



Innovation and Technology

# Big Data and the Future Actuary

How access to non-traditional data is unleashing innovation opportunities for the actuarial profession and insurance industry





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## Abstract

Insurance actuaries are operating in a shifting and complex landscape, with consumer data more accessible, pervasive, and abundant than ever before. In today's data-driven world, most consumer interactions now leave behind some form of digital exhaust. People's day-to-day actions are increasingly coded into ones and zeros for use by organizations in an ever-expanding number of ways.

As this new era of big data unfolds, consumer concern over data privacy and transparency continues to grow, creating both risks and opportunities for insurance actuaries and the insurance industry as a whole. The purpose of this report is to review the existing literature on how today's unprecedented access to data is reshaping the capabilities of insurance actuaries. Topics covered in this report include the ways in which actuaries are using non-traditional data sources, how this is likely to evolve into the future, and how the typical roles, technologies, and skillsets of the future actuary will look different than they do today.

## Introduction

Over the past 20 years, our society has experienced an explosion of new data sources, from electronic medical records and connected devices to social media, phone applications, and the Internet of Things. In order to remain competitive, actuaries are now tasked with determining how best to navigate these unprecedented digital waters. They are discovering new ways of accessing non-traditional data and determining how to make it useful to both insurance companies and consumers.

For the purposes of this report, the term “non-traditional data” refers to data that has not traditionally been used by insurance actuaries. From credit scores to epigenetic clocks, there are many non-traditional data sources that are beginning to inform actuarial analysis and predictive modeling.

From a historical lens, the potential of non-traditional data first entered the insurance industry spotlight in part due to a 2010 *Wall Street Journal* article, “Insurers Test Data Profiles to Identify Risky Clients.” Suddenly, insurance executives across the industry had the need for digital innovation on their radars.

Says the article, “Insurers have long used blood and urine tests to assess people's health—a costly process. Today, however, data-gathering companies have such extensive files on most U.S. consumers—online shopping details, catalog purchases, magazine subscriptions, leisure activities, and information from social-networking sites—that some insurers are exploring whether data can reveal nearly as much (Scism, 2010).” As it turns out, non-traditional data can reveal much more than blood and urine tests, from people’s lifestyle behaviors to the likelihood that they have an undiagnosed mental illness.

The first half of this report will discuss how access to non-traditional data is improving the ability of actuaries to perform traditional tasks, including pricing and underwriting. However, while these tasks remain important to the profitability of insurers, they do not add significant value to the consumer experience beyond making underwriting more convenient. Therefore, the second half of this report will discuss innovative ways that access to non-traditional data can be used to create new forms of win-win value for consumers and insurance companies alike.

## Section 1: Using Non-Traditional Data in Traditional Ways

**“The power of big data is that it is information about people’s behavior instead of information about their beliefs.” – Andy Pentland, Social Scientist, MIT Media Lab**

The most traditional and immediate ways that the use of non-traditional data is impacting the actuarial profession is by enabling new methods for pricing products and the simplification of underwriting.

Digitally dependent underwriting solutions are streamlining human operations, and machine learning algorithms have the potential to assess and check for errors in information much faster than a human can (Pentation Analytics, 2018). For example, Munich Re’s ALLFINANZ Spectra is a cloud-based automated underwriting solution in use by the life insurance industry. Agents or prospects enter minimal data, and Spectra then assesses insurability and probable pricing in an instant (Munich Re, 2018).

While in its early stages of testing and development, underwriting solution “Chronos” is taking the public’s love of selfies to new heights. Chronos allows life insurance applicants to upload a selfie of themselves, along with answering a few survey questions. By scanning hundreds of points across a photo of the applicant’s face, Chronos automatically estimates the applicant’s body mass index, age, and gender. Lapetus Solutions, Inc., the science and technology company that developed Chronos, hopes to be able to use this facial imaging technology to accurately predict even more in the future, such as an applicant’s smoking habits and life expectancy (Noiré, 2018).

We are also seeing trends toward usage-based insurance and real-time pricing, driven in large part by auto insurers now using telematic technologies to collect real-time data on the driving behaviors of insureds (CB Insights, 2019).

Underlying these innovations in simplified underwriting is the actuary’s ability to access and analyze non-traditional data in new and exciting ways. In Section 1 of this report, we will look specifically at how non-traditional data is transforming the traditional actuarial tasks of pricing and underwriting and how this will likely evolve in the future.

### 1.1 Current State

#### Demographic Data

At present, there is already a wide range of demographic data being used and experimented on in modeling risk. For example, combining the appropriate geographic and demographic data can now be used to predict the risk of disease, car accidents, and workplace safety issues for policyholders (Cariou, 2018).



However, a more urgent need for demographic data is to test whether predictive algorithms are discriminatory. Many states now prohibit insurance discrimination on the basis of race, religion, or national origin for underwriting, pricing, and claims settlement, regardless of actuarial justification, though actuarial justification is required. To achieve actuarial justification, insurers must first show a statistical relationship between a particular consumer, property, or environmental characteristic, and a designated outcome, for example, claims frequency or severity, loss ratio, pure premium, or the likelihood of fraud. Next, where anti-discriminatory regulations exist, insurers must also show that an algorithm does not discriminate against protected classes (Birnbaum, 2018).

Though an insurer may not intentionally discriminate in the design of an algorithm, for example, when no data on an applicant's protected class status is considered, many regulations still prohibit "disparate impact," meaning practices that, while not intentionally discriminatory, have the same discriminatory effect. In order to show that a predictive algorithm does not discriminate, demographic data on race, religion, and national origin is required as a testing mechanism. This is a challenge in states that prohibit insurers from asking about an applicant's race or protected class status (Birnbaum, 2018). Furthermore, by asking for this data directly, there is the risk that consumers may suspect discriminatory practices, even if the goal of collecting this data is to ensure the opposite.

Despite these challenges, it is increasingly important that the insurance industry find ways to test for discrimination and disparate impact. Regulators are growing increasingly concerned about the fact that predictive algorithms, especially when coupled with machine learning, can inherit the prejudices of prior decision-makers or reflect widespread societal patterns of inequality and exclusion. For example, California car insurance rates must not be set using home locations or credit scores, which too closely reflect the banned factors of race and income (Williams, 2018). Finding new and innovative ways to collect demographic data on an applicant's protected class status – or using proxies for these characteristics when they are unknown – is likely to become increasingly important as control variables in order to demonstrate compliance with anti-discrimination laws (Birnbaum, 2018).

### **Financial Data**

Another form of non-traditional data that has grown in popularity is the use of applicants' financial data. For example, credit scores have been proven to be strongly correlated to driver safety ratings and are more commonly being used to assess risk (Cariou, 2018).

Other forms of financial data are being used in pricing and underwriting as well, for example, the TrueRisk® Life Score, a proprietary new scoring algorithm launched by TransUnion in 2017, which uses individual credit information to predict mortality risk. TransUnion had Munich Re assess the algorithm, though insurers considering credit-based scores are still encouraged to begin with a retrospective validation study using their own experience data. Munich Re is assisting carriers in

conducting these retrospective studies and can recommend how to use the new score to streamline underwriting (Zhu, 2017).

### **Government Data**

The federal government collects thousands of data points on its citizens, including data on smoking, seat belt wearing, life satisfaction, and the number of members in each household. Using predictive analytics, actuaries can gather insights from this data in ways that could inform pricing over time (Cariou, 2018).

Additionally, government surveys like the American Community Survey, conducted by the United States Census Bureau, collects data on citizens' poverty status, household income, health insurance coverage, and more to help local, state, and federal agencies plan government programs, determine eligibility criteria, and encourage eligible people to participate in health insurance programs. For example, according to the United States Census Bureau website, health insurance coverage status and age data from the survey are used to encourage eligible people to enroll in Marketplace, Medicaid, and the Children's Health Insurance Program (CHIP).

### **Climate Data**

Actuaries can also use complex modeling to determine the probability of natural catastrophes and the expected intensity of those disasters in different areas, for example, informing predictions regarding why a natural disaster in one location can result in thousands more deaths than the same event in a different location (Cariou, 2018). As insurers grow increasingly concerned over the risks of climate change, climate-related data, for example, data on extreme weather events, rainfall, and sea levels, is of increasing value to future scenario modeling (Guerard, 2018).

### **Medical Data**

Meanwhile, medical data is becoming more accessible through the use of pharmacy and prescription drug records, lab tests, and electronic medical records. As examples, Milliman IntelliScript and ExamOne, a part of Quest Diagnostics, gather prescription claims data from pharmacy benefit managers and sell reports to insurers. A report can be delivered within seconds, including the drug name, fill date, dosage, pharmacy, and physician information. Another ExamOne service, QuestCheck, gives insurers doctor-ordered lab test results. Only in the past decade or so has this type of information been captured electronically, making it available (Marquand, 2016).

Another underwriting solution offered by Milliman is "Medical Data," which gives insurers the ability to analyze an applicant's medical claims data, such as procedure codes and diagnoses. While still in the early stages of adoption, this data is already being used by Milliman clients to inform underwriting decisions. According to Milliman's website, "Medical Data includes



diagnoses, hospital and physician procedures, inpatient and clinic-administered medications, and medical equipment information from medical billing records. Medical Data is integrated within Milliman's Irix® underwriting engine to generate enhanced automated underwriting decisions.”

Insurer access to electronic health records (EHRs) has also been a long-awaited underwriting input, since EHRs provide online access to a patient's records rather than relying on paper forms and transcribed reports. EHRs also store coded information about an applicant's medical data, including his or her allergies, medications, surgical procedures, lab results, and even social determinants of health. However, there are still barriers standing in the way of widespread EHR adoption by insurers. One such barrier is the wide range of different EHR platforms in use across the health care system, making the integration of health data across multiple EHR vendors a challenge. Another challenge is that many health care providers and patients have not yet adopted EHR systems. As EHR platform interoperability improves and the design of these platforms becomes more user-centric, expect to see their use by insurers increase as well (The Sequoia Project, 2018).

#### **Motor Vehicle Record Data**

Companies like ExamOne and LexisNexis Risk Solutions offer insurers motor vehicle reports from any state, showing insurers whether potential insureds have been charged with a DUI or received moving violations such as speeding tickets. According to LIMRA, about six in 10 insurers use prescription databases, lab results, and motor vehicle records in their underwriting processes (Marquand, 2016).

#### **Public Records Data**

Public records are also available to insurers, such as through companies like LexisNexis. For example, a public records search could turn up a bankruptcy or court document (Marquand, 2016).

#### **Telematics Data**

Smartphone-based telematics, where an app monitors the behavior of drivers in real time, is another innovation gaining steam in the U.S. auto insurance industry. Participation in the broader auto industry is growing as well. Usage-based insurance informed by telematics data will continue to be an area of focus for innovation in the P&C insurance industry throughout 2019 (CB Insights, 2019).

### **1.2 Future State**

#### **Epigenetics Data**

Would you like to know when you are going to die? How about how much longer you will likely live free of common diseases? Soon this may no longer be a theoretical debate. Epigenetic

testing is already answering these exact questions. Epigenetics is the study of how molecular changes in our DNA impact the functioning of our genes. “Epi,” which is Greek for “on top of,” implies the study of how our environments or experiences influence how our genetic codes are expressed. The study of epigenetics has led to the development of testing that can determine our cellular, rather than our chronological, age (Zimmerman, 2018).

As covered in a recent MIT Technology Review article, Steve Horvath, a UCLA biostatistician, has developed an epigenetic clock that is purported to predict how long someone will live and how much of that life will be free of diseases such as cancer, heart disease, and Alzheimer’s. By knowing a person’s chronological age, Horvath can look for changes in that person’s DNA to tell whether his or her body is aging unusually fast or slow at a cellular level. His team tested their epigenetic clock using 13,000 decades-old blood samples from people whose date of death is known. The results indicate that the clock is a useful predictor of all-cause mortality. “After five years of research, there is nobody who disputes that epigenetics predicts life span,” Horvath says (Weintraub, 2018).

While the epigenetic tests being developed will never be accurate enough to forecast an exact date or time of death, insurance companies are already finding them useful. For example, YouSurance, a digital managing general agency (MGA), is using epigenetic biomarkers to assess life insurance applicants’ health and lifespan (Sabes, 2018). Companies like Reinsurance Group of America are looking into the use of epigenetic clock technology as well (Weintraub, 2018).

The MIT Technology review article points out that the use of an epigenetic clock in insurance pricing and underwriting raises questions of fairness. If your epigenetic clock uncovers an unfavorable cellular age for an individual due to his or her genetics, is it fair to charge that individual a higher premium? The Genetic Information Nondiscrimination Act of 2008 protects consumers against discrimination on the basis of genes (Weintraub, 2018). This has left many in the insurance industry concerned about the consumer advantage offered by direct-to-consumer DNA testing kits, which arm consumers with information about their potential health risks. However, there are currently no regulations in place regarding the use of epigenetic testing by insurers, and Horvath hopes to be able to use the epigenetic clock to more precisely differentiate changes due to a person’s lifestyle and behavior as opposed to their genes (Weintraub, 2018). For example, an epigenetic test may one day be able to quantify the physical effect of smoking, how many cigarettes an applicant smokes a day, and whether an applicant quit a week ago or a year ago (Zimmerman, 2018). For this reason, it is expected that epigenetic testing will be a very important and widely used tool by insurance companies of the future.

### **Digital Behavioral Data: Wearables, Apps, and Online Platforms**

The most valuable type of data that insurers can collect about insurance applicants is behavioral data, and there are a growing number of ways that consumers are leaving behind data

breadcrumbs as they move through the world, from our GPS locational data to who we spend time with and where we spend our money.

Wearable devices, in particular, are one of the most promising sources of behavioral data. This fast-growing trend in consumer technology includes wearable devices such as the Apple iWatch, Nike+, Fitbit, and Google Glass, among others. Over the past decade, a proliferation of smartphone apps and wearable devices now monitors numerous aspects of our health, from our diet, mood, heart rate, and exercise to our medication compliance, screen time, sleep, and meditation. In fact, as of a 2019 article on the National Association of Insurance Commissioners website, more than one in five Internet users wear some type of wearable device on their wrist daily (NAIC, 2019).

Driven by trends like wearable adoption, big data is increasingly about decoding people's real-world behavior. As the future of actuarial science continues to move in this direction, the insurance industry will likely find new ways to use this data in pricing and underwriting insurance products (Dans, 2018).

Looking forward, computational social scientists are studying how digital behavioral data can be used to make useful predictions, from how likely applicants are to pay back a bank loan to their likelihood of getting diabetes or having a mental illness. This is an area of research that could be of significant value to insurers in the future.

According to a recent *Wall Street Journal* article, a team of researchers at the Center on Depression and Resilience at the University of Illinois at Chicago is working on an iPhone app called BiAffect that can analyze people's typing patterns to predict their mood, cognition, and mental health status. Initial research has found that this technology can predict episodes of mania and depression among users with bipolar and major depressive disorders based on their typing patterns (Higgins, 2018). Data such as this could potentially be used by actuaries of the future in order to better assess risk.

According to a recent NBC News article, another nascent field of research explores the impacts of screen time on health and cognition. The article highlights viewpoints and research findings from across the medical community. According to Dr. Judy Rosenberg, psychologist and founder of the Psychological Healing Center in Sherman Oaks, CA, "When we substitute TV for human relations, we disconnect from our human nature and substitute for virtual. We are wired to connect, and when we disconnect from humans and over-connect to TV at the cost of human connection, eventually we will 'starve to death' emotionally (Page, 2017)." As the effects of screen time on the brain are increasingly understood, data on the number of hours an insurance applicant spends bingeing on Netflix or staring at computer and phone screens could become another input used in modeling risk.

Next, social media data is of increasing interest to insurance companies as well. At present, most insurers are not using this data to price insurance products, though there is early exploration of the potential of this data to inform future risk assessment. New rules out of New York State are the first to clarify that use of social media data to inform pricing and underwriting is legal, on the condition that this does not discriminate against protected populations (Scism, 2019).

Meanwhile, social media data is proving useful in other ways and is commonly used by insurers to complement marketing, customer service, and communication strategies and to detect insurance fraud (Hook, 2017). Dating back to a 2013 study by Trimetric, an online data provider, social media has been used to detect fraudulent auto, fire, burglary, and worker's compensation claims, such as when a claimant is found on social media to have participated in activities beyond the restrictions of the treating physician (NAIC, 2015).

### 1.3 Regulations and Consumer Confidence

On January 18, 2019, the New York Department of Financial Services (NYDFS) released new rules on how life insurance companies can use non-traditional data to inform pricing decisions, with many other states expected to follow suit. While using non-traditional data has long been legal, New York is the first state to release guidelines on the practice. The ruling states that non-traditional data usage is acceptable as long as a company does not discriminate against protected classes by factors like race, religion, national origin, status as a victim of domestic violence, past lawful travel, or sexual orientation (Chen, 2019).

A recent NYDFS press release states that "...insurers' use of external data sources has the potential to benefit insurers and consumers alike by simplifying and expediting life insurance sales and underwriting processes. External data sources also have the potential to result in more accurate underwriting and pricing of life insurance." The release declares that there must be valid rationale supporting any differential treatment of otherwise like risks. According to the release, "[this is] particularly important where there is no demonstrable causal link between the classification and increased mortality and where an underwriting or rating guideline has a disparate impact on protected classes." The rules also make it clear that life insurers using non-traditional data are responsible for ensuring their algorithms are free of bias. This means that any third-party algorithmic software used in an effort to save time or money will have to be thoroughly tested by insurance companies to remain compliant (NYDFS, 2019).

These regulations pose new challenges since, as a recent *Forbes* article points out, we do not know how much testing it takes to determine if an algorithm is unbiased, and there is no agreed-upon standard for measuring bias or proving a lack of bias (Baron, 2019).

Additionally, the NYDFS rules also require insurers to notify potential insureds of the right to receive the specific reasons for an adverse underwriting decision (Eversheds Sutherland, 2019). As this rule suggests, consumer transparency is an issue of concern for both regulators and consumers alike. The growing use of non-traditional data in pricing and underwriting will likely escalate consumer concerns over trust, transparency, and data privacy.

Regarding the new rules, the *Wall Street Journal* makes some friendly and a bit dystopian consumer suggestions, including “Don’t post photos of yourself smoking on social-media sites. Do post photos of yourself running (Scism, 2019).” With personal data now seen as a new-age digital currency, consumers expect tangible value in return for sharing it and are demanding greater transparency around how their data is used (Evans, 2018). The insurance industry has long faced an uphill battle when it comes to building consumer trust and confidence. Adding fuel to the fire, consumers are now inundated with stories about privacy violations, such as those perpetrated by social media behemoths like Facebook (Baron, 2019). As consumers learn of the ways that many insurers now passively collect applicants’ personal data to inform premium decisions, consumer mistrust in the industry is likely to intensify.

Lastly, it remains difficult for consumers to fight pricing decisions that they perceive to be unfair, especially when those decisions are based on data they had not even realized they had given away (Baron, 2019). This suggests that there is significant innovation whitespace for insurance companies to make the consumer’s underwriting experience more convenient, transparent, participatory, and insightful.

#### **1.4 The Need for Consumer-Centric Innovation**

Guy Kawasaki, Silicon Valley-based author, speaker, entrepreneur, and venture capitalist, has a very popular TEDx Berkeley Talk on the ten principles of innovation. In it, he explains, “[Innovation] starts with the desire to make meaning as opposed to making money. Making meaning means that you change the world, and I think you’ll notice that if you happen to change the world, you will also probably make money.” Kawasaki then goes on to explain that making meaning is about putting consumers’ best interests at the center of every equation (Kawasaki, 2014).

So just how credible are Kawasaki’s claims? In 2015, Forrester researched whether customer-centricity really matters to business success. Forrester compared financial data across companies scoring both very high and very low on their Customer Experience (CX) Index between the years of 2010 and 2015, isolating only revenue that could be traced directly to consumer behavior. They then calculated the compound annual growth rates, finding that the CX leaders significantly outperformed their relatively laggard counterparts. When Forrester compared the total growth rate of all CX leaders to that of all CX laggards, they found that the leaders collectively had a 14-percentage point advantage. In other words, companies that ensure every decision they make is in the best interest of their consumers regularly outperform those that do not (Manning, 2016).

For these reasons, it will be important for non-traditional data to be used in ways that go beyond precision pricing; ways that create win-win forms of value for both consumers and insurance companies. While simplifying the underwriting process is a step in the right direction, this process still asks consumers to share a lot of personal data in return only for the potential to own an insurance policy that they may never use. This has led many in the industry to ask, how else can we use an applicant’s data to create new forms of value? Are there personal insights we

can deliver based on this data that create tangible value for applicants, such as insights that help people live healthier, happier, and wealthier lives?



## Section 2: Using Non-Traditional Data in Non-Traditional Ways

**“In this evolution, insurance will shift from its current state of ‘detect and repair’ to ‘predict and prevent,’ transforming every aspect of the industry in the process.” – McKinsey Article, April 2018**

While Section 1 of this report looked specifically at how non-traditional data is informing traditional actuarial activities, including pricing and underwriting, Section 2 of this report will review how non-traditional data is opening up new, non-traditional opportunities for innovation, pushing beyond the traditional roles that actuaries have historically played. This section will explore new ways non-traditional data is being used to innovate today, as well as what this might look like in the future.

### 2.1 Current State

#### Risk Management and Wellness Programs

If a risk score is useful to an insurer for pricing and underwriting products, it can also be useful to policyholders as a tool for better understanding and managing their risks. For example, telematics apps are now being used to provide policyholders personal insights into their driving behaviors while making suggestions on how to drive more safely.

Another example is John Hancock’s Vitality program, which is helping life insurance policyholders make healthier decisions that save them money on their premiums. A 2018 *New York Times* article shares the story of Brian and Carla Restid, who bought life insurance to protect and maintain their lifestyle throughout retirement. Once it became available, they upgraded to the Vitality pilot program to gain insights and motivation for getting into better shape and making healthier lifestyle choices. In exchange for improving their health and wellness, the Vitality program allowed them to save \$700 over the three years since they had joined (Sullivan, 2018).

According to Ms. Restid, “It provided a way for me to be accountable to myself.” Ms. Restid has an autoimmune disease that has slowed her down. “It provided me a way to get going and keep going. I was exercising before, but it wasn’t at the forefront of my mind. This set me on a life-changing program.” Every ten workouts, the Restids get to spin a wheel of fortune on an app to win points that they can cash in among partnering retailers (Sullivan, 2018).

The Vitality program is now included in all new life insurance policies underwritten by John Hancock. By participating, insureds have the ability to reduce annual premiums by as much as 15% in exchange for reporting their eating, drinking, and exercise habits. According to behavioral scientists, these short-term behavioral incentives and nudges can go a long way towards changing consumer behavior for the long term (Sullivan, 2018).

The potential of these types of programs may be significant for both insurers and consumers. However, offering these programs will demand new actuarial skillsets and partnerships, requiring

a deeper understanding of motivational and behavioral sciences. There are also design challenges related to delivering negative information to consumers about their health and longevity risks, which will likely require new partnerships between health care providers and insurance companies.

While these types of programs may be highly attractive to healthy individuals who feel confident in their ability to make healthy decisions, unhealthy individuals will most likely turn elsewhere for their insurance needs. This has led some insurance companies to explore how non-traditional data can be used to meet the specific needs of higher-risk consumer populations.

### **Patient Management Programs for the Chronically Ill**

Innovative collaborations between insurance companies and health care systems are beginning to emerge, with a specific focus on patient management programs that target high-risk patients struggling with chronic diseases. For example, in Wisconsin, Aurora Health Care and Anthem Blue Cross and Blue Shield have partnered on a 50-50 joint venture called Wisconsin Collaborative Insurance Company to offer a Well Priority product. As reported by a 2017 *Milwaukee Business Journal* article, both organizations expect the collaboration to improve the quality of health care, while lowering costs by using a multi-faceted, collaborative approach. The primary goal of the partnership is to analyze electronic medical record data, pharmacy data, and claims data to identify high-risk patients with whom proactive steps can be taken to improve their health and medication compliance, while helping them to avoid preventable hospitalizations (Foely, 2017).

These types of partnerships are important, since studies show that up to 40% of prescriptions written are never filled. This includes critical medications with the potential to cure disease and prevent medical conditions from worsening. Historically, medical providers had no way of knowing when prescriptions were going unfilled, despite the significant ways medication nonadherence can impact a patient's health. Innovative programs that combine clinical data with claims data can be used to identify patient barriers and unmet care needs, which could be anything ranging from low literacy to transportation issues and financial constraints (Foely, 2017).

Actuaries will play an important role in both the design of these patient management programs and the analysis of their success. Improving outcomes for patients with chronic diseases is no easy task, and data-driven insights will be critical in identifying the most effective patient interventions and iteratively improving program efficacy. Typically, program interventions range from follow-up phone calls and appointment or refill reminders to helping patients build care team relationships with nurse navigators, care coordinators, pharmacists, social workers, behavioral health specialists, or telehealth service providers (Foely, 2017).

While the collaboration of medical providers and insurers is a relatively new concept, it is one that is becoming increasingly popular. To succeed long-term, these collaborations must always keep the best interests of patients front and center, finding new ways to more easily and affordably comply with their treatments and live healthier lives, all while reducing the overall costs of care (Foely, 2017).

### **Value-Based Payment Models**

Another way non-traditional data is being used is to design innovative value-based payment contracts, making expensive treatments for the chronically ill more affordable, while producing better patient health outcomes. For example, in 2017, health insurer Aetna entered into a revolutionary contract with medical device manufacturer Medtronic, under which payment for Medtronic's insulin pump systems is now tied to how well patients fare after switching from multiple insulin daily injections (Berkrot, 2017).

By using one of Medtronic's three insulin pumps, Medtronic believes diabetic patients will be much more likely to take their insulin medications as prescribed, since the patient experience of using an insulin pump is far superior to requiring patients to give themselves multiple daily injections. As patients wear the Medtronic insulin pump, it constantly self-adjusts, keeping patients' blood sugar levels in range based on their personalized needs (Berkrot, 2017).

Additionally, Medtronic has also launched an innovative partnership with Fitbit to design a patient app that combines Medtronic's glucose monitoring data with Fitbit's lifestyle tracking data. The app gives patients and their doctors real-time insights into managing their diabetes by helping them understand how their exercise and lifestyle choices impact their condition (Dias, 2017). Aetna's members now have access to Medtronic's advanced patient support services, while the Fitbit partnership creates new sources of data that can be used by Medtronic and Aetna to track patient outcomes (Berkrot, 2017).

The Aetna and Medtronic partnership represents a growing industry shift toward value-based payment contracts for prescription drugs and medical devices. These contracts attempt to bring down skyrocketing health care costs by tying reimbursements to whether the products achieve their intended results. Medtronic's connected insulin pumps and Fitbit partnership allows for the real-time tracking of patient outcomes in ways that were not possible a decade ago (Dias, 2017).

As value-based risk-sharing agreements become more popular, insurance products will increasingly be designed to cover the most effective prescription drugs and delivery devices on formulary tiers that make these treatments more affordable to the patients who need them (Warren, 2019).

The future actuary will have many more opportunities to help design these next-generation value-based payment contracts, which, in turn, will help the insurance industry cover evidence-based treatments that help patients achieve better health outcomes. Actuarial skillsets will be

critical to determining the target outcomes underlying these contracts, tracking those outcomes, and analyzing the results.

Meanwhile, value-based reimbursement also poses new risks to health care providers. These risks will require actuarial, analytical, and data-mining capabilities that can help providers improve their quality of care and succeed in the new value-based environment, making actuarial expertise valuable in new ways to health care providers as well (Pantano, 2016).

## 2.2 Future State

### Pay-as-you-live and Usage-based Insurance

The actuary of the future will likely need to partner with data scientists, behavioral scientists, and design thinkers to create real-time, “pay-as-you-live” pricing solutions for connected insurance products, products that will simultaneously coach consumers on how to make better decisions for their health, safety, and wallet.

A 2018 McKinsey article paints a picture of what these types of insurance solutions could look like by the year 2030, welcoming readers to view the world through the eyes of Scott. They describe Scott as a customer of the future. His artificial assistant orders him an autonomous vehicle for a meeting. After getting into the car, Scott decides he would like to drive himself, so he switches the car into “active” mode. Scott’s artificial assistant recommends the safest route, as advised by Scott’s mobility insurer, which has the lowest likelihood of accidents and auto damage. By taking this route over others, Scott’s artificial assistant lets him know he will either earn or lose a certain number of premium dollars with both his mobility and life insurer based on his selected route and his decision to drive himself. As Scott makes decisions, the premium he owes is updated in real-time, with the option to connect his bank account for the amounts to be automatically deducted (Balasubramanian, 2018).

While Scott is driving, he gets into a fender bender. The autonomous vehicle registers the accident and runs its internal diagnostics to determine the extent of the damage. His artificial assistant then walks him through the process of taking three pictures and submitting them to his insurer. He is alerted that his claim is instantly approved and that a drone has been dispatched to his location for inspection. The autonomous vehicle is directed to the nearest in-network garage for repair while a replacement vehicle arrives to take Scott to his final destination (Balasubramanian, 2018). Once Scott arrives and is out of the car, his mobile coverage is automatically turned off.

The McKinsey article acknowledges that Scott’s story may seem far-fetched today, but these seamlessly integrated and data-driven experiences are likely to emerge across all lines of insurance over the next decade. All the technologies in the story already exist, and the rise of machine learning, convolutional neural networks, blockchain-enabled smart contracts, and

artificial intelligence will make these scenarios increasingly possible. According to the article, “in this evolution, insurance will shift from its current state of ‘detect and repair’ to ‘predict and prevent,’ transforming every aspect of the industry in the process (Balasubramanian, 2018).”

You can likely imagine many other future scenarios similar to Scott’s. For example, a 2017 *Financial Times* article discusses a future where a mobile app alerts policyholders before walking down a road where several people have recently fallen on ice (Ralph, 2017).

### **The Internet of Things**

As sensor technology is further embedded into our day-to-day lives, we will continue to see an explosion of connected devices. Smart toilets will be able to submit data to our smartphones, doctors, and insurers, informing us what probiotics and supplements we should be taking, what our nutritional profiles and microbiomes look like, whether we are pregnant, and whether we’ve developed certain diseases (Berry, 2018). Smart homes will empower elderly people to live autonomously in their homes for longer, while telemedicine platforms will arrive in autonomous vehicles, bringing the doctor’s office to the doorstep of elderly and rural patients.

Meanwhile, fitness trackers, wearable devices, smart watches, and budget-tracking apps will send real-time notifications to consumers when they blow their budgets, buy too much junk food, or forget to take their meds. Connected solutions will nudge consumers toward healthier habits, like getting more sleep, reducing screen time, eating healthier, meditating, or getting off the couch to take a few more steps. As these data-driven feedback loops become increasingly omnipresent in consumers’ day-to-day lives, insurers will be perfectly positioned to offer real-time monetary incentives that reward policyholders for following the advice of their robotic coaches.

### **Covering New Risks**

Another important role that future actuaries will play is determining how to price future insurance products that cover new risks. For example, new risks associated with autonomous vehicles, 3-D printed buildings, climate change, and cybercrime will create the need for new types of insurance products and risk assessments. Actuaries will play a vital role in enabling these new solutions to be designed, priced, and brought to market.

## Section 3: Becoming an Actuary of the Future

### 3.1 New Skillsets and Partnerships

The actuary of the future is likely to be part mathematician, part data scientist, part digital strategist, part computer programmer, and part design thinker. Actuaries are starting to expand their skillsets and are becoming better at collaborating, innovating, and working on agile teams, especially as partnerships become more common with insurtech providers, startups, product designers, consumer psychologists, wearable companies, health care providers, and IT specialists (*The One Brief*, 2019). It is also becoming easier for actuaries to learn new skills as free online learning platforms like Coursera and Udacity continue to emerge. For example, free classes are available that can help actuaries learn more about the use of machine learning, predictive modeling, and artificial intelligence. Actuaries are also increasingly expected to have the necessary skillsets to prove their algorithms are not discriminatory to regulators (*British Actuarial Journal*, 2018). At the same time, some actuaries are beginning to help make data more actionable and insightful to consumers (Carroll, 2017).

### 3.2 New Roles and Opportunities

Most importantly, access to non-traditional data is creating new opportunities for actuaries to lead innovation initiatives within their organizations. By understanding what consumers want most from their buying and policyholder experiences, actuaries can help design products that use data to deliver greater value (Carroll, 2017). Actuarial skillsets are becoming more valuable to health care providers, consultancies, insurtech developers, the government, and startups as well. For example, as the government is tasked with predicting the risks of complex issues, such as the future impacts of automation and climate change, actuaries are positioned to bring critical skillsets to the table. Additionally, as health care providers shift to value-based payment models, they will increasingly need actuarial skillsets in-house to help with tracking patient outcomes and informing decisions about how care is delivered (Kotecki, 2018).

### 3.3 New Tools and Technologies

With all of these new data sources providing both structured and unstructured data, actuaries will need up-to-date programming skills, for example, the ability to code in R or Python, allowing them to develop algorithms capable of handling very large and disparate sets of data efficiently (Houston, 2016). Cloud-based platforms and solution providers, such as Amazon Web Services (AWS) and Slice, are also becoming more critical to success. For example, Slice is a digital, cloud-based platform for insurance providers that enables the rapid introduction, evaluation, and adoption of new products, technologies, and business models. According to Slice's website, "We help you build your product in an on-demand, usage-based model that will allow you to offer more premium products and services at a fraction of the cost." Slice Insurance Cloud Services are fully digital, offering quotes to customers within seconds and eliminating the need for tiresome



paperwork or lengthy application processes. Partnerships with these types of solution providers and insurtech companies are increasingly becoming table stakes for competing in the digital age.

## Conclusion

Current trends suggest that the future relevance of the insurance industry will depend in large part on the willingness of insurers to empathize with consumers and design more user-centered solutions. We are looking over the precipice of an exciting new digital era. Actuaries and insurers who take the leap and invest significantly in innovation in ways that produce win-win solutions for both consumers and insurers will be likely to come out on top. The digital era is enabling insurers to compete on more than price, for example, by developing proprietary platforms and connected products that empower consumers to better connect their decisions to their health, safety, and wealth. The potential of big data holds limitless opportunities for actuaries to collaborate and innovate, especially for those who embrace curiosity, adaptability, and a commitment to human-centered design.

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## About The Society of Actuaries

The Society of Actuaries (SOA), formed in 1949, is one of the largest actuarial professional organizations in the world dedicated to serving more than 32,000 actuarial members and the public in the United States, Canada, and worldwide. In line with the SOA Vision Statement, actuaries act as business leaders who develop and use mathematical models to measure and manage risk in support of financial security for individuals, organizations, and the public.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement, and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

**Objectivity:** The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

**Quality:** The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and nonactuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

**Relevance:** The SOA provides timely research on public policy issues. Our research advances actuarial knowledge while providing critical insights on key policy issues, and thereby provides value to stakeholders and decision makers.

**Quantification:** The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

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