nQ Medical™

Transforming Medicine with AI

R. A. Bavasso
Co-Founder & CEO
bavasso@nq-medical.com

Leadership Team Assembled
Address "Optimal Use of AI" Dilemma

R. A. Bavasso, Founder & CEO
30 years in healthcare, MedEd, digital health and SaaS.
Top 100 Most Influential People in Pharma.
Founder/CEO *RIMEDIO, Inc.* – Life sciences eCommerce
Founder/President, *Exploria SPS, LLC* – $18M SaaS SFE
CEO *Pharmedica, Inc.* - Grew to $65M - Exit to Parthenon

Mark Pascarella, Founder & Exec. Chair
CEO, *Founders Wanted*
GM, *HootSuite* - 400% growth
CEO, *UberVu* - Expanded 60 countries and sale to Hootsuite
CEO, *Gotuit* – Grew to #1 Video on Demand Service

Luca Giancardo, PhD, CSO
Assistant Professor, UTHealth School of Biomedical Informatics/Center for Precision Health.
Fellow at MIT. Recipient of the R&D Award by R&D Magazine, ORNL Award in Technology Transfer.

Teresa Arroyo-Gallego, PhD
Chief Data Scientist
MIT/neuroQWERTY study lead researcher for mobile devices. machine learning and signal processing. Focused on development and application of artificial intelligence methods and systems to solve biomedical problems.

INDUSTRY ADVISORY BOARD

David Kreutter, PhD
Former SVP, Global Analytics,
Pfizer
Principal, *Kreutter Associates*

Naomi Fried, PhD
Former VP, Medical Information, Innovation, External Partnerships,
Biogen
Founder, *Health Innovation Strategies*

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Maulik Majmudar, MD
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Faculty, Harvard-MIT HST

Zoltan Mari, MD
Director, Lou Ruvo Center for Brain Health,
Movement Disorders,
Cleveland Clinic

David Lee Scher, MD
Interventional Cardiologist,
Digital Health Consultant,
Board Member, **HIMSS**

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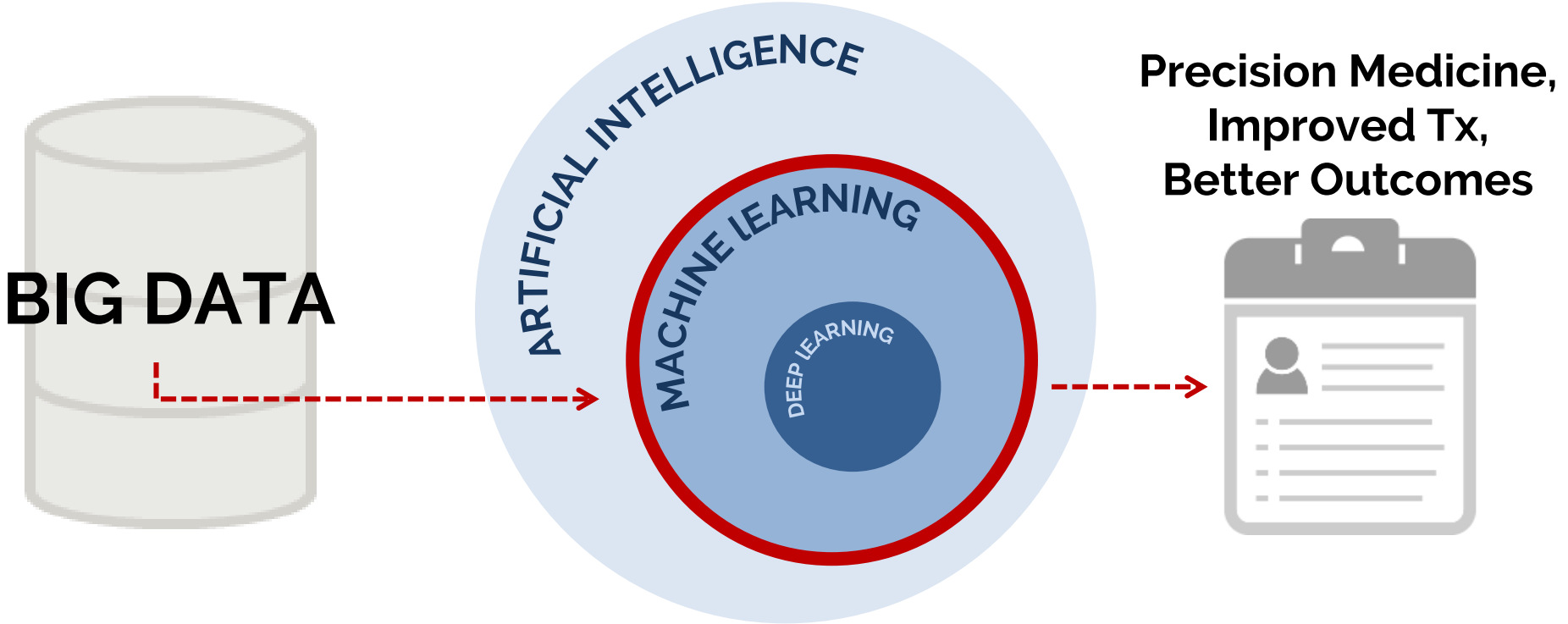
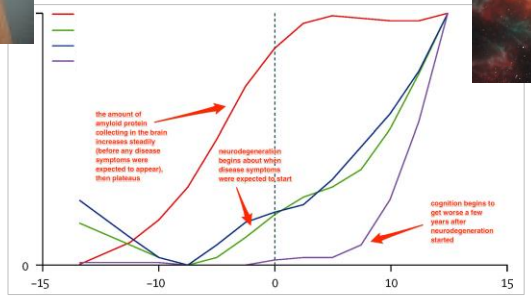
Give Machines Access to Data
Let Them Learn to Improve Healthcare



Unmet Market Need

Passive, High Frequency/Adherence, RW Data



nQ Medical™

nQ's AI Technology

Machine Learning Driven Computational Biomarkers

Discovered Powerful Medical Insight
Right at Your Fingertips - *neuroQWERTY*



Not influenced by:
- Device
- OS
- Speed
- Skill
- Language

Your Personal Device *is* Your Medical Device

- The average user:
  - ✓ Keeps phone **"on" 24/7**
  - ✓ Picks up device **more than 1,500 times a week**
  - ✓ Reaches for phone at **7:31 am every morning**
  - ✓ Use phone for **three hours sixteen minutes a day**

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http://www.dailymail.co.uk/sciencetech/article-2783677/How-YOU-look-phone-The-average-user-picks-device-1-500-times-day.html#ixzz4q1cpkazD

4 Years MIT R&D
Focused on Neurodegenerative Disorders

THE MICHAEL J. FOX FOUNDATION FOR PARKINSON'S RESEARCH

REVIEW

New Methods for the Assessment of Parkinson's Disease (2005 to 2015): A Systematic Review

Álvaro Sánchez-Ferro, MD, MSc,[1,2*] Morad

Computer keyboard interaction … early Parkinson's disease

L. Giancardo[1,†,*], A. Sánchez-Ferro[1-5,†], T. Arroyo-Gal… Mendoza[1], P. Montero[7], M. Matarazzo[2-5], J. A. Obeso[2] Estépar[9]

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[2]HM Hospitales - Centro Integral en Neurociencias HM CINAC, Mós…
[3]CEU San Pablo University, Campus de Moncloa, Calle Julián Rom…
[4]Centro de Investigación Biomédica en Red, Enfermedades Neurod…
[5]Instituto de Investigación Hospital 12 de Octubre (i+12), Madrid, Sp…
[6]Universidad Politécnica de Madrid, Spain
[7]Movement disorders unit, Hospital Clinico San Carlos, Madrid, Spa…
[8]The Institute of Medical Engineering and Science, Massachusetts …
[9]Brigham and Women's Hospital, Harvard Medical School, Boston, …
[†]L. G. and A.S.F. have contributed equally to this work
*gianca@mit.edu

ABSTRACT

Parkinson's disease (PD) is a slowly progressing neurodegenerative diseas… measurements of motor signs are of vital importance for diagnosing, monit… particularly for the early stages of the disease when putative neuroprotective… medical practice has limited tools to routinely monitor PD motor signs w… for patients and the healthcare system. In this paper, we present data in… keyboards can be used to detect motor signs in the early stages of PD. … times (the time required to press and release a key) during the normal use … converts it to a PD motor index. This is achieved by the automatic discov… using an ensemble regression algorithm. This new approach discriminated early PD groups (including de-novo PD subjects) from controls with an AUC=0.83. The performance was comparable or better than two other quantitative motor performance tests used clinically: alternating finger tapping (AUC=0.72) and single key tapping (AUC=0.58).

1994 IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 64, NO. 9, SEPTEMBER 2017 EMB

Detection of Motor Impairment in Parkinson's Disease Via Mobile Touchscreen Typing

Teresa Arroyo-Gallego, María Jesus Ledesma-Carbayo, Álvaro Sánchez-Ferro, Ian Butterworth, Carlos S. Mendoza, Michele Matarazzo, Paloma Montero, Roberto López-Blanco, Verónica Puertas-Martín, Rocío Trincado, and Luca Giancardo*

Abstract—Mobile technology is opening a wide range of opportunities for transforming the standard of care for chronic disorders. Using smartphones as tools for longitudinally tracking symptoms could enable personalization of drug regimens and improve patient monitoring. Parkinson's disease (PD) is an ideal candidate for these tools. At present, evaluation of PD signs requires trained experts to quantify motor impairment in the clinic, limiting the frequency and quality of the information available for understanding the status and progression of the disease. Mobile technology can help clinical decision making by completing the information of motor status between hospital visits. This paper presents an algorithm to detect PD by analyzing the typing activity on smartphones independently of the content of the typed text. We propose a set of touchscreen typing features based on a covariance, skewness, and kurtosis analysis of the timing information of the data to capture PD motor signs. We tested these features, both independently and in a multivariate framework, in a population of 21 PD and 23 control subjects, achieving a sensitivity/specificity of 0.81/0.81 for the best performing feature and 0.73/0.84 for the best multivariate method. The results of the alternating finger-tapping, an established motor test, measured in our cohort are 0.75/0.78. This paper contributes to the development of a home-based, high-compliance, and high-frequency PD motor test by analysis of routine typing on touchscreens.

Index Terms—Feature extraction, finger tapping, keystroke dynamics, mHealth, passive monitoring, signal processing, smartphone.

…nosis; inventions

18 April 2015

Correspondence and requests for materials should be addressed to L.G. (gianca@mit.edu)

www.nature.com/scientificreports

SCIENTIFIC REPORTS

…yboard interaction as …f early Parkinson's

…ent Detection via …h a Computer …ural Typing

…ndoza[1] & J. M. Hooker[1,2]

…, Massachusetts Institute of Technology, Cambridge, MA …tment of Radiology, Massachusetts General Hospital,

…itoring the timing of button presses, or finger …lowever, the massive amount of high resolution …rrently being discarded. Multiple studies have …d brain areas which are known to be affected by keyboard can be employed as means to observe and potentially quantify psychomotor impairment. We induced a psychomotor impairment via a sleep inertia paradigm in 14 healthy subjects, which is detected by our classifier with an Area Under the ROC Curve (AUC) of 0.93/0.91. The detection relies on novel features derived from key-hold times acquired on standard computer keyboards during an uncontrolled typing task. These features correlate with the progression to psychomotor impairment ($p < 0.001$) regardless of the content and language of the text typed, and perform consistently with different keyboards. The ability to acquire longitudinal measurements of subtle motor changes from a digital device without altering its functionality may allow for early screening and follow-up of motor-compromised neurodegenerative conditions, psychological disorders or intoxication at a negligible cost in the general population.

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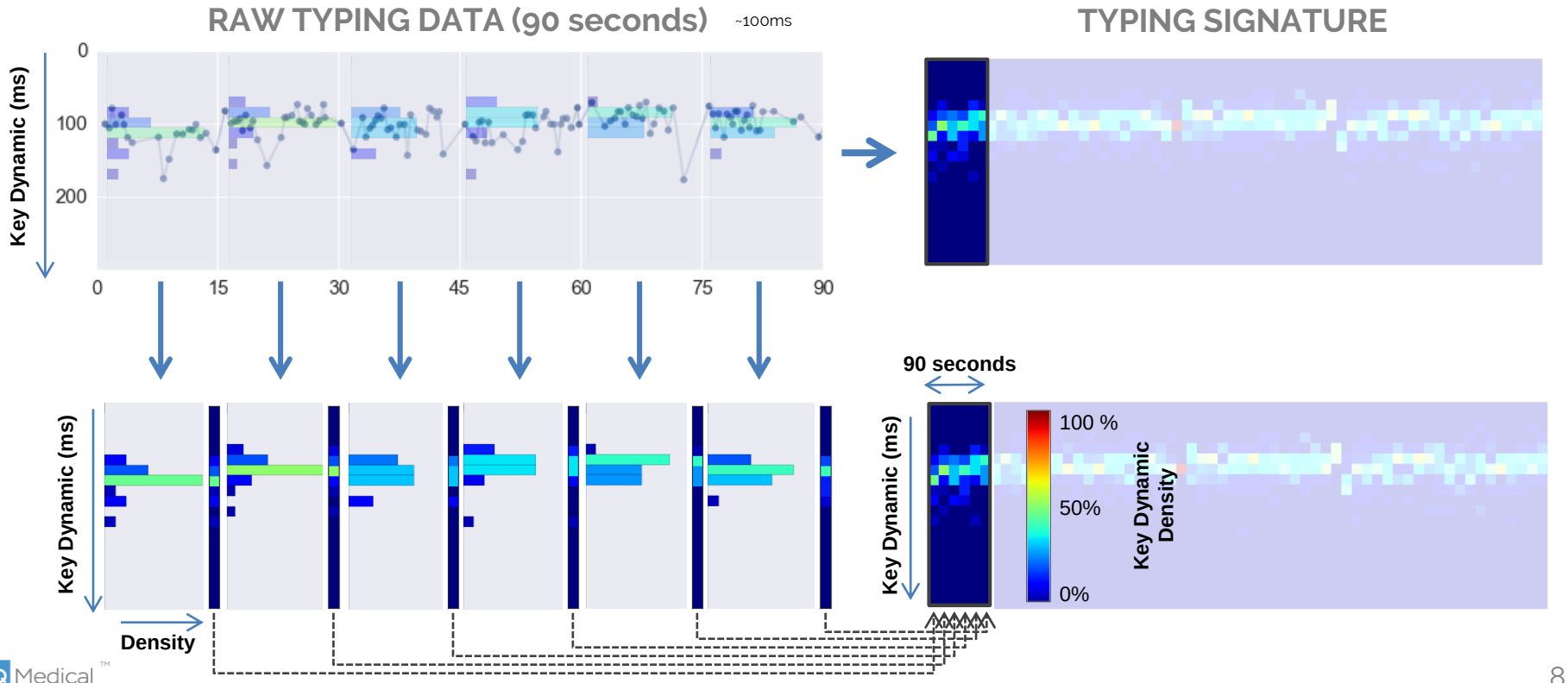
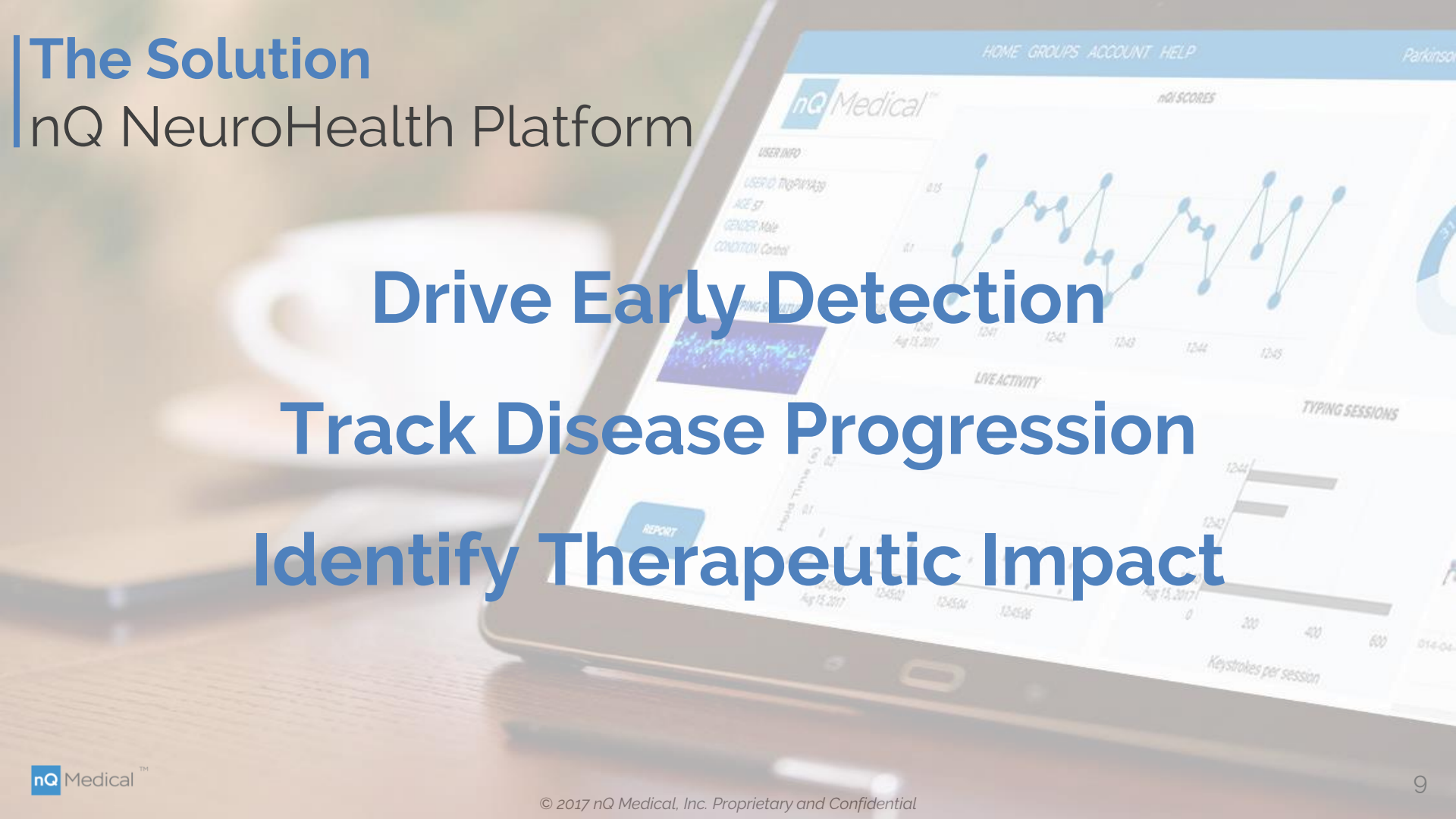
Visual Display of Disease

Computing a Typing Signature



The Solution

nQ NeuroHealth Platform



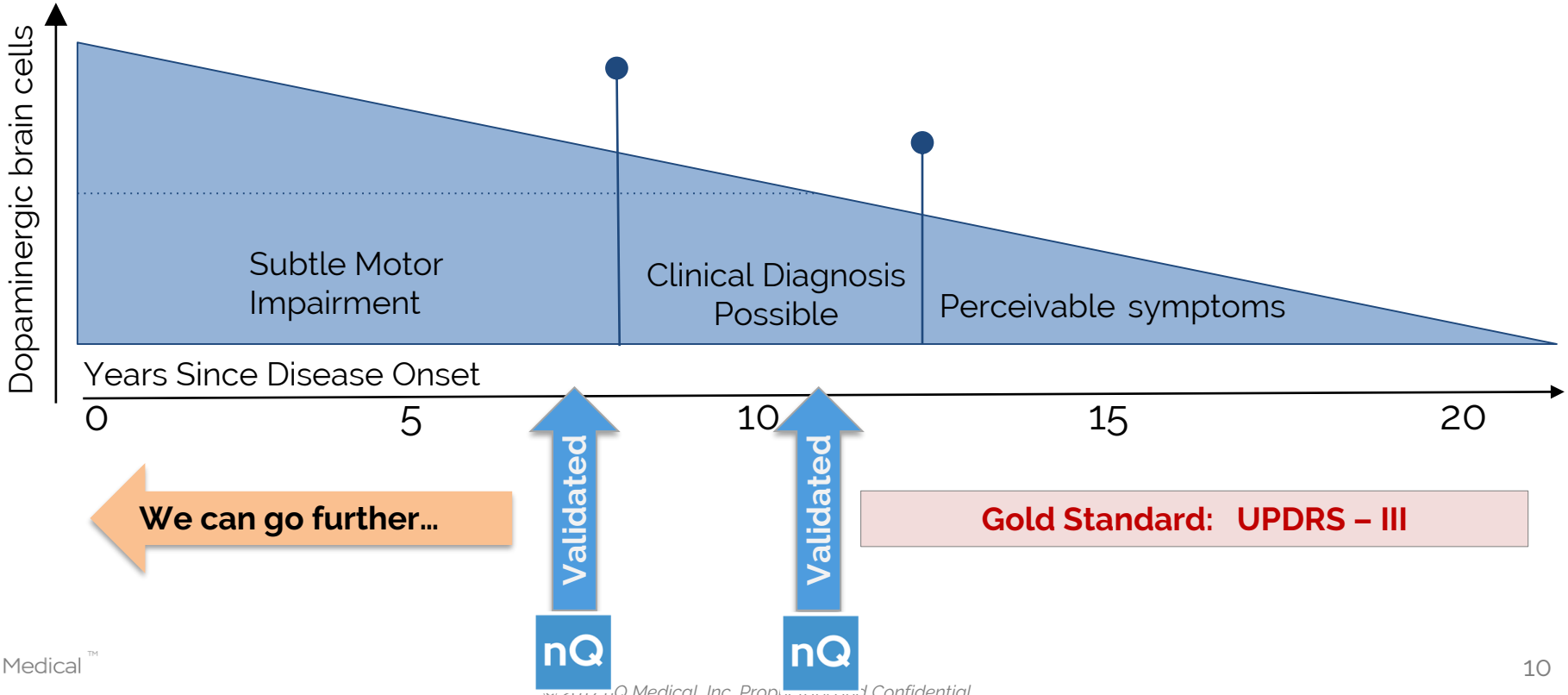
Drive Early Detection

Track Disease Progression

Identify Therapeutic Impact

Early Detection Validated

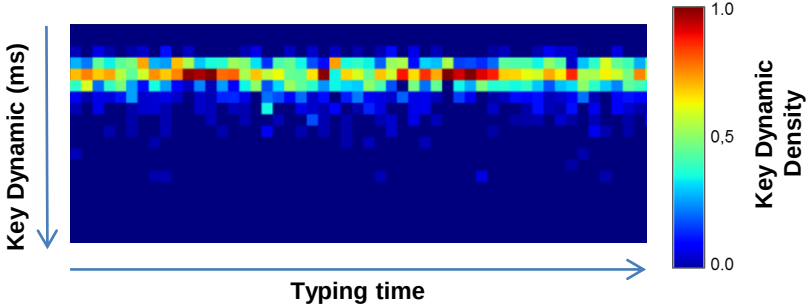
Revealing Signs of Disorder 5-10 years sooner



Helping Clinician “See” Disease Progression

Granularity Unseen by Human Eye

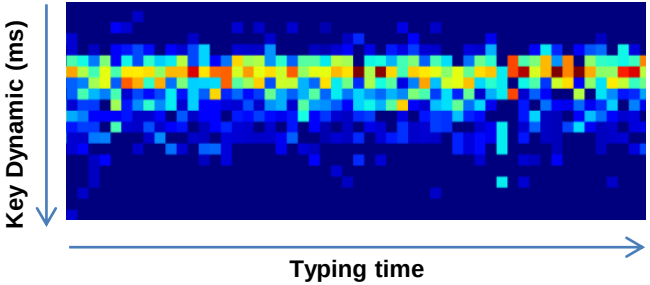
Healthy Control



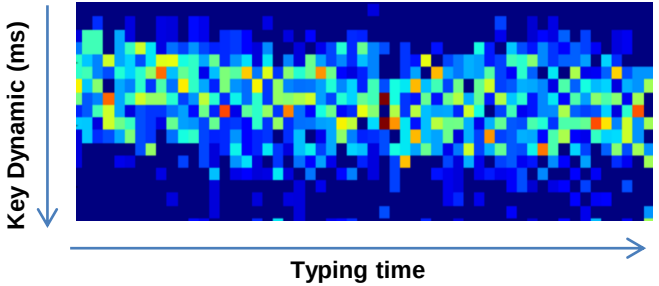
Our algorithms apply machine learning to detect pathological typing patterns and monitor disease progression

Parkinson’s Patients

Mild Symptoms



Severe Symptoms

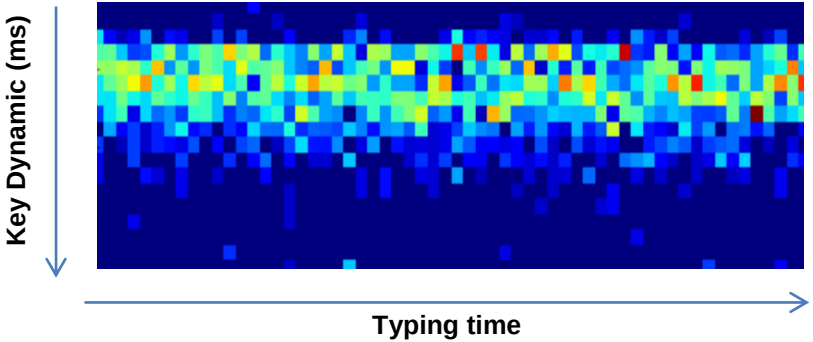


"neuroQWERTY: a Transparent Patient-centered Outcome Method to Quantify Parkinson’s Motor Signs for Drug Trials"
Trial Registration: NCT02522065

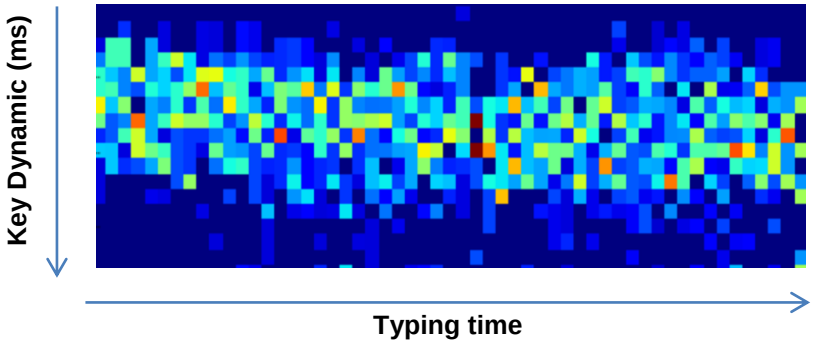
Measure Impact of Therapy
Does the Drug/Device Work?

Parkinson's Patient (late stage)

Deep Brain Stimulator **ON**
(less symptoms)

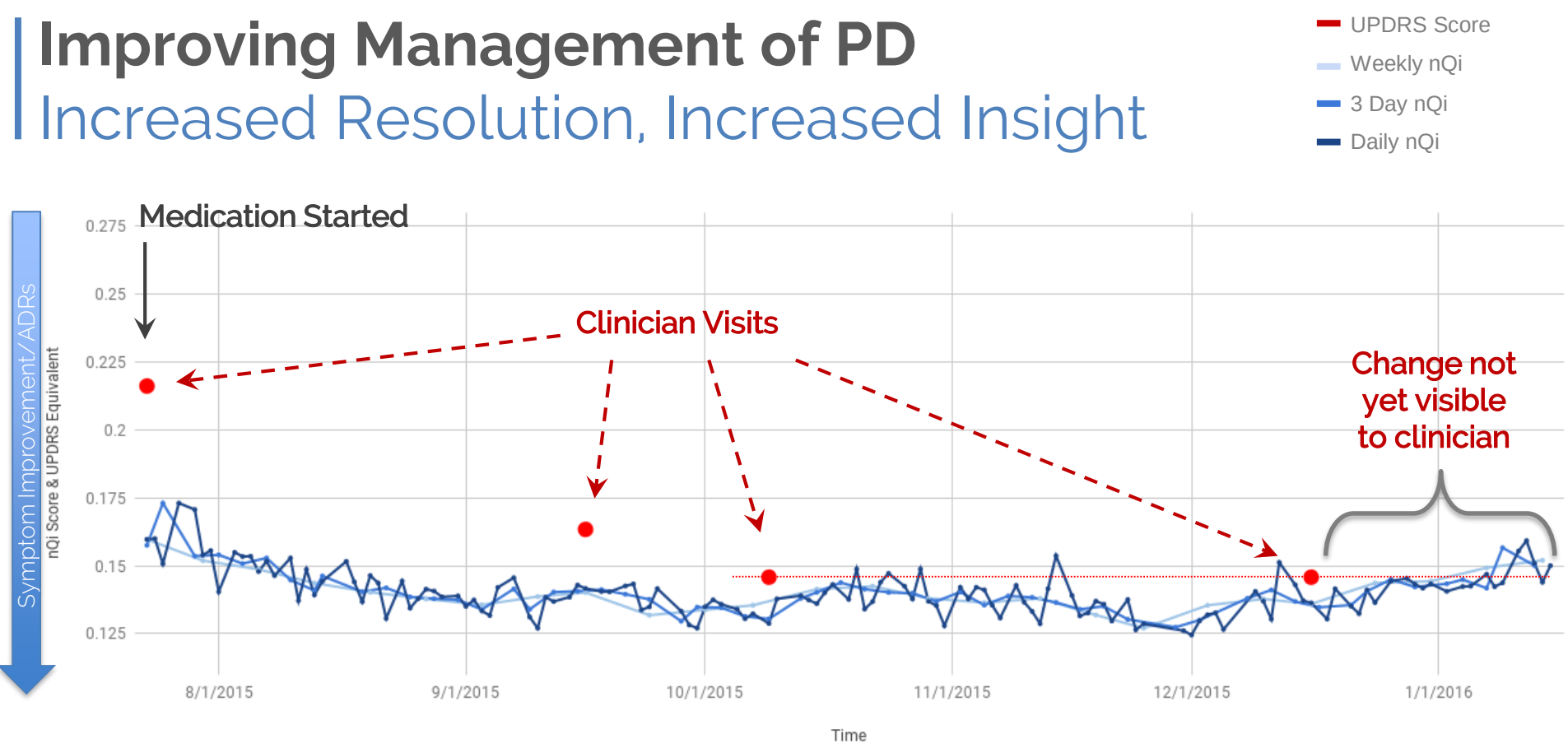


Deep Brain Stimulator **OFF**
(more symptoms)



"neuroQWERTY: a Transparent Patient-centered Outcome Method to Quantify Parkinson's Motor Signs for Drug Trials"
Trial Registration: NCT02522065

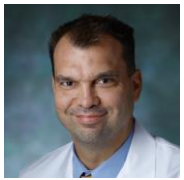
Improving Management of PD
Increased Resolution, Increased Insight



"neuroQWERTY: a Transparent Patient-centered Outcome Method to Quantify Parkinsonian Motor Signs for Drug Trials"
Trial Registration: NCT02522065 MJFF Grant ID: 10860

nQ Medical™

"The Need is Now for Earlier Diagnosis and Monitoring of Disease Progression"



Zoltan Mari, MD
Director, Movement Disorders Clinic
Cleveland Clinic Lou Ruvo Center for Brain Health
Cleveland Clinic, Las Vegas

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nQ Medical Business Model

End-to-End AI Platform Across Development Life Cycle

R&D → **Tx + App** → **Patient Engagement**

(Clinical Trials) (Therapeutic Companion) (Self-Care Management and Population Health)

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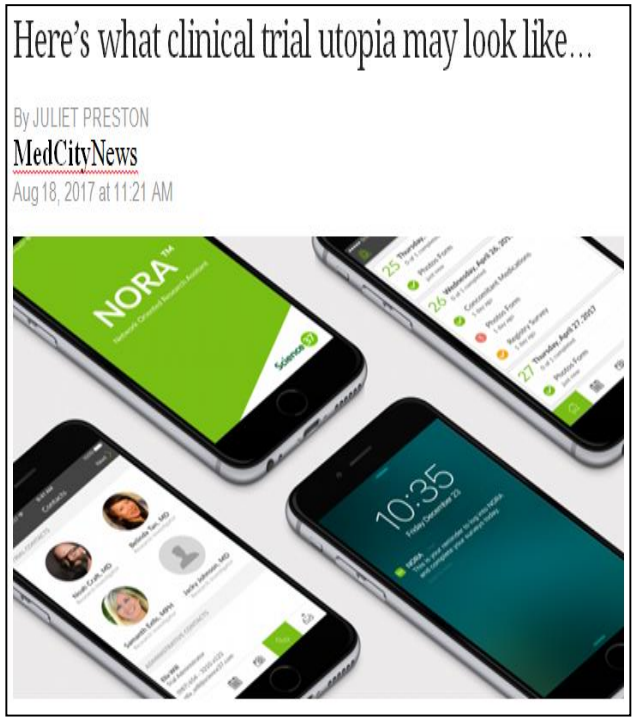
nQ Business Model – *R&D*
Address Clinical Trial Challenges

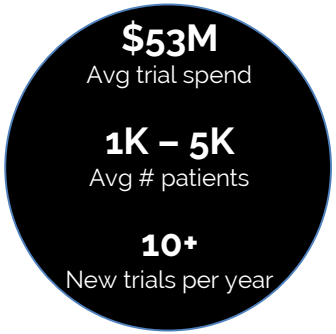


- Better, faster **identification of ideal study participants**
  - Shortening recruitment time to **save $3M/month**
- Less in-clinic observation **(at-home, unbiased real world data)** improves **compliance/$$$**
- **Passive/continuous monitoring** yields **earlier measure of drug impact** and increased speed to FDA approval/market launch

Market Size

$500/User = Potential Market of $30+ Billion

AD/PD Clinical Trials
168 Industry-Funded
(482 All-Funders)



ClinicalTrials.gov August 22, 2017: Active or Recruiting - Phases 1-3

https://aspe.hhs.gov/report/examination-clinical-trial-costs-and-barriers-drug-development

Parkinson's Disease

Parkinson's Disease Foundation 2016

Alzheimer's Disease

World Alzheimer Report 2015

nQ Business Model – *Companion Dx Management*
R&D to Commercial Brand Teams

Drug/Device + App (but it is NOT an App)

- **Distribution to Clinicians** *and* **Clinicians to Patients**
  - ✓ "Tiered" MedEd to clinicians
  - ✓ Campaign for nQi biomarker recognition
  - ✓ Collaboration with national organizations
- **Value-add for Brand/Sales Teams**

Commercially Funded Clinical Trial – UTexas Health
DBS Candidacy and Patient Self-Care

80 patients across late-stage Parkinson's DBS

Objectives:
- Objective monitoring of disease progression/Long-term programming response
- Predictive tool for best DBS candidates
- Patient decision support aid/Self-settings adjustment guide
- Support community neurologist referral to Movement Disorder Center/ Greater involvement in community care of DBS patients

Cohorts:
- Late-stage Parkinson's disease
- Appropriate candidates for DBS

nQ Business Model – *Population Health*

Patient Engagement for Payors/Health Systems

Geneia Case Study. Remote Patient Monitoring Reduces Medical Spend by 50 Percent and Improves Outcomes for Chronically-Ill Health Plan Members. Geneia, LLC 2017.

nQ Business Model
Growth Through Disease Expansion

Late-stage Parkinson's → THE MICHAEL J. FOX FOUNDATION FOR PARKINSON'S RESEARCH; UTHealth The University of Texas Health Science Center at Houston

Pre-Clinical, Beta Amyloid PD
Alzheimer's
Concussion/mTBI → Cleveland Clinic

Chronic Pain
Marijuana Impairment Biomarker → NIH National Institutes of Health

Depression → UnitedHealthcare®

nQ Value Proposition – "*Helping the Clinician See*"

24/7, Passive Data Collection + Powerful Machine Learning

Massively deployable

No proprietary device, no training, no active requirements. Unbiased.

High-Adherence /Frequency

Integrates seamlessly w/daily "in community" activities

Remote Patient Monitoring

Daily/Hourly disease progression granular reporting = Better outcomes

nQ desires to align with Strategic Partners to Transform Medicine with AI/Machine Learning