An Economic Analysis of the Value of Genetic Testing

A Deliverable of the Moving Genomics to the Clinic Project

The Context:

The Moving Genomics to the Clinic project (project overview here) seeks to amplify the evidentiary basis for the clinical efficacy and utility of genetic testing in order to increase the use of genetic testing and screening in a clinical setting in patients’ best interest. Genetic testing will allow for a more personalized approach to healthcare as well as an opportunity for better disease screening and more targeted treatment options across disease areas like cancer and rare disease.

An in-person workshop in February 2020 (workshop report here) to kick-off the project focused on exploring the key barriers to moving genomics into regular, everyday clinical practice. The incongruencies of coverage across types of genetic testing emerged as a central barrier. Types of genetic test are varied, but can generally be placed in four categories for conceptual evaluation: somatic testing, carrier testing, rare disease testing, and population health testing (see Figure 1 below).

![Figure 1. Types of genetic testing and test types (enlarged for easier viewing on page 4)](image)

Each of these four categories represent different opportunities for potential return-on-investment whether in determining the effectiveness of immunotherapy as a treatment for someone diagnosed with cancer (somatic testing using liquid biopsy; cancer use case) or shortening a hospital stay by accelerating a diagnosis (whole genome sequence; rare disease use case). Each of these categories of tests can provide different value propositions and, similarly, result in different economic outcomes. Amid incongruent coverage or even lack of coverage for many genetic tests, the Forum’s Moving Genomics to the Clinic Project will start...
by generating evidence to demonstrate to payers, providers, and others in the healthcare ecosystem how and to whom genetic testing provides economic value and further value.

The Opportunity:

The World Economic Forum is leading a working group to produce a holistic economic analysis to be publicly available at no cost as a Forum publication in Q2 of 2020 outlining the specific opportunities for return-on-investment across each of the four major categories of genetic testing (see Figure 1) and including case studies on previous and current efforts that successfully showcase such return-on-investment within each category. Subject matter experts within each area of genetic testing, including payers, providers, pharmaceutical companies, academics and patient advocates will work together to produce an original economic analysis. Each category of genetic testing could showcase prior successful use cases, the economic returns of such use cases (using data when it is available), and projections for future additional economic returns-on-investment by implementing regular genetic testing in a clinical setting. The final scope of the analysis and resulting white paper will be determined by the working group and external advisors.

The Impact:

The target audience for The Forum’s forthcoming white paper providing an economic analysis of the value of genetic testing is payers and policymakers, as they are key decision makers in the coverage of testing and integration into clinical practice. The Moving Genomics to the Clinic project community includes many of these decision makers, who directly participated in the project’s launch at a workshop in February 2020. At the workshop, the current ambiguous or incongruent levers dictating coverage of genetic testing was identified as a key barrier to moving genomic testing into clinical practice. As per Forum standard practice, the paper will be written in everyday language, so that it is accessible to readers outside the field of genetics or medicine. The paper will reach specific stakeholder groups, such as patient groups or advocacy organizations, using the Forum’s Precision Medicine community and its 100+ global members. Contributors to the paper will receive authorship opportunities, integration into the Precision Medicine global community, international visibility via the Forum’s media and content channels, and opportunities to showcase the work via events (Forum meetings and affiliated sessions).

The paper will build on the work of a prior economic analysis focused on opportunities for return-on-investment of cross-border data access for rare disease diagnosis confirmation using genomic and phenotypic data entitled Global Data Access for Solving Rare Disease: A Health Economics Value Framework. Released in late February, this prior economic framework for rare disease attracted more than a million global views just a week after its launch and nearly 15,000 unique paper downloads.

Process:

The paper’s development will be led by the World Economic Forum with the Forum serving as the paper’s project manager, publisher, and lead on media release logistics. The paper has the option to be launched publicly using the Forum’s media platform and virtual global event
calendar and via our Forum Partners on their respective digital platforms. Forum Partners will serve as authors, strategic advisors, peer reviewers and amplifiers of the final paper. The Forum will lead a working group of 4-6 key contributors from December 2020 until May 2021 who are committed to providing data, leading the analytical framework, and writing the white paper. The Forum will convene weekly working group meetings with participation from a designated lead author from each participating partner organization. Based on subject matter expertise and the topic of each section, each partner will provide a lead author or authors to write a section of the paper either independently or with another partner organization. After writing concludes, the Forum will handle all editing, publication, and media launch components.

**DRAFT Timeline:**

- **November 2020:** Identify partners interested in subject matter of the white paper; secure commitments to provide expertise and resources.
- **December 2020:** Host virtual meeting with all participating partners to create a paper outline and divide up any required research and writing; review writing timeline; establish communication cadence
- **January 2021:** Host weekly meetings with representatives from each partner organization
- **January 2021-March 2021:** Draft research and writing
- **March 2021:** Submit first draft of each section to the Forum team
- **April 2021:** Paper revisions and peer review process
- **May 2021:** Final paper released at postponed Forum Annual Meeting

**Get involved:**

Partners involved on the project are welcome via multiple levels of engagement including:

- **Join the working group to write the paper:** Write a section of the paper based on subject matter expertise; multiple partners will work together on each section
- **Nominate a subject-matter expert to provide strategic guidance:** Provide a subject matter expert to contribute to this work from an advisory level as the working group produces the paper
- **Peer review the final draft:** Nominate a subject matter expert or volunteer to peer review the final paper before its publication; provide suggested modifications to make the paper stronger

**Contact:**

For more information, contact Lynsey Chediak, Project Lead, Shaping the Future of Health and Healthcare, World Economic Forum at Lynsey.Chediak@weforum.org.
<table>
<thead>
<tr>
<th><strong>Somatic Testing</strong></th>
<th><strong>What is it?</strong></th>
<th>Testing of tumors or other tissues to determine genetic variants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Used For:</strong></td>
<td></td>
<td>Most commonly used in oncology. Genetic testing can help determine more targeted patient treatments or enrollment in clinical trials</td>
</tr>
</tbody>
</table>
| **Test Types**    |               | ▪ Gene expression profiling panels (e.g. OncotypeDx): for early stage breast cancer  
▪ Targeted NGS panels: for metastatic solid tumors  
▪ Liquid Biopsy (circulating cell-free DNA assay): for real-time mutational information |

<table>
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<tr>
<th><strong>Rare Disease Testing</strong></th>
<th><strong>What is it?</strong></th>
<th>Testing for undiagnosed diseases, predominantly in new-borns or children, where standard diagnostic methods have failed to provide clear answers</th>
</tr>
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<tbody>
<tr>
<td><strong>Used For:</strong></td>
<td></td>
<td>Identifying disease from inherited variants or unique changes in DNA (known as de novo mutations). Can also be used to further understand the number of pathogenic genetic variants at play throughout the lifetime of a person with a rare disease or understand the interplay of multiple genetic variants</td>
</tr>
</tbody>
</table>
| **Test Types**          |                 | ▪ NGS Panels  
▪ Whole Exome Sequencing  
▪ Whole Genome Sequencing |

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<tr>
<th><strong>Carrier Testing</strong></th>
<th><strong>What is it?</strong></th>
<th>Testing healthy individuals to identify inherited variants causing disease (e.g., sickle cell anemia, cystic fibrosis, Huntington’s)</th>
</tr>
</thead>
</table>
| **Used For:**       |                 | ▪ Testing healthy individuals to identify inherited variants causing disease (e.g., sickle cell anemia, cystic fibrosis, Huntington’s)  
▪ Additional uses are Carrier Screening (prior to conception), and Non-Invasive Prenatal Testing (NIPT) after conception, to identify germline conditions a newborn may inherit |
| **Test Type**        |                 | ▪ Targeted NGS Panels |

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<tr>
<th><strong>Population Health Testing</strong></th>
<th><strong>What is it?</strong></th>
<th>Testing performed on healthy persons to identify genetic variants which may impact health or use of medications</th>
</tr>
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</table>
| **Used For:**                 |                 | Testing for prevalent variants with actionable interventions, such as CDC Tier 1 which includes:  
▪ Increased risk of breast and ovarian cancers, due to BRCA1 or BRCA2 mutations  
▪ Lynch syndrome (LS): increased risk for colorectal, endometrial, and ovarian cancers  
▪ Familial hypercholesterolemia (FH): very high cholesterol levels increase risk for heart disease or stroke  
Pharmacogenomics: Response to medication based on individual’s genes |
| **Test Types**                |                 | ▪ Targeted NGS Panel  
▪ Whole Exome Sequencing |

* Population Health Genomics can be defined more broadly. We are using a narrow definition in this discussion, for greater focus.
Types of Genetic Testing

**Next Generation Sequencing (NGS)**

Refers to a group of technologies that produce thousands to millions of DNA sequences. Compares an individual’s DNA sequence to the reference genome to determine what genetic variations are present for that individual.

**Whole Genome Sequencing (WGS)**

Used to determine nearly all of the approximately 3 billion nucleotides of an individual’s complete genome (including non-coding regions). Whole Genome Sequencing examines an individual’s entire genome.

**Whole Exome Sequencing (WES)**

Determines the nucleotide sequence of the coding regions of an individual’s genome, which is approximately 1% of a person’s total genome (approximately 20,000 genes). This 1% contains the instructions for RNA (ribonucleic acid) and protein-coding regions of an individual’s genome.

**Targeted Next Generation Sequencing (NGS) Panels**

Targeted gene sequencing panels are useful tools for analyzing specific mutations in a given sample. Panels contain a select set of genes or gene regions that have known or suspected associations with specific diseases. Laboratories provide preconfigured panels for specific testing purposes (e.g., oncology, pharmacogenomics, CDC Tier1 genes). Panels can also be configured to test a large number of genes with known or suspected impact. Panels are the most cost-efficient type of testing.