Ephion Health is a digital health company revolutionising the monitoring of chronic patients

Using wearables and artificial intelligence to create new clinically validated digital biomarkers

ephion health

Ephion Health in a nutshell

WHAT

Ephion Health measures <u>functional capacity</u>

HOW

Multiple sources of data and Artificial Intelligence

WHY

To identify new digital biomarkers

WHO

Healthcare Providers
Clinical Decision Support Tool

Pharmaceutical companies
Prove the efficacy of drugs

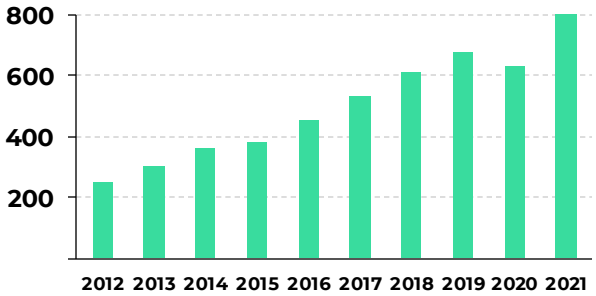
FUNCTIONAL CAPACITY (FC):

an individual's capacity for performing key tasks of daily living

FC IS A KEY METRIC OF

disease severity, progression and efficacy of therapy

Clinical Trials with FC assessments



Avg. YoY GROWTH 12%

Aging
Stroke
Oncology
Respiratory
Orthopaedics
Cardiovascular
Neuromuscular Diseases
1st product

Global spending on clinical trials for these conditions:
$40 billion a year by 2025

There is an unmet need that impacts all stakeholders

PROBLEM

Traditional methods to measure FC are **subjective** and show **low sensitivity**.

Functional Tests

6 Minutes Walk Test

	Activities	Extreme Difficulty or Unable to Perform Activity	Quite a Bit of Difficulty	Moderate Difficulty	A Little Bit of Difficulty	No Difficulty
a.	Any of your usual work, housework, or school activities.	0	1	2	3	4
b.	Your usual hobbies, recreational or sporting activities.	0	1	2	3	4
c.	Getting into or out of the bath.	0	1	2	3	4
d.	Walking between rooms.	0	1	2	3	4
e.	Putting on your shoes or socks.	0	1	2	3	4
f.	Squatting.	0	1	2	3	4
g.	Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
h.	Performing light activities around your home.	0	1	2	3	4
i.	Performing heaving activities around your home.	0	1	2	3	4
j.	Getting into or out of a car.	0	1	2	3	4
k.	Walking 2 blocks.	0	1	2	3	4
l.	Walking a mile.	0	1	2	3	4
m.	Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
n.	Standinf for 1 hour.	0	1	2	3	4
o.	Sitting for 1 hour.	0	1	2	3	4
p.	Running on even ground.	0	1	2	3	4
q.	Running on uneven ground.	0	1	2	3	4
r.	Making sharp turns while running fast.	0	1	2	3	4
s.	Hopping.	0	1	2	3	4
t.	Rolling over in bed.	0	1	2	3	4
Column Totals:						

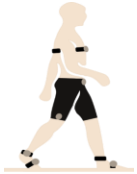
Questionnaires

Patient Reported Outcomes

Clinical and pharmaceutical research are **slow and inefficient**.

Our AI based system brings a precise and sensitive solution

Functional test with Wearables



Doctor & patient REPORTING

Continuos Monitoring

Google Fit Apple Health

App
smartphone

AI Analysis
cloud

ephion health

Biomarker
results site

We integrate data from multiple sources, analyse it with artificial intelligence and provide a disease specific biomarker of patient functional capacity

A hardware agnostic and customizable system

Sensorization of tests

- 3rd party wearables: **Ephion Health is hardware agnostic**.
- **High Usability**: seamless **integration with current protocols** and test.
- **Plug-and-play**

Current validated wearables

IMU & Heart rate

Movesense MD Sensor & Movella DOT

- Single channel ECG, Heart rate, R-R intervals
- 9-axis movement sensor: 3 x accelerometer, 3 x gyroscope, 3 x magnetometer
- Configurable sample rates
- In-built memory for logging data
- Bluetooth® Low Energy (BLE)
- Water (IP68) and shock proof construction

Plantar Pressure

Moticon OpenGo & Sensoria smart-sock

- 16 Plantar Pressure Sensors: 0,25N/cm^2 resolution
- 6-axis movement sensor: 3 x accelerometer, 3 x gyroscope
- Configurable sample rates
- In-built memory for logging data
- Bluetooth® Low Energy (BLE)

Surface electromyography

Myontec MBody3

- 6 EMG biosignal channels: Quadriceps, Hamstrings, Gluteus
- 9-axis movement sensor: 3 x accelerometer, 3 x gyroscope, 3 x magnetometer
- Configurable sample rates
- In-built memory for logging data
- Bluetooth® Low Energy (BLE)

Examples of other possible wearables

ECG & Respiratory rate

Vivalink - ECG Patch Monitor

- ECG rhythm
- Heart rate
- Heart rate variability
- RR-interval
- Respiratory rate
- Skin temperature
- Step count
- Posture
- 3-Axis accelerometer

Acousto-mechanical sensing

Sibel Health - Aria

- Swallow count
- Cough count
- Talk time
- Movement
- Body position
- Skin temperature
- Fall count

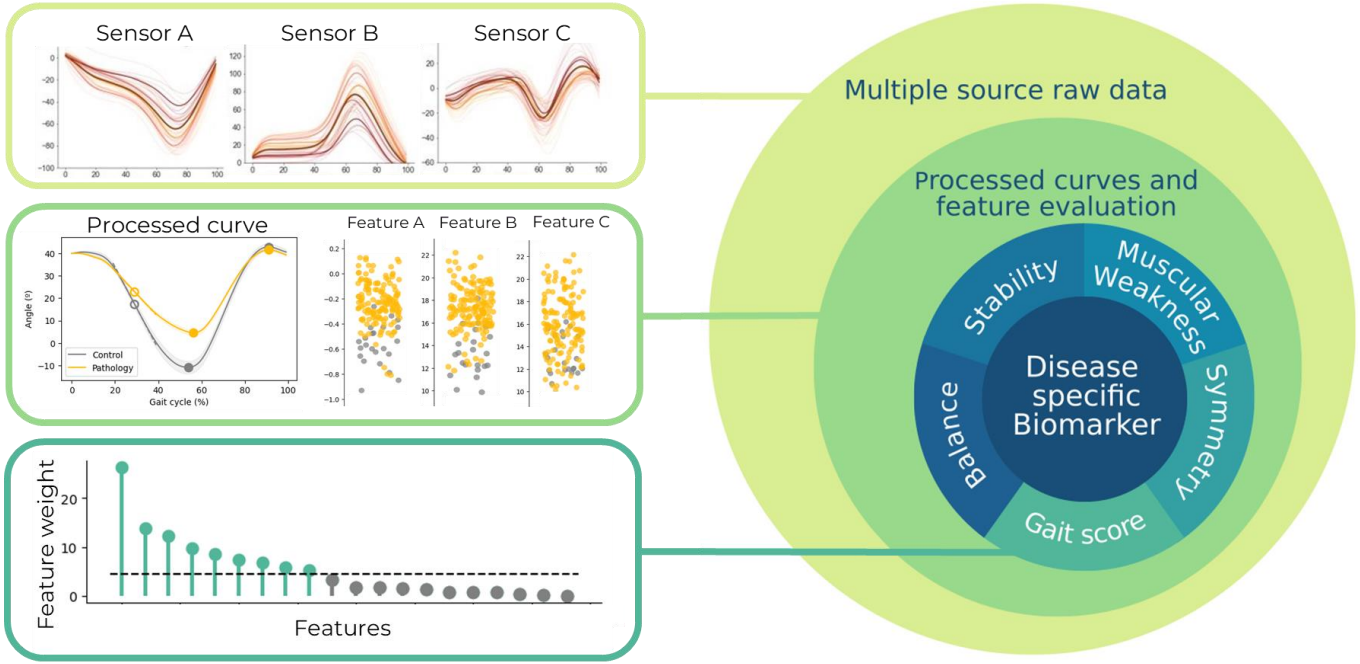
Grip strength

Squegg

Our core technology allows us to generate unique Digital Biomarkers

AI Analysis

Our algorithms analyze patient data to **reliably measure** disease progression and **response to treatment.**



Current calculated parameters

ephion health

Spatio-temporal parameters	
Parameters	**Definition**
Distance (m)	Distance covered by the patient during the test
Number of steps	Steps walked during the test
Speed (m/s)	Velocity of the patient gait
Cadence (steps/min)	Number of steps per minutes
Stride length (m)	Length in meters of a gait cycle normalized to height
Stride velocity (m/s)	Velocity in meters / second of a gait cycle
Stance phase (%)	Percentage of time in stance phase, foot- ground contact, on the overall gait cycle.
Swing phase (%)	Percentage of time in swing phase, foot in the air, on the overall gait cycle.
Single Support (%)	Percentage of time in single support, one foot on the ground, on the overall gait cycle.
Double Support (%)	Percentage of time in double support, both feet on the ground, on the overall gait cycle.
Step duration (s)	Time token to perform a step

Cardiorespiratory parameters	
Parameters	**Definition**
Heart Rate (bpm)	Evolution of the heart rate value throughout the test
R – R intervals	Time intervals between consecutive heart beats
Heart Rate Variability (SDNN)	Variability of RR intervals calculated as the standard deviation of RR intervals
Initial values of Heart Rate (bpm)	Mean value of the first 15 samples of signal
Final values of Heart Rate (bpm)	Mean value of the last 10 samples of signal
Mean Heart Rate (bpm)	Mean value of the heart rate signal
Heart Rate tendency	Slope between initial heart rate mean and final heart rate mean
Heart Rate signal area	Area under the curve of heart rate signal
Heart Rate variability	Standard deviation of heart rate signal (in all signal, on the first 15 samples and the last 10 samples)
Heart Rate values on countdown phase (bpm)	Mean of heart rate countdown signal (rest signal)
RMSDD (ms)	Root mean square of successive differences between R-R
Initial values of R-R intervals	Mean value of the first 15 samples of signal
Final values of R-R intervals	Mean value of the last 10 samples of signal
Mean R-R intervals	Mean value of the heart rate signal
R-R intervals tendency	Slope between initial heart rate mean and final heart rate mean
R-R intervals signal area	Area under the curve of R-R signal

Current calculated parameters

ephion health

Kinematic parameters	
Parameters	**Definition**
Trunk angle	Mean profile of flexion-extension segment angle evolution throughout gait cycle.
	Mean profile of lateral flexion-extension segment angle evolution throughout gait cycle.
	Mean profile of internal-external rotation segment angle evolution throughout gait cycle.
Pelvis angle	Mean profile of flexion-extension joint angle evolution throughout gait cycle.
	Mean profile of lateral flexion-extension segment angle evolution throughout gait cycle.
	Mean profile of internal-external rotation segment angle evolution throughout gait cycle.
Hip flexion angle	Mean profile of flexion-extension joint angle evolution throughout gait cycle. Right and Left side.
Knee flexion angle	Mean profile of flexion-extension joint angle evolution throughout gait cycle. Right and Left side.
Ankle flexion angle	Mean profile of flexion-extension evolution throughout gait cycle. Right and Left side.
Thigh flexion angle	Mean profile of flexion-extension segment angle evolution throughout gait cycle. Right and Left side.
	Mean profile of abduction - adduction segment angle evolution throughout gait cycle. Right and Left side.
	Mean profile of internal – external rotation segment angle evolution throughout gait cycle. Right and Left side.
Shank flexion angle	Mean profile of flexion-extension segment angle evolution throughout gait cycle. Right and Left side.
	Mean profile of abduction - adduction segment angle evolution throughout gait cycle. Right and Left side.
	Mean profile of internal – external rotation segment angle evolution throughout gait cycle. Right and Left side.
Foot flexion angle	Mean profile of flexion-extension segment angle evolution throughout gait cycle. Right and Left side.
	Mean profile of internal – external rotation segment angle evolution throughout gait cycle. Right and Left side.
	Mean profile of eversion - inversion segment angle evolution throughout gait cycle. Right and Left side.

Electromyography (EMG) parameters	
Parameters	**Definition**
Maximum voluntary contraction (MVC)	Maximum muscle activation while doing isometric exercises, is related with muscle strength
Muscle Distribution	% of activation of each muscle in respect to the total activation
Co-activation indices	Timing of simultaneous activation of two muscles. Relation between (H/Q, H/G, Q/G).
Hamstring muscle	Mean profile of muscle activation evolution throughout gait cycle. Right and Left Side.
Gluteus muscle	Mean profile of muscle activation evolution throughout gait cycle. Right and Left Side.
Quadriceps muscle	Mean profile of muscle activation evolution throughout gait cycle. Right and Left Side.

Plantar pressure parameters	
Parameters	**Definition**
Ground Force Reaction	Mean profile of vertical force evolution throughout gait cycle. Right and Left side.
Force Balance (%)	Comparison of the percentage of the total force on right side versus left side
Centre of Pressure evolution	Mean profile of centre of pressure evolution throughout gait cycle. Right and Left side.
Angle of Centre of Pressure trajectory	Angle that Centre of pressure trajectory performs during the execution of gait cycle.

Current calculated parameters

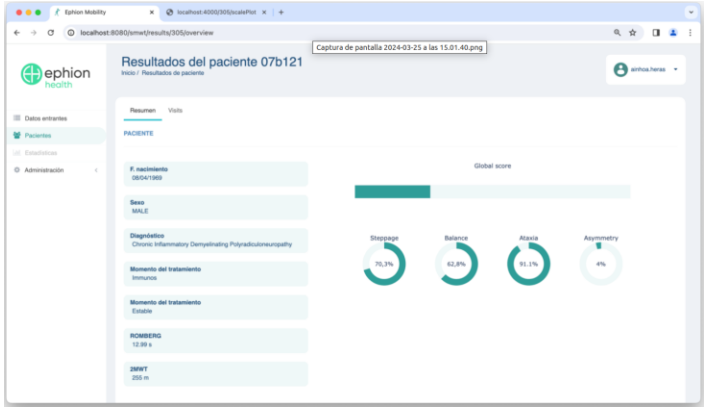
Features calculated on all the gait parameters (Kinematics, EMG, Plantar Pressure)	
Parameters	**Definition**
Peaks and valleys	Maximum point between heel-off and middle-swing phase. Value and % of gait cycle when it occurs.
	Maximum point between heel-strike and heel-off phase. Value and % of gait cycle when it occurs.
	Maximum point during swing phase. Value and % of gait cycle when it occurs.
	Minimum point between middle-stance and toe-off phase. Value and % of gait cycle when it occurs.
	Minimum point between pre-swing and middle-swing phase. Value and % of gait cycle when it occurs.
	Prominance of each peak and valley detected during gait cycle.
Distance and amplitude between peaks and valleys	Distance in % of cycle between maximums and minimums during gait cycle.
	Amplitude of the pattern between maximums and minimums during gait cycle.
Peak slope during stance phase	Slope value between maximum and minimum point during stance phase.
Mean	Mean value during gait cycle.
Variability	Standard deviation of pattern during gait cycle.
Area	Area under the curve of the pattern during gait cycle.
Range of motion	Amplitude (maximum – minimum) of the pattern during gait cycle, and per each phase (stance and swing)

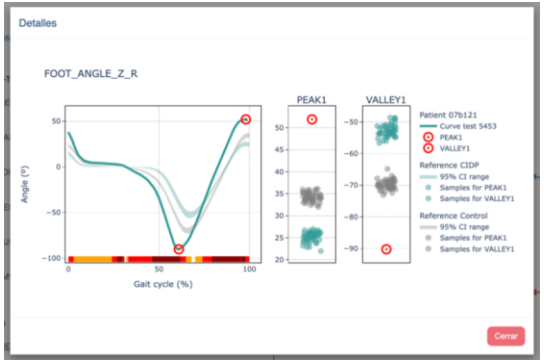
Results site with easy to interpret insights

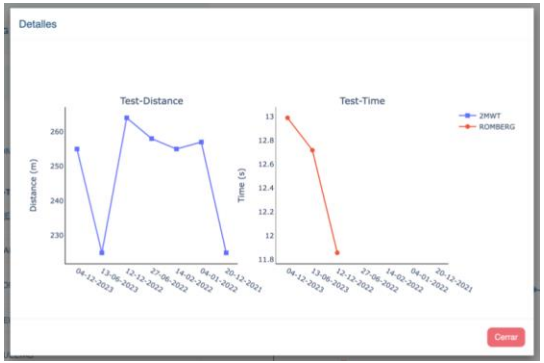
Instant Results

Results from the analysis are graphically presented in a secure site:

- **Digital biomarkers**
- **Longitudinal evolution of clinically relevant parameters**
- **Scales and completed questionnaires**



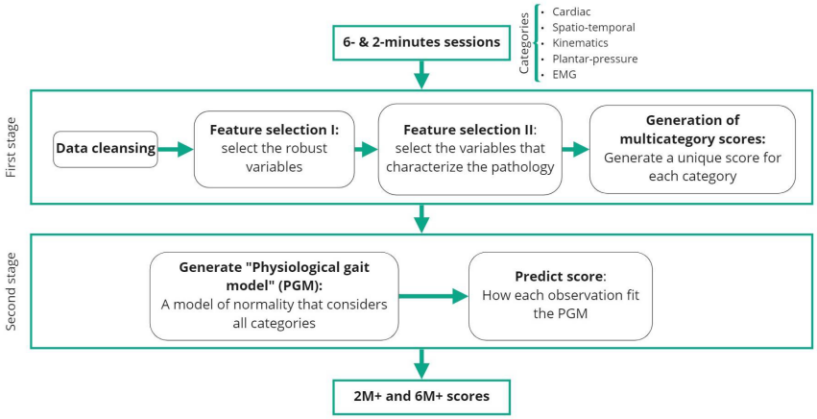


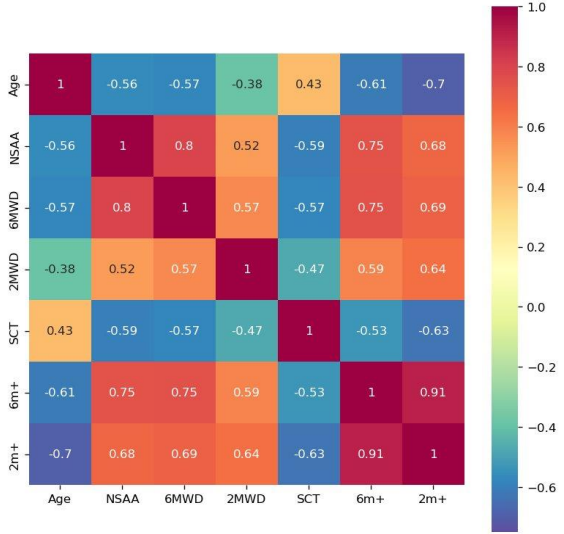


Use case: DMD composite biomarker

Study in collaboration with Hospital Sant Joan de Deu (Barcelona)

28 male children suffering from DMD (age 6.3–15.4 years)
Control group: 27 healthy male children (age 9.0–13.9 years)
Tests: 2MWD, 6MWD & NSAA
Longitudinal data: 2019-2024





Ephion composite biomarkers (2M & 6M) correlation matrix:

- Ephion 6M highly correlated with NSAA, similar to 6MWD
- Ephion 2M mantains high correlation to NSAA, contrary to 2MWD
- Higher correlation of the Ephion Score with Age compared to NSAA and Distance

Use case: DMD composite biomarker

97%
Intra-class correlation coefficient
RELIABILITY

94%
Of classified patients were truly patients
SPECIFICITY

86%
Of patients were classified as patients
SENSITIVITY

91%
Discrimination pathology from controls
ACCURACY

↓ **36%*** of sample size reduction when using our biomarker

*in DMD Clinical Trials as compared to 6MWT

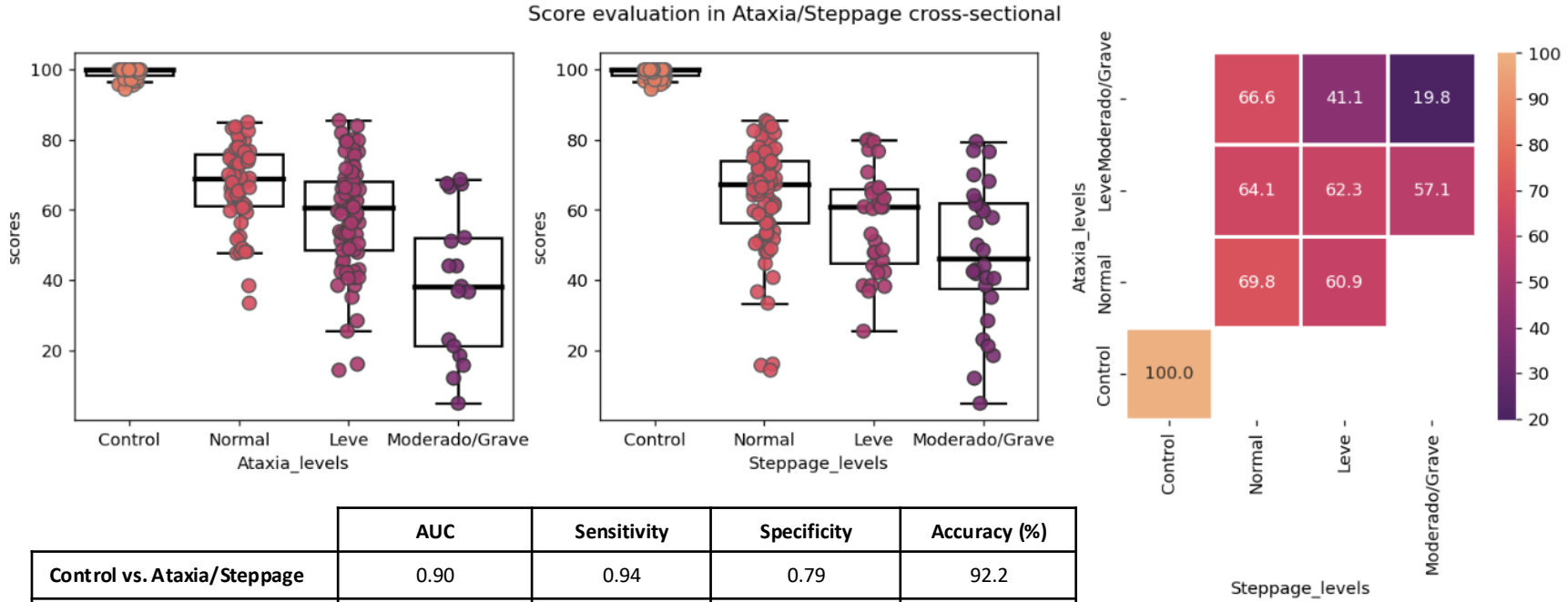
2.7% of change is considered clinically significant MCID

Concurrent validity: correlations coefficients (Spearman)

	NSAA	6MWD	AGE
Ephion Biomarker	0.72	0.68	-0.60
SYDE (SV95C)	0.676	0.678	-0.488

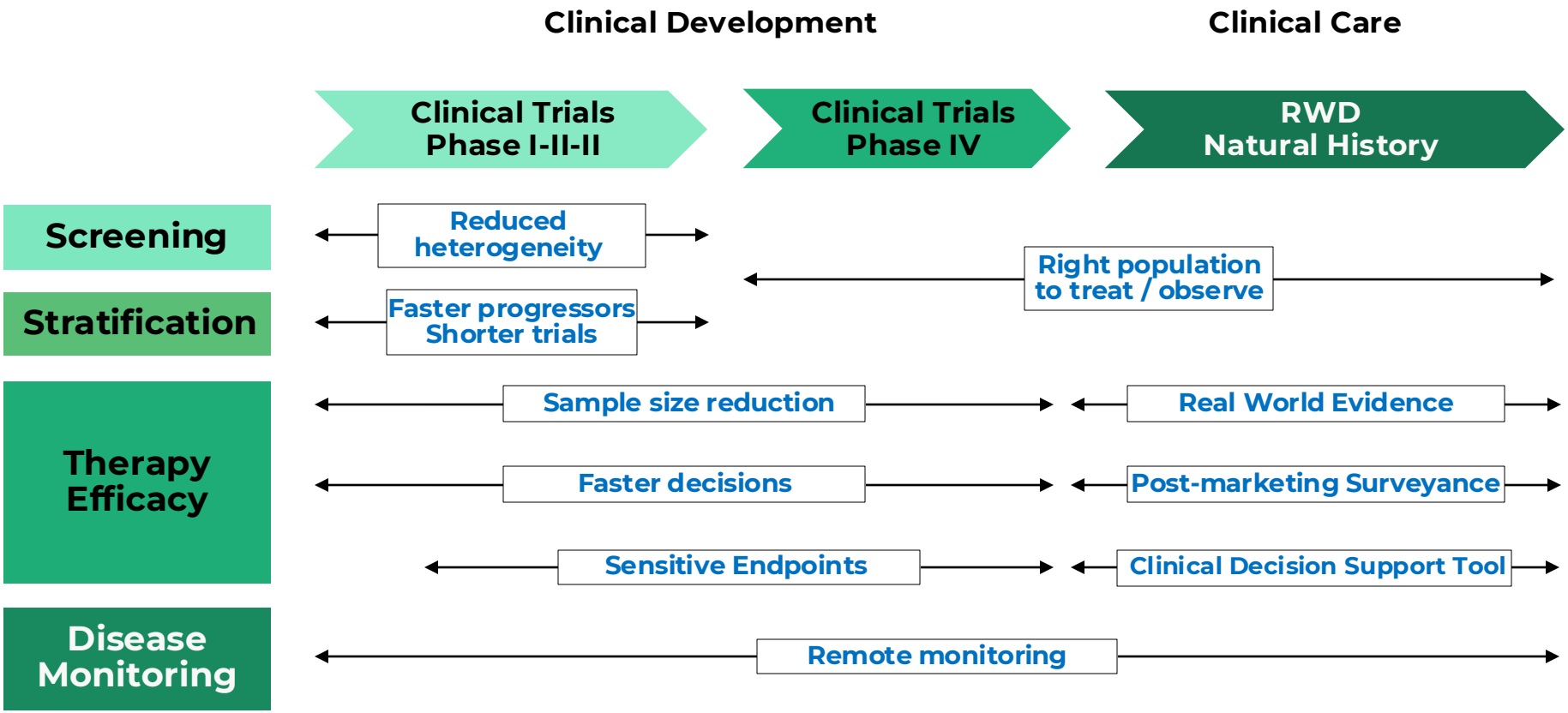
Use case: Neuropathies composite biomarker

The score differentiates **perfectly** controls from pathology



	AUC	Sensitivity	Specificity	Accuracy (%)
Control vs. Ataxia/Steppage	0.90	0.94	0.79	92.2
Control vs. Ataxia	0.91	0.92	0.83	90.4
Control vs. Steppage	0.93	0.98	0.83	93.9

Our technology creates value in the entire health ecosystem



Our first product is clinically validated and used by Key Opinion Leaders

Currently used by KOL to monitor patients with NEUROMUSCULAR DISEASES

Hospital Sant Joan de Deu (Barcelona)
Duchenne Muscular Dystrophy
Link to publication

Dr. Julita Medina

"Thanks to Ephion we have been able to follow-up patients with higher accuracy"

RigsHospitalet (Copenhagen, DK)
Becker Muscular Dystrophy
Myotonic Muscular Dystrophy

Dr. John Vissing

"Ephion is a highly relevant system to be used in the clinic as well as in research"

Hospital Sant Pau (Barcelona)
CIDP
Peripheral Neuropathies
Link to publication

Dr. Luis Querol

"Ephion's tool could have great applicability in all Neurological diseases"

Newcastle University (UK)
POMPE
Link to publication

Dr. Jordi Diaz-Manera

"I believe Ephion's tool could be of great value in Clinical Trials"

sensors

MDPI

Article

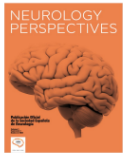
Multidimensional Biomechanics-Based Score to Assess Disease Progression in Duchenne Muscular Dystrophy

Carolina Migliorelli [1,*], Meritxell Gómez-Martinez [1], Paula Subías-Beltrán [1], Mireia Claramunt-Molet [1,2], Sebastian Idelsohn-Zielonka [1,2], Eudald Mas-Hurtado [1], Felip Miralles [1,2], Marisol Montolio [3,4], Marina Roselló-Ruano [3,4] and Julita Medina-Cantillo [5,6]

Neurology Perspectives. 2023;3(S1):197

ELSEVIER

Neurology perspectives



19044 - ANÁLISIS DEL PATRÓN DE LA MARCHA EN PACIENTES CON NEUROPATÍAS PERIFÉRICAS MEDIANTE SENSORES BIOMECÁNICOS PORTÁTILES

Tejada Illa, C.[1]; Claramunt Molet, M.[2]; Pi Cervera, A.[2]; Idelsohn Zielonka, S.[3]; Vidal, N.[4]; Martín Aguilar, L.[4]; Caballero Ávila, M.[4]; Lleixà, C.[4]; Rojas García, R.[4]; Olivé, M.[4]; Querol, L.[4]; Pascual Goñi, E.[4]

[1]Unidad de Enfermedades Neuromusculares. Institut de Recerca Hospital de la Santa Creu i Sant Pau; [2]Salud digital. Ephion Health; [3]Salud Digital. Ephion Health y EURECAT; [4]Unidad de Enfermedades Neuromusculares. Hospital de la Santa Creu i Sant Pau.

PNS PERIPHERAL NERVE SOCIETY

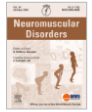
Analysis of gait patterns in patients with peripheral neuropathies using a novel wearable system

Clara Tejada Illa, Mireia Claramunt-Molet, Ariadna Pi-Cervera, Sebastian Idelsohn-Zielonka Nuria Vidal, Lorena Martín-Aguilar, Marta Caballero-Ávila, Cinta Lleixà, Ricardo Rojas-García, Luis Querol, Elba Pascual-Goñi

ELSEVIER

Neuromuscular Disorders

Volume 32, Supplement 1, October 2022, Page S76



P.84 Gait analysis of patients with Pompe disease using a portable system

M. Claramunt [1], S. Idelssonhn [1], M. James [2], M. Corti [3], V. Anton [4], B. Byrne [3], J. Díaz Manera [2]

A hardware agnostic and SCALABLE platform

	Discovery	Validation	Commercial
Mobility disorders Musculoskeletal Neuromuscular Neurological	**Duchenne** **Becker** **Pompe** **Neuropathies** **Multiple Sclerosis** **Parkinson's** **ALS** **Frailty** **Stroke**	**Peer Reviewed scientific publications**	MDR CE FDA REGISTERED
Cardiovascular			
Respiratory			
Oncology			

LESCER
INVALCOR Biomecánica
Vall d'Hebron Institut de Recerca
ITALFARMACO
SANT PAU Campus Salut Barcelona
argenx
astellas
Amicus Therapeutics
CAPSBE Consorci d'Atenció Primària de Salut Barcelona Esquerra
IQVIA™
DEEP Building Digital Measures

We are not just different, we are better

Our AI can work with any wearable from any vendor and generate composite biomarkers

	Ephion Health	Koneksa	Sysnav	Aparito	BioSensics	Clario
Multi-modal Data	**Yes**	No	No	No	**Yes**	**Yes**
Hardware Agnostic	**Yes**	**Yes**	No	**Yes**	No	No
Composite Biomarker	**Yes**	No	No	No	No	No
AI Analysis	**Yes**	No	No	No	No	No

We are collaborating with key players in the healthcare industry

Joint Go-To-Market strategy with IQVIA

Ephion Health was selected for the **2023 Accelerator Program by IQVIA**.

Joint Go-to-Market strategy: **Real World Evidence studies for new drugs in Neuromuscular Diseases.**

Second product in development: MONITORING of frail elderly patients

New product in collaboration with Quirón Salud

A digital solution to objectively **monitor frail elderly patients and predict risk of falling**

250 elderly patients will be monitored with Ephion Health platform **in the hospital and remotely at home**

Our technology is patented and certified

Patent Filed

Positive International Search Report

Favorable Written Opinion of the International Searching Authority

National phases in **November 2024**

Certification as a medical device

Software as a Medical Device under MDR (EU) 2017/745: **Type IIa**

FDA Registered

Software as a Medical Device **Type II (510k exempt)**

We are entrepreneurs, engineers and doctors joined by a common vision

ephion health

Mireia Claramunt
CTO

Sebas Idelsohn
CSO

Quique Llaudet
CEO

Dr. Julita Medina
SJD Sant Joan de Déu Barcelona · Hospital

Dr. Luis Querol
Institut de Recerca Sant Pau

Dr. Jordi Diaz
The John Walton Muscular Dystrophy Research Centre

Google for Startups Alumni 2024

BARCELONA HEALTH HUB

i4KIDS PEDIATRIC INNOVATION HUB

DEEP Building Digital Measures

ephion
health

quique@ephion.health