I. Abstract

Genetic healthcare depends upon accessible, cost-effective and high-quality genetic testing. Large-scale commercial laboratories enable access and throughput for effective service delivery. Academic medical centers are well-positioned to enable content-specific (disease, tissue, or test type) test development which often requires combined clinical, technological and research expertise. Industry-academic partnerships can optimize diagnostic genetics services by integrating commercial scale with specialized clinical and research expertise. London Health Sciences Center (LHSC) Molecular Genetics Laboratory is an Ontario, Canada, referral genetic laboratory for a number of genetic disorders. As part of a collaborative effort involving clinical, scientific and laboratory expertise we developed custom NGS gene panel-based technology that enables simultaneous sequencing and copy number assessment and that outperforms the classic gold standard of Sanger sequencing and MLPA at sub-exon resolution. As the provincial clinical center of excellence for neurology genetics, LHSC applied this technology to develop NGS-based gene panels for epilepsy, Charcot-Marie-Tooth and mitochondrial genome sequencing. Using 1,000s of clinical specimens tested in the LHSC clinical laboratory, we demonstrate sensitivity and specificity that is superior to Sanger sequencing and MLPA testing combined, as part of a cost-effective clinical pipeline. LabCorp and Dynacare (owned by LabCorp), two of the largest laboratories in the USA and Canada respectively, commercialize these tests providing market access, billing and insurance support and high throughput and high quality clinical testing. Analytics, informatics and clinical reporting are provided by LHSC’s experts. LabCorp’s telegenetic counselors are available to support non-genetics ordering physicians with comprehensive pre- and post-test genetic counseling. This industry-academic partnership demonstrates effective, scalable, and industry-leading quality for delivery of genetic testing services.

II. Telegenetic Counseling

LabCorp (Integrated Genetics) genetic counselors translate and communicate genetic information into practical, understandable terms. They identify genetic risks, explain appropriate testing options, discuss the implications of test results, and help patients make thoughtful genetic health care decisions. With more than 25 years of experience, Integrated Genetics offers the largest US national commercial network of genetic counselors offering two types of counseling:

**Comprehensive genetic counseling:**
- Genetic risk assessment, including a review of the patient’s personal and family medical histories and genetic test results
- Patient education about genetic risk factors and appropriate testing options
- Patient information and support for informed decision-making
- Coordinated patient care to assist you in offering the right test at the right time to the right patient
- Written consultation summary sent to the referring health care provider

**Genetic results counseling:**
- Targeted discussion between the patient and a genetic counselor about the results of Integrated Genetics or LabCorp testing
- Based on the result, an overview of any relevant follow-up testing that should be considered
- Written consultation summary provided to the referring physician and patient
- Does not include family medical history discussion
- No additional charge for genetic results counseling

Genetic counseling is available through the LabCorp Telegenetic Counseling to You program. Telegenetic Counseling to You provides an audio and video connection between the patient and the genetic counselor which allows them to see and hear each other during the genetic counseling session. The patient can access Telegenetic Counseling to You conveniently from their home or office. They can set up an appointment for this program by using an online scheduling tool.

III. Integrated Test Service

This integrated test service allows both partners to capitalize on respective expertise. LabCorp provides commercial market access including sales, marketing, account management, sample collection and logistics. LabCorp’s Canadian business, Dynacare, provides lab testing service in a CAP/CLIA certified environment including all state-specific licenses and enables high throughput and scalable wet lab sample processing. LHSC provides analytical expertise and individual patient reporting in the academic environment integrating clinical input. LabCorp provides genetic counseling support. LHSC provides ongoing test development focusing on long term innovation.

**Figure 1. Test service workflow demonstrating LabCorp/Dynacare and LHSC roles**

IV. The new gold standard for Molecular Testing: parallel Mutation and CNV assessment for all genes

**Figure 2. NGS CNV detection algorithm outperforms classical gold standard of MLPA and a-CGH**

Coverage distribution plot demonstrating NGS pileup uniformity achieved by Roche/Nimblegen random fragmentation based genomic enrichment protocol (bottom), and not by other 3 chemistries tested. This uniformity enables computational conversion of sequencing data to copy number data directly for highly sensitive and specific assessment of sequence and CNV data for every gene and every exon on every sample

**Figure 3. Unique custom chemistry ensures deep and uniform coverage and outperforms classical gold standard of Sanger sequencing**

Top pile up includes 12 samples assessed with Epilepsy panel, middle pile up includes 24 samples assessed with the CMT Neuropathy panel and bottom pile up includes 24 samples assessed with the Mitochondrial Genome sequencing panel. This technology was validated to outperform the classical gold standard of parallel Sanger and MLPA testing on multiple targeted gene panels across 1000’s of patient samples (PMID: 28818680, 27376475) achieving:
- 100% sensitivity and specificity for sequence and copy number alterations,
- mean coverage of 500x,
- full coverage with no dropouts,
- detection of previously non-detectable alterations, and
- detection of heteroplasmy to 5% sensitivity for mutations and CNVs.