CASE STUDY

Health Care
TGen Infrastructure

Unraveling the Genetic Mystery of Disease

TGen, Dell Technologies, and Intel bring high performance computing to research and clinical care

How Intel® and Dell Technologies lead the way

Together Intel and Dell Technologies are driving innovation and next-generation capabilities with the broadest portfolio of trusted client and enterprise solutions for cloud and data management, enabling businesses to move faster, innovate more, and operate efficiently.

Customer Strategic Challenges

An NIH-funded study shows that 40 percent of rare disease patients are diagnosed incorrectly before the cause of their illness is found.[1] And more than half of that group spend five to 30 years on a chaotic journey through numerous referrals before a doctor makes the correct diagnosis.[2]

To better understand rare diseases—some so rare they don't have names—including different forms of cancer, researchers are turning to the human genome. Their work is helping oncologists and other physicians make faster diagnoses and prescribe effective treatments. And thanks to the lower cost of compute and other developments, this form of personalized medicine is becoming more feasible and economical for widespread use.

The nonprofit Translational Genomics Research Institute (TGen), an affiliate of City of Hope, applies technologies to the human genome. Their goal: help physicians and researchers move discoveries into the clinic at an accelerated pace to better diagnose, treat, cure, and prevent diseases based on underlying genetic causes.

In collaboration with Dell Technologies and Intel, TGen has built a high performance computing (HPC) infrastructure that is optimized for life sciences. It includes Intel® Xeon® Scalable processors and Dell rack servers such as the PowerEdge R640 and C4140 and the PowerEdge M1000e blade enclosure. The HPC infrastructure also takes advantage of Intel® Optane™ memory, which increases storage capacity and system acceleration. This partnership—which, beyond hardware, includes problem solving by dedicated engineers at Intel and Dell Technologies—has sped up the process and helped save lives.

The next phase of genomics will rely on artificial intelligence (AI), increasing both speed and efficiency. However, this will require exponentially more data and faster compute. Yet by scaling up through AI, significantly more people can benefit from genomically guided, personalized medicine.

The need for speed

Seven hours. That's how long it takes today to process a genomic sample to understand the cause of a patient's disease and develop a treatment. But it wasn't always this fast.

When TGen first began working with next-generation sequencing (NGS) in 2008, it took approximately two weeks—an eternity as far as use in a clinical setting—for a supercomputer to perform the processing. That meant a new patient would wait not just two weeks to get their genome sequenced, but for all those already waiting in line to go first.

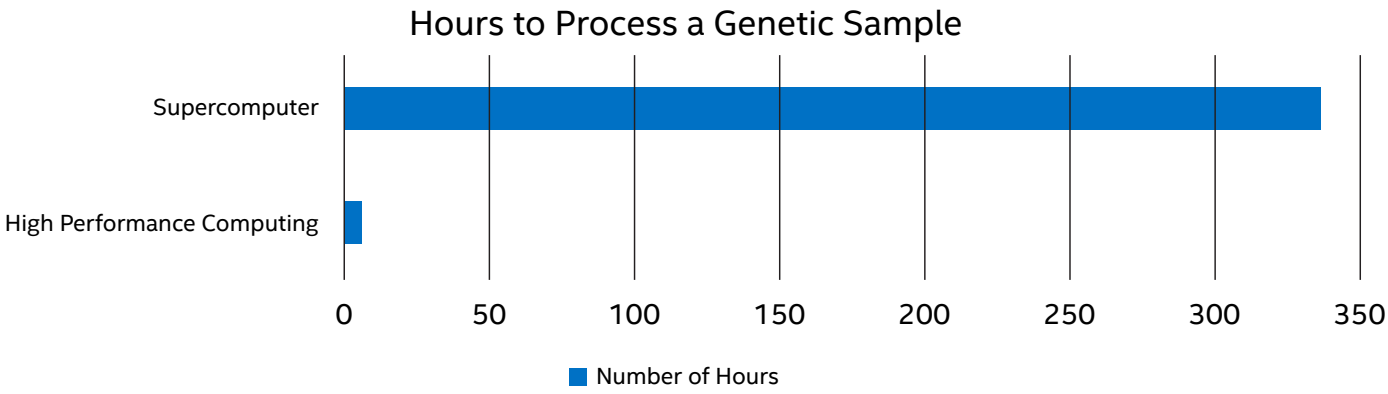

Figure 1. The Intel, Dell, and TGen collaboration transformed DNA sequencing by cutting processing time.[3]

This lack of optimization led to discussions between TGen, Dell Technologies, and Intel, which led to establishing a HPC project in 2012. Intel and Dell contributed in-kind donations, and engineers from both companies volunteered their time to help create an optimized platform at TGen, purpose built to rapidly process NGS samples (Figure 1).

In describing the types of patients well suited to this method, TGen Distinguished Professor and Director of Quantitative Medicine and Systems Biology Division Dr. Nicholas Schork said, "Every hospital has patients who stump the physicians. These patients present severe, debilitating conditions, and a series of doctors examine them. But they rarely discover the cause and offer an effective treatment plan."

Genomic data provides a basis for treatment

Genomic sequencing can help identify an anomaly in the patient's DNA, which could shed light on these otherwise unknown conditions. For instance, the DNA in a cancer patient's tumor may lack a gene needed for a certain function to keep a cancer from growing. "That data can help us gain an entry point into the molecular pathology driving the tumor's growth," said Dr. Schork, "and narrow down which drugs can genomically target the tumor."

This can help oncologists treat patients with neuroblastoma, a deadly, aggressive cancer that attacks the nervous system of infants and young children. It is the most common cancer in infants, with approximately 800 new cases each year in the United States.[4] The first pediatric precision clinical trial to use these techniques to treat affected children was conducted at Helen DeVos Children's Hospital in Grand Rapids, Michigan.

Technology opens the doors to insight

In building its HPC infrastructure, TGen sought out technology partners whose work in the field would continue to evolve. This would help ensure compatibility so that new components could be added without having to rebuild the solution from the ground up. The solution design also took compute, storage, networking, and software into consideration.

"Both Intel and Dell remain committed to the goal of improving human health with TGen," said Dr. Schork. "We're planning the next generation of our system, and their engineers are helping us solve our data processing and throughput challenges."

Bryce Olson

Cancer survivor/cancer fighter

For Bryce Olson, a marketing strategist at Intel, standard treatment would not stop his aggressive advanced metastatic prostate cancer from growing. Faced with a limited life expectancy but not yet too sick to work, he asked to be transferred to Intel's healthcare group.

There Bryce learned about Intel's work with hospitals and research organizations in the field of genomics and precision medicine. The notion that sequencing a patient's DNA could yield a more complete diagnosis and new treatment options triggered Bryce to get his genome sequenced.

The data revealed that Bryce's cancer grew along a specific pathway. With that information, Bryce joined a clinical trial of a new drug meant to inhibit that particular cancer.

Bryce's cancer responded to that new treatment. He's in remission and has become an advocate for genomics-guided precision medicine. However, if Bryce's cancer begins to grow again, sifting through genomic records—to find patients with very similar genomic profiles and whose cancer has been stopped using a specific approach—could be his best hope.

"The only way to treat patients like me, long term, is to amass and analyze data with AI," said Bryce. To help oncologists treat patients with rare forms of cancer, AI can process tremendously large sets of data in ways that people can't. This makes it possible to find patterns and insights that had eluded researchers and physicians.

Today, Bryce is a global strategist at Intel's Health and Life Sciences Group. He's also launched a patient-driven movement called Sequence Me to help other advanced cancer patients get on the path to precision medicine.

By working with Intel and Dell Technologies, TGen can:

- Concentrate its resources on R&D, not complex infrastructure
- Optimize genomic pipelines for rapid results
- Identify treatments in clinically relevant timeframes
- Reduce cost while increasing the effectiveness of bioinformatics
- Maintain compliance and protect confidential data

Addressing the wider public

While TGen's goal is still discovering treatments for rare diseases, their work provides benefits to the general population. In the past, the limiting factor had been the time it took to process data. Now that time has dramatically decreased.

"Previously we had to be very selective," said Dr. Schork. "That meant we couldn't go down every avenue. But with the improvement of sequencing technology, costs have come down considerably. Now we can compare an individual patient's DNA sequence to DNA from larger groups."

TGen can now examine huge data pools to find very small connections in the way a gene anomaly is shared by multiple people with similar diseases that are difficult to treat. By scaling up the amount of data that can be analyzed to make connections, it's possible to sequence DNA from a biopsy of a patient's tumor to identify the genomic lesions contributing to its growth and then tailor drug treatment to combat those unique sets of mutations.

By moving to this method of diagnosis and treatment, oncologists can prescribe the combination of drugs that deliver the most benefit while avoiding those that aren't likely to help. This can result in more-effective treatment with fewer side effects.

Learn More

For more information about the technology deployed at TGen, visit delltechnologies.com/tgen.

For more information about Intel's work with the health and life sciences industry, visit intel.com/healthcare/bigdata.

For more information about Intel® server technology, visit intel.com/xeon.

To explore other customer stories highlighting data-centric innovations, visit intel.com/customerspotlight.

Artificial intelligence offers enhanced treatment options

The number of potential matches between different drugs and genomic alterations is immense. For that reason, TGen seeks to build infrastructure comprised of expert knowledge combined with large-scale computing on patient DNA. This can be used to augment the work of oncologists and other physicians in how they personalize treatment.

By using machine learning, the researchers at TGen are looking for patterns in patient and tumor DNA to create models that can help inform doctors in their decision-making. But to achieve this requires massive amounts of data and the ability to store, analyze, and detect anomalies.

However, in the future, as HPC from Intel and Dell Technologies improves these processes, it will become routine for anyone diagnosed with cancer or other serious diseases to have their genome sequenced. The research, treatment, and technology advancing these lifesaving techniques will help democratize personalized medicine, enabling more patients to benefit and more doctors to save lives.

About TGen, an affiliate of City of Hope

Translational Genomics Research Institute (TGen) is a Phoenix, Arizona–based nonprofit organization dedicated to conducting groundbreaking research with life-changing results. TGen is affiliated with City of Hope, a world-renowned independent research and treatment center for cancer, diabetes, and other life-threatening diseases. This precision medicine affiliation enables both institutes to complement each other in research and patient care, with City of Hope providing a significant clinical setting to advance scientific discoveries made by TGen. TGen is focused on helping patients with neurological disorders, cancer, diabetes, and infectious diseases through cutting-edge translational research (the process of rapidly moving research toward patient benefit). TGen physicians and scientists work to unravel the genetic components of both common and complex rare diseases in adults and children. Working with collaborators in the scientific and medical communities worldwide, TGen makes a substantial contribution to help our patients through efficiency and effectiveness of the translational process. For more information, visit tgen.org.

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6376651/.
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6376651/.
3. https://www.intel.com/content/www/us/en/healthcare-it/solutions/videos/healthcare-tgen-video.html.
4. https://www.cancer.org/cancer/neuroblastoma/about/key-statistics.html.