Automated Guidance of Post-Operative DBS Programming

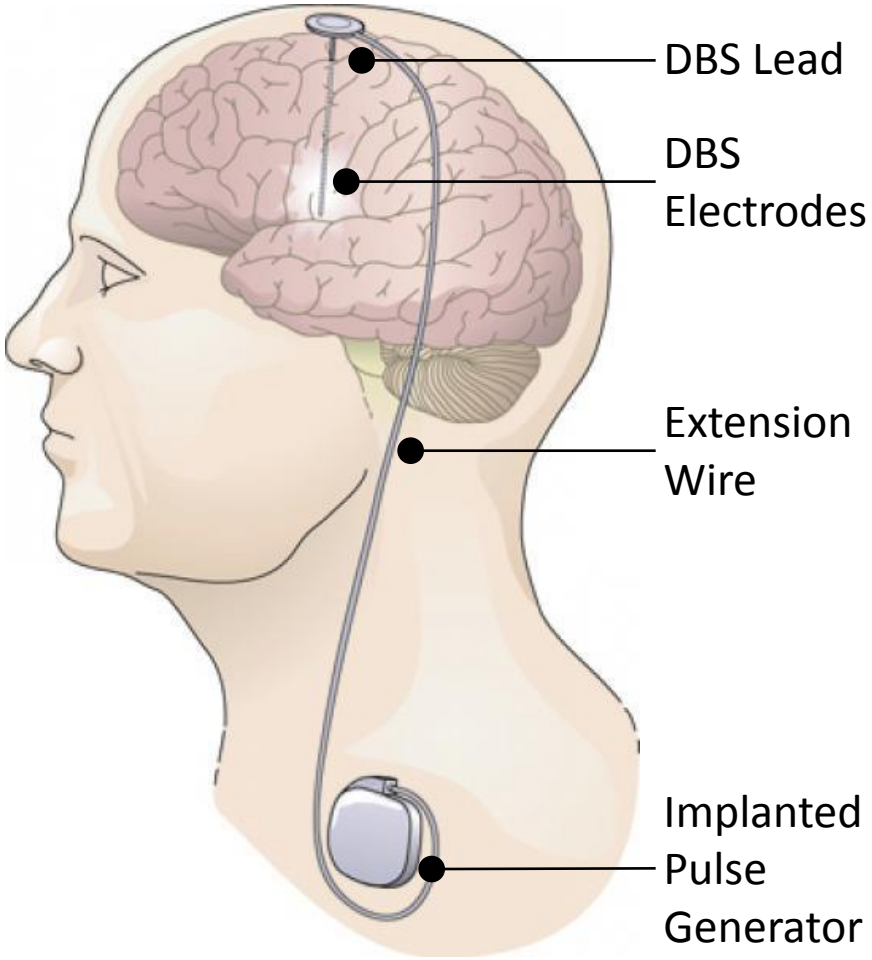
Webinar Will Begin at 12:00 PM EDT

GREAT LAKES NEUROTECHNOLOGIES

Outline

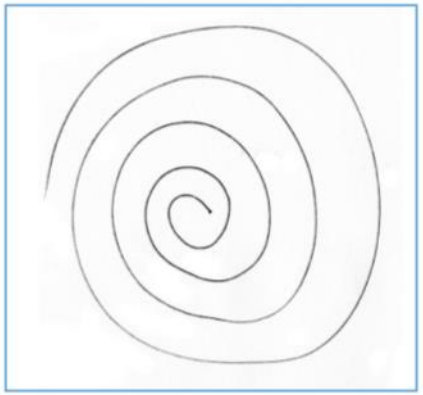
- Introduction to DBS
- Challenges and Technological Opportunities
  - Kinesia ProView
- Automated, Technology-Assisted DBS Programming

Deep Brain Stimulation



- The clinical utility of deep brain stimulation (DBS) for the treatment of Parkinson's disease is well established

DBS OFF



DBS ON

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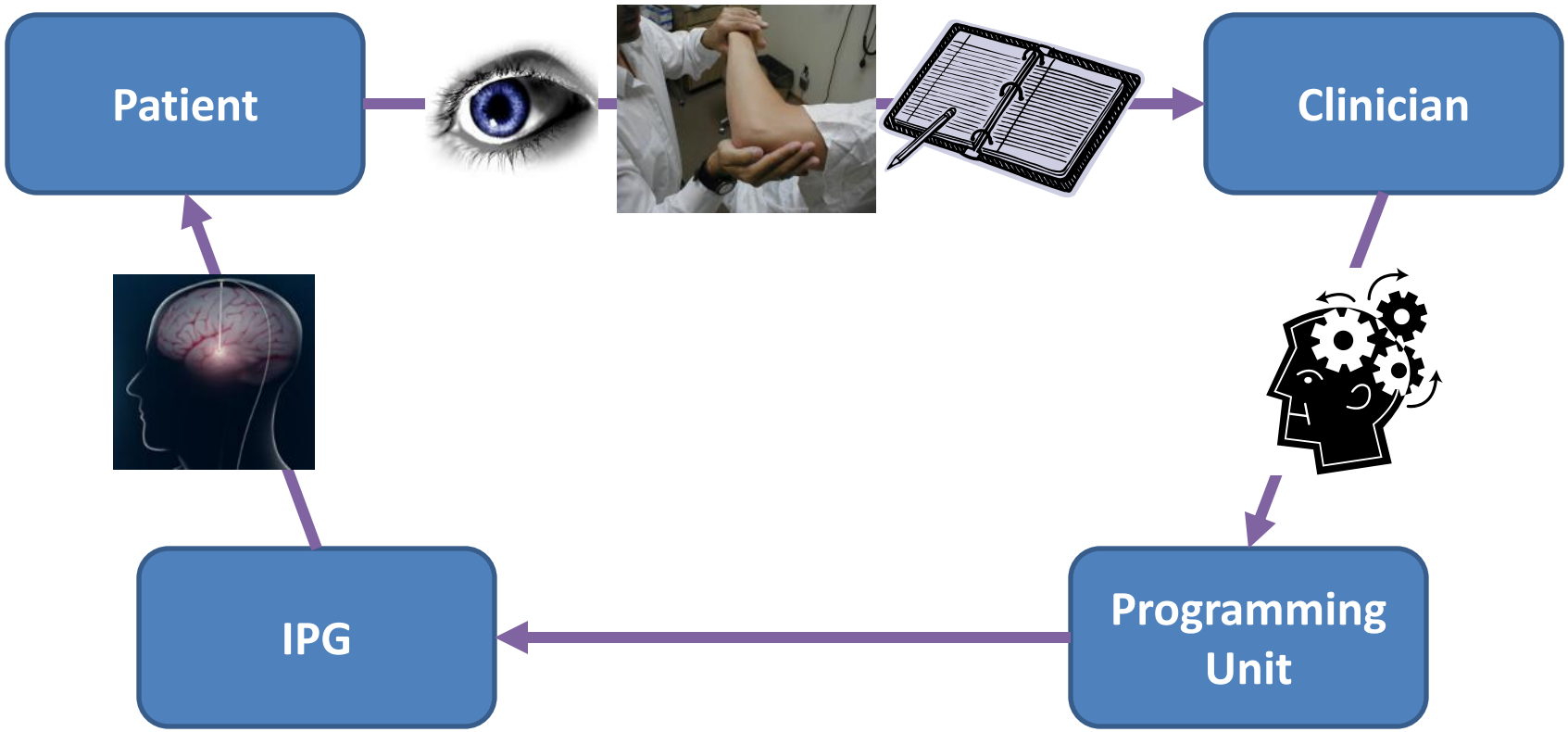
DBS Programming Workflow



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Challenges in DBS

Clinician Training

- Great disparity in outcomes due to varied post-operative management

Vast Stimulation Parameter Space

- Thousands of combinations of DBS parameters (e.g., contact, polarity, frequency, pulse width, amplitude)

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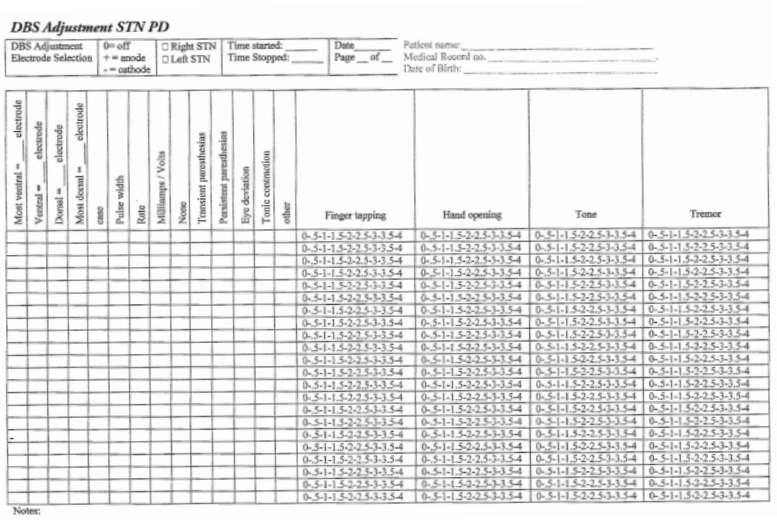
Challenges in DBS

Symptom Assessment

- Not possible to evaluate all symptoms, lack of sensitivity in clinical scales



DBS Adjustment STN PD

DBS Adjustment Electrode Selection | 0= off, + = anode, - = cathode | □ Right STN □ Left STN | Time started: ____ Time Stopped: ____ | Date____ Page __ of __ | Patient name: ____ Medical Record no. ____ Date of Birth: ____

Most ventral = ___ electrode	Ventral = ___ electrode	Dorsal = ___ electrode	Most dorsal = ___ electrode case	Pulse width	Rate	Milliamps / Volts	Noise	Transient paresthesias	Persistent paresthesias	Eye deviation	Tonic contraction	other	Finger tapping	Hand opening	Tone	Tremor
													0-.5-1-1.5-2-2.5-3-3.5-4	0-.5-1-1.5-2-2.5-3-3.5-4	0-.5-1-1.5-2-2.5-3-3.5-4	0-.5-1-1.5-2-2.5-3-3.5-4

Notes:

Longitudinal Tracking

- Documenting programming sessions typically on paper, difficult to quickly review history

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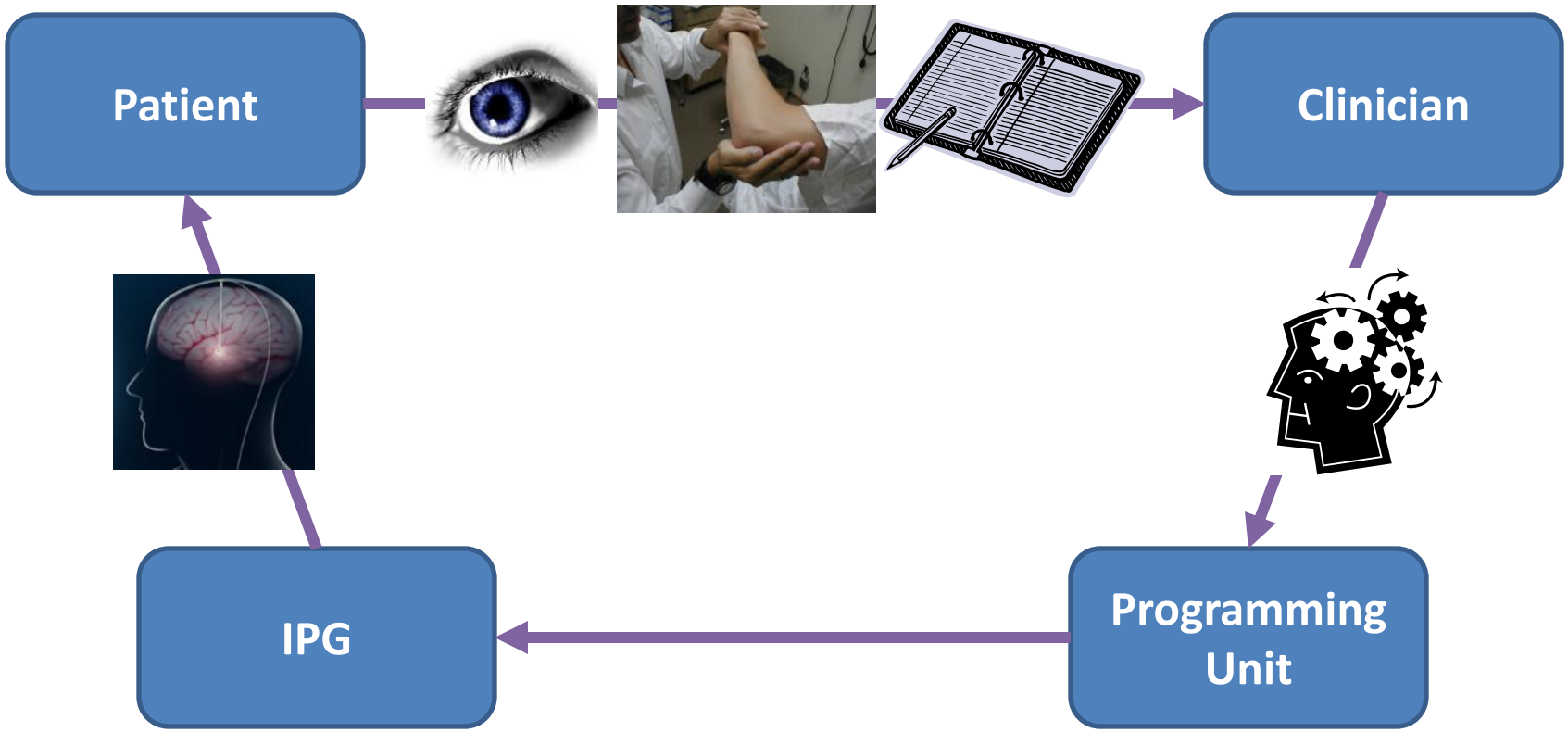
DBS Programming Workflow



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Algorithms for Symptom Rating

- Automated algorithms for rating symptom severity:
  - Tremor
  - Dyskinesia
  - Upper Extremity Bradykinesia
  - Lower Extremity Bradykinesia
  - Gait, Freezing of Gait

Funding	Over $25 Million
Collaborators	Over 20 Collaborating Institutions
Publications	Over 40 Peer-Reviewed & Presentations

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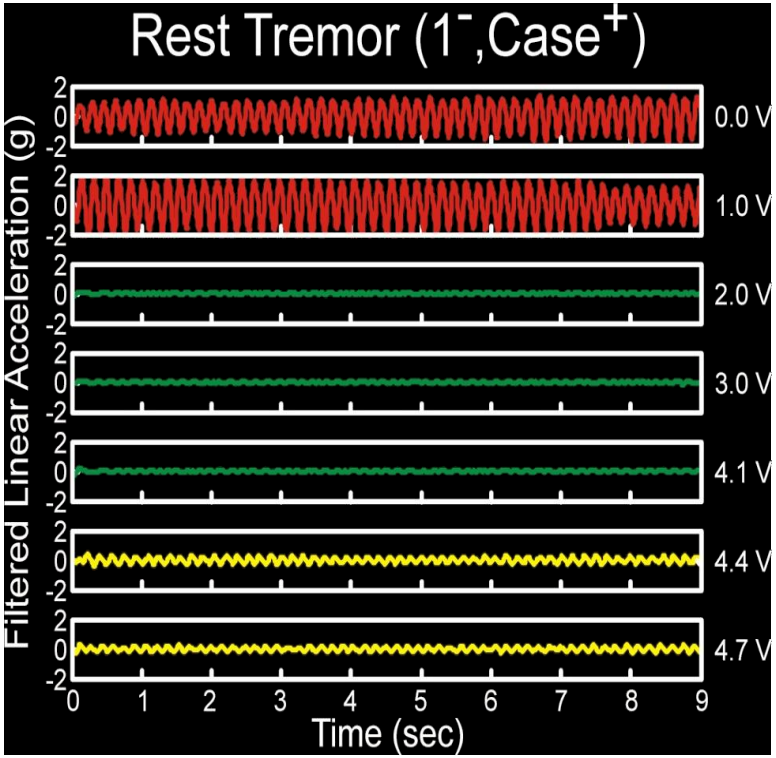
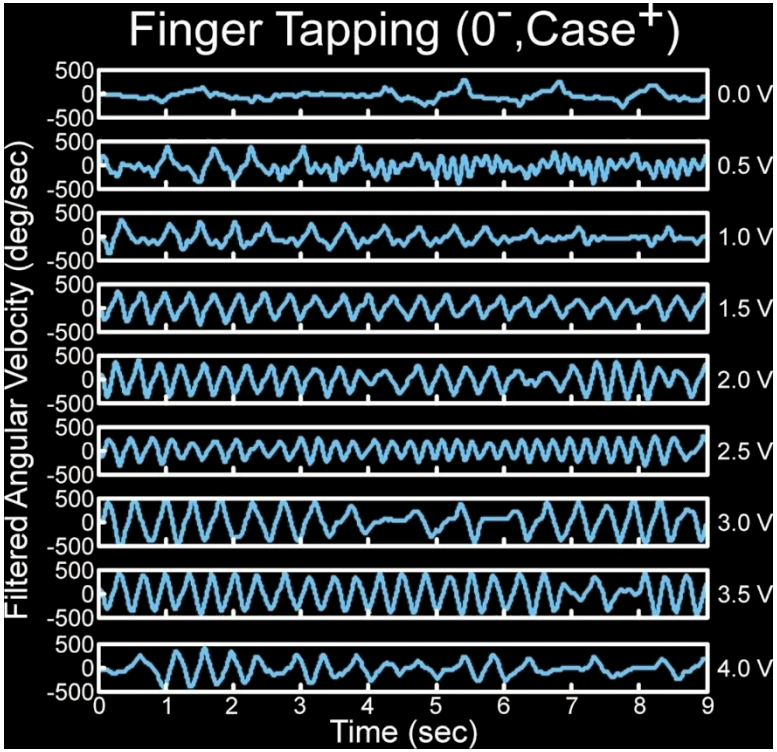
Kinematic DBS Response



Tremor tuning produces sudden, dramatic effects on symptomatic benefit



Bradykinesia tuning produces gradual, fine effects on symptomatic benefit

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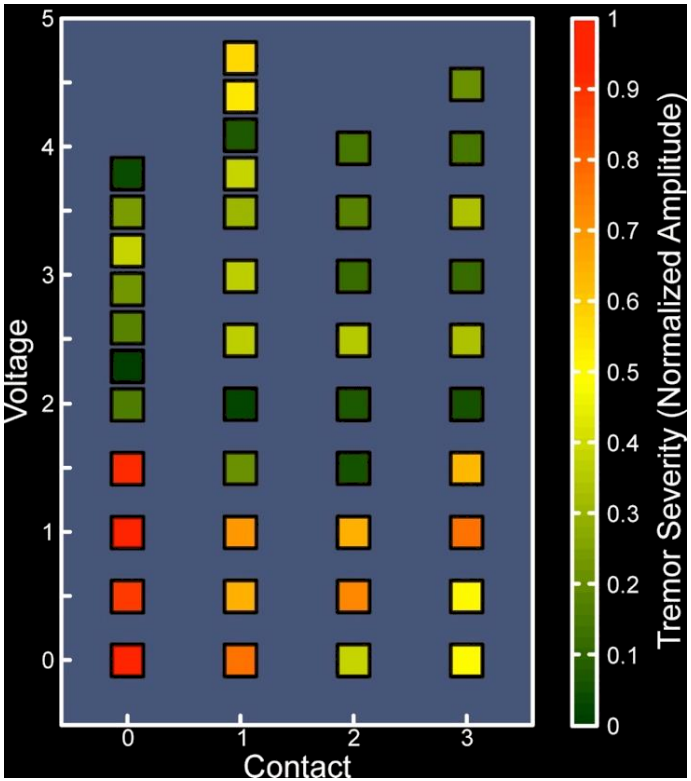
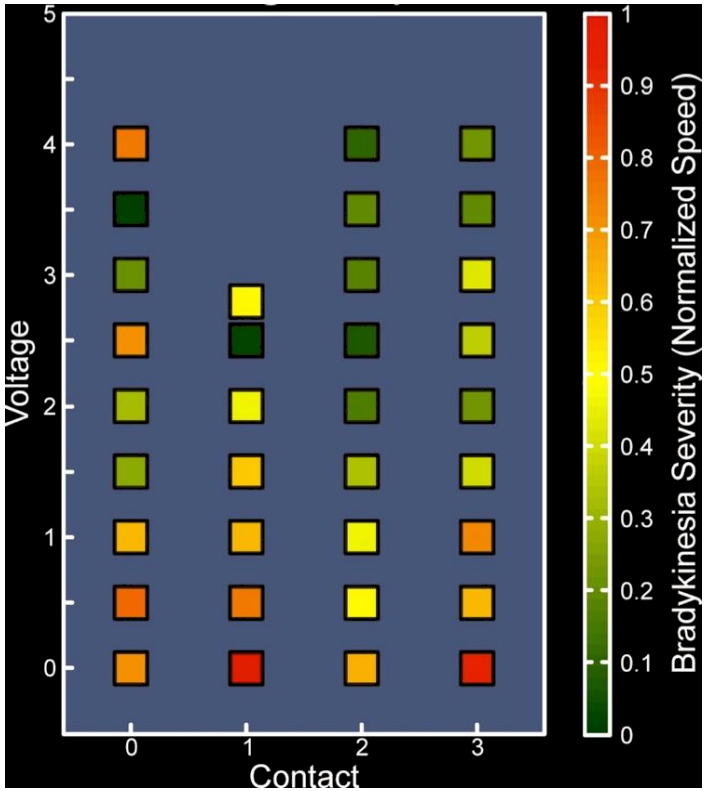
Tuning Maps





- Color-coded visualizations of DBS symptom response

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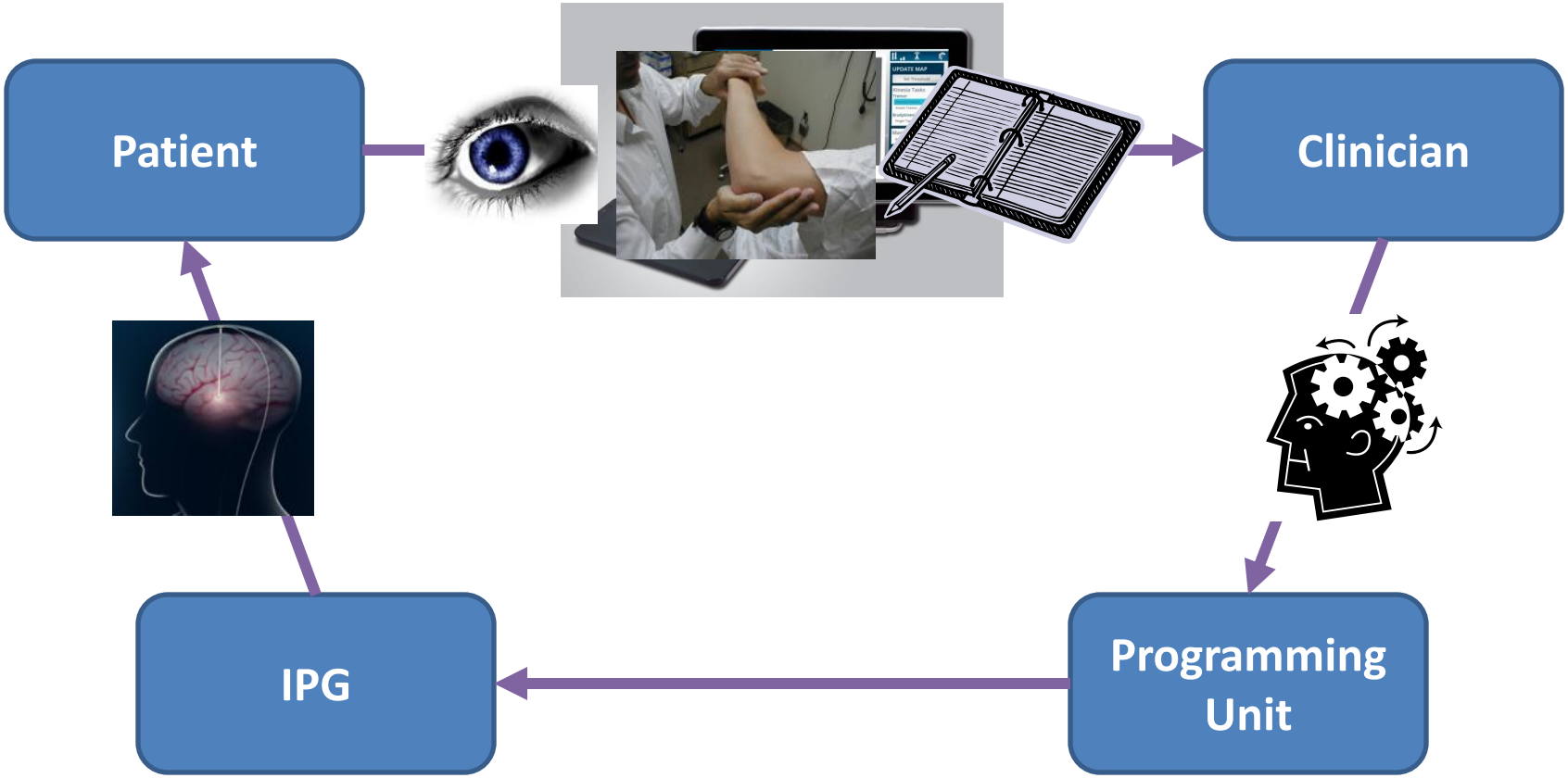
DBS Programming Workflow



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Kinesia ProView

Objective **quantification** and **visualization** of deep brain stimulation response

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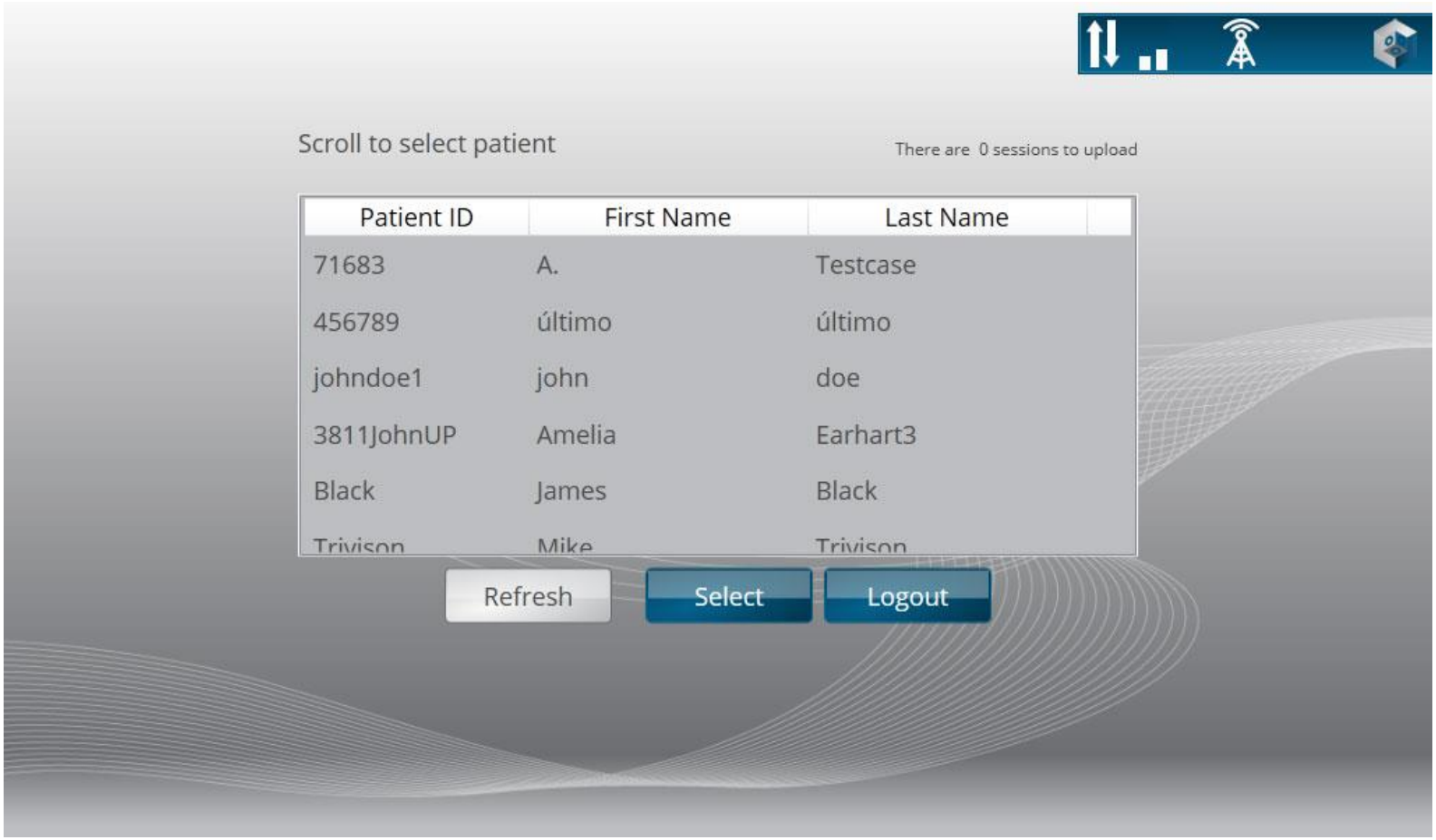
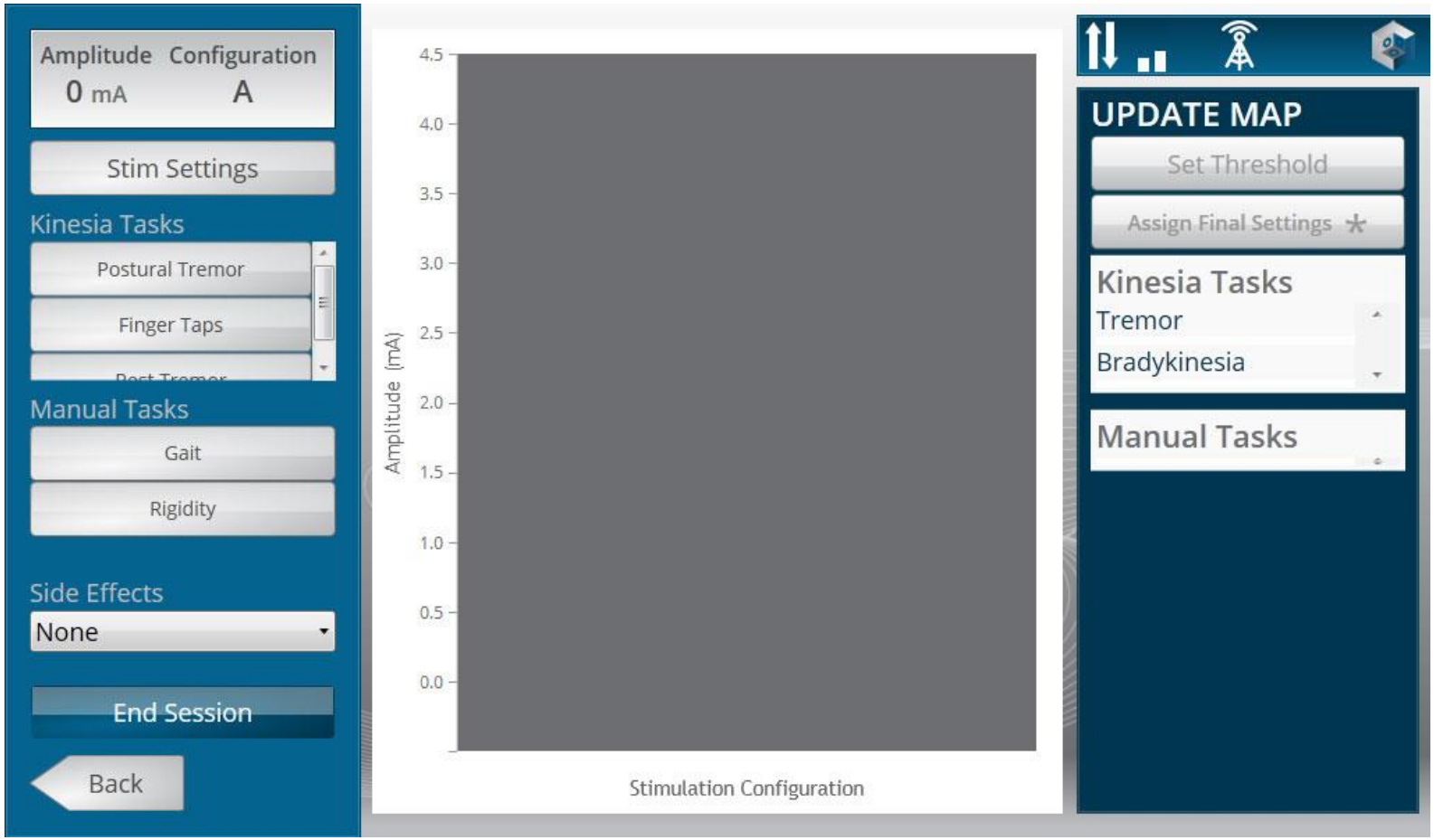
HIPAA Compliant Log-in

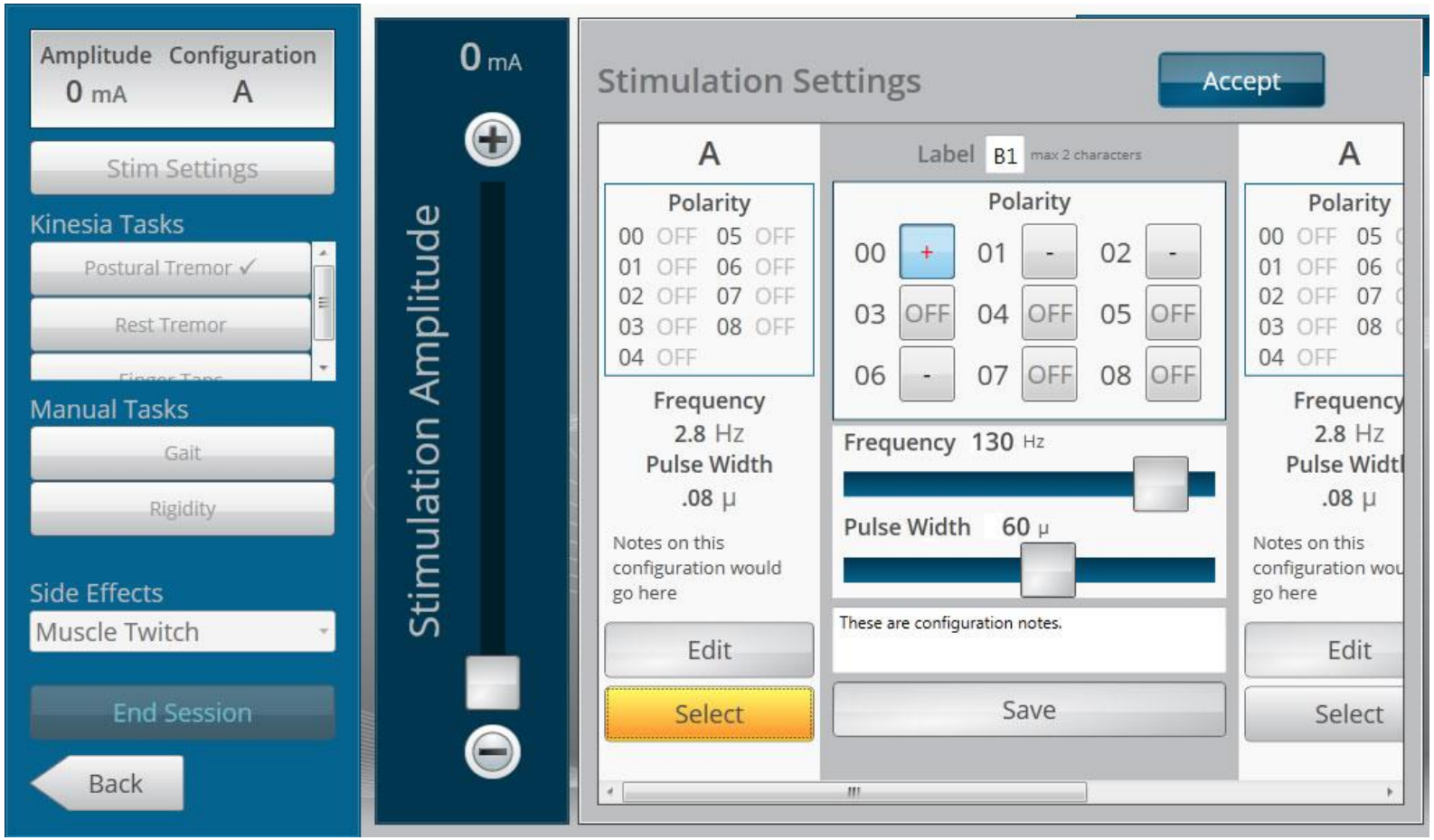
Patient List



Tuning Map Home Screen

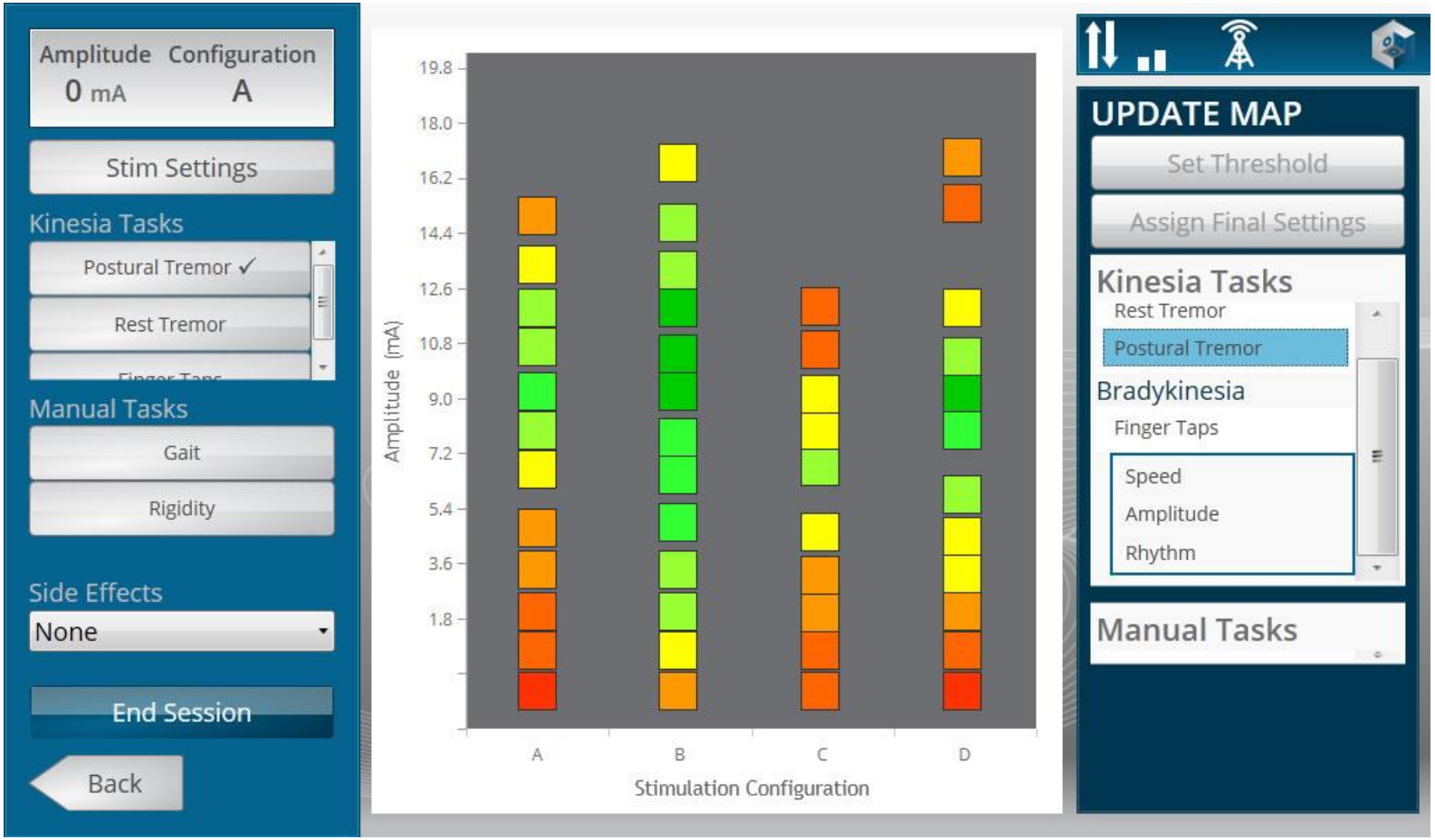


Stimulation Settings

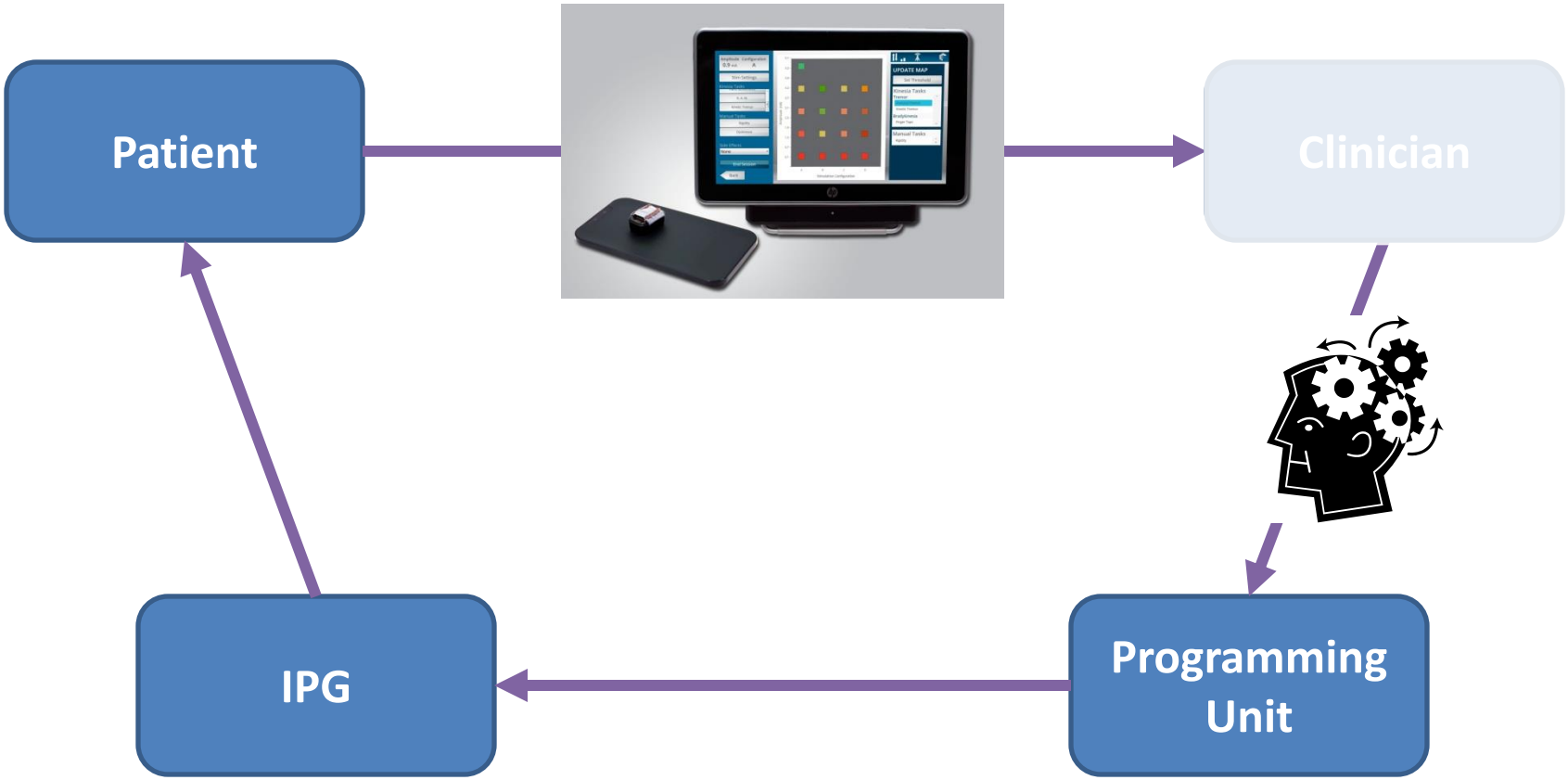


Sensor-Based Assessment

Populated Tuning Map



DBS Programming Workflow



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Automated DBS Programming

1. Motion sensor assessments to develop a functional map
2. Intelligent algorithms for navigating the parameter space to maximize symptomatic benefits while minimizing side effects and battery consumption

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Value Proposition

- Automated programming has potential benefits for both clinicians and patients

Clinician	Patient
• Improved workflow • Improved patient outcome tracking	• Improved outcomes • Reduced battery replacement • Expanded access • Reduced travel burden

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Study Protocol

- 9 PD subjects with DBS visit clinic at 1, 2, and 4 months post-implant
- Conduct a standard monopolar review of parameter space
- At each stimulation setting, assess tremor (rest and postural) and bradykinesia (finger tapping and pronation/supination)
- Record final clinician-selected stimulation settings

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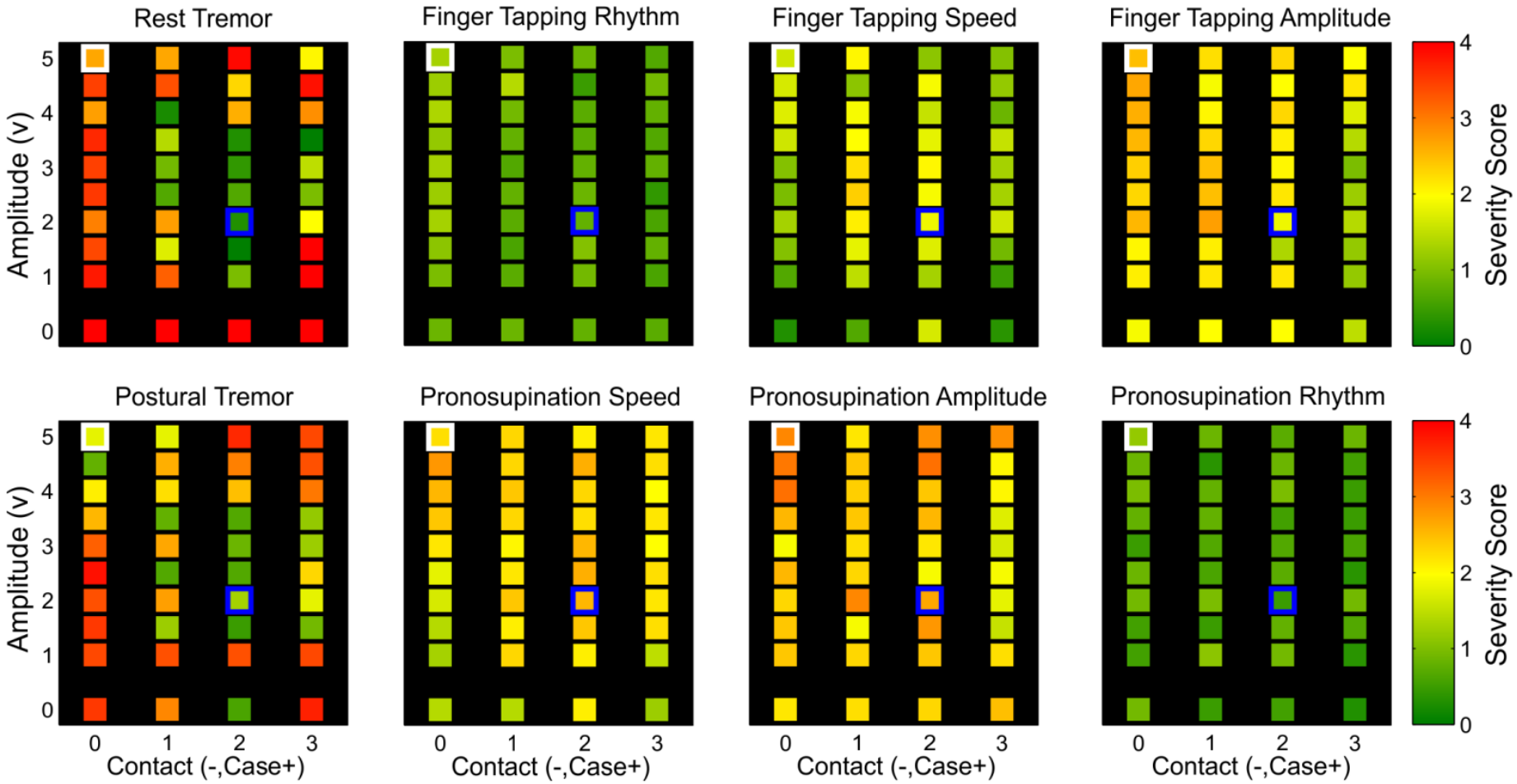
DBS Functional Map



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Parameter Optimization Analysis

- Two algorithms were developed post-hoc to select the “optimal” stimulation contact and voltage combination across all motor tasks
  1. Therapeutic benefit
  2. Battery life
- Relative effectiveness of settings determined by the clinician and those determined by each algorithm were compared

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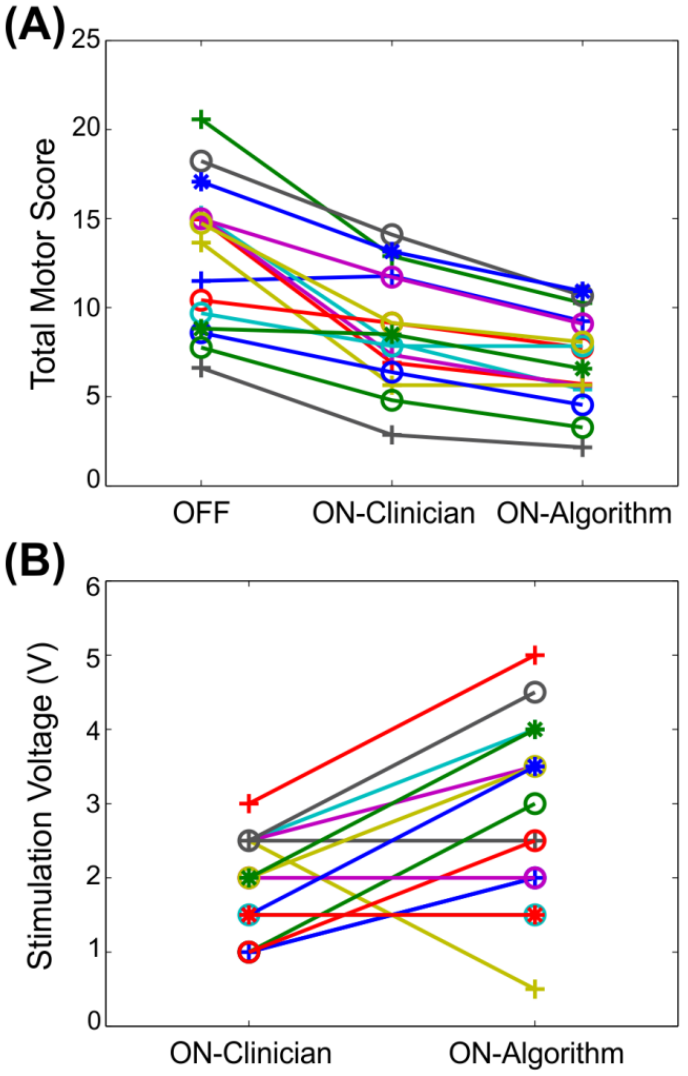
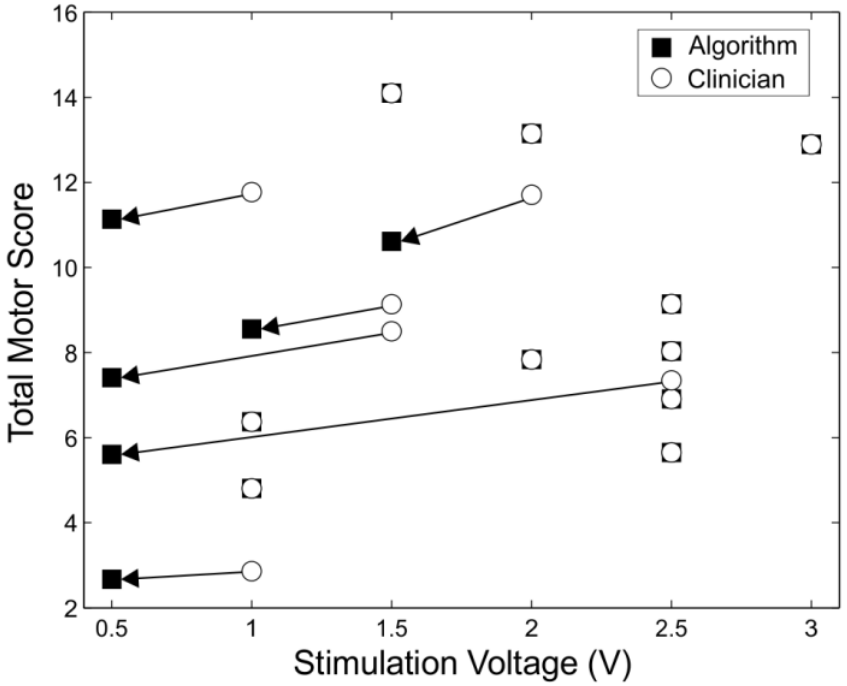
Optimization of Therapeutic Benefit

- Increased therapeutic benefit relative to the clinician settings in 14/16 programming sessions
  - 31.7% vs 45.1%
- Most often at expense of increase in stimulation amplitude



Optimization of Battery Life

- Lower voltage while maintaining therapeutic benefit in 6/16 sessions
  - 50% reduction



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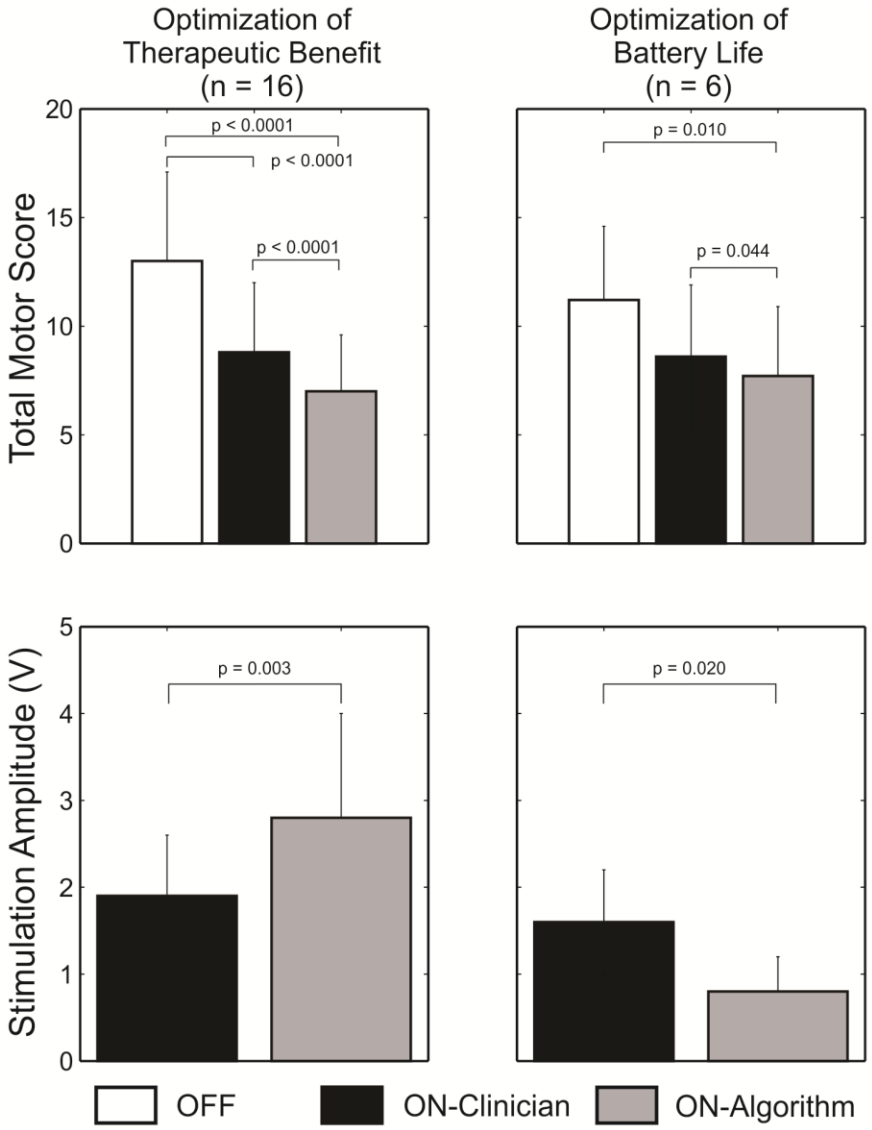
Statistical Comparisons (paired t-tests)



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Conclusions and Implications

- Automated objective assessment in DBS programming can identify settings that:
  1. Improve symptoms, or
  2. Obtain similar benefit as clinicians with significant improvement in battery life
- “Online” evaluation of automated guidance of DBS programming ongoing

Acknowledgements

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Questions?

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