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Genetic Testing in Underwriting: Implications for Life Insurance Markets

Patricia Born, Ph.D.

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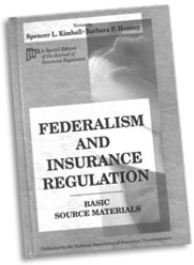

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Genetic Testing in Underwriting: Implications for Life Insurance Markets

Patricia Born, Ph.D.*

Abstract

This paper discusses and analyzes the problems for life insurers when individuals obtain results from genetic tests that can have bearing on their estimated mortality. Some forms of genetic information are valuable in the underwriting process, especially test results that may be relied on by medical doctors for treatment. To the extent that test results lead to better medical care, underwriting consequences may be favorable. If the information is not allowed for underwriting, insurers will experience some degree of adverse selection, which will raise the cost of coverage for all applicants and reduce the availability of coverage. This paper considers one recent proposal in the state of Florida to extend a ban on the use of genetic test results in health insurance underwriting to life insurance, disability and long-term care (LTC). This paper concludes that the financial consequence of a ban on the use of genetic information in life insurance underwriting could significantly increase the risk of insolvency; legislation that imposes restrictions on the use of genetic information may be a reasonable compromise to a complete ban.

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1. Introduction

While the federal Genetic Information Nondiscrimination Act (GINA, 2008) severely restricts the use of genetic information for health insurance underwriting, there is no such federal rule addressing the use of genetic test results by life insurers.[1] After lengthy debate, Congress agreed that life insurers would be exempt from the requirements of GINA based upon particular characteristics of life insurance products that are, in part, discussed in this paper. Citing the same potential for unfair discrimination and the need to preserve a level of privacy, state legislatures have also been active in proposing regulations that affect underwriting in life insurance, disability and long-term care (LTC).[2]

In the spring of 2019, the Florida legislature considered two proposals (S. 258 and H.R. 879) that would amend s. 627.4301 of the Florida statutes. The current statute imposes a ban on the use of genetic test results by health insurers; the proposed amendments would extend the ban to underwriting in life insurance and long-term care insurance (LTCI). If passed, the proposed amendment would make Florida the first state to ban the use of genetic test information for underwriting purposes in life insurance. Table 1 provides the definition of genetic information in the existing statute along with the relevant parts of s. 627.4301 as amended by these bills. The additional language proposed by the bills is underlined.

Table 1:
Definition of Genetic Information and Relevant Parts of s. 627.4301

Definition: "Genetic information" means information derived from genetic testing to determine the presence or absence of variations or mutations, including carrier status, in an individual's genetic material or genes that are scientifically or medically believed to cause a disease, disorder or syndrome, or are associated with a statistically increased risk of developing a disease, disorder or syndrome, which is asymptomatic at the time of testing. Such testing does not include routine physical examinations or chemical, blood or urine analysis, unless conducted purposefully to obtain genetic information, or questions regarding family history.
Relevant parts of s. 627.4301, where "life insurer" is added by H. 855 or S. 258 include:
"Life insurer" has the same meaning as in s. 624.602 37 and includes an insurer issuing life insurance contracts that grant additional benefits in the event of the insured's disability.
Health insurers, life insurers, and long-term care insurers may not require or solicit genetic information, use genetic test results in the absence of a diagnosis of a condition related to genetic information, or consider a person's decisions or actions relating to genetic testing in any manner for any insurance purpose.

This paper highlights the implications of banning the use of genetic test results in life insurance. The analysis below weighs the positive and negative consequences

1. Prior to the enactment of GINA, many states had enacted restrictions on the use of genetic test results in underwriting, but only for health insurance (Meyer, 1995–1996).

2. For a list of proposed legislation, see the National Health Genome Research Institute at *https://www.Genome.com*.

for maintaining the status quo and for various levels of restrictions on the use of genetic test results. The consequences differ across stakeholders, some of whom are more directly affected (e.g., life insurers and life insurance applicants) and others that are perhaps more indirectly affected (e.g., existing life insurance policyholders and life insurance agents). The analysis in this paper suggests that a complete ban on genetic test information could be detrimental to the industry as the potential for information asymmetry between insurers and applicants continues to grow. Consumers, on the other hand, may or may not benefit from such a ban. On the one hand, consumers who receive positive genetic test results (indicating increased mortality risk) would not be singled out and charged more for coverage. Consequently, consumers with negative test results would be prohibited from using these results to obtain favorable rates. To the extent that state insurance regulators are concerned about the privacy of genetic information and the potential for unfair discrimination, a compromise might include limitations on the use without completely banning the information.[3]

The paper continues as follows. Section 2 explains the importance of underwriting and good faith negotiations between insurers and applicants for insurance. The section emphasizes the potential for anti-selection when individuals have private information that is related to their risk and may, consequently, influence their decision to purchase, and this information would be relevant for the insurer's decision to offer coverage and/or establish a price for the coverage. The consequences are especially severe since the life insurer has only one opportunity to underwrite for a contract that may be in place for decades. Section 3 provides a brief review of the value of genetic testing as it pertains to medical treatment decisions, medical research, and the estimation of morbidity and mortality in a population. This is followed, in Section 4, with a discussion of the social and behavioral considerations surrounding access to genetic tests and the sharing of the results. Section 5 provides the core analysis of the costs and benefits to various stakeholders of banning or limiting the use of genetic test results. The analysis considers examples from a variety of sources to emphasize the likelihood that endowing individuals with private information will lead to adverse selection that has consequences for the entire life insurance market. Section 6 provides a short review of legislative actions pertaining to the use of genetic test information in other states. A final section concludes with a discussion of how legislatures may wish to consider a compromise that would allow time for more research into the implications of a complete ban as the availability and affordability of genetic testing continues to increase.

3. See Klitzman et al. (2014) for a discussion of several possible regulatory approaches.

2. The Life Insurance Underwriting Process

Accuracy in assessing risk is especially important in life insurance; the consequences of over- or under-estimating the risk can be especially severe because the life insurer has only one opportunity to underwrite for a contract that will be in place for decades. In the aggregate, the impact of "noisy" underwriting information from any one individual is likely counteracted by the potential for noisy information from other applicants and/or existing policyholders. Statistically, as insurers compile a large pool of policyholders, the expected outcome for the group becomes more certain.

Criteria used in the underwriting process should contribute to reducing information asymmetries that are relevant for the risk under consideration. From the insurer's perspective, some criteria are less valuable than others because they do not contribute to a more accurate classification of risk. Criteria that are costly to obtain or verify may not be collected if the value of the information is less than the cost to obtain it. Still other criteria may have considerable statistical importance in understanding a risk, but applying these criteria for making underwriting decisions might be unfairly discriminatory and contradictory to the objective of pooling risks. Thus, the underwriting process reflects a balancing of consumer protections with the need for financial solvency.

The application of underwriting criteria is a science unique to each insurer and differs depending on the insurance product. Consumers should expect that any information they divulge may be used by the insurer to decide whether to offer coverage and how much to charge; however, how a company weighs the criteria is not publicly known. Underwriting practices vary from company to company and are proprietary: This is part of what makes the life insurance market competitive to the benefit of consumers. However, the complexity and lack of transparency help explain, to some degree, public misunderstanding of how insurance prices are determined.

One of the primary goals of insurance regulation is to maintain smooth functioning markets. State insurance regulators should carefully consider any actions that affect the availability of coverage against premature death. They must be concerned with whether an insurer's use of underwriting criteria is not unfairly discriminatory and that the premiums charged are not excessive, but are adequate to maintain solvency.

3. The Value of Genetic Information

Since life insurer performance relies heavily on their ability to predict mortality, there may be great value in new information—genetic traits—that is relevant to mortality risk. However, it is important to understand the extent of information that can be gained in this way. Genes are hereditary parts of DNA that are transferred between generations and, subsequently, strongly influence the way one develops.

Technically, genes contain instructions for the development of proteins that determine the structure and function of every cell in the body. Genes can determine physical traits that can cause or contribute to a disease.

More than 5,000 genes have been identified as relating to a particular disease. In some cases, the disease is associated with one gene, while in others, it may be a combination of two or more genes. Those most extensively studied are listed in Table 2. Evaluation of the results of these studies suggests that these particular genes have informational value for underwriting, i.e., predictive value in estimating the probability of developing the disease.[4] In simulations of the consequences for life insurers of precluding the use of genetic test information, both the Canadian Actuarial Society (Howard, 2014) and the Society of Actuaries (SOA) (Lombardo, 2018) consider these 13 genes.[5] Each of these genes has consequences for mortality, but they are not necessarily used in underwriting today.

Table 2:
Genetic Tests with Informational Value for Underwriting

Gene	Penetrance
Breast cancer BRCA1 or BRCA2	75
Hypertrophic cardiomyopathy (HTCM)	69
Dilated cardiomyopathy (DCM)	75
Arrhythmogenic right ventricular cardiomyopathy (ARVCM)	75
Long QT syndrome (Long QT)	25
Brugada syndrome (Brugada)	75
Huntington's disease (Huntington)	95
Polycystic kidney disease (PKD)	100
Myotonic dystrophy (DM1 or 2)	75
Alzheimer's disease early onset – autosomal dominance (ADEO)	100
Hereditary nonpolyposis colorectal cancer (HNPCC)	50
Marfan syndrome (Marfan)	50
Catecholaminergic polymorphic ventricular tachycardia (CPVT)	75

Source: Lombardo (2018).

Over time, as genomic research continues, the number of conditions that can be predicted through a genetic test is likely to increase. A genetic test may be performed on a sample of blood, hair, skin, amniotic fluid or other tissue. The sample is sent to a laboratory, which produces a report that depends on the purpose of the test. For example, a test may be performed to confirm a particular genetic mutation or, conversely, indicate that a person is not a carrier of a specific genetic mutation. Genetic tests may be done for a variety of purposes, including for newborn and prenatal screening and forensic testing for legal purposes. When used for diagnostic testing, the purpose is to rule out or confirm a diagnosis that is suspected based on

4. See Howard, R. (2014) and Lombardo (2018). The figures in the table are the assumptions used by Lombardo (2018), for the U.S. model in 2018, and thus differ slightly than those used by Howard (2014) for Canada in 2014.

5. The genes considered in the analysis are a subset of genes that can currently be identified through genetic tests. The simulations are described in more detail below in Section 5.

physical signs and symptoms. A genetic test can also reveal if someone has a higher than average probability of developing some types of disease later in life. This sort of "predictive" genetic test can establish, for example, that the probability of developing a disease increases from 50% to 90%.

The probability that an individual who tests positive on a particular genetic test will express the associated trait and ultimately develop the disease is referred to as the penetrance of the gene. A mortality ratio can also be applied to each gene, such that a higher rating indicates a higher mortality associated with the genetic trait. This is typically expressed as an addition or percentage of standard mortality. For example, a positive test for the BRCA1 or BRCA2 gene suggests a 350% increase in mortality at the attained age. A positive test for Huntington's disease or for Alzheimer's disease (early onset) both have mortality ratios of 1000%. Other statistics used to evaluate and compare the informational value of these genes include the number of years following testing for which the mortality is taken as standard, i.e., after a positive test, the number of years before the disease will emerge, and the path over time of the increase in mortality from standard. The estimated penetrance of the most-studied genes is shown in the second column of Table 2 and suggests a wide range of informational value.

It is important to note that over time, other types of medical tests—e.g., tests for cholesterol levels—were first considered controversial when initial evidence showed a wide variation in predicted value. Early studies of tests for BRCA revealed wide-varying predictive value, but this predicted value is more settled in the 60% to 70% range, and testing is now better in identifying subsets of the gene that matter more than others. Genetic testing is an evolving science, but many tests already have shown predictive value for mortality and could, therefore, be essential for life insurance underwriting.

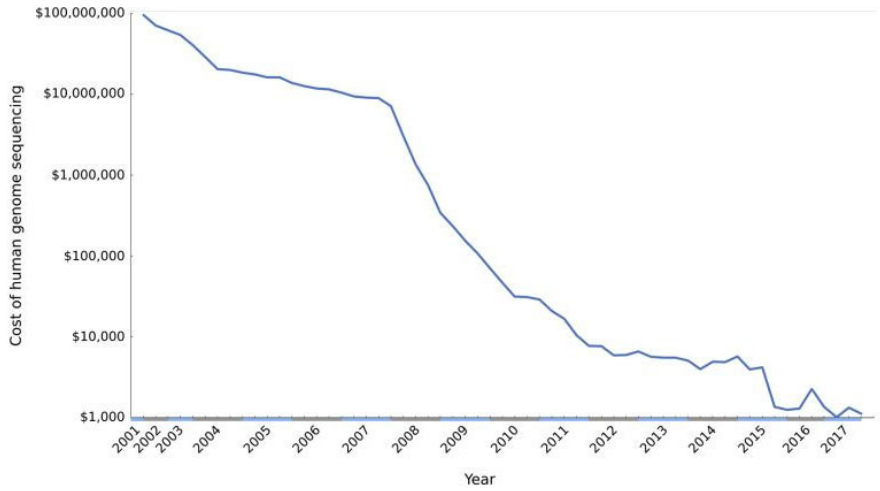
4. Genetic Testing: Social and Behavioral Considerations

The impact of genetic testing on life insurer operations depends greatly on the scale of testing in the population, which was rather limited until the early 2000s. Demand for tests was low due to the prohibitive cost of genetic sequencing—roughly $100 million in 2001. There are several reasons why an individual might take a genetic test. First, it is possible that the individual is already symptomatic and would like to confirm or rule out a specific genetic cause. In this case, the individual's symptoms may have a negative underwriting consequence, but a test could improve the underwriting outcome either because a negative result rules out the genetic cause or the positive result helps in tailoring the medical treatment (Vukcevic & Chen, 2017).

Demand theory implies that as the cost declines, more people will obtain a genetic test, all else equal. The U.S. National Library of Medicine (NLM) reports that "the cost of genetic testing can range from under $100 to more than $2000,

depending on the nature and complexity of the test." The cost of a sequencing test has dropped significantly over the past two decades, as shown in Figure 1. This is largely due to the development of "next generation" and "higher throughput" technologies that enable researchers to test many sequences in parallel, thus making the process more efficient and quicker.[6]

Figure 1:
Cost of Sequencing a Human-Size Genome



Source: National Human Genome Research Institute.

Direct-to-consumer genetic testing has historically been marketed for consumers to obtain genealogical information, which has no value for life insurance underwriting. Increasingly, however, the products available to consumers provide medical information. For example, the vendor 23andMe offers a genetic testing product that evaluates the consumer's risks for certain named diseases, including Parkinson's, celiac, and late-onset Alzheimer's. As the price continues to drop, the demand for these tests that provide medical information is likely to increase. Ancestry.com reported selling approximately 1.5 million genetic testing kits during a Black Friday sale from Nov. 24–27, 2017. Health-based test kits sold by 23andMe were in the top five best-selling items on Amazon in the same period. According to Credence Research, the market for direct-to-consumer genetic tests is expected to grow to $611 million by 2026, up from $117 million in 2017.

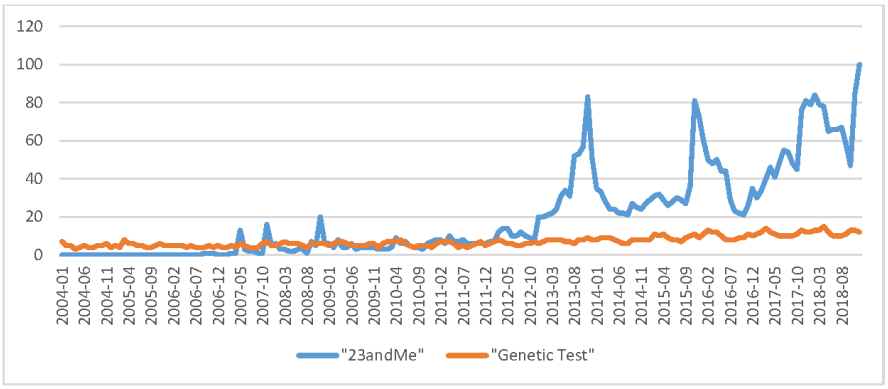
The increased proliferation of genetic testing is accompanied by increased concerns about the privacy of such information (Greene et al., 2015). The privacy protections of the federal Health Insurance Portability and Accountability Act of 1996 (HIPAA) usually do not apply to direct-to-consumer genetic testing because

6. See Adams and Eng (2018) for a review and discussion of the evolution of sequencing methodologies.

the vendors selling such tests are often not "covered entities" and thus not subject to HIPAA. The U.S. Food and Drug Administration (FDA) regulates consumer tests related to health. It authorized the first direct-to-consumer test for detecting genetic variants that may determine how well medications will work in October 2018. The Federal Trade Commission (FTC) recently warned consumers to consider the privacy implications of genetic testing kits and maintains that consumers should not consider genetic tests as a substitute for traditional health care evaluations. Consumer organizations actively educate the consumer on the potential adverse consequences of obtaining a genetic test before having secured life insurance.[7]

Figure 2 provides additional evidence of how interest in obtaining genetic tests is growing. The figure shows that the number of individuals in the U.S. seeking information on genetic tests has grown at a slow but steady pace, while individuals specifically seeking information from 23andMe has increased dramatically in the past five years. The growing interest has important implications for life insurers, who can expect that more and more applicants for coverage will have additional information about their mortality risk.

Figure 2:
Searches for "Genetic Test" and "23andMe" from Google Trends, 2004–2018



Source: Authors search in Google Trends.

Consumer Responses to Genetic Test Results

Consumer testing for genetic information is important in the life insurance context because test information may affect whether one chooses to purchase life insurance, the number of life insurance policies purchased and the amounts of life insurance purchased. Demand for life insurance, generally, is driven by factors such

7. The American Council of Life Insurers (ACLI), in addition to current protections found under current federal and state laws, has publicly stated that it is supportive of additional appropriate protections that could be afforded through consent, authorization and security standards (ACLI, 2019).

as household income, family, education, age and employment. Studies addressing how demand responds to additional information from genetic testing are limited and, to date, have not been conclusive. For example, two studies of women tested for the BRCA1 gene mutation could not confirm evidence of adverse selection in the life insurance market (Viswanathan et al., 2007; Zick et al., 2000). A study of adults tested for Alzheimer's risk also did not find evidence of adverse selection in the life insurance market but did find evidence of adverse selection for LTCI (Zick, 2005). Notably, 17% of those who tested positive changed their LTCI policy in the year after testing positive of Alzheimer's risk, while coverage was changed by only 2% of those who tested negative and 4% of those who did not receive test results. The authors evaluated open-ended comments associated with these changes and confirmed that no respondents decreased their coverage. Rather, their findings suggest an increase in the take-up and expansion of LTC coverage. It is unclear, however, that the findings of studies such as this one, conducted even a few years ago, are relevant given the increasing volume of genetic testing, including those available direct-to-consumer.

One indication of how individuals may respond to genetic test results is evident in the demand for life insurance policies with no medical underwriting. According to Klein (2013), beginning in the mid to late 2000s, there has been renewed interest in "simplified issue" coverage, driven in part by a desire for faster underwriting. The popularity of these types of policies suggests that individuals do have an interest in withholding information that would normally be used in the life insurance underwriting process.

Proponents of banning the use of genetic test results in underwriting for life insurance argue that individuals would be more likely to undergo genetic testing in clinical settings if the information would not be shared with insurers. Fear of "genetic discrimination" was impetus for GINA (2008) and is a widely cited social reason for banning the use of genetic test results (Prince, 2018; Rothstein, 2018). On the other hand, genetic test results could help promote earlier medical intervention and might improve life expectancy. For this reason, allowing insurers access to results of genetic tests has the potential to improve the underwriting situation for many—not only those who receive a negative result, but also for those who get a positive result but take subsequent action to improve their medical condition.

5. Analysis of Potential Outcomes

Genetic tests can reveal important information about an individual's mortality. Preventing life insurers from using this information puts them at a disadvantage when developing adequate rates for coverage. This disadvantage is especially pronounced in life insurance underwriting when compared to health insurance because the life insurer does not have the same opportunity as a health insurer to reprice coverage when new information is revealed. Life insurers generally establish

premiums for long-term and whole life policies that are guaranteed at a certain level. This long-term relationship poses two key problems for the life insurer. First, policyholders who negotiate new coverage with private information about their potential substandard mortality may be underpriced, i.e., priced as if they are standard risks. The increased mortality experience over time will subsequently result in an inadequate pool of premium dollars collected from this cohort to pay the total death benefits, although prices can be raised for the next cohort of policyholders, if necessary. In addition, currently insured policyholders who learn about their increased mortality risk will be more likely than the standard risk policyholders to keep their insurance coverage active. Insurers generally expect a proportion of policyholders will let their coverage lapse, and this factors into pricing decisions. Policyholder lapse behavior that departs from the norm, i.e., due to some individuals having private information about their mortality risk, affects the accuracy of pricing.

The consequences of a ban on using genetic test results on insurers is illustrated here using two approaches. The following approach provides a simple analysis of how misestimation of mortality and lapse experience affects life insurer solvency. The analysis uses realistic estimates of mortality and lapse behavior to calculate breakeven premiums. No additional assumptions are made about how individuals or the market will respond. Rather, this approach simply shows how misestimation—due to individuals' private information about their mortality—is related to the deterioration of the insurer's ability to pay claims over time. The reader is invited to review the 2018 SOA report for a more comprehensive examination of the effects of banning genetic test information in the U.S. life insurance market, which considers potential changes in testing behavior and demand for life insurance.

Simple Analysis of Breakeven Premiums

In the following analysis, the implications for the life insurer are simplified to illustrate the financial consequences when policyholders have private information about their mortality. The analysis emphasizes the consequences by evaluating breakeven prices (i.e., the amount an insurer needs to charge to cover only expected future death benefits) under different assumptions about mortality information. While the example is purposely simple, it explains how adverse selection results from private information and how, in the extreme, this can lead to an unraveling of the insurance market altogether.

The analysis involves a 10-year term policy. Of course, the consequences for different types of insurance coverage will differ; the consequences for a 10-year term policy are not nearly as great as those for a longer term or whole life policy, simply due to the number of years at which information can be learned and revealed (or not revealed). In this example, the policy is sold to males, age 40, who are non-smokers in good health. For the purposes of the analysis, it is assumed that 10,000 policies are sold, and each policy has a face value of $100,000. For tractability, all death benefits are assumed to be paid out at the end of the year in which deaths occur, and a discount rate of 5% is used for discounting future values. For simplicity,

any additional amount that would be necessary to cover administrative expenses and profit are not included.

The implications of private information are illustrated as variations from a baseline scenario, shown in Panel A of Table A-1 in the Appendix. The first set of columns (A–G) in the table show the annual expected mortality experience. In year one, the pool of insureds at the beginning of the year (BOY) is 10,000. In each subsequent year, the pool size is shown to decline due to the expected mortality experience in the pool and 500 policies that are expected to lapse each year. The breakeven premium is calculated by first considering the expected death benefits that must be paid each year (shown in column H). These are discounted to present value (column I) to obtain the amount today that would be necessary to meet all expected future obligations, shown at the bottom of column I. Finally, column J shows the factor applied to each year's experience to account for the fact that: 1) premiums collected in any year will earn interest until needed to pay claims; and 2) the pool of individuals from whom premiums can be collected each year is decreasing over time. The annual level premium is calculated by dividing the present value of the total expected benefit payments per policyholder by the present value (PV) factor of 6.3849.

Columns K–N illustrate the changes to the insurer's balance of expected premiums collected minus expected benefits paid over the 10-year period, including interest that is earned on the balance each year. The values in Column N illustrate that if the insurer charges each policyholder $226.30 at the beginning of the 10-year term and charges all policyholders who remain in the pool $226.30 each year, it will accrue funds just sufficient to make all expected death benefit payments for this cohort of 10,000 insureds by the end of the 10 years.

Panels B–D of Table A-1 provide three alternative scenarios for comparison with the baseline result. The scenarios are arbitrary but are designed to illustrate how misestimation of either the mortality information (Panel B and Panel C) or lapse experience (Panel D) can affect the insurer's solvency, i.e., ability to meet the expected death benefit obligation.

First, consider that the insurer may underestimate the mortality experience of this pool of insureds. This is possible if just a small proportion of the insureds are now more likely to be substandard risks, but the insurer is not aware of this. The table shows how a difference in the probability of death of just 0.00005 in each year results in only a small change in the total number of deaths over the time period (188 to 192), but if the insurer charges only $226.30 per policyholder, it will have insufficient funds in year 10 to pay all death benefits for which it is obligated.

In Panel B, if the insurer had charged each policy holder $231 each year, it would expect to break even. While the insurer cannot change the premium for this cohort, the insurer must respond to the new mortality experience by increasing premiums for the next year's cohort, and it must do this for every policyholder since it cannot determine which policyholders are substandard. While the premium increase that is suggested in this example is small ($5 more per year), any increase in premiums has the potential to affect demand for coverage. Individuals with a greater need, i.e., higher mortality risk, will be more likely to purchase coverage

while individuals with a lower need, upon receiving a higher price, may decline coverage. Thus, subsequent cohorts face increasing prices and the insurer experiences higher-than-expected mortality, leading to another price increase for the next cohort. Panel C provides an indication of how this plays out if the insurer's estimates of mortality are off to an even greater degree due to this adverse selection over time. In Panel C, where the insurer's mortality estimates are off by 20%, the insurer is insolvent by the fifth year of coverage.

The figures in Panel D illustrate what happens when the insurer overestimates the lapse rate on policies purchased by the cohort. This is possible if only a small proportion of individuals in the cohort have received genetic test results that suggest increased mortality risk, or subsequently obtain positive genetic test results after they have purchased coverage and, consequently, decide to hold onto the life insurance coverage when they may have let it lapse without this information. We might assume that the individuals more likely to keep coverage will be those who have positive genetic test results, which would, consequently, increase the mortality rates over the contract period as well. However, for simplicity, the mortality rates are not changed in this scenario, so that the effect of the change in lapse rate is isolated. The scenario suggests that the insurer is unable to meet the expected death benefit obligation in the 10^{th} year. If the insurer continues to note a reduction in lapse behavior, premiums for future cohorts will have to increase. Since the insurer cannot identify a priori which applicants are more likely to lapse, it will have to charge all applicants in subsequent cohorts a higher premium in order to ensure solvency.

A more likely scenario, over time, is one in which the mortality experience of the pool increases (as shown in the change from Panel A to Panel B), and coverage lapses decline (as shown in the change from Panel A to Panel D). These changes lead to the so-called "death spiral" in which insurers are forced to increase rates to stay solvent; however, increasing rates continue to discourage standard risks from purchasing coverage, resulting in an increasingly larger share of substandard risks in the pool. While it is not clear how fast such a process would play out in this arena, the phenomenon suggests that eventually, premiums are so high that the insurer may attract only the highest risks, if it attracts any applicants at all.

The analysis shows that if the information obtained from a genetic test is kept private, and the results would have been relevant for underwriting, adverse selection will increase. This happens in two ways, specifically: 1) through a change in the risk profile of applicants seeking coverage; and 2) through a change in the risk profile of policyholders who keep their coverage through the policy period. With more and more genetic tests being performed, the potential for adverse selection grows, creating further complications for the market. To remain financially viable, life insurers must increase prices to account for the changing composition of the risk pool, and the increase in prices will increasingly drive the lower (or standard) risk-types out of the market as their demand for coverage responds to the price increase. Ultimately, adverse selection will affect the affordability of products, and consequently, availability is reduced as insurers are unwilling or unable to participate in the market.

The SOA Model

The SOA produced a report in 2018 (Lombardo, 2018) that considers the impact of genetic testing in life insurance. The report contains a simulation of the outcomes for the U.S. life insurance market under various assumptions about the information value of genetic tests (e.g., the prevalence and rating of certain genes), incorporating individual and insurer responses to the information.[8] The report concludes that "legislation prohibiting the use of genetic information and family history during the underwriting process has the potential to materially affect U.S. life insurance industry claims." They estimate the following impacts:

- "If only the applicant knows the result of genetic testing, but both the applicant and the insurance company know the family history at time of underwriting, the present value of new business claim costs modeled increase by 4% to 8% overall, and industry-wide claim costs could rise by as much at 3% on a present value basis.
- If the applicant alone knows the result of genetic testing and family history and the insurance company knows neither, the present value of new business claim costs modeled increases by 5% to 10% overall, and industry-wide claim costs could rise by as much at 4% on a present value basis.
- In general, estimated increases in industry-wide claims cost are low at first and increase over time. In the first 10 years, projected modeled claims increase by less than 1%. The cost increase rises quickly over the next 20 years to upwards of 5% of projected claims, as the Baseline In Force and New Business policies run off." (pp. 32-33)

The analysis by the SOA contains several assumptions, and the results are sensitive to the validity of these assumptions. While it is reasonable to assume the volume of genetic testing will increase, for example, the rate of increase and the corresponding increase in the information that may be relevant for underwriting cannot be predicted. Further, the change in demand for coverage—interest in obtaining greater amounts of life insurance coverage or elasticity of demand with respect to the changes in price—is also unclear. For this reason, the SOA study includes several sensitivity tests using different ranges of assumptions.

6. State Developments

According to the National Human Genome Research Institute (NHGRI), states have enacted or proposed more than 792 statutes pertaining to genetic information.

8. The SOA approach follows the simulation approach used by Howard (2014) for Canada, with some different assumptions.

To date, 68 statutes extend underwriting restrictions to other forms of insurance besides health insurance.[9] Many of the statutes that target life insurance operations impose limitations on life insurers' ability to require a genetic test or perform a genetic test without informed consent. A sample of current provisions (as of early 2019) that impose restrictions on life insurers is shown in Table 3 along with the statute information. No state has enacted a complete ban on the use of genetic test information for the purposes of life insurance underwriting.

7. Conclusion

In addressing the question of whether life insurers should be allowed genetic test information for the purposes of underwriting, a variety of issues must be considered, and the conclusions are not black or white. Some forms of genetic information are valuable in the underwriting process, especially test results that may be relied on by medical doctors for treatment. To the extent that test results lead to better medical care, underwriting consequences may be favorable. If the information is not allowed for underwriting, insurers will experience some degree of adverse selection, which will raise the cost of coverage for all applicants and reduce the availability of coverage.

State insurance regulators need to strike a balance between insurers' need for accurate underwriting information and the concerns of the medical community and consumers. Some form of compromise may be possible, such that a complete ban would not be imposed on the use of genetic testing information. Table 4 shows a new subsection to Florida s. 627.4301 that was proposed in an amendment to Senate Bill 258, filed April 5, 2019. The amendment would restrict the use of genetic test information without imposing a complete ban. Item (3)(c) puts the burden on life insurers to justify underwriting decisions with objective statistical evidence related to actual or anticipated loss experience, and thus allows for, and even encourages, further study on the statistical accuracy of this information for underwriting. A complete ban would necessarily complicate insurers' ability to perform statistical analysis of genetics information and the impact on mortality experience.

The discussion and analysis in this paper emphasize the problems for life insurers when individuals have private information about their mortality. The financial consequence—a need to maintain solvency in order to meet obligatory death benefit payments—is significant and sizable. Restrictions may be necessary to placate concerns from consumers and the medical community, but a well-functioning life insurance market requires that insurers be allowed access to information that is material in providing financially viable life insurance products.

9. Roughly 29 state bills failed or died in committee; several other bills, including those proposed in Florida, are still under consideration.

Table 3:
State Provisions Affecting Genetic Testing in Life Insurance Products

Provision	State (statute)
Information about a genetic condition may not be used for underwriting or ratemaking of life and disability insurance policies unless supported by the applicant's medical condition, medical history, and either claims experience or actuarial projections.	Arizona §20-448
Life and disability insurers may not discriminate based solely on the fact that the person to be insured carries a gene that may be associated with disability in that person or the person's offspring, but which causes no adverse effects in the carrier, including, but not limited to, Tay-Sachs trait, sickle cell trait, thalassemia trait and X-linked hemophilia trait.	California §10140
Policies may only limit benefits otherwise payable if loss is caused or contributed to by the presence or absence of genetic characteristics if the insurer imposes limitations for other medical conditions that present an increased risk.	California §10146
Insurers may not refuse to issue or deliver any policy of life insurance or disability insurance that affords certain services and benefits or impose a higher premium rate or charge for those policies solely because the person to be insured has the sickle-cell trait.	Florida F §626.9706 et seq.
Life, disability income or long-term care (LTC) insurers also may not provide for rates or any other aspect of coverage that is not reasonably related to the risk involved.	Kansas §40-2259
Life, credit life, disability, LTC, accidental injury, specified disease, hospital indemnity or credit accident insurers, or an annuity may not discriminate unfairly, which includes the use of genetic test results in a manner that is not reasonably related to anticipated claims experience.	Maine 24A §6981
Unless there is actuarial justification, an insurer may not refuse to insure or make or allow a differential in ratings, premium payments or dividends in connection with life insurance and annuity contracts because the applicant or policyholder has the sickle-cell trait, thalassemia-minor trait, hemoglobin C trait, Tay-Sachs trait or a genetic trait that is harmless in itself.	Maryland §27-208
An insurer, agent or broker authorized to issue life insurance policies, policies against disability from injury or disease, or policies for LTC may not practice unfair discrimination because of the results of a genetic test or the provision of genetic information or require an applicant to undergo a genetic test as a condition of issuance or renewal of a policy. Unfair discrimination involves discriminatory practices against persons unless such action is based on reliable information relating to the insured's mortality or morbidity and based on sound actuarial principles or actual or reasonably anticipated claim experience. These insurers may ask if an applicant has taken a genetic test.	Massachusetts MGL 175 §1081, §180E
The rejection of an application or the determining of rates, terms or conditions of a life or disability insurance contract is permissible if the applicant's medical condition and history, as well as either claims experience or actuarial projections, establish that substantial differences in claims are likely to result from the genetic condition.	Montana §33-18-206
Discrimination by an insurer against a person or his/her family member based on genetic analysis, genetic information or genetic propensity is prohibited. Life, disability income or long-term care insurance (LTCI) are exempt if use is based on sound actuarial principles or related to actual or reasonably anticipated experience.	New Mexico §24-21-1 et seq.
No insurance company may refuse to issue or deliver any policy of life insurance solely by reason of the fact that the person to be insured possesses sickle cell trait or hemoglobin C trait. A policy also may not carry a higher premium rate or charge by reason of the fact that the person to be insured possesses these traits.	North Carolina §58-58-25
The genetic information of a person's blood relative may not be used to reject, deny, limit, cancel, refuse to renew, increase the rates of, affect the terms and conditions of, or otherwise affect any policy of insurance.	Oregon §746.135
It is an unfair method of competition or unfair and deceptive act or practice to make or permit any unfair discrimination against any individual by conditioning insurance rates, the provision or renewal of insurance coverage, or other conditions of insurance based on the results of genetic testing where there is not a relationship between the information and the cost of the insurance risk that the insurer would assume by insuring the proposed insured.	Vermont VSA 8 §4724

Source: Author's search of statutes in the Genome Statutes and Legislation Database at *www.Genome.gov*, Aug. 20, 2019.

Table 4:
Amended Language – Restrictions on the Use of Genetic Information

(3) RESTRICTIONS ON THE USE OF GENETIC INFORMATION BY LIFE INSURERS, LONG-TERM CARE INSURERS, AND DISABILITY INCOME INSURERS.

(a) A life insurer, long-term care insurer, or disability income insurer may not:

1. Require an applicant to take a genetic test;
2. Collect an applicant's genetic information or genetic test results without the applicant's authorization; or
3. Consider the results of a genetic test that is designed to share information with an individual concerning the applicant's race, ethnicity, or national origin and that is not related to an applicant's medical condition or future health risk.

(b) A life insurer, long-term care insurer, or disability income insurer may only consider genetic test results included in an individual's medical record if the tests have been reviewed and confirmed by the individual's physician and the insurer complies with paragraph (c).

(c) A life insurer, long-term care insurer, or disability income insurer may not cancel, limit, or deny coverage, or establish differentials in premium rates, based on genetic information unless such action is based on objective statistical evidence related to actual or anticipated loss experience that is relevant to an individual's life expectancy or health. A life insurer, long-term care insurer, or disability income insurer shall document the rationale for such action and provide the documentation to the office upon request.

(d) Genetic information, including genetic test results, is nonpublic, private health information and is subject to the privacy protections under ss. 626.9651 and 760.40.

(e) This subsection does not relieve the obligation of a life insurer, long-term care insurer, or disability income insurer to comply with ss. 626.9706 and 626.9707.

(f) This subsection does not apply to health insurers.

(g) This subsection applies to policies entered into or renewed on or after January 1, 2020.

Appendix Table A-1:
Effects of Misestimation of Mortality or Lapse Rates in Level Premium Term Coverage

PANEL A: Baseline

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Year	Age	P(Death)	# BOY	# Deaths	# Lapses	# EOY	Claims Payments	PV of Payments	PV Factor	Beginning Balance	Premiums Collected	Interest	Ending Balance
1	40	0.00179	10000	17.9022	500	9482	$1,790,218.99	$1,704,970.46	1.00000		$2,262,969.65	$113,148.48	$585,899.15
2	41	0.00191	9482	18.1031	500	8964	$1,810,310.40	$1,642,004.90	0.90306	$585,899.15	$2,145,769.96	$136,583.46	$1,057,942.16
3	42	0.00204	8964	18.3105	500	8446	$1,831,045.63	$1,581,726.06	0.81306	$1,057,942.16	$2,028,524.80	$154,323.35	$1,409,744.67
4	43	0.00219	8446	18.5056	500	7927	$1,850,560.85	$1,522,460.99	0.72957	$1,409,744.67	$1,911,232.71	$166,048.87	$1,636,465.41
5	44	0.00236	7927	18.7052	500	7408	$1,870,522.39	$1,465,603.24	0.65217	$1,636,465.41	$1,793,896.47	$171,518.09	$1,731,357.58
6	45	0.00254	7408	18.8239	500	6890	$1,882,392.20	$1,404,670.05	0.58047	$1,731,357.58	$1,676,515.05	$170,393.63	$1,695,874.06
7	46	0.00275	6890	18.9594	500	6371	$1,895,937.54	$1,347,407.41	0.51412	$1,695,874.06	$1,559,106.77	$162,749.04	$1,521,792.33
8	47	0.00302	6371	19.2268	500	5851	$1,922,676.16	$1,301,342.91	0.45275	$1,521,792.33	$1,441,667.84	$148,173.01	$1,188,957.01
9	48	0.00335	5851	19.5794	500	5332	$1,957,935.39	$1,262,102.61	0.39605	$1,188,957.01	$1,324,168.40	$125,656.27	$680,846.29
10	49	0.00372	5332	19.8181	500	4812	$1,981,807.23	$1,216,657.72	0.34370	$680,846.29	$1,206,589.17	$94,371.77	$0.00
								$14,448,946.34	6.3849				
								$226.30					

PANEL B: Probability of death underestimated by 0.00005

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Year	Age	P(Death)	# BOY	# Deaths	# Lapses	# EOY	Claims Payments	PV of Payments	PV Factor	Beginning Balance	Premiums Collected	Interest	Ending Balance
1	40	0.00184	10000	18.4022	500	9482	$1,840,218.99	$1,752,589.51	1.00000		$2,262,969.65	$113,148.48	$535,899.15
2	41	0.00196	9482	18.5762	500	8963	$1,857,622.93	$1,684,918.76	0.90301	$535,899.15	$2,145,656.81	$134,077.80	$958,010.82
3	42	0.00209	8963	18.7566	500	8444	$1,875,661.96	$1,620,267.32	0.81297	$958,010.82	$2,028,304.58	$149,315.77	$1,259,969.21
4	43	0.00224	8444	18.9247	500	7925	$1,892,471.19	$1,556,940.73	0.72945	$1,259,969.21	$1,910,911.53	$158,544.04	$1,436,953.60
5	44	0.00241	7925	19.0972	500	7406	$1,909,715.30	$1,496,311.91	0.65202	$1,436,953.60	$1,793,480.44	$161,521.70	$1,482,240.45
6	45	0.00259	7406	19.1886	500	6887	$1,918,856.73	$1,431,880.43	0.58030	$1,482,240.45	$1,676,010.33	$157,912.54	$1,397,306.59
7	46	0.00280	6887	19.2966	500	6368	$1,929,658.71	$1,371,372.42	0.51592	$1,397,306.59	$1,558,519.51	$147,791.31	$1,173,958.72
8	47	0.00307	6368	19.5363	500	5848	$1,953,630.02	$1,322,293.70	0.45254	$1,173,958.72	$1,441,004.30	$130,748.15	$792,081.15
9	48	0.00340	5848	19.8609	500	5328	$1,986,091.80	$1,280,252.48	0.39583	$792,081.15	$1,323,434.81	$105,775.80	$235,199.95
10	49	0.00377	5328	20.0714	500	4808	$2,007,139.46	$1,232,209.52	0.34347	$235,199.95	$1,205,791.86	$72,049.59	($494,098.06)
								$14,749,036.78	6.3835				
								$231.00					

Panel C: Probability of death underestimated by 20 percent

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Year	Age	P(Death)	# BOY	# Deaths	# Lapses	# EOY	Claims Payments	PV of Payments	PV Factor	Beginning Balance	Premiums Collected	Interest	Ending Balance
1	40	0.00215	10000	21.4826	500	9479	$2,148,262.78	$2,045,964.56	1.00000		$2,262,969.65	$113,148.48	$227,855.35
2	41	0.00229	9479	21.7155	500	8957	$2,171,552.19	$1,969,661.85	0.90272	$227,855.35	$2,141,959.71	$118,640.75	$319,903.62
3	42	0.00245	8957	21.9549	500	8435	$2,195,491.64	$1,896,518.22	0.81241	$319,903.62	$2,026,897.07	$117,340.03	$268,649.09
4	43	0.00263	8435	22.1782	500	7913	$2,217,823.50	$1,824,608.88	0.72863	$268,649.09	$1,908,780.26	$108,871.47	$68,477.32
5	44	0.00283	7913	22.4052	500	7390	$2,240,518.29	$1,755,504.71	0.65098	$68,477.32	$1,790,612.91	$92,954.51	($288,473.55)
6	45	0.00305	7390	22.5332	500	6868	$2,253,318.38	$1,681,460.87	0.57905	($288,473.55)	$1,672,394.20	$69,196.03	($800,201.69)
7	46	0.00330	6868	22.6789	500	6345	$2,267,886.82	$1,611,744.82	0.51248	($800,201.69)	$1,554,146.53	$37,697.24	($1,476,244.74)
8	47	0.00362	6345	22.9793	500	5822	$2,297,926.09	$1,555,326.83	0.45093	($1,476,244.74)	$1,435,865.89	($2,018.94)	($2,340,323.88)
9	48	0.00402	5822	23.3772	500	5299	$2,337,721.12	$1,506,915.88	0.39406	($2,340,323.88)	$1,317,517.27	($51,140.33)	($3,411,668.06)
10	49	0.00446	5299	23.6337	500	4775	$2,363,365.45	$1,450,901.37	0.34156	($3,411,668.06)	$1,199,078.59	($110,629.47)	($4,686,581.39)
								$17,298,637.99	6.3728				
								$270.93					

Panel D: Lapse Rate overestimated

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Year	Age	P(Death)	# BOY	# Deaths	# Lapses	# EOY	Claims Payments	PV of Payments	PV Factor	Beginning Balance	Premiums Collected	Interest	Ending Balance
1	40	0.00179	10000	17.9022	200	9782	$1,790,218.99	$1,704,970.46	1.00000		$2,262,969.65	$113,148.48	$585,899.15
2	41	0.00191	9782	18.6759	200	9563	$1,867,586.03	$1,693,955.58	0.93163	$585,899.15	$2,213,659.04	$139,977.91	$1,071,950.07
3	42	0.00204	9563	19.5349	200	9344	$1,953,488.65	$1,687,496.94	0.86743	$1,071,950.07	$2,164,173.36	$161,806.17	$1,444,440.95
4	43	0.00219	9344	20.4737	200	9123	$2,047,368.93	$1,684,375.49	0.80716	$1,444,440.95	$2,114,493.28	$177,946.71	$1,689,512.01
5	44	0.00236	9123	21.5279	200	8902	$2,152,789.76	$1,686,767.11	0.75059	$1,689,512.01	$2,064,600.76	$187,705.64	$1,789,028.65
6	45	0.00254	8902	22.6185	200	8679	$2,261,847.87	$1,687,825.71	0.69749	$1,789,028.65	$2,014,469.67	$190,174.92	$1,731,825.36
7	46	0.00275	8679	23.8842	200	8455	$2,388,415.86	$1,697,102.56	0.64766	$1,731,825.36	$1,964,091.78	$184,795.86	$1,492,297.14
8	47	0.00302	8455	25.5184	200	8230	$2,551,837.04	$1,727,183.75	0.60091	$1,492,297.14	$1,913,427.47	$170,286.23	$1,024,173.80
9	48	0.00335	8230	27.5376	200	8002	$2,753,762.94	$1,775,100.14	0.55703	$1,024,173.80	$1,862,393.35	$144,328.36	$277,132.57
10	49	0.00372	8002	29.7438	200	7773	$2,974,383.76	$1,826,013.61	0.51584	$277,132.57	$1,810,902.28	$104,401.74	($781,947.16)
								$17,171,091.36	7.3757				
								$268.93					

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