Transforming Neurological Care in 30 Seconds with QDG Health

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Filling an unmet need for Parkinson's disease

The number of people living with Parkinson's disease (PD) globally has doubled in the past 25 years. It is expected to double again in the next 15 years[1]. As the fastest-growing neurological disease, PD has been called an emerging pandemic. In the same amount of time, we have seen no significant innovations in PD drug therapies and a stagnation in the number and availability of neurologists to care for people with PD (PwP).

PwP, their care providers, and the therapeutic industry experience a critical unmet need: they lack a health management system that can provide remote symptom monitoring and AI-informed therapy adjustments in real-time, and which can provide high-resolution metrics of disease for clinical trials similar to the system that has revolutionized diabetes management using Continuous Glucose Monitoring (CGM) platforms.

To address this need, Dr. Helen Bronte-Stewart – director of the Human Motor Control and Neuromodulation Lab and John E. Cahill Family Professor of Neurology and Neurological Sciences

at Stanford – has developed Quantitative Digitography (QDG) technology and created QDG Health: a comprehensive health management system whose technology provides validated, quantitative measures of all cardinal motor signs of PD in real-time from a 30-second repetitive alternating finger-tapping (RAFT) task on a proprietary digitography device (KeyDuo). A recent paper [2] published in *npj Parkinson's disease* posits QDG as a high-resolution tool for objective motor monitoring with promising remote and in-clinic utility.

What You'll Learn

In this deep dive, we'll explore how a simple 30-second finger-tapping test is transforming Parkinson's care and why it represents a watershed moment in neurological treatment.

Scientific and Technological Foundation of QDG

Building upon over two decades of fine-motor control research in PD [2]-[10], The system's [Figure 1] elegance lies in its simplicity:

- **The Test**: Patients perform a 30-second RAFT task
- **The Technology**: Advanced sensors measure movement dynamics through tensioned levers
- **The Analysis**: The 'PRECISE' AI-enhanced algorithm converts these movements into validated digital biomarkers
- **The Output**: Results appear directly in the patient's electronic health record, providing an informative dashboard and two statistically transformed overall scores:
    - A *Mobility Score* (0-100) integrating six voluntary movement parameters
    - A *Tremor Severity Score* (0-100) measuring tremor duration percentage and amplitude

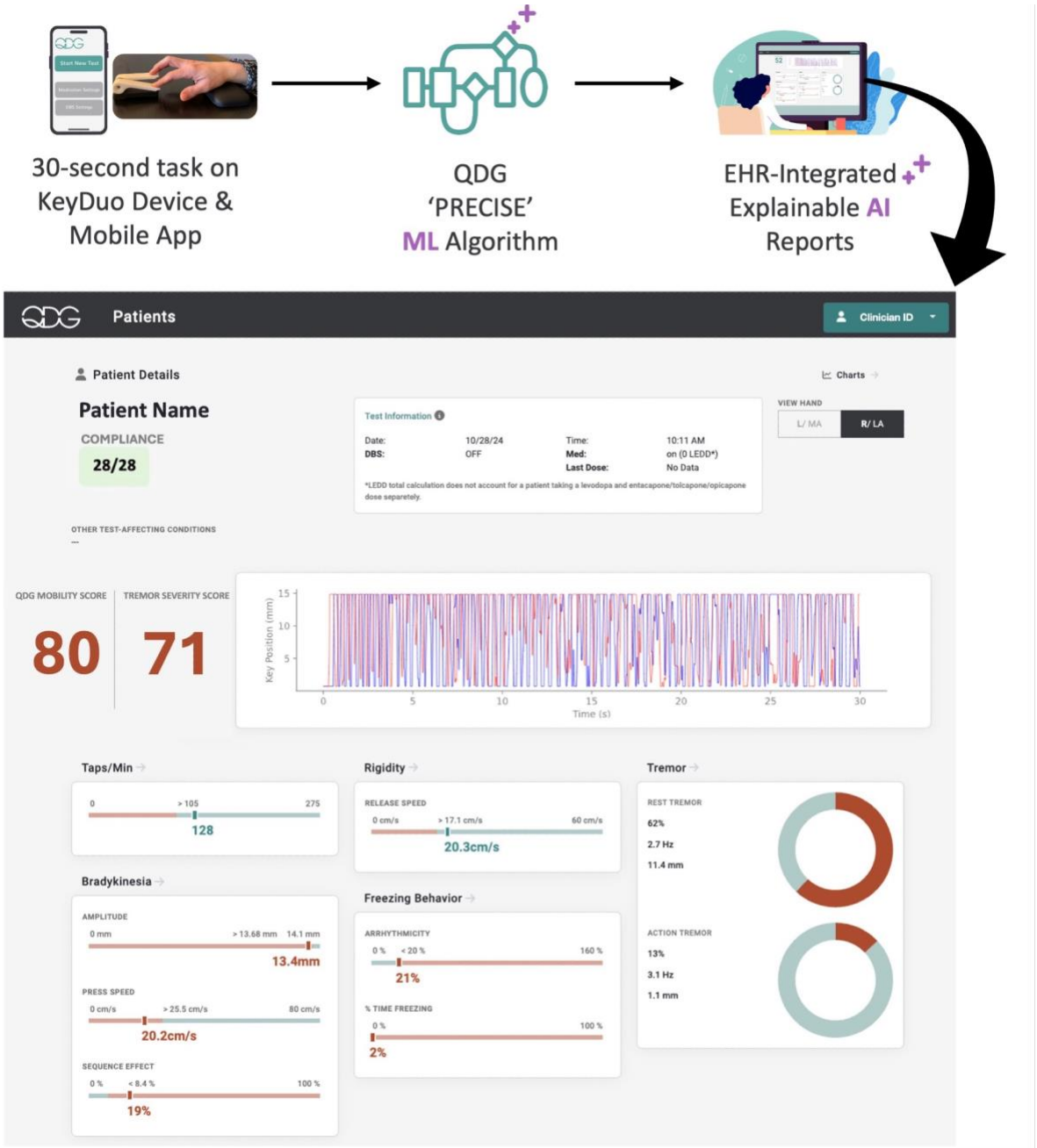

Figure 1: QDG System overview. (Top) 30-second RAFT task using the KeyDuo and Mobile App is analyzed through the PRECISE Algorithm, which sends test results to an electronic health record (EHR). (Bottom) QDG Clinician Dashboard View for Single Test. QDG patient information and therapy status is shown above, with RAFT trace displayed for the patient's more-affected hand. The QDG Mobility Score and Tremor Severity Score are next to the trace, with the individual metrics of bradykinesia, rigidity, tremor, and freezing behavior shown below. Each metric contains a scale of values where a threshold separates the red ('abnormal') range from the blue ('normal') range. This threshold is based on the 75th percentile values of healthy controls in each metric.

QDG translates 30 seconds of finger tapping on the KeyDuo into validated precise measurements of PD motor symptoms. The technology's foundation lies in sensing the

displacement of its adjacent tensioned engineered levers, providing high-resolution signals of movement dynamics in temporal and amplitude domains.

The "PRECISE" algorithm transforms KeyDuo's raw data into validated biomarkers that measure key PD symptoms. It tracks bradykinesia through four key measurements: tapping frequency, pressing amplitude, execution speed, and sequence effect—a unique PD characteristic also seen in handwriting, limb movement, and speech [7], [11]. The system also measures rigidity through lever release speeds [6], eliminating the need for subjective in-person assessments. The algorithm further quantifies gait-related impairments through arrhythmicity (coefficient of variation of inter-strike intervals), which correlates with PD-associated gait dysfunction [7]. Additionally, it classifies tremor strikes using an XGBoost model [9], separating these involuntary movements from intentional ones to ensure accurate measurements of all symptoms.

Tapping into PD care

QDG Health transforms care for PD through its comprehensive motor symptom measurement in areas of PD care that critically need it: remote monitoring; in-clinic, ER, and inpatient evaluations; and clinical trials. Dr. Bronte-Stewart's team has begun exploring the scope of QDG's remote use cases, including continuous motor monitoring, medication response monitoring, pre-diagnostic assessment, and deep brain stimulation (DBS) evaluation and programming. As detailed in the recent clinical remote trial [10], the system's effectiveness has been remarkable:

- **High Compliance**: 100% of patients successfully completed daily testing for at least 16/30 days
- **User-Friendly**: Nearly all participants rated the system as easy to use
- **Clinically Valuable**: Strong, significant correlation between QDG Mobility Scores and self-reported impact on Activities of Daily Living.
- **Clinical Scope:** Provided clinical insights across disease duration (pre-diagnosis (0) to advanced PD (20 years)) [Figure 2].
- **Medicare Approved**: Meets CMS requirements for remote monitoring reimbursement

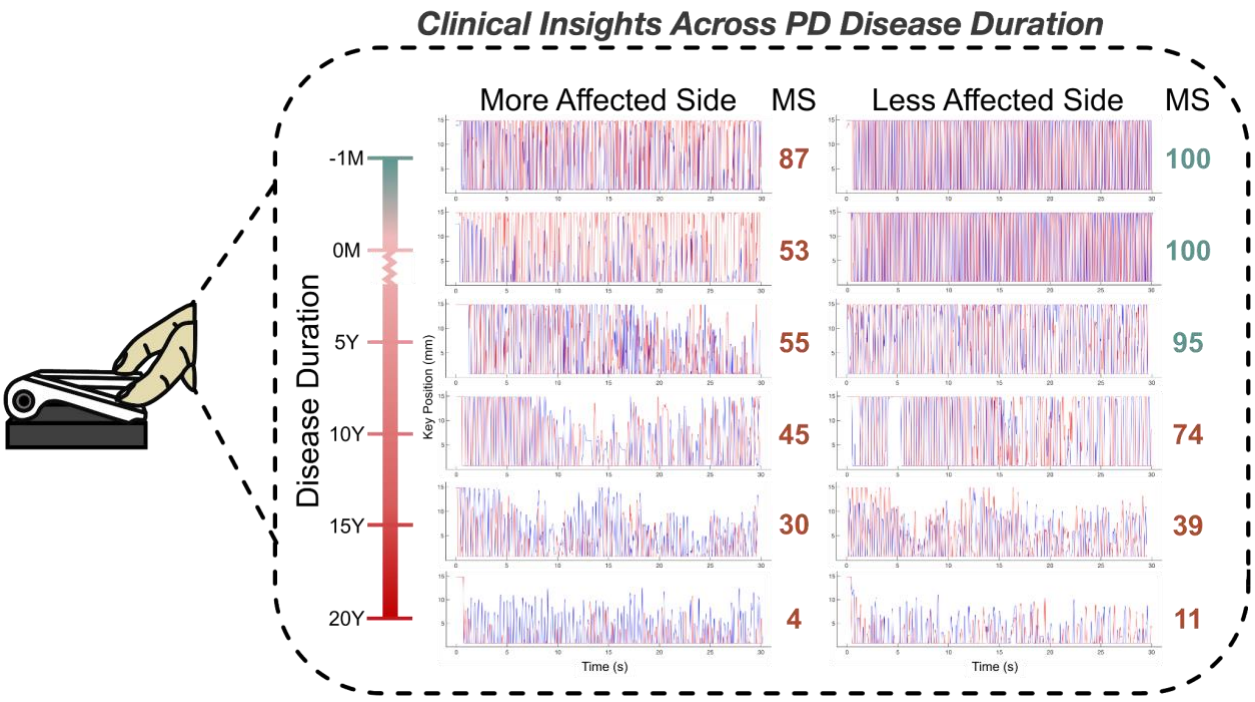

Figure 2: QDG's Clinical Insights. Representative QDG traces with corresponding Mobility Scores from a representative participant pre-diagnosis and with 0 months with PD, and participants with 5, 10, 15, and 20 years of PD duration. Each RAFT trace displays the amplitude of lever strikes (millimeters) over time (seconds); the blue and red strikes represent the index and middle fingers on right-hand traces (vice versa on left hand). A normal mobility score (>92) is in green and abnormal in red (adapted from [10]).

QDG's high-resolution, granular insights into the immediate motor responses to medication [2] make it game-changing for DBS candidacy evaluation, which requires both off- and on-medication assessments. This requires the PwP to make two visits to the clinic, often from long distances, off medication, and requiring an overnight stay. QDG DBS evaluations can be done remotely from the PwP's home, which is safer, more convenient, and less expensive.

Clinical trials remain a major challenge in PD treatment. While an average of 142 trials occur every year, few make it to the final stages—only 12% reached Phase III in 2023 [12]. Current testing methods are part of the problem. The FDA requires patients to self-report their symptoms every 30 minutes for two days, but this approach isn't effective for early-stage patients who don't yet show certain symptoms. As most trials are now targeting early-stage PD, there is a critical need for a validated, high-resolution outcome that is sensitive to small changes in motor function while being correlated with the PwP's perception of their function.

These trials are also time-consuming and expensive, typically requiring 600-1,200 participants and lasting up to 66 months. The screening process alone can mean testing ten candidates to find one suitable participant.

QDG's technology could transform the clinical trial process for PD. Its precise measurements would:

- Require fewer participants for statistically valid results
- Speed up screening and recruitment
- Provide more detailed insights into treatment effectiveness
- Enable remote testing, making trials more accessible, diverse, and cost-effective

The next step for QDG is clearance by the FDA. In November 2024, the FDA granted **Breakthrough Device Designation** to the QDG system, facilitating an expedited route and commitment to deliver QDG into the hands of healthcare providers and PwP. QDG technology has an expanded scope of neurological diseases and conditions beyond PD [Figure 3], enabling it to benefit a broader array of patients and healthcare providers.

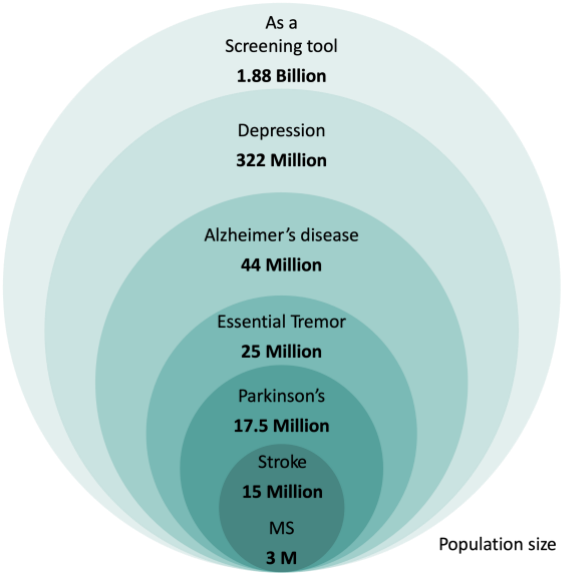

Figure 3. QDG's expanded scope of use beyond PD, illustrated by the estimated global prevalence of key neuropsychiatric conditions that stand to benefit from this breakthrough technology.

QDG for breakthrough discoveries in motor function

QDG Health is leading a healthcare revolution, transforming how neurological and musculoskeletal conditions are measured, monitored, and managed. By replacing subjective assessments with precise, real-time monitoring, QDG Health is not just improving PD management – it is unleashing the potential for breakthrough discoveries in motor function. The technology bridges the critical gap between patients and physicians while opening new revenue streams for healthcare systems. As clinical validation expands into other conditions, QDG is building the foundation for a future where objective, data-driven, and AI-informed care is not just possible, but the gold standard.

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