Telemedicine and Mobile Health Applications to identify Parkinson’s predictive and progression markers, and delineate cohorts for future interventional trials.

Project Lead: Dr Michele Hu (NDCN, Oxford University), co-I Dr Max Little (Aston University)

Telemedicine or “healing at a distance” involves the remote delivery of health care services using telecommunications technology, with the primary purpose of increasing access to care (1,2). As populations age globally, the burden of PD will increase rapidly, with the number of affected individuals set to double from 2005 to 2030. Even wealthy nations such as those in Europe/USA will increasingly struggle to provide the necessary specialist care for appropriate management of these patients. With increasing focus on efficiency in healthcare delivery evidenced via the US Affordable Care Act and parallel strategies, the area of Mobile Health, supported by mobile communication devices including wireless patient monitoring devices/sensors, smartphones and tablet computers is currently undergoing explosive growth. This is likely to be an innovation that will change the face of future healthcare, supported by the current wide global availability of broadband (2.6 billion people) and smartphones (1.4 billion).

Previous work from Dr Little in our group has shown that self-administered tests of gait and postural sway performed using consumer-grade smartphones with in-built accelerometers can objectively measure and quantify the key movement severity symptoms of PD. Using a random forest classifier, an average sensitivity of 98.5% and average specificity of 97.5% was found to separate PD subjects from matched controls (3). Furthermore, Parkinson’s speech degradation (dysphonia), analysed using a simple recording of an “ahhh” phonation, could reliably classify PD compared to control subjects with 99% overall accuracy (4) and predict motor severity assessed via a parallel clinician-rated UPDRS measurement with a 2 UPDRS point difference from clinician’s estimates (5). The Hoehn and Yahr scale, often a vital pre-requisite for clinical PD trial entry, has also been shown by Dr Little and coworkers to be reliably calculated from UPDRS scores in 566 PD subjects from the PD-DOC cohort dataset (6). Little and colleagues have also led the Parkinson’s Voice Initiative (http://www.parkinsonsvoice.org), which successfully collected 10,000 landline voice recordings from people across the globe with ongoing current analysis.

Since 2014, the Oxford Parkinson’s Disease Centre (OPDC) Monument Discovery cohort led by Dr Hu (http://opdc.ox.ac.uk) has successfully implemented this low cost mobile health approach using recycled android smartphones to measure voice, rest and postural tremor, postural sway and gait, manual dexterity and reaction times over a 6 minute test applied to a cohort of 1000 incident PD subjects, 300 age-matched control and 300 PD at-risk individuals recruited from a 2.1 million UK Thames Valley population base (7-9). Recordings from 300 study participants at baseline with 18 monthly longitudinal assessments are currently being analysed and validated against a range of motor, non-motor and cognitive measures collected in parallel. Smartphone recordings are currently taken at all OPDC Discovery longitudinal visits, and more intensively 4 times daily over a 1 week period at home in subjects who either own their own smartphone, or are willing to take home recordings using a loaned smartphone from clinic.

In the current application, we propose to extend the above Mobile Health methodology to all longitudinal cohorts delineated in this collaboration with the following principle aims:

1. Improve the earlier diagnosis of pre-motor prodromal PD using enriched at-risk cohorts (e.g subjects with polysomnographically-proven REM sleep behaviour disorder (RBD), GBA and LRRK2 monogenic carriers)
2. Improve identification and recruitment of eligible PD subjects to interventional treatment trials through remote assessment of motor severity measures as described above.
3. Improve current markers of PD stratification and subsequent progression to clinically-relevant end points including early gait freezing, falls and monitoring of dopaminergic medication response.
4. Improve remote monitoring of motor fluctuations including gait freezing and wearing-off periods encountered by PD subjects in the complex disease phase, to facilitate decision making and complex interventions including apomorphine, surgery and duodopa.

References: