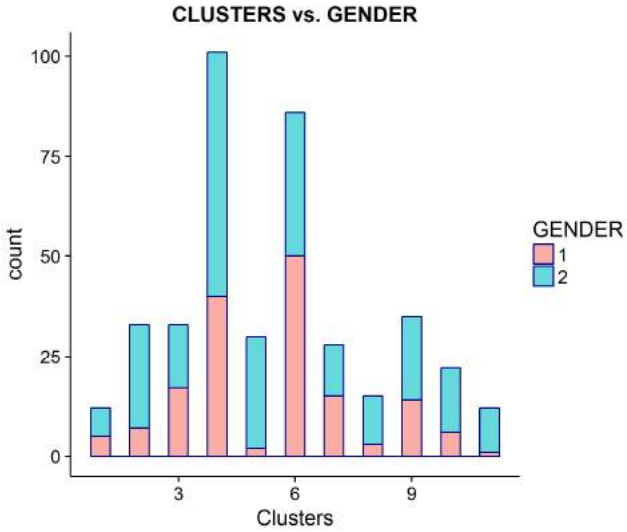


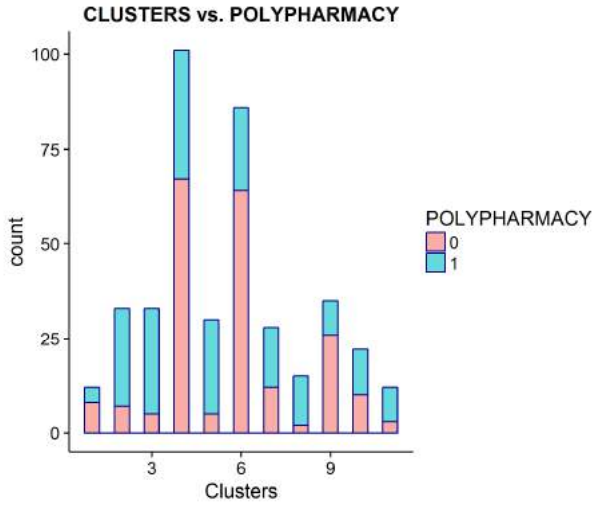
PCA components

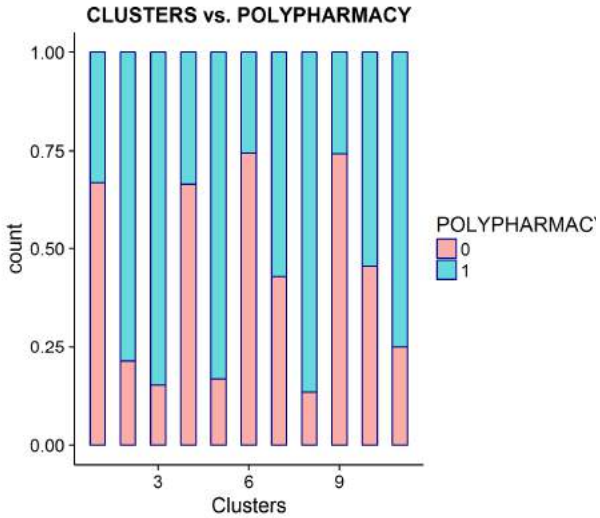


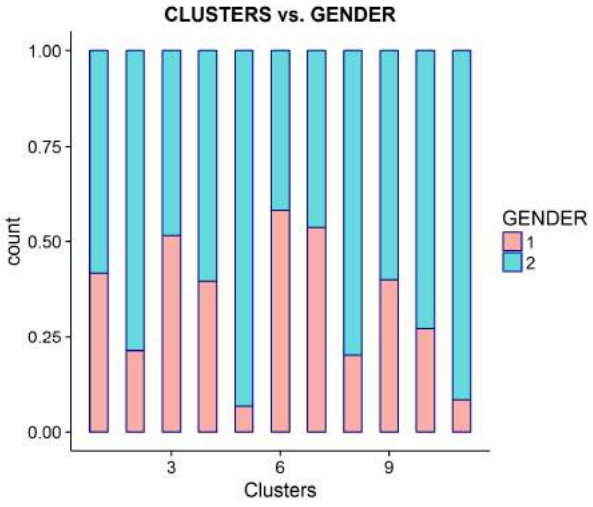


Cluster analysis

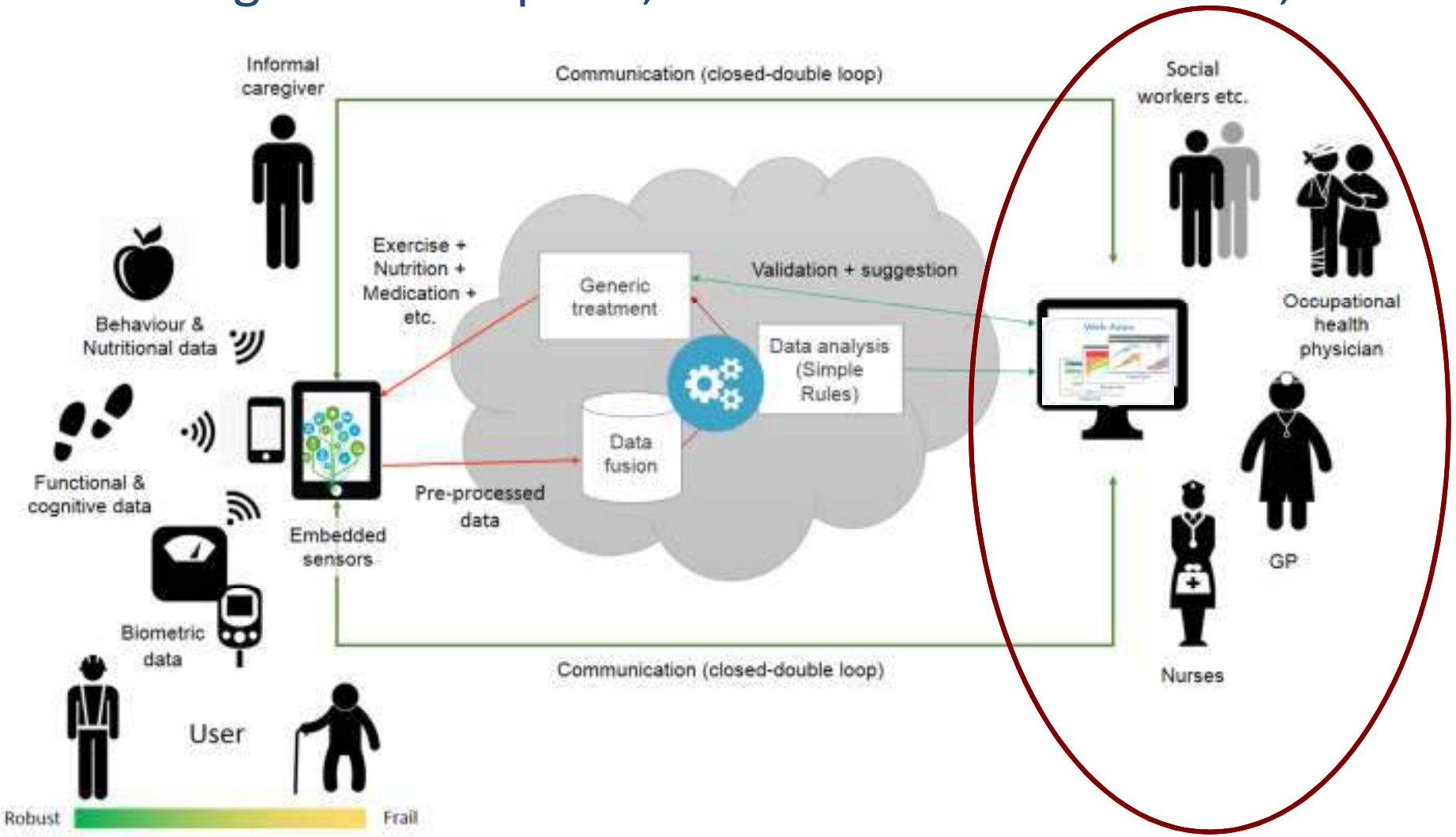








ICT platforms: Care models, Patient management, Integrated care plans, Professional coordination,..








Technology Enabled Primary Care - Right First Time, All the Time





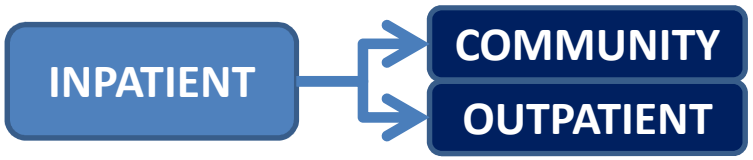




An ICT platform adequate to the Culture of the Geriatric Service

Hospital Universitario de Getafe
SaludMadrid
Comunidad de Madrid

- **Comprehensive Geriatrics Assessment**
  - **Clinical Evaluation**
    - PHYSICAL
    - COGNITIVE
  - **Functional Evaluation**
    - SOCIAL
    - AFFECTIVE
    - SENSORY
- **Transition of care delivery**



- **Prevention**



ACANTO

A CyberphysicAl social NeTwOrk using robot friends

ACANTO is a continuation of a recently finished project: DALI: Devices for Assisted Living



Methods – trial design - intervention

- Use of telemonitoring system every 48 hours to collect:
  - ✓**<u>Vital signs</u>**: blood pressure, heart rate, respiratory rate, oxygen saturation, glucose and weight
  - ✓**<u>Functional status</u>**: part of the Performance Battery:
    - Gait speed in 4 meters





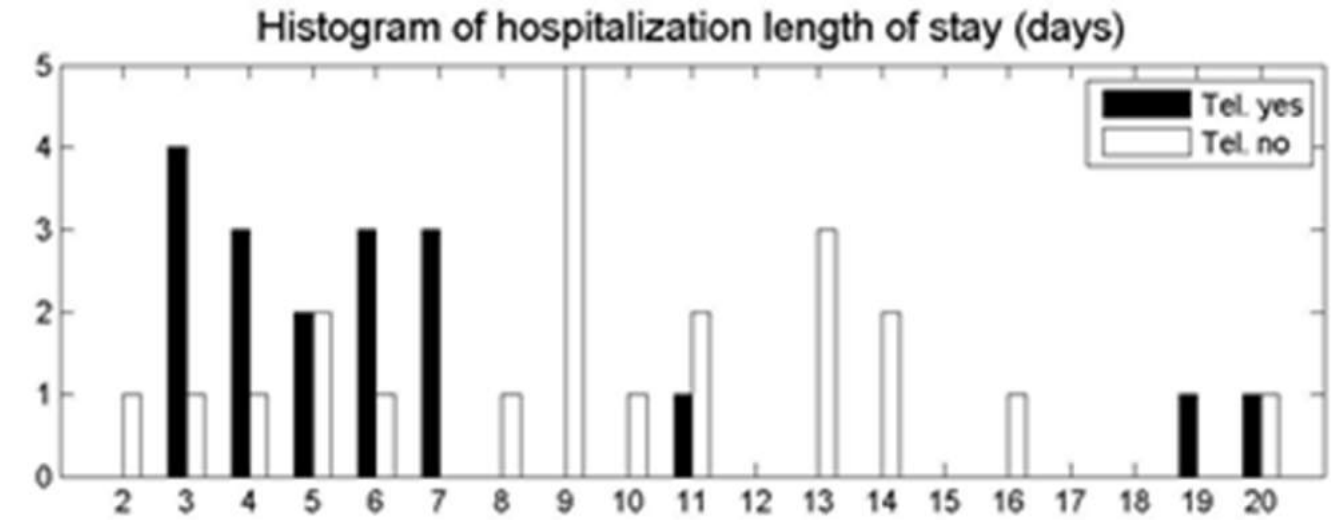
saludnova

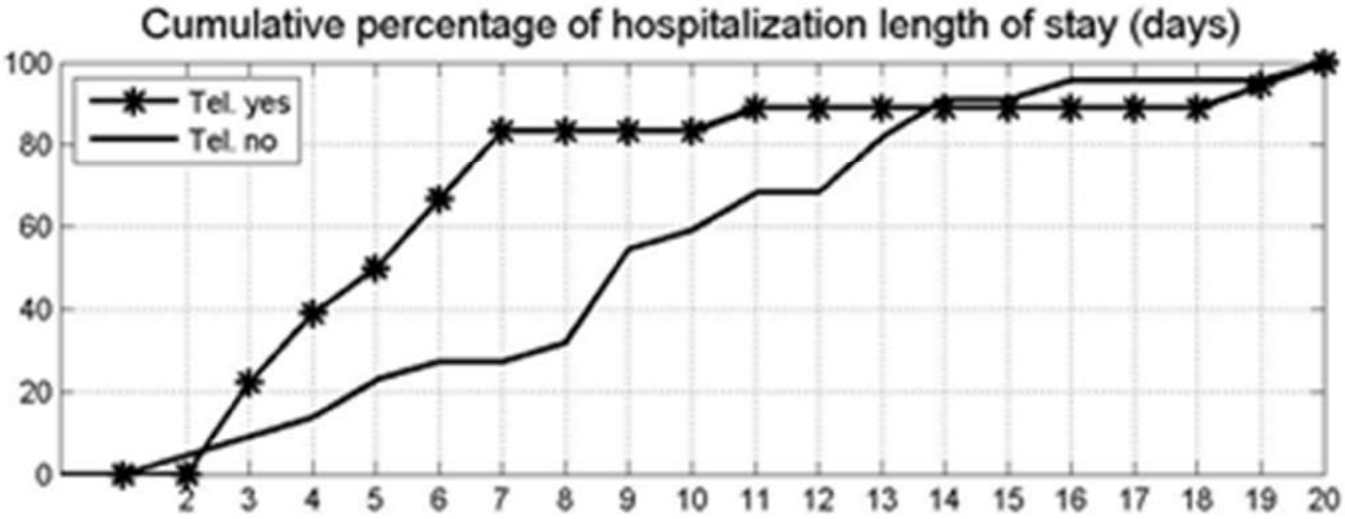
CarelineH@me®

Tecnología cercana al paciente

Telemonitorización domiciliaria

Results – hospitalization length





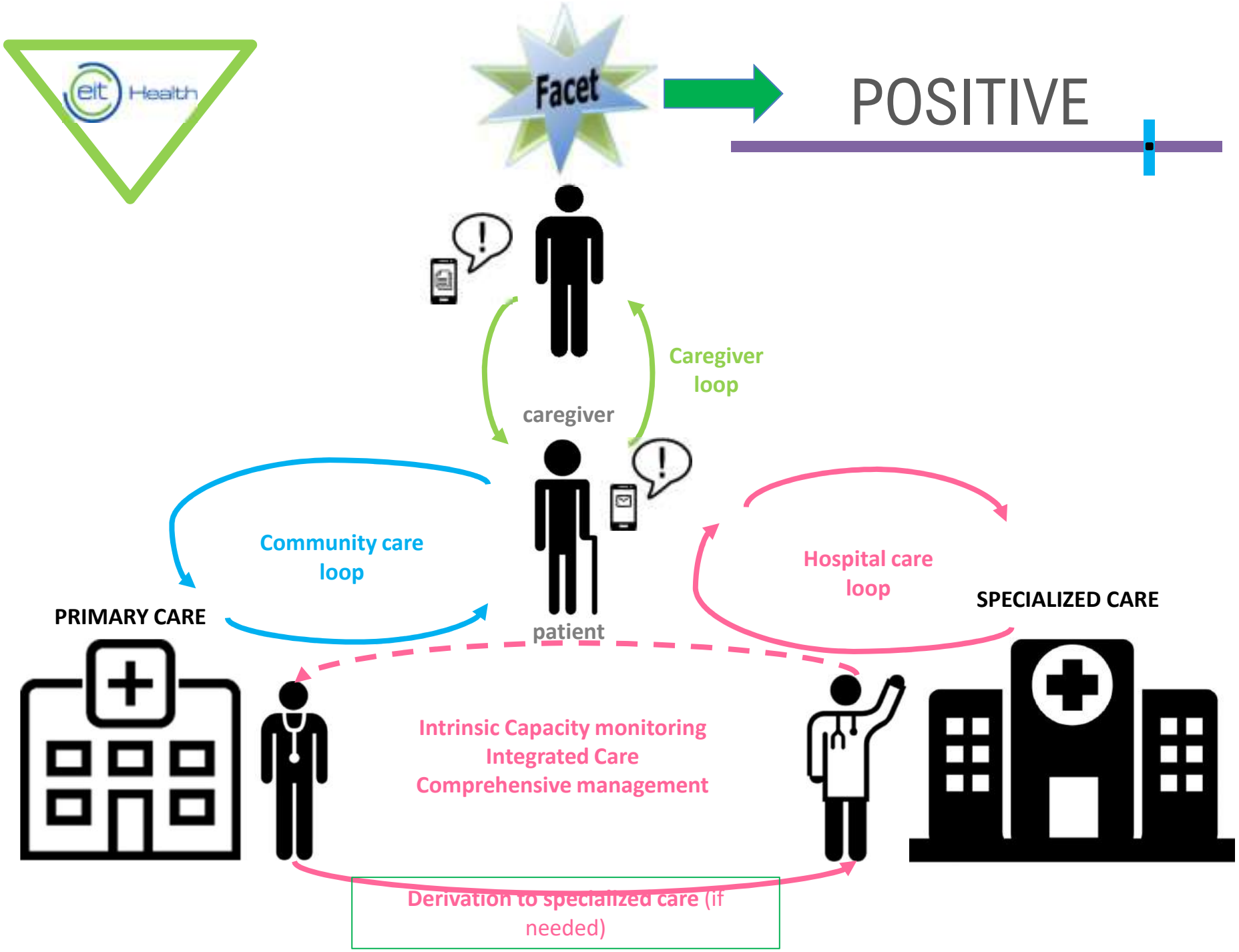
Groups were statistically different (p-value 0.02) and the difference of medians was **3.5 days**.

Alonso-Bouzon C y cols, 2019 (unpublished)

MyHealthyDiet Social Network






Facet
POSITIVE
Caregiver loop
caregiver
patient
Community care loop
Hospital care loop
PRIMARY CARE
SPECIALIZED CARE
Intrinsic Capacity monitoring
Integrated Care
Comprehensive management
Derivation to specialized care (if needed)

THE THIRD TRANSITION

BREAKING THE CLINICAL INERTIA

CARE		CARE
DISEASE		FUNCTION
SURVIVAL		QUALITY OF LIFE
TO DO		RATIO RISK/BENEFIT
LONG-TERM		TIMELY
REACTIVE		PREVENTIVE
CARE OF EPISODES		INTEGRATED/CONTINUED CARE



Rodriguez-Mañas et al., JAMDA 2017
Rodriguez-Mañas et al, ADVANTAGE proposal, 2016



ALMA

THANK YOU

e.mail: leocadio.rodriguez@salud.madrid.org

fundación para la Investigación Biomédica Hospital Universitario de Getafe

SaludMadrid

Hospital Universitario de Getafe
Comunidad de Madrid