

www.ispor.org



Collaborating With Patients to Define Digital Endpoints and Biomarkers That Truly Matter

Monday May 18, 2026 | 3:15PM – 4:15PM

Discussion Topics

	Topic	Presenter(s)
1	Welcome, Introductions (10 mins)	Anita Burrell
2	Digital COA acceptance (10 mins)	Bryan Bennett
3	Developing digital technologies (10 mins)	Arturo Cabra
4	Co-creating with patients (10 mins)	Angie Botto van Bemden
5	Q&A (15 mins)	All
6	Closing remarks	Anita Burrell

Today's Panel



Anita Burrell
Past Chair,
Digital Health
SIG and
Founder, Anita
Burrell
Consulting LLC



Bryan Bennett
Chair, Past Chair
Clinical Outcome
Assessment SIG
and Head Patient
Centred Outcomes
Jazz
Pharmaceuticals,
UK



Arturo Cabra
Medical Devices
& Diagnostics
SIG,
HEOR Global
Leader, GE
Healthcare



Angie Botto van Bemden
Chair, Patient
Centered SIG and
CEO, Clinical
Research Experts &
Founder,
Musculoskeletal
Research
International

Antitrust Compliance Statement

- ISPOR has a policy of strict compliance with both United States, and other applicable international antitrust laws and regulations.
- Antitrust laws prohibit competitors from engaging in actions that could result in an unreasonable restraint of trade.
- ISPOR members (and others attending ISPOR meetings and/or events) must avoid discussing certain topics when they are together including, prices, fees, rates, profit margins, or other terms or conditions of sale.
- Members (and others attending ISPOR meetings and/or events) have an obligation to terminate any discussion, seek legal counsel's advice, or, if necessary, terminate any meeting if the discussion might be construed to raise antitrust risks.
- The Antitrust policy is available on the ISPOR website.

Author's Disclosure

Bryan Bennett is an employee of Jazz Pharmaceuticals and holds stock in Jazz Pharmaceuticals.

Anita Burrell has no conflicts of interest relating to digital endpoints or biomarkers to disclose

Arturo Cabra is an employee and shareholder of GE HealthCare, which commercializes Medical Devices and Diagnostics globally.

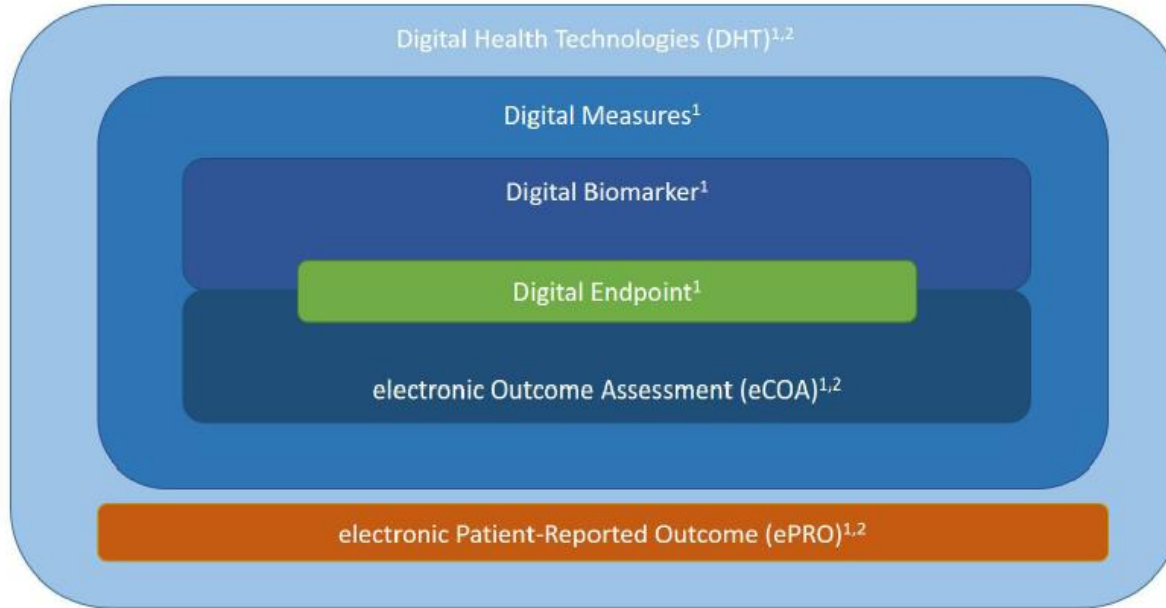
1

What defines a digital endpoint or biomarker?

What is a Digital Endpoint?

- **Digital Endpoint** “A precisely defined variable intended to reflect an outcome of interest that is 1) collected digitally with a sensor, and 2) statistically analyzed to address a particular research question.” [DiME](#)
- **Digital Endpoint:** “A Digital Endpoint (a precisely defined variable intended to reflect an outcome of interest that is statistically analysed to address a particular research question) is derived from or includes a digital measurement. Digital endpoints can be **clinical outcome assessments** (clinical relevance established De Novo) or **biomarkers** (reliable relationship with existing clinical outcome can be established). [EMA Q&A June 2020](#)

Overlap of terms



(1) EMA: https://www.ema.europa.eu/en/documents/other/questions-answers-qualification-digital-technology-based-methodologies-support-approval-medicinal_en.pdf

(2) FDA: <https://www.fda.gov/media/155022/download>

Figure 3 Semantic overview of terminology used by EMA and FDA. Digital health technologies obtain digital measures, which include digital biomarkers and electronic clinical outcome assessment (eCOA). Digital biomarkers and eCOAs both can provide digital endpoints. EMA, European Medicines Agency; FDA, Food and Drug Administration.

Pros and cons of digital measures

- Pros

- Can be collected outside of a clinical setting
- Offers more relevant data to be collected
- More frequent/real time assessment
- Can reduce burden on patients
- Can reduce trial costs

- Cons

- May lead to data privacy and security risks
- Current lack of consistency in regulatory guidance
- Need to consider technical validation and clinical validation
- May lead to access inequity
- Potential for compliance and selection bias

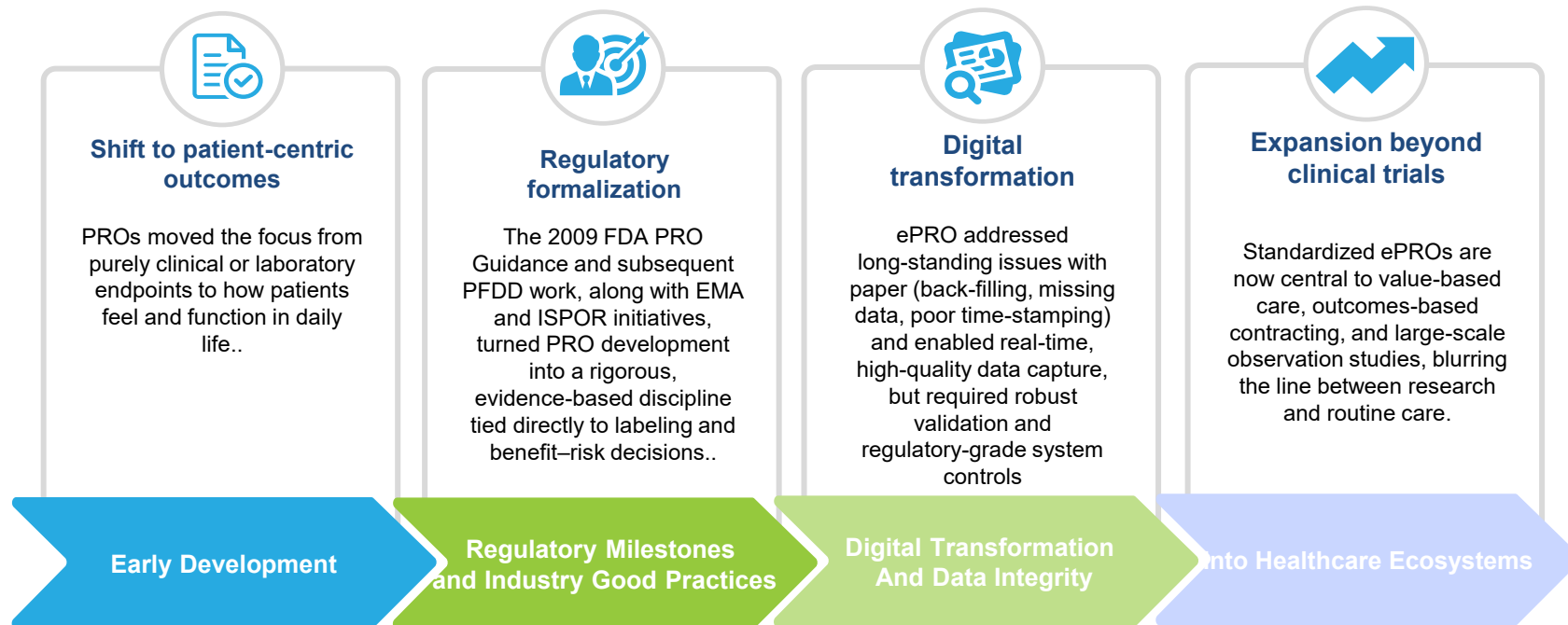
2

Evolving Journey of Digital COA

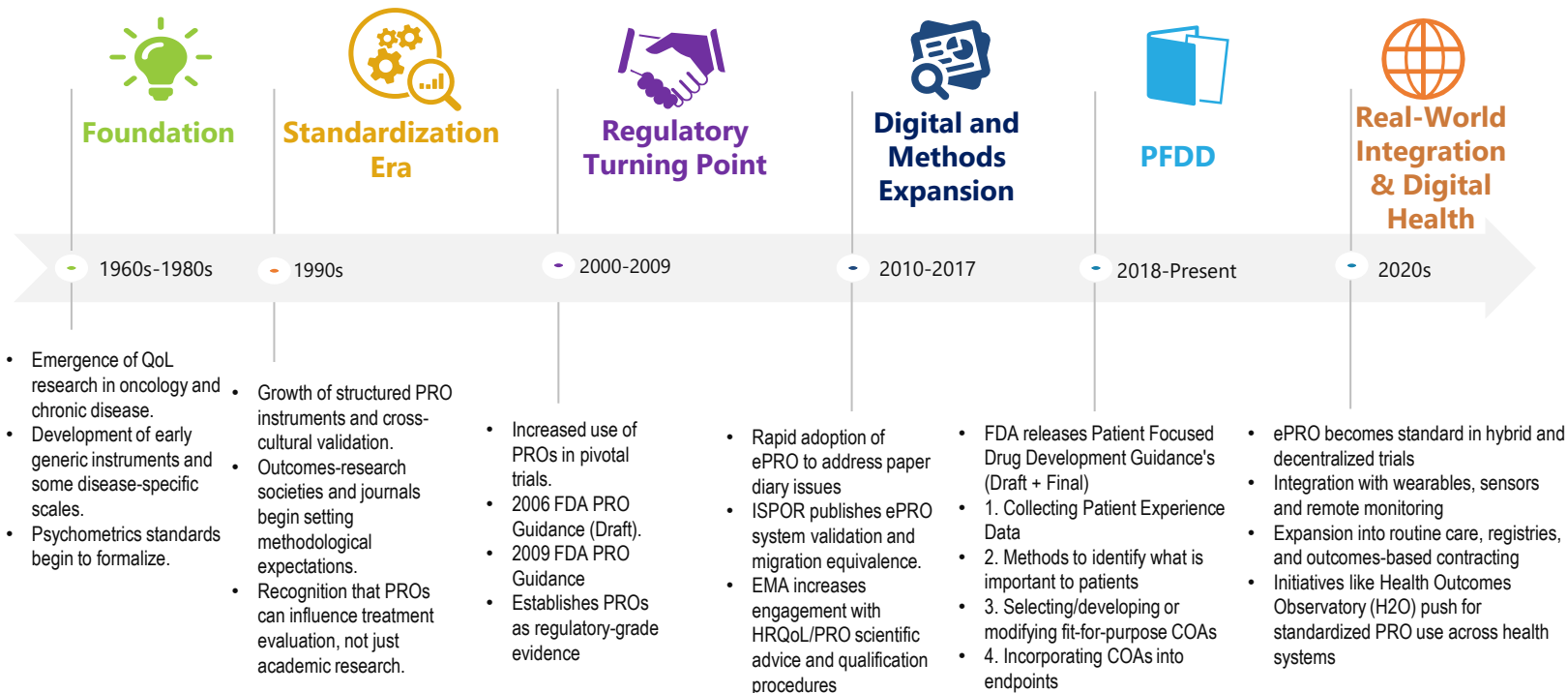
POLLING QUESTION

- When was the last time you developed a COA strategy with a recommendation for using paper questionnaires?
 - A - <2 years ago
 - B - 2-5 years ago
 - C - >5 years ago
 - D - Never
 - E - Not my role

The Path to Perfection...?



The Evolution – A Long (a Continuing) Journey



Case Study 1: Standardization Era (1990s)

Context: A widely used clinician-reported and patient-reported outcome measure was migrated from paper to digital by a vendor without involving the instrument developer.

What Went Wrong

- Response options were reformatted into a scrolling list instead of a single visible set
- Instructions were shortened to *'Select your answer'*
- Items intended to be grouped were separated across screens
- Navigation changed the cognitive flow of the measure

Impact

- The instrument developer rejected the digital version
- Sponsor had to rebuild the digital version and repeat usability testing
- Trial timelines were delayed
- Additional costs incurred for reprogramming and revalidation

Lesson Learnt

- Digital migration must preserve the **content validity**, **layout** and **cognitive burden** – even small changes can invalidate a validated instrument

Case Study 2: Modern Digital Era (2020s)
Context: A Phase II study used multi-sensor wearables to capture mobility and sleep endpoints alongside ePRO.

What Went Wrong

- Participants found the wearable uncomfortable
- Charging requirements were unclear
- Bluetooth synching failed intermittently
- Participants removed the device during daily activities
- Compliance dropped below 50% by Week 4

Impact

- Large gaps, missing data, in sensor derived endpoint data
- Inability to calculate pre-specified digital endpoints
- Regulators questioned the interpretability of the results
- Sponsor removed the digital endpoint from the final analysis

Lesson Learnt

- Digital COAs can fail when participant burden, usability, and device logistics are underestimated
- Modern digital endpoints require human-centred design and robust testing

Case Study 3: When Things Go Very Wrong

Context: A global Phase III trial provisioned devices for data capture.

What Went Wrong

- Devices were shipped late and to the wrong sites
- Sites lacked training on setup and troubleshooting
- Many patients did not complete baseline assessments
- No contingency plan (e.g. BYOD, web backup)

Impact

- ~40% baseline PRO data missing
- Baseline-adjusted endpoints were uninterpretable
- Trial required protocol amendments and additional monitoring (time and costs)
- Major delays in trial

Lesson Learnt

- Operational failures – not technology – can be the biggest risk to eCOA success.
- Device logistics must be treated as a critical path activity

Closing Thoughts

3

Developing Digital Technologies:

Author's Disclosure



Arturo Cabra is an employee and shareholder of **GE HealthCare**, which commercializes Medical Devices and Diagnostics globally.

Content for informational purposes only. Opinions expressed are my own.

| The Signal Exists. The Access Doesn't.

3.5 years

avg. time to Alzheimer's diagnosis
after first symptoms (Int J Geriatric Psychiatry, 2025)

3+ years

avg. time to Parkinson's diagnosis
non-motor symptoms triple referral delays (BMC Primary Care, 2025)

GATE 1

Regulatory Clearance

FDA / EMA acceptance

Clearance ≠ Coverage

>

GATE 2

Payer Coverage

Evidence of Value

Coverage ≠ Access

>

GATE 3

Patient Access

Diverse populations, real-world settings

This is the real finish line

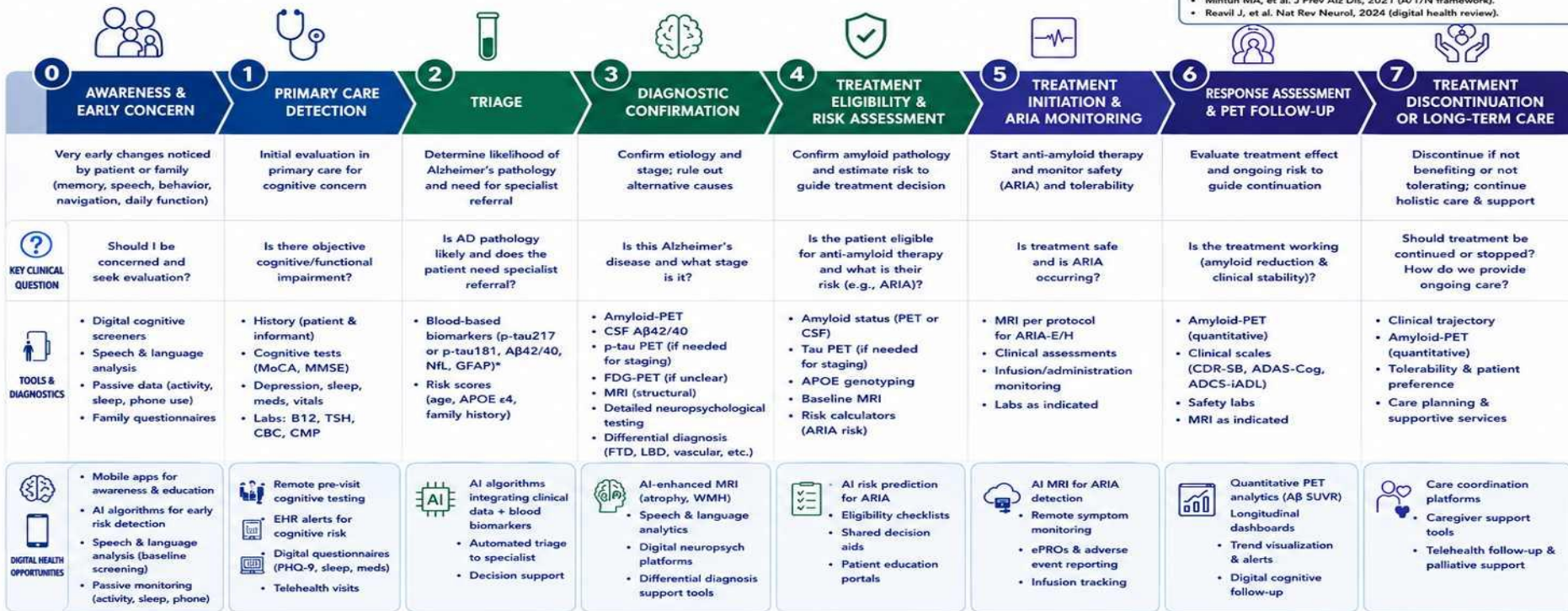
Digital biomarkers can compress the diagnostic gap — but only if the evidence crosses **all three gates**.

ALZHEIMER'S DISEASE PATIENT PATHWAY

Biomarker-enabled, digitally supported care from very early suspicion to severe Alzheimer's disease

EVIDENCE BASE (Peer-reviewed)

- Alzheimer's Association. Alzheimer's & Dementia, 2024 (biomarker-based diagnosis & staging).
- Mila-Alornà M, et al. Lancet Neurology, 2024 (blood biomarkers guideline).
- Cummings J, et al. Alzheimer's & Dementia, 2023 (locanemab AUR).
- Mintun MA, et al. J Prev Alz Dis, 2021 (A/T/N framework).
- Reavil J, et al. Nat Rev Neurol, 2024 (digital health review).



DISEASE CONTINUUM (CLINICAL STAGE)



*Blood biomarkers are evolving. Use assays with demonstrated clinical performance and per local regulatory guidance.

Abbreviations: AD = Alzheimer's disease; ARIA = Amyloid-Related Imaging Abnormalities; PET = Positron Emission Tomography; CSF = Cerebrospinal Fluid; Aβ = Amyloid beta; p-tau = phosphorylated tau; NFL = Neurofilament light chain; WMH = White Matter Hyperintensities; IADLs = Instrumental Activities of Daily Living; ADLs = Activities of Daily Living; EHR = Electronic Health Record; ePROs = electronic Patient-Reported Outcomes.

Two Tracks. No Bridge.

DIGITAL BIOMARKER TRACK

→ Developers build

Raw signal → Digital Biomarker → Endpoint

→ Validated against

Cognitive scores, clinical benchmarks, each other

→ Language

AUC, sensitivity, signal fidelity

CLINICAL / PAYER TRACK

→ Payers and clinicians trust

Clinical diagnostics (UPDRS, MMSE), Gold Standard, Biomarkers

→ Guidelines require

Concordance with established gold standards and validation

→ Language

Guideline concordance, Budget Impact, Accuracy, Diagnostic and Clinical Utility

GAP

Until digital health validates against what payers and clinicians already trust, the bridge does not exist.

What Bridging the Gap Looks Like

The Mobilise-D Case

- One wearable sensor (lower back). One algorithmic pipeline.
- 24 validated Digital Mobility Outcomes (DMOs)
- Validated alongside UPDRS — not instead of it
- Enables real-time, continuous monitoring between clinic visits
- >90% patient adherence across 5 disease cohorts

Same device. Same pipeline. Five diseases: Parkinson's • COPD • Multiple Sclerosis • Heart Failure • Hip Fracture Recovery

Mobilise-D consortium (2023–2024). Innovative Health Initiative

PLOS ONE

STUDY PROTOCOL

Connecting real-world digital mobility assessment to clinical outcomes for regulatory and clinical endorsement—the Mobilise-D study protocol



A. Stefanie Mikołajczak¹, Lynn Rochester², Walter Maetziel³, Basil Sharrack⁴, Heleen Demeyer^{5,6,7}, Claudia Mazza⁸, Brian Caulfield^{9,10}, Judith Garcia-Aymerich^{11,12,13}, Beatrix Vereijken¹⁴, Valdo Amara¹⁵, Ram Miller¹⁶, Paolo Piraino¹⁷, Nadir Ammour¹⁸, Mark Forrest Gordon¹⁹, Thierry Troosters²⁰, Alison J. Yarnall²¹, Lisa Alcock²², Heiko Götner²³, Jürgen Winkler²⁴, Jochen Klucken²⁵, Christian Schlenstedt²⁶, Henrik Watz²⁷, Anne-Marie Kirsten²⁸, Ioannis Vogiatzis²⁹, Nikolaos Chynkiamis³⁰, Emily Hume³¹, Dimitrios Megaritis³², Alice Nieuwboer³³, Pieter Giniis³⁴, Ellen Buckley³⁵, Gavin Brittain³⁶, Giancarlo Comi^{37,38}, Letizia Leocani³⁹, Jorunn L. Helbostad⁴⁰, Lars Gunnar Johnsen⁴¹, Kristin Taraldsen^{42,43}, Hubert Blain⁴⁴, Valérie Driss⁴⁵, Anja Freil⁴⁶, Milo A. Puhani⁴⁷, Ashley Pothenus⁴⁸, Magda Bosch de Basea⁴⁹, Elena Gimeno⁵⁰, Nicholas S. Hopkinson⁵¹, Sara C. Buttery⁵², Jeffrey M. Hausdorff^{53,54,55}, Anat Mirelman^{56,57}, Jordi Evers⁵⁸, Isabel Neatroux⁵⁹, David Singleton⁶⁰, Lars Schwickert⁶¹, Clemens Becker⁶², Carl-Philipp Jansen⁶³, and members of the clinical validation study (WP4) on behalf of Mobilise-D consortium[†]

OPEN ACCESS

The word that mattered:

Additive

not replacement.

That is how digital earns trust in clinical guidelines.

| Design the Evidence Backwards — Start from the Patient

1. PATIENT

What does the patient
experience?
What function or outcome matters
in their daily life?

Co-create from day one



2. CLINICAL STANDARD

What gold standard does the
clinician trust?

CSF, PET, UPDRS, MMSE

*Validate your digital signal against
this, not around it*



3. EVIDENCE OF VALUE

Will the evidence (and the product)
support any change in the patient
outcomes

Additional Patients diagnosed,
Diagnostic Accuracy, outcomes
data

*Pre-specify these before Phase III,
not after*

The evidentiary chain must be designed in reverse — from the patient's reality, through the clinical standard, back to the digital signal.

The signal is not the problem. Digital biomarkers and clinical biomarkers need to speak the same language

Payers fund what guidelines recommend. Guidelines trust what is validated against gold standards.

Digital biomarkers sometimes generate evidence and validated it against those gold standards — and when they do, it becomes news but, we need to think how we integrate the digital technologies in the patient pathway (not replacing biomarkers but as enablers).

"What evidence do digital technologies need to bridge the gap between signal and patient outcomes — and what can we build, together as a community, to improve those outcomes and achieve optimal patient access "

4

Co-Creating with Patients

From Digital Signal to Meaningful Outcome: Who Decides?

THE MEASUREMENT GAP

Digital $\neq$ Meaningful

Capturing a signal digitally does not make it patient-relevant

Continuous $\neq$ Relevant

More frequent data does not equal better clinical insight

Precise $\neq$ Patient-Centered

Algorithmic precision is worthless without lived-experience anchoring

130+

AI-powered digital endpoints deployed in trials 2008-2022
(HumanFirst Institute, 2022)

0

DHT-derived biomarkers formally qualified by FDA as DDT
as of July 2024 (Bakker et al., CPT 2025)

“Who defines what matters?”

Without patient involvement in concept definition, digital endpoints risk measuring what is technically feasible rather than what is meaningful to patients

Conceptual Validity: The Missing First Step

Before any algorithm, there must be a concept- defined by patients living with the condition.

CONCEPT OF INTEREST

What truly matters to patients? Articulate lived experience.

PATIENT-DERIVED MODEL

Co-design the conceptual framework with patients before selecting any sensor.

DIGITAL SIGNAL MAPPING

Map candidate digital measures to the patient-defined concept.

MEANINGFUL CHANGE

Pre-specify thresholds of meaningful change anchored in patient experience.

KEY FRAMEWORKS | V3 Framework (DiME/BEST) • FDA PFDD Guidance Series (1-4) • EMA Context of Use (Q&A 2020) • ISPOR COA Good Practices



Regulatory & HTA Expectations Are Rising

FDA

- PFDD Guidance Series 1-4 (2018-2022): patient voice in COA development
- DHT for Remote Data Acquisition — Final Guidance (2023): fit-for-purpose standard
- Digital Health Advisory Committee established (Oct 2023)
- Real-World Evidence framework expanded to wearables & sensors (Dec 2025)
- Sponsors must justify DHT selection, demonstrate conceptual validity
- Diversity Action Plans required for equitable trial design (2024+)

EMA & HTA

- EMA Q&A: Qualification of Digital Technology-Based Methodologies (2020)
- Landmark: Stride velocity 95th centile qualified as primary endpoint in DMD (2024)
- EU Health Data Space (EHDS) 2025: patient data governance mandate
- NICE, G-BA, CADTH: patient-centric evidence increasingly required for HTA
- Conceptual validity + patient relevance now core evidentiary expectations
- ISPOR PICOTS-ComTeC framework: standardizing digital health evidence (2024)

*****Future is not digital endpoints. It is decision-relevant digital endpoints!**

Equity & the Risk of Digital Exclusion

Culture

Language, cultural norms & trust in technology shape who adopts/participates

Limiting Conditions

Disability, motor/cognitive impairment constrain device usability

Education & Health Literacy

Lower literacy correlates with lower DHT adoption & data quality

Age

Older adults 65+ systematically underrepresented in DHT trials

Residence

Rural & low-connectivity areas excluded by bandwidth-dependent devices

Socioeconomic Status

Device cost, data plans & time burden create access inequity

EVIDENCE: Only 4.96% of completed clinical trials used connected DHT for data capture (2013-2023).

Those trials systematically underrepresented older adults & African American participants. Digital inclusion must be DESIGNED- not assumed. (ClinicalTrials.gov analysis; npj Digital Medicine 2022)

Data Governance & Trust: The Hidden Determinant of Adoption

Patients Ask...

- Who OWNS my data?
- How is it USED- and for what purpose?
- Who is it SHARED with (industry, insurers)?
- Do I BENEFIT from its use?
- Can I REVOKE consent- granularly?
- What happens to my data if I withdraw?

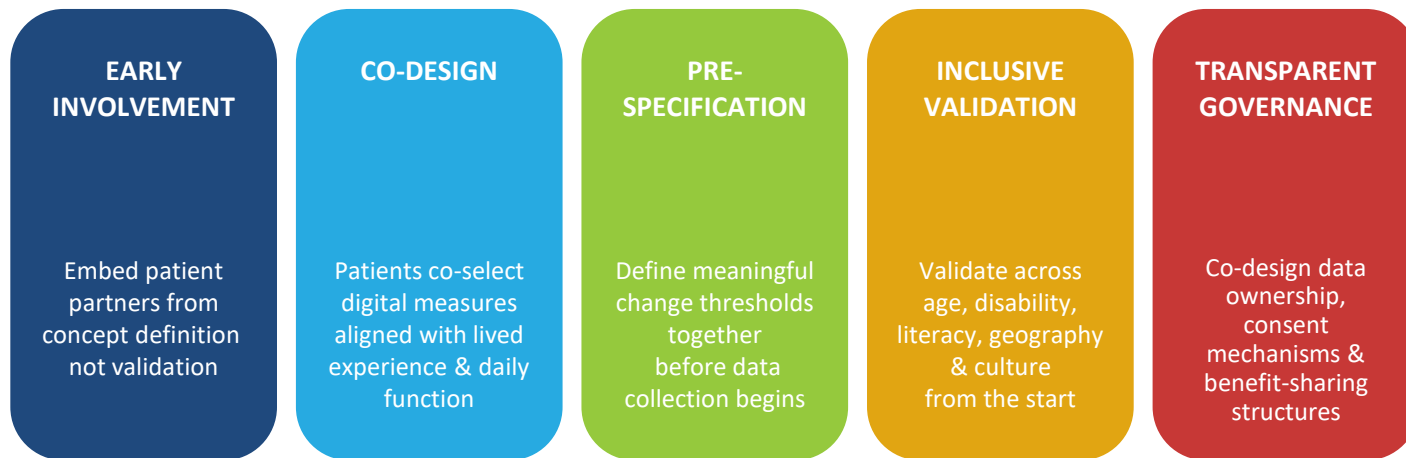
Framework Requirements

- GDPR / HIPAA / EHDS compliance- data minimization & purpose limitation
- Granular, dynamic, withdraw-able consent management
- Transparent data flow mapping & audit trails
- Patient access to their own data (Right of Access)
- Benefit-sharing mechanisms- co-ownership models
- De-identified tokens & blockchain consent tracking (npj Digital Medicine 2025)

⚠ KEY FINDING: 55% of digital health study consent forms are missing critical data governance disclosures

including rights around data sharing, secondary use, and withdrawal. Trust drives adherence- and adherence drives data quality. (PMC 2025; NIH DHT Guidance Analysis)

Moving From Promise to Practice: A Structured Co-Design Model



Digital technologies offer extraordinary opportunity.
But without methodological discipline and patient partnership, they risk widening disparities and weakening decision relevance.

Co-design is the mechanism by which digital endpoints earn the trust of patients, regulators, and payers alike.

5

Q & A



Polling Question

Which topic from today's session would you most like to see developed further? (Select all that apply)

- A** Co-design and conceptual validity in digital endpoint development
- B** Regulatory qualification pathways: FDA Drug Development Tools & EMA procedures
- C** Health equity, digital access & inclusion-by-design strategies
- D** Patient data governance, trust & consent management frameworks
- E** From evidence to adoption: HTA and value-based assessment of digital endpoints

ISPOR, the professional society for health economics and outcomes research (HEOR), is an international, multistakeholder, nonprofit dedicated to advancing HEOR excellence to improve decision making for health globally. The Society is the leading source for scientific conferences, peer-reviewed and MEDLINE-indexed publications, good practices guidance, education, collaboration, and tools/resources in the field.

ISPOR's community of more than 20,000 individual and chapter members from 120+ countries includes a wide variety of healthcare stakeholders, including researchers, academicians, regulators and assessors, public and private payers, healthcare providers, industry, and patient representatives. The Society's leadership has served as an unbiased resource and catalyst for innovation in the field for more than 20 years.

www.ispor.org



ISPOR

Improving healthcare decisions