The Economic Impact and Application of Human Genetics and Genomics

Report demonstrates that human genetics and genomics is fundamental for biomedical research, widely deployed in healthcare, and boosts the U.S. economy.

This project describes the positive impacts for the economy, society, and individual health that are derived from modern human genetics and genomics science and its associated commercial and clinical applications. These highlights are from a new report by ASHG and TEConomy Partners.

Twenty years after the completion of the Human Genome Project, there has been widespread expansion of human genetics and genomics technology and its application universe. Technologies for sequencing and for genome analysis have advanced quite spectacularly – to the extent that genome sequencing is quite affordable, and an entire genome may be sequenced in less than a day. Today, this expansion has brought human genetics and genomics to a visible inflection point. The speed and affordability of gene sequencing and advanced genomic data analytics have helped produce deep biomedical insights and innovations, which are being combined with advancing biopharmaceutical, diagnostics, and other medical technologies that can leverage genomic information. The result is that genomics is now part of the everyday clinical practice of medicine across many medical specializations and medical conditions.

Economic Impact Highlights

DIRECT EFFECT
- Human Genetics & Genomics Focused Research Expenditures, Services, and Corporate Operations in the U.S.

INDIRECT EFFECT
- Purchase of Secondary Inputs & Services from U.S. Suppliers and Vendors
- Human Genetics & Genomic Supported Employees Spending Disposable Income in the U.S. Economy

INDUCED EFFECT

Total Economic Impacts of Human Genetics & Genomics

DIRECT EFFECT

$3.3B FEDERAL RESEARCH

INDIRECT EFFECT

152,000 INDUSTRY JOBS

INDUCED EFFECT

850,000 TOTAL SUPPORTED JOBS

$265B TOTAL ECONOMIC IMPACT

$5.2B DIRECT FEDERAL TAX REVENUES

4.75:1.00 FEDERAL RETURN ON INVESTMENT

Federal research funding, using a conservative definition of what constitutes human genetics and genomics research, reached $3.3 billion in 2019, with most of this coming from NIH.

With a direct employment estimate of nearly 166,000 academic and industry jobs, human genetics and genomics supports more than 850,000 total jobs. Each direct human genetics and genomics job supports 4.12 additional jobs in the U.S. economy.

The direct economic activity generated by the human genetics and genomics industry exceeds $108 billion in 2019 and ultimately supports a total of more than $265 billion across the U.S. economy. Every $1.00 of direct human genetics and genomics activity generates an additional $1.45 in the U.S. economy.

The federal tax revenues of $5.2 billion generated by the direct operations of the human genetics and genomics domain alone, surpasses the single year federal investment in human genetics and genomics of approximately $3.3 billion across all federal agencies.

In the simplest of terms, from a federal investment and revenue perspective, the overall economic impacts of U.S. human genetics and genomics generates a return on investment (ROI) of more than 4.75 to 1.00 ($3.3 billion in federal investment in human genetics and genomics – while the whole domain generates $15.5 billion in federal tax revenues).
Functional Impact Highlights

Genomics has become fundamental to advancement of biomedical research, and the insights, tools, and technologies provided by genetics and genomics are now widely deployed in clinical healthcare. These functional applications are divided into eight medical domains as shown in the figure below.

Current Functional Impact Domains (Applications) of Human Genetics and Genomics

- **Environmental Genomics and Metagenomics**: Examining the impact of human interactions with the environment on the human genome, gene regulation, mutation, and disease etiology.
- **Minable Big Data (Discovery Science)**: Analyzing sequencing data from large and diverse populations to provide deep insights into disease biology and identify characteristics associated with health.
- **Identifying Predisposition to Diseases and Disorders**: Genetic and genomic testing to identify carrier status, and identify predisposition for genetic disease via prenatal, newborn and adult screening.
- **Diagnosing Diseases and Disorders**: Using biomarkers and gene signatures to diagnose the presence of diseases or disorders that are associated with specific genes or gene products.
- **Pharmacogenomics (Personalized Medicine)**: Using sequencing data to enable the prescription of drugs best suited to the patient’s genotype (increasing efficacy and reducing adverse events).
- **Gene Editing and Gene Therapy**: Modifying the genes associated with a disease or disorder to treat or cure the disease.
- **Human-Microbe Interaction**: Examining the human genome’s impact upon hosted microbial populations, and microbe impacts upon the human genome and gene expression.
- **Rational Drug Development**: Using genetic information and gene associated biomarkers to inform molecular targeting in drug design.

In addition to applications to human medicine, there are additional non-medical applications for human genetics and genomics including in forensic science, anthropology, genealogy, evolutionary biology, and paternity testing.

Whether for medical or non-medical applications, it is evident that human genetics and genomics advancements provide extremely large-scale benefits across a broad variety of functional impact domains. Genetics and genomics are considered fundamental within modern biological science, providing answers to basic biological research questions, and they underpin a diverse range of applied innovations and applications that are greatly enhancing human health and well-being.