VIEWPOINT

Consumer Genomic Testing in 2020

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Consumer genomic testing (CGT) can be defined as DNA tests sold or marketed directly to consumers for recreational, ancestry-related, or health-related purposes. Direct-to-consumer (DTC) testing does not typically involve a health professional in the selection of testing and return of test results, whereas consumer-driven genomic testing may involve a physician or other health professional who could have a financial relationship with the testing company. CGT has been part of the landscape of biomedicine for several decades.[1] The earliest examples of these tests included DNA testing of a small number of single-nucleotide variations (SNVs) associated with nutritional status, drug metabolism, and mental health risk. Some of these tests were controversial; for example, tests that measured SNVs to predict risk of developing depression were criticized by geneticists, ethicists, and government regulators.[2]

Over time, CGT has become considerably more complex, including tests such as SNV arrays and genome sequencing, in which millions of variations can be detected simultaneously. CGT has also moved closer to providing testing similar to services offered by clinical laboratories. In 2017, the US Food and Drug Administration granted authorization to a single company to offer health-related DTC genetic tests for risk of multiple health conditions, including Alzheimer disease, Parkinson disease, and α_1-antitrypsin deficiency. Since then, additional authorizations for pharmacogenomics testing and cancer risk have been granted.[3] If estimates that by 2021 more than 100 million people worldwide will have undergone CGT prove true, it seems likely that more adults will have had their DNA tested outside of the traditional health care system than within it.[4] Although this presents an opportunity for the increased appropriate use of genomic information in health, the influx of CGT results also poses challenges for clinicians and their patients.

In 2019, the National Academies of Sciences, Engineering, and Medicine Roundtable on Genomics and Precision Health conducted a workshop to explore the current landscape of CGT, including consumer drivers for the uptake of CGT, how CGT may affect traditionally underserved and minority populations, integration of CGT into health systems, and the policy and regulatory issues of this rapidly evolving field.[5]

The increase in CGT uptake over the past several years may be attributed to a variety of factors, including marketing, declining testing costs, and an increasing perception that CGT provides health value. Perhaps less obvious are 2 additional factors. First, CGT companies are increasingly intermixing low-cost health-related CGT with ancestry-related CGT. This is exemplified by a 2019 announcement by Ancestry to launch health-related testing as one of its products and by 23andMe bundling ancestry and health testing services into a gift package costing less than US $100 for the 2019 holiday season. Some marketing of ancestry testing to minority groups has been controversial but may serve to engage populations that might not have otherwise participated in health-related CGT testing. Second, some companies (eg, InVitae) have developed a hybrid model for CGT testing. In this model, testing is marketed directly to consumers, but health professionals provide the consumer with medical advice regarding selection and interpretation of test results.[6] Given the profusion of options for accessing CGT, there is potential for inappropriate testing of consumers who may be less equipped to understand the limitations and potential harms that may arise from engaging in CGT. Clinicians will need to be able to guide patients who have intentionally or less deliberately received, perhaps as a gift, health-related genomic test results.

Cost reductions and increased availability of clinical-quality CGT raises the possibility that CGT may enhance access to genomic services for individuals who have had difficulty obtaining traditional genetic services, including those in underserved and rural populations. However, for some non-European ancestry groups it is likely that CGT may have less useful, and perhaps misleading, information regarding disease risk. This is in part because the genomic data underlying the interpretation of rare and common variant disease risk has been heavily skewed to include individuals of European ancestry. Testing in ancestrally diverse populations may yield ambiguous results, such as reporting increased numbers of variants of unknown significance.[7] Gaps in the data for individuals of non-European ancestry can result in both false-positive and false-negative results when CGT companies report risk that is not contextualized by ancestry. This is particularly troubling for African American populations that have disproportionate health burdens from conditions such as breast cancer, type 2 diabetes, and cardiovascular disease. Although not unique to CGT, underattribution or overattribution of risk might have untoward consequences for individuals receiving test results outside of a traditional model of medical care. Although global efforts are underway to close the gap in knowledge about disease variant associations in diverse populations, it seems premature to consider CGT a replacement for medical genetic services delivered in the context of a health care system in which more holistic health risk assessment can be provided.

There is a considerable gap between CGT and integration of the results into their health care for most individuals. This may be particularly true for those engaging in CGT who do not have access to geneticists or genetic counselors, including those in rural populations for whom specialized care is not easily accessed. Ideal models for delivering CGT results that ensure

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patient understanding and connection to necessary downstream health services are in evolution. Anecdotally, although consumers may express gratitude for having the genetic test available to them, delays in help with rapid support for understanding and acting on CGT results can be emotionally distressing. Many health care professionals and health systems are poorly prepared to help patients with interpretation of genomic testing results and evidence-based approaches to managing newly identified risk. Most electronic health record systems used in the US have no ability to integrate structured genomic data from any source and lack clinical decision support capabilities for genomic test results. It is also not clear whether health care professionals will accept CGT results as valid, or by what metrics validity should be judged. Current regulatory structures under Clinical Laboratory Improvement Amendments and the College of American Pathologists, even when followed by companies that provide CGT, do not ensure the utility of genomic testing. Given the rate of the uptake of CGT, effective approaches for the appropriate integration of valid CGT results into health care systems should developed. Absent this, opportunities for improving health outcomes may be missed.

The current and rapidly evolving landscape of CGT also poses myriad confidentiality, privacy, and data security concerns for consumers and health professionals.[8] These concerns go beyond the well-covered potential for long-term care and disability insurance discrimination. For example some CGT companies have developed relationships with academic and commercial third parties for research purposes and profit. As of 2020, no US federal regulations cover data-sharing relationships by commercial entities not be covered by the Health Insurance Portability and Accountability Act. That is, deidentified data can be shared. At least 1 company, LunaDNA, has positioned the consumer as a financial stakeholder in the sharing of DNA sequence and health data, representing a novel approach in which contributing DNA and health data makes participants shareholders in the company. Consumer attitudes regarding data sharing to third parties are poorly understood. However, there have been some examples of companies that targeted unwitting consumers for testing for ill-gained profit that could adversely affect public opinion of all CGT companies.[9] Another emerging concern is the use of CGT results by third parties for law enforcement purposes, as evidenced by a number of high-profile criminal cases solved in the US through use of ancestry databases. In 2019, the idea that CGT might affect national security, in part, prompted the US military to warn service members from engaging in CGT.[10] Policy makers and regulatory bodies have a considerable task ahead to catch up with the CGT marketplace to ensure transparency and reduce the potential for consumer harm. Health professionals should be cognizant that this area is currently not well regulated. Consumers with concerns about how their data are used should look carefully at the details of user agreements before engaging in CGT.

Since the late 2000s, there has been rapid advancement in the translation of genomic science into health care applications. In parallel, CGT has expanded and evolved in ways that would have been difficult to predict at the time of the completion of the human genome project. Consumers, health professionals, health care system leadership, and policy makers lag behind in understanding the implications of CGT. Additional research is needed to understand how CGT affects individuals and populations, as well as innovative regulatory approaches to maximize potential benefits while safeguarding consumers from potential harms. Nimble and forward-thinking leadership is needed from organizations, including the US Food and Drug Administration, the Centers for Medicare & Medicaid Services, and the Department of Justice, as well as the private sector to ensure that CGT continues to evolve in ways that benefit both individuals and society.

ARTICLE INFORMATION

Published Online: March 19, 2020. doi:10.1001/jama.2020.3525

Conflict of Interest Disclosures: None reported.

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