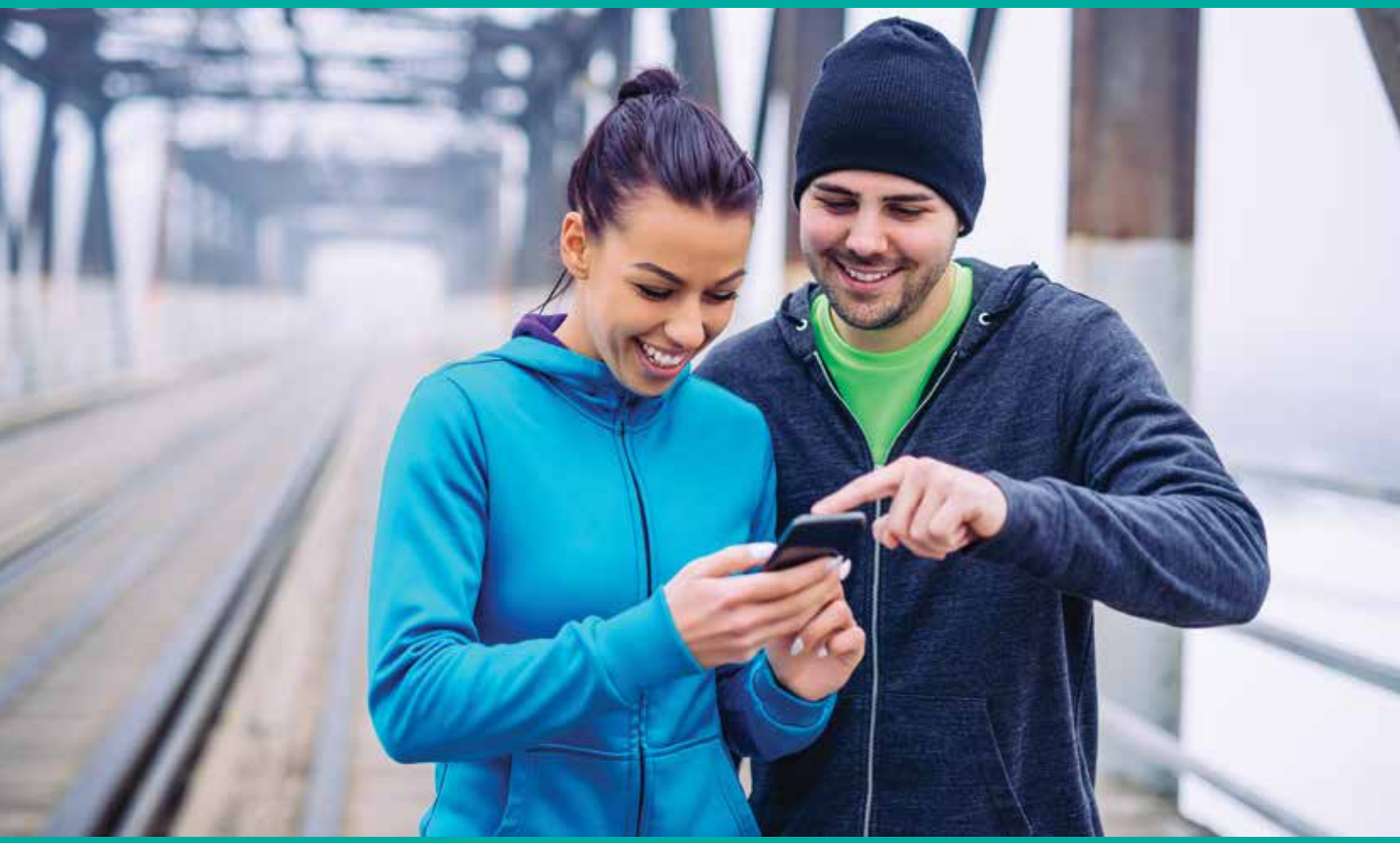
Thought Leadership Unit



Bespoke health promotion: How personalisation is transforming health

Opinion paper

Foreword by Caroline Pain

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Foreword

Across the globe, lifestyle-related diseases like cardiovascular disease and cancer continue to grow more prevalent, putting a huge strain on health systems. It's clear that current approaches to health promotion are not sufficient to effect behavioural change on a large scale.

But perhaps large-scale change is not the point. Perhaps the health industry needs to focus more on the micro-level, on changing health behaviours one person at a time. Today it is more possible than ever to take a highly targeted approach to changing behaviours. The advent of big data analysis, DNA testing and interactive health engagement is moving us ever closer to an age of personalised medicine that is both more effective and more cost effective than today's health care model.

In this paper, we examine a holistic approach to individual health that promises to increase the efficacy of prevention and intervention strategies, thereby increasing healthspan and lifespan and reducing the pressure on health care systems. The approach brings together personalised health and lifestyle data with digital and social health care and support. In this way, health care is becoming hyper-personalised and predictive — down to genetic profiling. By making care relevant and targeted to the individual, it has the power to encourage participation in preventative measures to help them stay healthy. This approach benefits not only the individual at its centre, but also health systems and entire societies.

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Introduction

In 2013, actress and director Angelina Jolie told a very private medical story in a very public forum: the pages of the *New York Times*. In an essay entitled "My Medical Choice," Jolie explained her decision to undergo a preventive double mastectomy, a decision that stemmed from genetic testing she had had done. Jolie's mother had died of breast cancer at age 56, and genetic testing revealed that she herself ran an elevated risk due to a gene variant (or faulty gene) known as BRCA1. According to Jolie, her surgery reduced her chance of developing breast cancer from 87 percent to under 5 percent. "I can tell my children that they don't need to fear they will lose me to breast cancer," she wrote.[1]

But Jolie's story didn't just affect her family. Her story quickly sped around the globe thanks to social media. Celebrities and ordinary people alike shared it on Facebook, Twitter and other platforms, sparking an upswing in requests for genetic testing. A study of insured women in the U.S. calculated a 64 percent increase in BRCA1 and BRCA2 testing, which accounted for an extra 4,500 tests in just the 15 days after the essay appeared. In the U.K., where genetic testing is offered at no cost through the National Health Service, referrals more than doubled. (Interestingly, the so-called Angelina Jolie effect didn't lead to an increase in overall mastectomy rates, allaying fears that huge numbers of women would undergo unnecessary surgery.) [2],[3],[4]

Genomics and the UK's National Health Service

The Human Genome Project marked the beginning of a series of international cancer genome sequencing studies. The UK, regarded as an international leader in genomics, has already begun to bring genomics into the NHS through the establishment of Genomics England and the 100,000 Genome Project, which is sequencing the genomes of patients with rare diseases and cancer. Organisers say the effort is "the largest national sequencing project of its kind in the world."[5]

The impact of Jolie's essay even went beyond genetic testing. In one of the hundreds of reader comments posted on the ***New York Times'*** website, a woman from Texas wrote, "For me it is not cancer but obesity and the eminent risk of diabetes. Your op-ed shared on Twitter by [actress] Kristen Bell got me out of bed early this morning to work out."

There's no way to know whether that woman will succeed in staving off diabetes, but there's also no question that both her story and Jolie's highlight a fundamental shift in health care. Rather than being passive recipients of health services, some individuals are taking more responsibility for their own care and are playing a more active role in their own health management. As the Quebec Network for Personalized Health Care has put it, "In the new paradigm, the *patient* will become a *citizen*."[6]

1 http://www.nytimes.com/2013/05/14/opinion/my-medical-choice.html
2 https://www.genomicseducation.hee.nhs.uk/news/item/325-genomics-and-the-angelina-jolie-effect/
3 https://breast-cancer-research.biomedcentral.com/articles/10.1186/s13058-014-0442-6
4 https://www.theguardian.com/science/2016/dec/14/angelina-jolie-effect-boosted-genetic-testing-rates-study-finds-breast-ovarian-cancer
5 https://www.genomicsengland.co.uk/the-100000-genomes-project/
6 http://qnphc.org/personalized-health-care/

But they won't be "citizens" of demand-driven legacy health care systems. Instead, they'll engage with value-based systems offering care that is:

- **Predictive:** Genetic profiles and other personal information will help doctors identify individual risk factors and choose just the right methods and treatments to monitor a patient's risk of developing certain diseases and conditions.
- **Personalised:** Clinical interventions will be based on each individual's unique genetic, medical and environmental conditions.
- **Participatory:** Individuals will become partners in their own care, and clinicians will use a range of tools to keep them engaged outside the doctor's office and hospital.
- **Preventative:** Personalised methodologies and treatments will enable people to take appropriate measures to help them stay fit and well as they age.

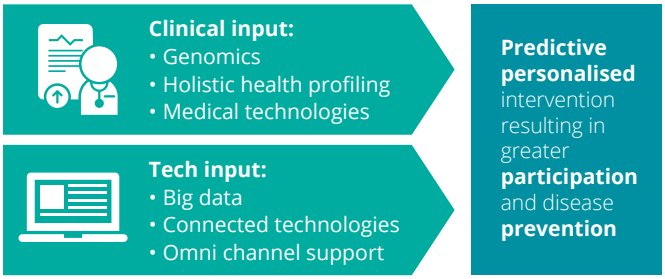


Image shows: The P4 health care model: Delivering personalisation, prediction, prevention and participation through collaborative med-tech strategies.

The P4 health care model described above is nothing new, of course. Around 400 B.C., Hippocrates advised physicians to "give different drugs to different patients, for the sweet ones do not benefit everyone, nor do the astringent ones, nor are all the patients able to drink the same things." And physicians have long seen family histories as a key tool in predicting the risk of various diseases.[7],[8]

But much has happened in recent years that has changed, and continues to change, the face of health promotion and disease prevention. One important factor is the advent of the Internet of Things and connected devices like smartphones and fitness trackers; according to technology firm Ericsson, 90 percent of people over age 6 will have a mobile phone by 2020 — and many of those phones will be used to send and receive health information. Another factor is the advent of relatively inexpensive DNA testing; today, it can costs less than $1,000 to sequence a person's entire genome, and some expect the cost to drop to less than $100 in the foreseeable future. (By way of comparison, the first sequencing of the human genome, completed in 2003, cost $2.7 billion and took 13 years to complete.)[9],[10],[11],[12]

Can personalised health care really prompt people to change their lifestyles in order to achieve better health outcomes while lowering the burden for individuals and health systems? In this paper, we'll explore the ways personalisation and technology are revolutionising the way we approach health.

First, however, it's important to consider the need for health promotion and greater personalisation in health care.

7 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3761360/
8 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2945014/
9 https://thenextweb.com/insider/2014/11/18/2020-90-worlds-population-aged-6-will-mobile-phone-report/
10 https://www.genome.gov/27565109/the-cost-of-sequencing-a-human-genome/
11 https://techcrunch.com/2017/01/10/illumina-wants-to-sequence-your-whole-genome-for-100/
12 http://qnphc.org/personalized-health-care/

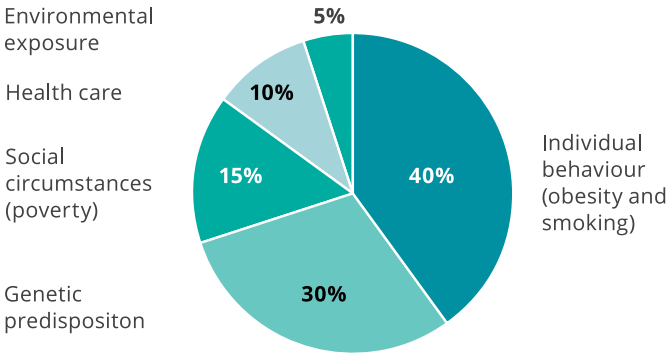
Chapter 1:

The need for health promotion — individual behaviours and lifestyle

Partly because of the world's growing middle class, in particular across the Middle East and Asia, we are seeing a worldwide increase in lifestyle-related diseases like cardiovascular disease and cancer. This is putting a huge strain on local health care systems, with people living longer and needing more expensive and longer-term treatment. There is a pressing need to move away from reactive, demand-driven health care systems to preventative, need-driven health care systems.

While prevention and early intervention strategies — via data analysis and risk management — can make a difference, one of the industry's key challenges is to motivate and help people to modify their behaviour and to ensure that new behaviours stick. That's extremely important because some 40 percent of premature deaths are the result of individual behaviour, with obesity and smoking leading the way.[13]

Despite ample evidence of the dangers of smoking, obesity, overuse of alcohol and sedentary lifestyles, people around the world continue making poor choices. The worldwide obesity rate has tripled since 1975, for example, with clear health implications. According to the U.S. Centers for Disease Control and Prevention, obesity is a prime cause of hypertension, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnoea and several forms of cancer, not to mention clinical depression, low quality of life and difficulty with physical functioning. What's more, a billion people continue to use tobacco (80 percent of them in low- and middle-income countries), a practice that causes seven million deaths each year.[14,15]



Premature death cause

Bernie Williams, Director, Product & Practitioner Support, My DNA Health, says, "The growing global obesity epidemic and associated health conditions, including type 2 diabetes, is a major issue and has been driven by environmental and societal changes that promote overeating and sedentary behaviour. There is a genetic contribution to obesity, body size and shape. Some genetic variants, for instance, can cause leptin deficiency, contributing to obesity, but can also alter hormone regulation, driving increased food intake. Recognising the contribution that genetics and satiety have on obesity and weight gain highlights the damaging and powerful effects of the current obesogenic environment with its constant stimuli encouraging consumption of high calorie foods."[16]

Research has shown that individuals who have never smoked, who consume alcohol in moderation, who follow a healthy diet and who get adequate exercise live an average of 11 to 14 years longer than those who do the opposite in all four areas. (The same lifestyle choices can also increase healthspan, the number of years one lives without illness.)[17,18]

13 http://www.nejm.org/doi/full/10.1056/NEJMsa073350
14 http://www.who.int/mediacentre/factsheets/fs311/en/
15 http://www.who.int/mediacentre/factsheets/fs339/en/
16 Bernie Williams, Director, Product & Practitioner Support, My DNA Health
17 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4468355/
18 https://publichealth.wustl.edu/heatlhspan-is-more-important-than-lifespan-so-why-dont-more-people-know-about-it/

While individuals must ultimately make the decision to become healthier, not everyone can come to this realisation, alter their behaviour and implement safe, informed changes to their diets and lifestyles without support. A thoughtful combination of education programmes and early intervention strategies can help to encourage an active lifestyle and a healthy diet — the best hopes for beating obesity and other noncommunicable diseases.

To be effective, strategies need to be multipronged, according to psychologist Dr Meg Arroll with Simply Research in the U.S. and UK: "On a micro level people are more likely to make positive lifestyle choices to benefit their health and adhere to their new behaviours if the strategy is personalised. On a macro level, government and health care system initiatives such as banning smoking and offering smoking cessation programs also have an impact. However, environmental and infrastructure challenges also need to be addressed. It should be easier for people to exercise and access good nutrition. For example, there are cities in the United States. where you have to drive to get to a park where you can exercise."[19]

Health care payers have already begun aligning prevention and early intervention strategies with the rapid advancements being made in genomics research.

In the UK, genetics research facility UK Biobank has collected information from 100,000 human genomes from approximately 75,000 volunteer individuals. The individuals have a range of ancestries, albeit largely Caucasian, based on the properties of each individual's genetic makeup and where consent was provided, information found in their National Health Service (NHS) medical records. With a mission to improve human health and to get the best value for genetics out of this group of people, UK Biobank's study involved gathering information over time and providing insight at a fixed date and again later, which in some cases was after the development of diseases. This enabled researchers to gather clues on what had happened over time and why. The study has provided an enormously rich set of data that includes physical measurements, medical history, vision, lung capacity and blood samples for biomarkers (cholesterol, for example), plus follow-up studies including participants' diets over time.

With such a vast resource of genetic data available, researchers have examined the relationship between genetic information and various outcomes, in terms of whether people develop diseases. This is helpful in not only understanding the disease, but in understanding its causality.

It is now understood that genetics can only help predict health outcomes to an extent. However, it is only when this information is combined with a person's lifestyle choices and physical condition that medicine can begin to more fully map out the causes of disease and determine how to treat people, such as choosing the drugs or behavioural recommendations best suited to the individual to improve their health.[20],[21]

In October 2018, the NHS in the UK launched a new Genomic Medicine Service and began implementing genetic testing for rare disease markers to support the delivery of more personalised, effective medical care by helping match people to the best treatment. [22] For individual nations to truly leverage genetics, major studies of their own populations need to be conducted. As the contributors to UK Biobank pointed out, the study group was largely Caucasian, which is true of many genetic databases. Iceland has launched a major study of its population to ensure the results are as relevant as possible and will enable more accurate identification of ethnic-unique disease types. It looks as though Estonia and the United Arab Emirates are set to follow suit. [23],[24]

The influence of family and social circles

The long-term health prospects of individuals are also influenced by social support — in both positive and negative ways. On the negative side, a lack of social support causes 162,000 deaths in the United States, roughly as many as lung cancer. (Some researchers measure social support by looking at factors like marital status; contact with family, friends and neighbours; participation in voluntary organisations; and attendance at religious services.) On the positive side, the presence of constructive support has been proven to help people make better lifestyle decisions.

19 Dr Meg Arroll, Director, Simply Research (Chartered Psychologist, Chartered Scientist)
20 https://soundcloud.com/jenny-mills-362181607/the-uk-biobank-genetic-data-release
21 http://www.ukbiobank.ac.uk/
22 https://labtestsonline.org.uk/news/genetic-testing
23 https://www.nature.com/articles/s10038-017-0402-y
24 https://medicalxpress.com/news/2018-05-estonia-dna-population.html

For example, smokers who enjoy support from their romantic partners are more likely to make a quit attempt and to stick with that decision after three months.[25],[26],[27]

"For those who are motivated to change, the presence of social support, in the form of family and peer support (e.g., diet/exercise buddies), social modelling and access to practical advice can improve health outcomes," says Dr Arroll in conversation with Aetna International. "The active participation in meaningful prevention and intervention strategies, with the added factor of community and social support, can increase adherence to health-related behaviours and improve long-term health. Interventions take time, though. For example, eating habits are formed very early in life, therefore family environments and contexts are key to the development and maintenance of these habits. It stands to reason they will also be central in helping individuals to adopt and maintain better habits."

Indeed, families play a fundamental role in guiding health decisions, as is the case in so many other areas of human development. It is in our families that we learn what to eat and how (or whether) to exercise. Adolescents whose parents or siblings use tobacco are more likely to pick up the habit. (Family distress is an even stronger predictor of smoking.) And spousal involvement significantly improves long-term results when a person who has never cooked for himself needs to change his diet.[28]

Lack of support drives a lack of action/change

A 2012 study of Mexican American households in Houston, Texas, demonstrates the potential benefits of positive social support. Study participants were asked whether they wanted to improve their diet and exercise levels and whether they had friends and family members who had played a significant role in their lives in the previous year. Follow-up assessments after three months showed that "having at least one network member who encourages one to eat more fruits and vegetables and to engage in regular physical activity was associated with motivation to change the relevant behaviour."[29]

Unfortunately, some 40 percent of participants in the Houston study didn't report having an encourager, pointing out the need for additional avenues of motivation. These additional avenues include groups like Weight Watchers and Alcoholics Anonymous, which put a premium on group support, as well as the social media tools health advocates are increasingly using.[30],[31]

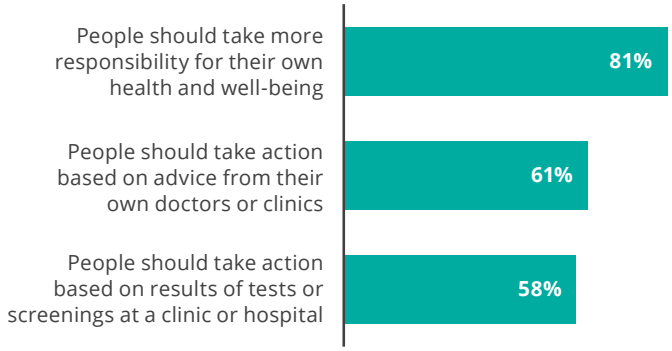
The lack of encouragers in the Houston study was not surprising. Today, many families are fractured, and many individuals don't have tight networks of friends. In industrialised countries, extended families are increasingly separated by many kilometres and even oceans, and it's becoming more and more common for people to live alone. One 2010 review of literature on social relationships and mortality risk offered some stark statistics: "In the UK, according to a recent survey by the Mental Health Foundation, 10 percent of people often feel lonely, a third have a close friend or relative who they think is very lonely, and half think that people are getting lonelier in general. Similarly, across the Atlantic, over the past two decades there has been a three-fold increase in the number of Americans who say they have no close confidants." How dangerous is loneliness? One 2017 study found that loneliness has the same health impact as smoking 15 cigarettes a day.[32],[33]

25 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3134519/
26 https://www.ncbi.nlm.nih.gov/pubmed/16271297
27 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4751868/
28 https://www.purdue.edu/hhs/hdfs/fii/wp-content/uploads/2015/07/s_wifis01c04.pdf
29 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3252202
30 https://www.weightwatchers.com/us/plans#/tabs/meetings
31 https://www.aa.org/pages/en_US/information-on-alcoholics-anonymous
32 http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000316
33 http://www.iflscience.com/health-and-medicine/loneliness-is-as-bad-for-your-health-as-smoking-15-cigarettes-a-day/

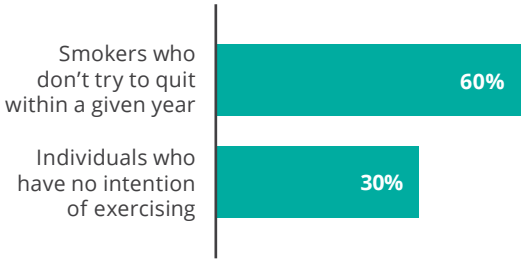
The role of insurance partners in communities

The need for a supportive community is an especially significant factor for expatriates and the globally mobile, such as those individuals served by international health and wellness benefits providers like Aetna International. Almost by definition, these people are removed from their traditional friends, family and community support groups. While leaving their home environments can give them a chance to break free of poor health habits, it can also leave them without encouragers to support them.

Moreover, expats and the globally mobile typically worry more about major health issues (e.g., cancer) and rare catastrophes than the day-to-day decisions that can ensure good health. When we surveyed one of our core market segments, 81 percent of respondents said people should take more responsibility for their own health and well-being; however, less than two-thirds said they would take action based on advice from their own doctors or clinics (61 percent) or based on the results of tests or screenings at a clinic or hospital (58 percent).[34]



Unfortunately, many people are never motivated to take the first step toward better health. Sixty percent of smokers don't try to quit within a given year, while 30 percent of individuals have no intention to exercise. Depending on which expert you consult, these people are either experiencing "amotivation" or are in a "precontemplative" state. This could be due to low self-confidence, low outcome expectations or a belief that the required effort is not worthwhile. (Some people might question working hard in the gym for an hour, if that will only add a minimal amount of time to their life.)[35]



However, the UK's NHS reports a reduction in smoking and related conditions which they attribute to the government's public policies. An advertising campaign that targeted teens with negative messaging and graphic imagery appeared to produce positive results.[36]

34 Aetna International. Evaluating Consumer Perspectives of IPMI. Quantitative Market Study. July 2016.
35 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4468355/
36 http://news.bbc.co.uk/2/hi/health/231193.stm

Chapter 2:

The role of science and genetics

Health promotion is critically important since 40 percent of premature deaths are the result of individual behaviour, according to a New England Journal of Medicine article (based on data collected in 2000) that focused on the U.S. Other contributing factors, the article said, are genetic predisposition (30 percent), social circumstances like poverty (15 percent), health care (10 percent) and environmental exposure (5 percent).[37]

Newer research, however, indicates that genetics may play a much smaller role in mortality — below 7 percent, in fact. Computational geneticists with Calico Life Sciences recently analysed 54 million public family trees created on the Ancestry.com website, looking at birth and death dates for 406 million individuals. When they correlated the lifespans of various groups — spouses, parent-child pairs, siblings and first cousins, etc.—they determined that the lifespans of spouses correlated as much as or more than the lifespans of genetic relatives. As a Stat News report explained, "Since spouses share relatively few DNA variants, that suggested a strong influence of non-genetic factors that they do share, like living far from disease outbreaks, having access to clean water, being literate, eating healthy food, and not smoking." Moreover, people tend to marry people with similar lifestyles and socioeconomic statuses, a practice social scientists call assortative mating. (That said, research has shown that genetic predisposition may play an outsized role in helping people live past the century mark.) [38],[39],[40]

As our understanding of the role of genetics has changed, so too has our ability to understand and modify that role, thanks to the increasing investment in the potential of genomics and the availability of DNA testing. For consumers who want to take charge of their own and their family's genetic story, it is vital for them to have access to testing, expert follow-up including genetic counselling, tailored preventive and condition treatment and care packages tailored to their needs, lifestyle factors, behavioural typography and likely treatment responses.

For example, prenatal genetic screening programs provide easy access to non-invasive tests to help determine whether a baby may have a chromosomal condition. And, as we discussed through the work of UK Biobank and the NHS, the benefits of genome sequencing examined in conjunction with electronic medical records and other health data can enable the application of more precise health advice and treatment. It remains to be seen who will pay for this level of personalisation. In many countries, individuals are used to paying to access a commensurate quality of health care and care outcomes. It stands to reason that people may also want to pay to access personalised, precision care as part of their investment in their future health and to protect their wealth in the long run. When the government, employers and population health managers also benefit, will the added cost of personalised medicine be absorbed for the benefit of improving the health prospects and productivity of the population and lowering the burden on budgets in the long run?

Types of genetic tests

What can a DNA test tell me?

What exactly is genetic testing? According to the U.S. National Human Genome Research Institute, genetic testing "uses laboratory methods to look at your genes, which are the DNA instructions you inherit from your mother and your father. Genetic tests may be used to identify increased risks of health problems, to choose treatments or to assess responses to treatments."[41]

37 http://www.nejm.org/doi/full/10.1056/NEJMsa073350
38 https://www.statnews.com/2018/11/06/life-span-genes-ancestry-database/
39 http://www.genetics.org/content/210/3/1109
40 https://www.scientificamerican.com/article/genetic-factors-associated-with-increased-longevity-identified/
41 https://www.genome.gov/19516567/faq-about-genetic-testing/

There are hundreds of different tests available, from prenatal screening that determines the likelihood of birth defects to forensic testing that can implicate a crime suspect. These tests look at all or part of the human genome, a string of some 3.2 billion nucleotide pairs that affect everything from hair colour to disease risk.[42]

Not all genetic tests look at the entire human genome, however. Clinically relevant tests fall into three categories:

- **Whole-genome sequencing** looks at the entire genome, as the name implies.
- **Whole-exome sequencing** looks at the regions of DNA that code for proteins, approximately 2 percent of the whole genome.
- **Genotyping** looks at regions of DNA that are associated with specific characteristics, approximately 0.03 percent of the whole genome.[43]

Genotyping offers a window into your paternal and maternal lineage and can potentially tell you what percentage of your makeup is Irish, Scandinavian or Southeast Asian. Some tests also report fun facts such as your likelihood of having blue eyes (something you already know), losing your hair (something you may fear) or having waxy ears (something you'd probably not want to share at a dinner party).

Most direct-to-consumer services like AncestryDNA offer genotyping, although a few are beginning to offer more extensive tests. For example, a firm called Veritas now offers whole-genome sequencing for $999 (with physician approval). The company promises insights on more than 1,200 hereditary diseases, 200 drug responses and 70 physical traits.[44]

Generalised tests normally report genetic variations or gene variants which are associated with changes that have a minor impact on function and can be influenced by lifestyle and diet choices. (Remember that lifestyle choices are a bigger factor in premature deaths than genetics.) At times, tests can indicate the potential for developing cancer or rare diseases like sickle cell anaemia and cystic fibrosis; in such cases medical and/or genetic counselling resources are necessary, as the results can be complex, difficult for consumers to understand and potentially distressing. Counselling will also help individuals avoid any self-diagnosis without medical intervention. It must also be noted that the presence of a genetic marker doesn't mean the associated disease will ever develop, just that the odds of it appearing may be somewhat higher. As Bert Vogelstein, director of the Ludwig Center for Cancer Genetics and Therapeutics at Johns Hopkins University, says, "Whole-genome testing is not a crystal ball. It may become one important determinant in patient care, but certainly not the only one — and possibly not even a major one."[45]

From a demand-side perspective, genetic testing is on the cusp of becoming mainstream. AncestryDNA now has more than seven million individual DNA records in its consumer database, representing the desire of many people to learn where their families came from. Literature about the service includes this statement: "AncestryDNA can reveal the source of your greatness. Discover your ethnic origins — and get inspired by the places in your past." (How accurate the results are can vary depending on an individual's region of origin, as Burmese-American journalist Alex Wagner discovered when researching her book *Futureface*. Because testing companies don't have many DNA samples from Burma, one test told her she was part Mongolian. As she explained to an interviewer, "There are political considerations like, it's hard to get DNA out of certain countries. And so these tests will sort of correct that by looking at … what's the nearest country?")[46,47]

The growing popularity of ancestry-related DNA tests, coupled with stories like Angelina Jolie's, makes it more likely individuals will seek out DNA sequencing for health reasons. However, the results can be complex. If individuals are left to interpret the findings and determine whether and how to make any lifestyle adjustments for themselves — even with the support of family and primary care physicians — they might not make the best decisions at the right time. In fact, genetic testing should go hand in hand with genetic counselling. As the U.S. National Cancer Institute's PDQ summary on DNA testing explains, "It is important that individuals who are candidates for genetic testing undergo genetic education and counselling before testing to facilitate informed decision-making and adaptation to the risk or condition. Genetic education and counselling allows individuals to consider the various medical uncertainties, diagnosis or medical

42 https://en.wikipedia.org/wiki/Introduction_to_genetics
43 https://www.mygenefood.com/finding-best-dna-test-genotype-sequence/
44 https://www.veritasgenetics.com/mygenome
45 https://www.scientificamerican.com/article/whole-genome-sequencing-predict-disease/
46 https://blogs.ancestry.com/cm/what-over-7-million-people-learned-when-they-took-ancestrydna-tests/
47 https://www.npr.org/2018/04/30/607042034/a-journalist-seeks-out-her-roots-but-finds-few-answers-in-the-soil

management options based on varied test results; and the risks, benefits and limitations of genetic testing."[48],[49]

Clearly individuals need guidance from their physicians and health and wellness benefits partners in interpreting test results. A *Prevention* magazine report on DNA testing described how a Navigenics test told Dr Robert C. Green that his risk of developing multiple sclerosis was 20 percent higher than normal. What it didn't say (or at least didn't emphasize) was that the average risk is a scant 0.3 percent, which made his risk just 0.5 percent. As the Prevention report explained, "These are both very low risks (3 out of every 1,000 versus 5 out of every 1,000, respectively), yet the results were highlighted in orange, indicating an elevated risk. Green, a geneticist, understood his real risk, but the average person might not, causing needless worry."[50]

Dr Green's story illustrates one downside of knowing one's genetic predispositions: the potential for negative mental health consequences; one study found that 10 to 20 percent of individuals who test positive for a known familial mutation suffer psychological problems, with other contributing factors being a pre-existing cancer fear, a high perception of the risk of getting cancer and being single (which reinforces the importance of social support.) Had Dr Green not understood the minimal risk he faced, he could have potentially slipped into depression, developing a real condition while fearing a potential one. Individuals who undertake genetic testing, whether through a mail-order service or through their doctor, must be helped to understand that genetic tendencies are descriptive, not determinative.[51]

As Dr Meg Arroll points out, "the evidence for DNA testing as a tool for promoting lifestyle change is limited but growing." The results of studies are beginning to underline the hypothesis that communicating genetic risk for developing an illness will result in a behaviour change. "In my opinion, I see this type of personalised data as part of a health transformation package; it provides us with a 'health postcode or ZIP code' to avoid but not the satnav directions on how to navigate this risky area," Dr Arroll says. "In other words, this is the 'why' not the 'how.'

We all need practical, achievable steps to make meaningful changes to our health; simply knowing that we are at risk of a disease may increase anxiety if there isn't a well-designed intervention to support people in their health behaviour change." A study by Finnish researchers found that telling people how their genes might increase the risk of a heart attack or stroke in the next 10 years encouraged 90 percent of people to adopt healthier habits. The study's lead author, Dr Elisabeth Widen from the University of Helsinki, said, "Many of the participants already knew that they had high levels of cholesterol. But it was receiving information on their personal genetic risk that triggered changes."[52]

For example, early-stage lung cancer patients with high expression of the RRM1 gene can expect to survive 120 months (the median), compared with 60.2 months for those with a low expression of the same gene. Imagine the case of a smoker whose mother smoked two packs a day and survived relatively unscathed. He might well try harder to quit if he learned that he, unlike his mother, had a low expression of the RRM1 gene. (Of course, he would benefit in countless other ways from quitting smoking, regardless of his genetic predisposition.)[53]

It seems that genetic profiling, combined with a person's metabolic and attitudinal baselines, is as close as we may get to being able to predict the health concerns that may lie in our future. For individuals keen to understand where their health is today and how they can avoid health complications to lead the healthiest possible life in the future, the logical next step is to give them the road map so they can reach that future. This is where professionals can help, tailoring that road map to the individual's unique needs and circumstances, enabling the individual to take appropriate, effective action. For example, virtually everyone carries mutations affecting drug response. It's important to know whether individuals can handle the type and dose of drug that is being recommended in treatment journeys.

Developments in genomics have led to a broadening in the services offered by genetic counsellors. The role of the genetic counsellor has changed over the years, from communicating the inheritance risk of certain diseases to a far broader communications and

48 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5343946/pdf/ijms-18-00412.pdf
49 https://www.ncbi.nlm.nih.gov/books/NBK65817/
50 https://www.prevention.com/health/healthy-living/dna-testing-genetic-diseases
51 https://link.springer.com/article/10.1007/s10897-015-9894-9
52 https://www.independent.co.uk/news/health/dna-test-disease-risk-ancestry-genetics-health-heart-disease-a8400426.html?amp
53 https://www.medpagetoday.com/hematologyoncology/lungcancer/5108

emotional support service that — according to the Human Genetics Society of Australia — helps individuals to "understand and adapt to the medical, psychological, familial and reproductive implications of the genetic contribution to specific health conditions." The benefits of genetic counselling to the individual include help understanding testing options and results and with making calm, measured and informed decisions about managing their health care.[54],[55]

Until DNA sequencing offers the satnav directions Dr Arroll envisions, results from genotyping services like Navigenics offer information that can be useful, but only when kept in context and reviewed in consultation with a physician.

"The new science of genomics is opening up opportunities for intervention and personalised prevention strategies and has already created opportunities for a new health care system," says Bernie Williams, Director, Product and Practitioner Support, My DNA Health. "The growing public concern around cardiovascular, type 2 diabetes and neurodegenerative conditions is fuelling an increasing interest in genetic testing and the promise of prevention strategies through lifestyle and nutrition. There are also the mid-lifers who may be showing symptoms, perhaps have a family history and want to know what they need to do to prevent these conditions and to achieve optimal health."

While many people, including Bernie Williams, believe that DNA test results can be considered useful for helping to prevent the onset of disease, others point to a lack of certainty as to why particular genes are activated or deactivated. (Possible causes include such factors as stress, emotional upsets, toxicity, diet, exercise and sleep.) Epigenetics — which studies whether risks can be mitigated by making the right lifestyle changes — is still a young science. While there is reasonable evidence to suggest that following a lifestyle prescription that addresses diet, exercise, sleep and stress could help prevent the onset of certain diseases, the extent of its influence and efficacy is still under investigation. Moreover, as scientists are quick to point out, correlation doesn't equal causation. However, as stated earlier, it never hurts to make lifestyle changes like quitting smoking, adopting a healthy diet, avoiding stress and getting enough sleep.

There are some areas where an individual's genetic makeup can guide health care decisions. The American Society of Clinical Oncology's genetics toolkit offers detailed guidelines and links to disease-specific recommendations; for example, patients with any new cancer who have a TP53 mutation should try to avoid radiation therapy, while patients with newly diagnosed breast cancer and BRCA1 or BRCA2 mutations should consider bilateral mastectomy. But the society's general guidelines are particularly useful in determining the appropriateness of pre-symptomatic genetic testing. Such testing should occur, the society argues, when an individual has a family or personal history of cancer, when the results can be interpreted and when knowing genetic susceptibility would affect medical management. (Of course, family and personal history is not always a reliable indicator. For example, Tay-Sachs disease most often affects families with no history of the disease, although it primarily touches people of certain ethnic groups, including Ashkenazi Jews and French Canadians. That's why the National Tay-Sachs & Allied Diseases Association in the U.S. recommends preconception carrier screening for people in the at-risk populations.) [56],[57],[58]

The fields of genetics and epigenetics are complex, but the takeaways for individuals are simple. First, just because you have a genetic marker for a certain disease doesn't mean you'll get it. Second, understanding which genetic disease markers are present may enable you to take some preventative measures to help ensure you avoid it. Third, if you have been diagnosed with a condition, genetic profiling can be combined with other clinical test results to personalise your treatment journey. Fourth, following health and wellness strategies may help mitigate your risk, but there's no guarantee. Fifth, lifestyle changes like quitting smoking or increasing physical activity aren't going to do any harm; in fact, they help reduce disease triggers like inflammation and excess weight regardless of your genetic makeup.

At the moment, that is probably the right approach. Until DNA sequencing offers the satnav directions Dr Arroll describes, results from genotyping services like Navigenics offer information that can be useful, but only when kept in context and reviewed in consultation with a physician.

54 http://www.who.int/genomics/professionals/counselling/en/
55 https://www.hgsa.org.au/asgc/definition-of-genetic-counselling
56 https://www.asco.org/practice-guidelines/cancer-care-initiatives/genetics-toolkit/genetic-testing
57 https://www.ncbi.nlm.nih.gov/books/NBK65817/#CDR0000062865__78
58 https://www.ntsad.org/index.php/carrier-screening/tay-sachs-screening

Chapter 3:

The role of connected technology

No area of technology has transformed health care more in recent years than the internet. Two concepts are especially relevant: Web 2.0 and the Internet of Things.

Web 2.0

When the World Wide Web debuted in 1989, it was little more than what one writer has described as "a massive collection of static electronic brochures." With the advent of Web 2.0 — the term was coined in 2004 — the Web morphed into something interactive and personal. Individuals became both consumers and creators, and publishers began customising content. Three years later, Apple's iPhone appeared (quickly followed by Android devices), and Web 2.0 was no longer confined to desktop and laptop computers.[59,60]

The advent of Web 2.0 allowed for the development of a host of social media services. While networking sites like Facebook get the most attention, the category is quite broad, encompassing everything from blogs and content syndication to games and video file sharing to texting and microblogging (think Twitter). And their reach is astonishing; Facebook has 2.2 billion users, Instagram has 800 million users and Twitter has 330 million users (January 2018).[61]

When social media strategies are combined with educational healthy choices programs in schools and the community, we can truly start to make a difference. Although empirical proof is spotty — and in some cases marred by poorly designed studies — in aggregate there is a substantial body of support for the conclusion that mass media campaigns, including social media efforts, can change population health behaviours.[62]

Each form of social media offers the potential for sharing health messages, offering — as one scholar put it — "a transformational means for information and communication technology (ICT) to support the original goals of the Ottawa Charter for Health Promotion onward through the Bangkok Charter aimed at achieving health for all."[63,64]

Of course, the "for all" part of that statement presumes internet access, which is not always the case. Half the world's population has internet access, while two-thirds of the people on the planet use mobile phones (as of December 2017). Only about half of mobile phone users have smartphones, limiting the health-promotion tactics that could reach them. Still, for those who have access, technology can be a powerful tool.[65,66,67]

The Internet of Things

If mobile devices freed the Internet from desktop and laptop computers, the Internet of Things (IoT) freed it from computers entirely. IoT is the network of physical devices — everything from vehicles to refrigerators to wearables — that can connect to the internet and therefore to other devices.

British technologist Kevin Ashton coined the term in 1999, but it's only been in the last few years that IoT applications have exploded. By one measure, worldwide

59 https://www.lifewire.com/what-is-web-2-0-2483694
60 https://en.wikipedia.org/wiki/Smartphone#Early_smartphones_outside_Japan, March 2018
61 https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/
62 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4248563/
63 https://www.researchgate.net/publication/51113567_Harnessing_Social_Media_for_Health_Promotion_and_Behavior_Change
64 http://journals.sagepub.com/doi/pdf/10.1177/1757975912464593
65 http://www.internetworldstats.com/stats.htm
66 https://www.statista.com/statistics/203734/global-smartphone-penetration-per-capita-since-2005/
67 https://www.statista.com/statistics/470018/mobile-phone-user-penetration-worldwide/

spending on IoT technology stood at $157 billion in 2016 and is expected to reach $457 billion by 2020, a nearly threefold increase. Health care represents a relatively small piece of that pie, but it's growing; in fact, health care IoT spending is expected to reach $117 billion in 2020 (roughly matching IoT spending by governments).[68],[69],[70],[71]

The most common IoT devices in health care are wearables like the Fitbit, which track everything from steps taken to hours slept. But IoT offers many more possibilities, including virtual health, which improves access, diagnosis, treatment and condition management. Such offerings can benefit the expatriates and globally mobile individuals that companies like Aetna International serve, but they can also benefit people who have mobility issues or simply don't want to visit a doctor's office at the height of flu season.[72]

Wearables

Wearables allow for the easy, automatic collection of health data. They're best known for measuring steps taken and minutes spent exercising, but increasingly they're doing more than just amass information. Newer Fitbits, for example, nudge users if they've been sedentary for too long — and those gentle prods can make a difference. When the company looked at data for people who were getting six reminders to move in a day, it found they received 40 percent fewer reminders to move after a few months. "That's a very detailed example, but I feel like it's such an important one, because it means the user's innate behaviour is changing," Fitbit's Vice President of Research Shelton Yuen told *Wired* magazine.[73]

Wearables offer so much potential that some health insurers offer them free or at a discount as incentives to increase physical activity amongst members. "This encourages individuals to engage in health and can help lower premiums," says Dr Sneh Khemka, Vice President, Population Health, Aetna International, and vHealth by Aetna. "This also enables the health care ecosystem to gather anonymised data to predict trends and take appropriate steps."

Currently, about six percent of consumers who own a wearable activity tracker got them from their employers, according to a survey by the consulting firm Endeavour Partners. That share is likely to skyrocket, with an estimated 13 million wearables integrated into corporate wellness plans in 2018.[74]

Wearables are also tapping into many of the psychological techniques that keep us reaching for our mobile devices. For example, Fitbit users earn virtual badges as their steps pile up — e.g., the Italy badge for walking the entire length of Italy, which is 736 miles — and they receive gentle reminders when they're not reaching their goals. "The gamification of physical activity and competitiveness on a social level is very powerful for younger people — and it's all designed to improve outcomes," says Dr Khemka.[75],[76],[77]

It's predicted that around 110 million devices will have been sold in the U.S. alone by the end of 2018. However, surveys have found that 32 percent of users stop wearing their devices after 6 months, and 50 percent after one year. It is suggested that consumers remain unconvinced about the tangible long-term benefit of

68 https://www.statista.com/topics/2637/internet-of-things/
69 https://www.statista.com/statistics/666864/iot-spending-by-vertical-worldwide/
70 https://www.forbes.com/sites/louiscolumbus/2017/12/10/2017-roundup-of-internet-of-things-forecasts/#2775c7cc1480
71 https://www.forbes.com/sites/tjmccue/2015/04/22/117-billion-market-for-internet-of-things-in-healthcare-by-2020/#6407add669d9
72 https://www.aetnainternational.com/en/about-us/explore/future-health/virtual-health-care.html
73 https://www.wired.com/story/science-says-fitness-trackers-dont-work-wear-one-anyway/
74 https://www.washingtonpost.com/news/on-leadership/wp/2014/12/18/fitness-trackers-chase-after-the-corporate-market/?utm_term=.72604a7ac713
75 https://www.developgoodhabits.com/fitbit-badge-list/
76 https://venturebeat.com/2016/10/07/fitbit-charge-2-review-chatter/
77 https://www.theodysseyonline.com/five-ways-the-fitbit-changed-my-life

tracking multiple data with no clear evidence on how it's affecting their health.[78]

A real shortcoming of consumer-grade wearables is accuracy. According to one study, devices can be as much as 24 percent off in calculating daily energy expenditure. Moreover, users need help interpreting results and charting a path forward. [79]

Fortunately, professional-grade wearables offer more accurate results. For example, Firstbeat's Bodyguard 2 device measures heart rate variability, which offers a window into everything from breathing control to metabolic processes to stress reactions. In the hands of a qualified coach, that data can be used to craft effective health-improvement plans.[80]

"Heart rate variability analysis reveals how the body reacts to daily life, connecting the dots between lifestyle and well-being and pointing the way toward a healthier, more productive life," Ker Tyler, Chief Executive, Fit for Leadership told Aetna International. "A good coach can translate the data into appropriate actions that a person can take before a significant emotional event like a heart attack or stroke."

Integration of new data streams

The ability for organisations to capture data from a variety of digital sources and to store it securely means that individuals and population health managers, from governments and health systems to large employers, can benefit. The convergence of data drawn from wearables, health records, medical insurers and genetics databases builds a richer picture of an individual's health and enables that person to take their data history with them. It becomes a means of quickly and effectively sharing all your health and lifestyle data with a care practitioner who can then help plot a journey to optimum health. For example, Apple has created a health wallet that enables an individual to port their health information to various care providers.

Social media

Web 2.0 and the IoT enable many applications, including social media networks, to provide us with the means of reaching out and finding people who share our views and ideas. Psychologists know that social support is crucial — that the community is a powerful motivational tool. People who perceive a sense of relatedness and connection to other people feel more motivated. Making goals public can be a useful motivational tool. If the network is a positive crowd, it can be immensely helpful in supporting individuals, providing them guidance and keeping them going and motivated with inspirational success stories that they and others can emulate. Used well, social media tools can build both self-efficacy (the belief that the individual has the tools, knowledge and training to achieve the desired outcome) and response efficacy (the belief that the new behaviour will lead to the desired outcome). Combined with social support, those beliefs can lead individuals to make autonomous choices to change because they feel that "we're all in this together." [81]

"Social media have given healthcare professionals effective tools to communicate with populations and promote community engagement activities such as fundraising and advertising," found a 2016 review of the use of social media for health in low and middle-income countries. "It has been estimated that 70 percent of U.S. healthcare organizations utilize social media in at least one form. Interactions on social media platforms also occur around various healthcare topics, including health promotion and patient education, and have been credited with enabling more effective and responsive health care services in high-income countries."[82]

Applications for health promotion via social media are as diverse as the media themselves. At one extreme are broad-brush campaigns that seek to raise awareness of particular health issues, much like print

78 https://patientstalk.net/2017/03/20/will-wearables-change-consumers-behavior/
79 https://www.ncbi.nlm.nih.gov/pubmed/24777201/
80 https://www.firstbeat.com/en/science-and-physiology/heart-rate-variability/
81 https://ed.ted.com/on/6gvMYprE
82 https://open.library.ubc.ca/cIRcle/collections/graduateresearch/42591/items/1.0307467

and broadcast campaigns have done for generations; success is often measured in terms of likes on Facebook or retweets on Twitter (although it's an open question whether liking something on Facebook leads to concrete action in the real world). A good example are mass media campaigns that have been associated with a decline in the number of young people starting smoking and with an increase in the number of adults who kick the habit.[83] At the other extreme are highly personalised messages, such as those tied to wearable fitness trackers.

Numerous researchers have conducted systematic reviews to determine the benefits of using social media in health promotion. What they've typically found is that there's more potential than proof. One review of 10 studies found that all but one reported "significant improvements in some aspect of health behaviour change or outcomes related to behaviour change"; however, it also noted that effect sizes were small in magnitude and not statistically significant. Another review of 37 websites dedicated to public health behaviour change found that few were using evidence-based approaches or were based on public health theory, which the researchers argued was a key factor in program impact.[84,85]

Virtual diagnostics and remote patient monitoring

Wireless technology enables remote patient monitoring (RPM) devices to collect a variety of important data, from blood pressure and pulse rate to sleeping patterns, and transmit it to health care professionals. Data can then be analysed and corrective actions taken. In other words, small problems or negative behaviours can be detected at the earliest possible stage, helping to prevent them becoming bigger, costlier issues. In addition, the ability for remote testing kits to be made available via post — providing immediate phlebotomy results post-test, for example — offers similar advantages. Both services allow individuals who are invested in their own well-being to continue to benefit from precision, personalised treatment journeys.

New tech

New technologies could also offer additional opportunities to effect behavioural change in individuals and communities. For example, the augmented reality features found on Apple's iPhone 8 and iPhone X will likely be used by social media platforms in the future. And online communities like Facebook could soon be turning to video hangout platforms similar to Houseparty, which is used by over one million people each day. One can imagine, for example, a virtual support-group meeting for people seeking to lose weight.[86,87]

Personalisation and technology

Once an individual is motivated to change, connected technology can play an important role. In fact, it's fundamental to the future of health care — both in providing more convenient, sophisticated access to care and as a tool that can help support healthy behaviours. For example, social media and mobile phone connectivity have the potential to be a positive force for change; the key is harnessing their global popularity to reach individuals in the midst of daily life and help them make better health choices, thereby promoting a greater healthspan and reducing their need for health care. By utilising connected technology and social media networks to encourage people to modify their choices, we can help to stem the rising tide of lifestyle-related diseases.

How connected tech can influence and support healthy behaviours

So can tech be used as a source of motivation? Despite relatively weak blanket endorsements by researchers, individual programs have shown encouraging potential.

83 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4248563/
84 http://www.jmir.org/2014/2/e40/
85 https://www.researchgate.net/publication/51113567_Harnessing_Social_Media_for_Health_Promotion_and_Behavior_Change
86 https://www.apple.com/newsroom/2017/09/the-future-is-here-iphone-x/
87 https://techcrunch.com/2016/11/21/the-internet-third-place/

A small but intriguing research project shows the potential for social media peer pressure to improve health outcomes (perhaps replacing or supplementing the important family support noted above). In 2014, researchers at the University of Pennsylvania recruited 217 graduate students to enrol in a 13-week exercise program at an on-campus gym. A third of the participants (the "media" group) received promotional media messages on a weekly basis. Another third (the "social" group) were randomly assigned anonymous peers whose progress was shared with them. (For example, a student would receive a real-time notification when a peer had completed a class.) Across the study, researchers tracked class participation to see whether the motivational messages or the peer comparisons had any impact. During the first half of the program, enrolment rates were significantly higher among both intervention groups compared with the control group. During the second half, however, average enrolments for the media group were roughly equivalent to enrolments for the control group, while enrolments for the social group remained high. As the researchers explained, "The results suggest that promotional messages encouraged non-active people to try enrolling once. However, continued messaging did not have an enduring effect beyond that. Social influence, by contrast, significantly increased the likelihood of repeated enrolment."[88]

A randomised trial in the UK also showed the power of tech-based support, this time with smoking cessation. In the trial, 5,800 smokers were divided into two groups. The control group received generic text messages about the trial, while the intervention group received personalised messages designed to keep them on the path toward quitting. In addition, participants could request the mobile number of another trial participant so the two could text each other for support. At the end of the six-month trial, intervention participants were twice as likely as their peers to have quit. (Abstinence was biochemically verified, unlike in previous trials that reported similar results but relied on self-reporting.)[89]

Connected tech also allows users to earn tangible rewards in the form of points that can be redeemed for anything from Amazon gift cards to fitness equipment. (In the U.S. alone, employers spent $6.8 billion on such programs in 2016, a more than six-fold increase in just five years.) A 2014 study by Vitality, a leading vendor in this growing industry, found that members who were consistently active had hospital costs that were 16 percent lower than for inactive members after five years; even those who moved from inactive to active status saw their hospital costs drop by 6 percent. (It's important to note that some studies have shown contradictory results for workplace wellness programs; one recent randomised trial found no "significant causal effects of treatment on total medical expenditures, health behaviours, employee productivity or self-reported health status in the first year.")[90],[91],[92],[93]

Motivating the unmotivated

Just as in the pre-digital world, people must be motivated to make lifestyle changes. A text reminder that you haven't yet reached your daily step goal is unlikely to get you out the door if you have no sense of ownership of that goal.

The studies above hint at ways to keep people motivated. Next the industry must wrestle with how to get people motivated in the first place. Here, too, a personalised approach is essential. "Technology isn't a panacea for every person," says Caroline Pain, Aetna International's Senior Vice President, Customer Proposition. "Some people will respond to social and physical intervention; others will respond to a chat bot. Our task is to find the best avenue for the customer in an omni-channel way."

Moreover, she says, "Technology by itself is not as important as the concept of data and customer experience. The personalised nature of data is driving ever-increasing opportunities to identify where behaviours — particularly modifiable ones — can be diagnosed and intervention strategies created."

Clearly, the more personalised the experience in matching the individual's needs, the more organisations are able to increase engagement through cognitive methods such as rewards and goal setting. One-size-fits-all solutions have far less impact.

88 http://www.sciencedirect.com/science/article/pii/S2211335515001072
89 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3143315/
90 https://www.bloomberg.com/news/articles/2018-01-26/workplace-wellness-programs-really-don-t-work
91 https://www.vitalitygroup.com/insights/2017engagementstudy/
92 https://www.vitalitygroup.com/wp-content/uploads/2016/12/042014_VitalityInsights_WearablesAtWork.pdf
93 https://www.nber.org/papers/w24229?utm_campaign=ntw&utm_medium=email&utm_source=ntw

Conclusion

Today we stand on the threshold of an exciting new world where scientific advancements and medical technologies converge as disparate as DNA testing, wearable fitness devices, virtual health care and social media can radically transform health care for the better. Anecdotal stories and research studies illustrate how new technologies can be put to work combatting old problems.

It's easy to envision a day when technology facilitates predictive, preventative, participatory and, most important, personalised health care solutions to nagging health issues. This will represent a fundamental shift in the way society addresses diseases that are related to lifestyle choices and genetic irregularities. By doing so, we stand a good chance of increasing the numbers of healthy, happy, productive individuals among us, all while easing mounting pressures on health care systems.

But technology alone will never be enough. Health professionals will still need to translate bits and bytes of data into meaningful actions individuals can take — and those individuals must actually take the steps required to improve their own health. Moreover, we can't be blinded by the apparent certainties technology promises. For example, a genetic predisposition for developing a particular disease is no guarantee that that disease will ever develop — nor does maintaining a healthy lifestyle always guarantee a life of perfect health. The human body is an amazing machine, but even the best machines develop bugs and act in unexpected ways.

In the end, it's probably wise to look at new technologies as nothing more or less than tools. And it's probably wise to remember the words of Nobel laureate Muhammad Yunus, who has said (albeit in a very different context), "While technology is important, it's what we do with it that truly matters."[94]

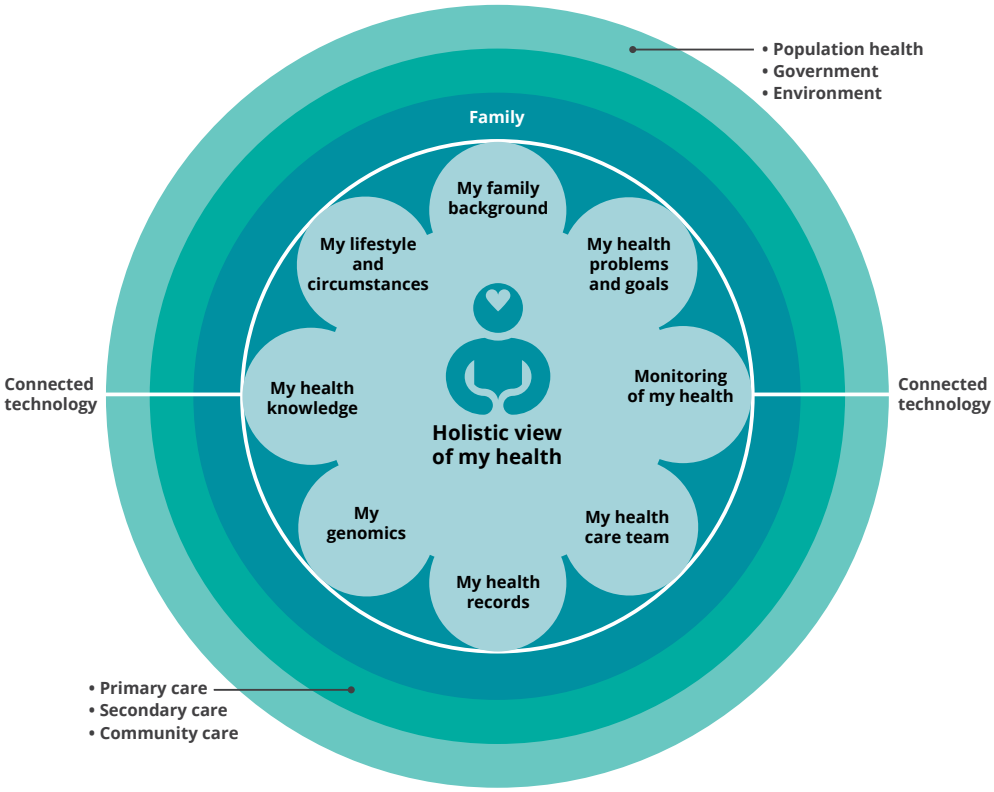


Image shows: The individual at the centre of a holistic approach to health and well-being, supported by personalised, predictive, preventative and participative strategies — delivered and supported by connected technology. At Aetna International, we call this approach "connected care".

94 https://www.huffingtonpost.com/muhammad-yunus/a-global-conversation-to-_b_1951292.html

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Senior Vice President, Customer Proposition

In Caroline's role as Senior Vice President of Customer Proposition for Aetna International, she leads the organisation's global marketing, digital strategy, product development, customer experience and individual direct sales functions. Her responsibilities include delivering every aspect of the marketing mix to a b2b and, increasingly, b2c audience in multiple languages as well as catering for diverse cultures and legal and regulatory environments.

Caroline joined Aetna International in 2012 and has more than 20 years of experience leading sizable teams across a range of disciplines including Marketing, Sales, Analytics, Digital, Planning, BPO, Change and Customer Strategy. She has run operational, sales and program teams, on both the client and agency side. She has held P&L accountability and was also responsible, while working for Aviva (the largest insurer in the UK), for optimising the more than $200 million marketing budget.

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About Aetna International

Aetna International is reshaping health care across the globe by developing solutions to improve the quality, affordability and accessibility of health care. To this end, we raise awareness of critical health challenges facing the world and examine potential solutions that could help combat and prevent the worsening of some of the world's most serious health care problems.

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