

# From Play to Precision Care: Clinical Telegaming Biomarkers to Evaluate Medication Efficacy for Improving MS Patients' Quality of Life

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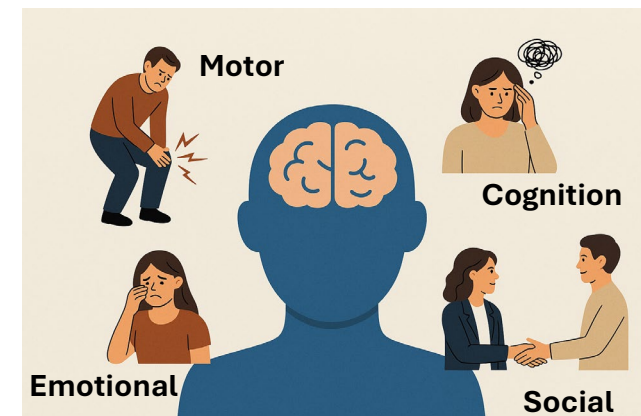
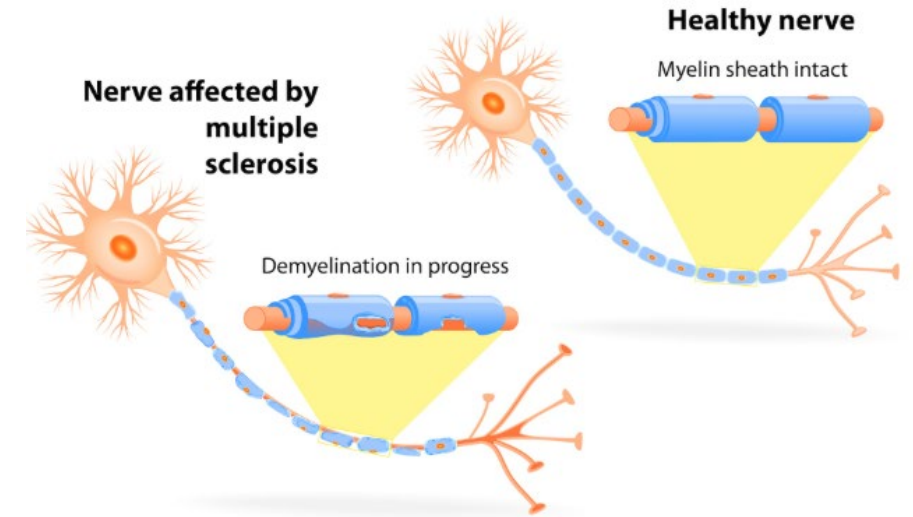
Brain Health Alliance

# Outline

- Background
- Problem
- Research Question
- Approach

# Background: Multiple Sclerosis

- A chronic autoimmune disease
  - The immune system damages the myelin in the central nervous system
- MS affects motor, cognitive, emotional, and social functioning



# Background: Clinical treatment and assessment

- Disease-Modifying Therapies (DMTs)
  - Medications that reduce relapses, slow disease progression, and limit new brain lesions in MS.
  - Cost: \$70,000–90,000/year.
- Current assessments
  - Brief clinic visits
  - Limited coverage of QOL (Quality of Life) domains.

# Problem

- Lack of tools to evaluate individual treatment efficacy.
- Social, emotional, and cognitive aspects often overlooked.
- Continuing ineffective drugs → health risks + wasted cost.

# Research Approach

- Clinical Telegaming
  - Home-based, interactive games.
  - Capture motor, cognitive, and social data.
  - Derive **digital biomarkers** to track treatment efficacy.

- Taswell, C. (2010, December). A new PDS PORTAL for clinical telegaming rehabilitation and intervention. In *2010 IEEE International Conference on Bioinformatics and Biomedicine Workshops (BIBMW)* (pp. 874-875). IEEE.
- Lockery, D., Peters, J. F., & Taswell, C. (2011). CTGaming: A problem-oriented registry for clinical telegaming rehabilitation and intervention. *Journal of Emerging Technologies in Web Intelligence*, 3(1), 28-37.

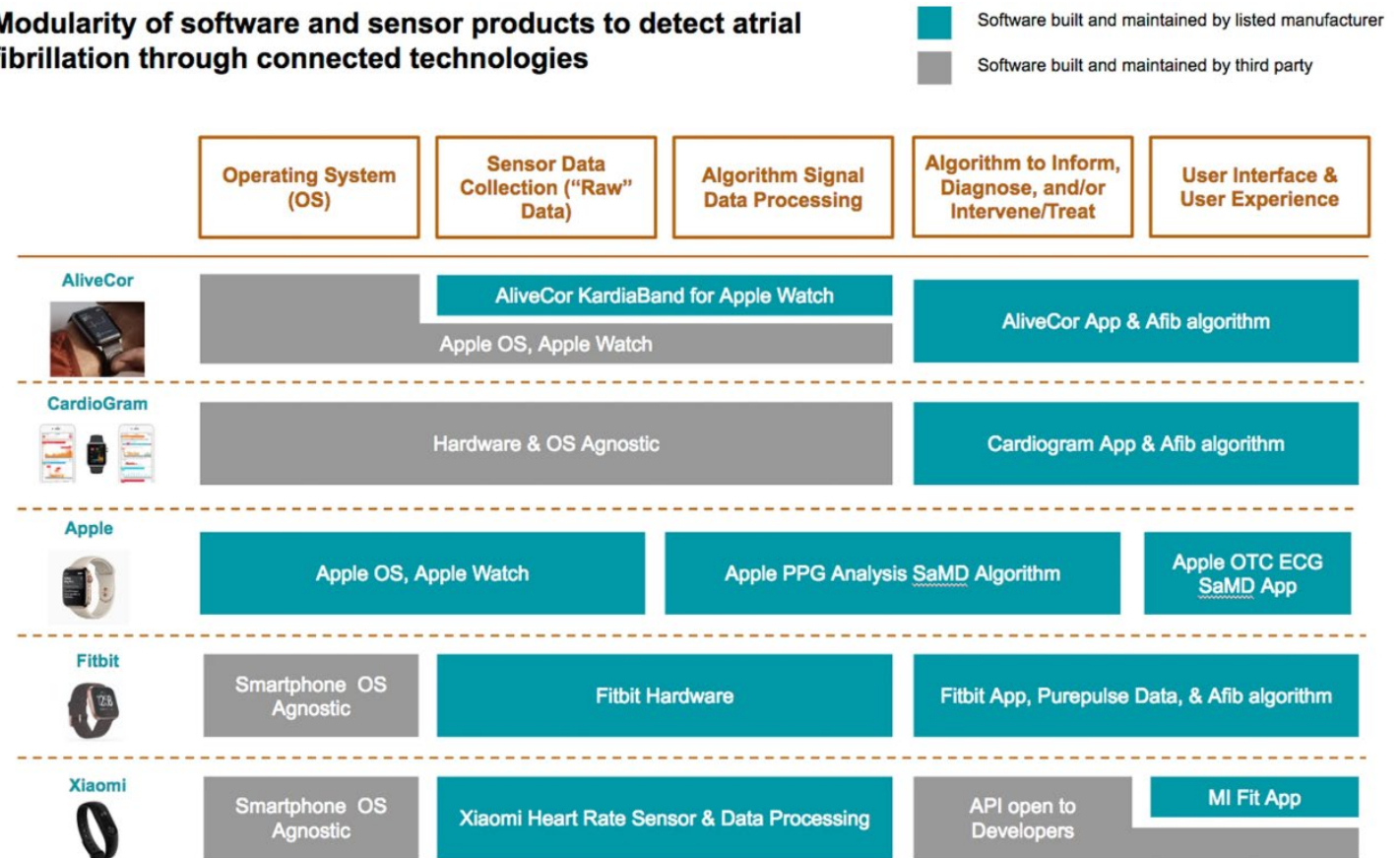
# Biomarkers

- Definition
  - Objectively measured indicators of physiologic processes, pathologic processes or pharmacologic responses to a therapeutic intervention
- Types (“Molecular biomarkers in multiple sclerosis”)
  - Diagnostic
  - Prognostic
  - Predictive
  - Disease activity
  - Treatment response

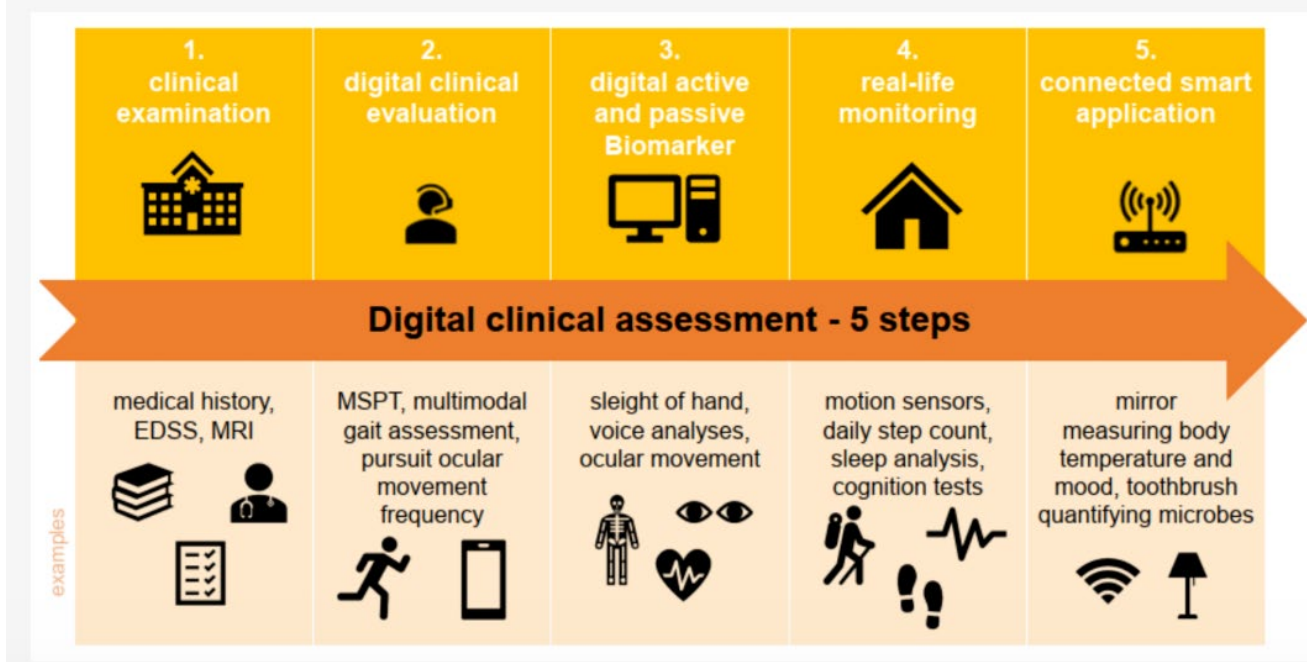
# Digital Biomarkers

- Biomarkers collected using sensors and computational tools

**Modularity of software and sensor products to detect atrial fibrillation through connected technologies**



**Figure 1.** Developing a digital clinical assessment. (EDSS: Expanded Disability Status Scale; MRI: magnetic resonance imaging; and MSPT: Multiple Sclerosis Performance Test). © Multiple Sclerosis Center Dresden.



**Table 1.** Challenges in implementing digital biomarkers in the clinic.

| Benefits                   | Challenges          |
|----------------------------|---------------------|
| Continuous real-time data  | Privacy             |
| Better real-world evidence | Adherence/retention |
| Greater power              | High variability    |
| Novel, sensitive endpoints | Validation required |
| Faster decisions           | Complex analysis    |
| Big data                   | Data storage        |

# Biomarkers

- Biomarkers collected through existing digital devices (wearable...)
- Biomarkers collected through clinical telegaming
  - What are unique data?
  - For what? Social interaction?
  - What are unique requirements?

# Research Objective

- Motor–Sensory Function: movement smoothness, coordination, reaction speed.
- Social–Behavioral Function: cooperation, caregiver–patient interaction.
- Precision Care: link biomarkers with medication outcomes for N-of-1 care.

# Method

- Co-Design with neurologists, patients, caregivers.
- Biomarker Development from gameplay telemetry.
- Feasibility Testing in home environments.
- Preliminary Validation against in-clinic assessments.

# Expected Contributions

- New suite of motor and social biomarkers.
- Feasibility and patient acceptance for at-home use.
- Evidence of biomarker–medication linkage for precision care.

# Clinical & Economic Significance

- Avoid wasted drug costs (>\$40,000 over 6 months).
- Support neurologists' decision-making.
- Improve patient engagement and quality of life.

# Conclusion

- Challenge: Limited treatment evaluation + high costs.
- Solution: Clinical Telegaming → digital biomarkers for MS.
- Impact: Improves patient QOL, supports precision medicine, reduces costs.





# Approach

- Existing methods to measure daily physical activity
  - In-clinic
  - at-home
    - Wearable devices (smart watch?)
- Our approach
  - Clinical telegaming
  - Why?
  - What advantages over the existing ones?