

White Paper Series

The Truth Told About Health Scoring

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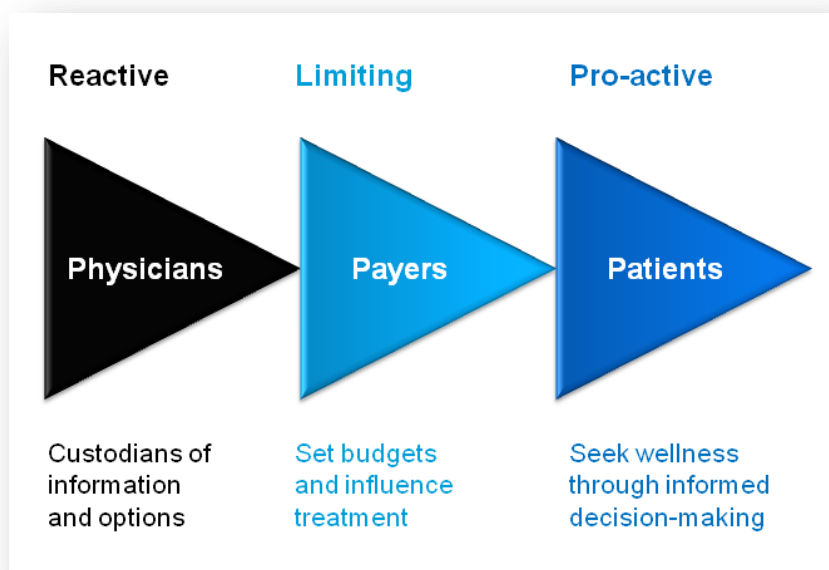
The changing face of healthcare

A person's health is influenced by many factors, which interact with each other and have complex knock-on effects. Several common major medical conditions are affected by an individual's overall health and behaviour patterns. It is well known that a healthy lifestyle can reduce the risk of later illnesses, while certain behaviours can lead to health complications. A 2004 study found that approximately 37% of premature deaths in the US could be attributed to modifiable health behaviours: smoking was the leading cause, followed by poor diet and physical inactivity, then alcohol consumption. The authors commented that the rates of premature deaths due to poor diet and lack of exercise could soon overtake those attributable to tobacco use.¹

'Wellness' is a complex concept, but can broadly be broken down by the following components: nutrition; exercise; emotional wellbeing; lifestyle choices; sleep patterns and stress. Adjustments to these factors influence the other factors, and in turn, the person's overall level of wellness. Positive changes in lifestyle can have wide ranging health benefits but ultimately, change can only be implemented by the individual.

In the past, available information was limited and lifestyle adjustments were largely made only once a health problem was detected, and then under the guidance of healthcare professionals. Today we have an informed population, due partly to the availability of electronic mass media. This is now precipitating a shift away from the reactive model of health to a more proactive approach where the individual works towards the maintenance of their wellness before problems arise (Figure 1) – it is now recognized that it is important to focus on wellness rather than deal only with illness once it is too late.

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Figure 1. Evolution of healthcare in an information-enabled society.

This shift in attitudes has broad implications for both public health and individual companies: improved health may lead to reduced healthcare costs and increase workplace productivity. An example of this is provided by Safeway, a major retailer in both the US and UK, where employees are tested for tobacco usage, healthy weight, blood pressure and cholesterol levels. For each test passed employees receive discounts off a 'base level premium'. As a result of this encouragement of healthy behaviours, Safeway's per capita healthcare costs remained static while those of comparable US companies rose by 38% over the same period.² The new focus on patient-centred healthcare is also reflected in the attitudes of payors, who are increasingly favouring a move towards outcome-based payments. Section 2075 of the Patient Protection and Affordable Healthcare Act (ACA; Obamacare) states that beginning in 2014, employers may use up to 30% of the total amount of employees' health insurance premiums to provide outcome-based wellness incentives,³ Forward-looking insurance companies will consider more innovative ways to motivate and monitor the health of their members and lead them to lower premiums for doing so.⁴ Pharmacists, who are becoming more central to health and wellbeing initiatives, will also have a key role to play, potentially becoming advocates of a proactive, holistic approach to wellness and its long-term advantages.

Payors are increasingly favouring a move towards outcome-based payments

Although people are generally better informed than ever about health issues, the promotion of adjustments towards a healthy lifestyle still requires education and the supply of information on how to optimize wellbeing. Technology now allows a person to collect and process data on their own physiology and lifestyle to assist in maintenance of their own

health. Here we will review such technology, examine how health scoring algorithms can assist with the promotion of wellness and discuss their potential impact.

Information and personal data collection tools

A wide array of technologies are now available that allow data to be collected on various components of wellness. Technologies and applications (apps) have combined, for example, to allow for remote monitoring and diagnosis by physicians. AirStrip CARDIOLOGY enables physicians to make faster, more informed diagnoses and treatment decisions by accessing live and historical ECG data for patients. Similarly, iBGStar aids the remote and self management of diabetes. One of the most advanced apps for condition management and remote monitoring, approved by the FDA, is the WellDoc Diabetes Management software.

Devices for measuring physical attributes, such as blood pressure, blood glucose, and total cholesterol are also commonly used by patients with chronic diseases such as diabetes or hypertension. Furthermore, devices that can be used by healthy individuals to monitor exercise and energy expenditure are increasingly popular, and range from simple heart rate monitors or step counters to more elaborate computerized exercise machines. These tools provide data on the user's performance and many can upload the data to further systems to be processed. Undoubtedly, the largest growth area has been in apps, facilitated by the widespread use of tablets and smartphones. Although some of these apps may be gimmicks, many are valuable, validated genuine tools to assist in improving health and wellness. For example, a large number of apps are now available to aid diagnosis and patient monitoring of chronic conditions as well as to monitor various aspects of health and lifestyle such as nutrition, exercise, and fitness. These may rely on user input or receive data from other devices. Apps have been designed to help the user self manage disease and prevent complications, for example the iBP Blood Pressure app helps users track their blood pressure while OnTrackDiabetes helps diabetics manage their condition by tracking various relevant parameters.

Advantages of wellness technologies

There are several advantages to the increasing use of such wellness technologies. Firstly, they provide the user with a source of information by which they can educate themselves on maintaining a healthy lifestyle and how they could improve their behaviour. Also, by recording data in real time and tracking progress, the technology does not rely on a person's estimate or recollection of nutrition or exercise, enabling a more accurate evaluation of achievements. While lifestyle modification can reduce the risk of later medical conditions, the use of devices to measure physical attributes could also accelerate the diagnosis of chronic diseases, reducing severity and associated treatment costs. Technologies to help monitor compliance such as pill reminders and medication trackers can assist the patient to act within a prescribed interval. MoviPill, medication reminder application may enhance

treatment compliance by making the treatment adherence process more competitive. Further, some technologies may alert the healthcare team if a dose is not recorded. In addition, enhanced treatment and monitoring may enable care to be administered remotely, reducing the need for hospital visits and associated cost, both to the individual and the healthcare provider. Such an example is provided by Medipal, a doctor-patient communication application that enables communication with a remotely located doctor. This empowerment of patients can also enhance motivational competition with themselves or others, further improving outcomes. Complex information on a wide range of variables can be processed and viewed in an easy-to-understand format, then stored and compared over time. Motivation is important for people attempting to maintain a healthy lifestyle or improve wellness. For example, it is well known that tracking nutritional input and physical activity assists weight loss and it is easier and more convenient to do so using an electronic device. As well as the benefits to the individual, physicians can use this information to ensure treatment is more patient centred and effective. Indeed, in a recent survey 75% of doctors believed that patient self-tracking leads to better outcomes.⁵

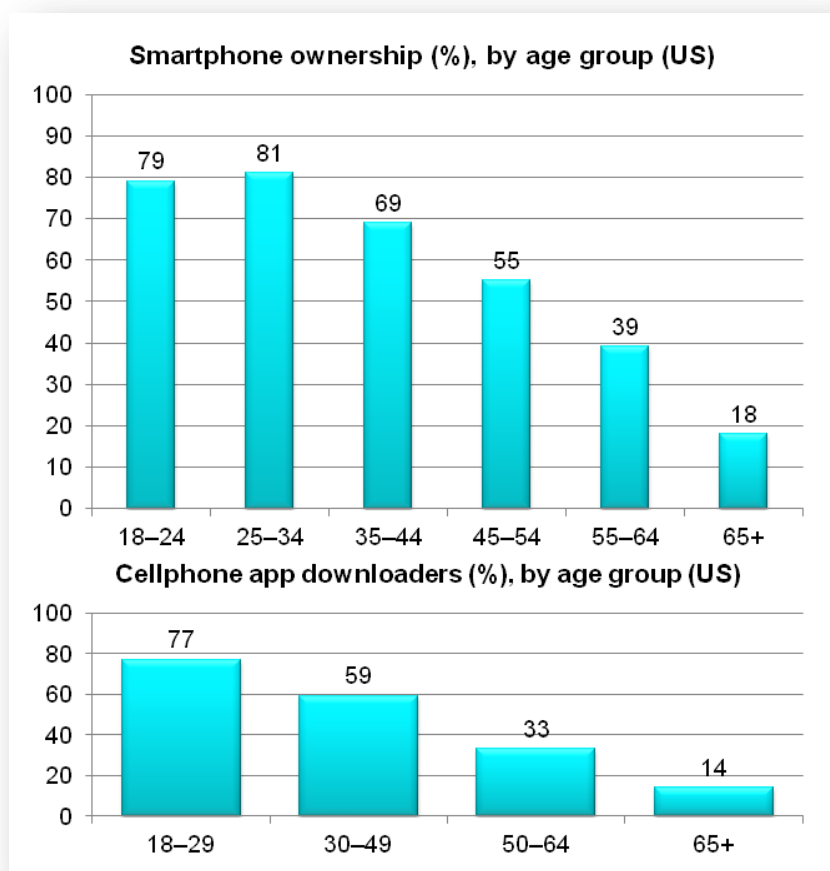
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As well as the obvious advantage to the user of improved wellness and prevention of disease there are also financial opportunities in mobile health. The mobile health sector was worth \$4.5 billion in 2013⁶ and could reach \$50 billion in 2020.⁷ Furthermore, the socioeconomic advantages should not be underestimated. A recent assessment report for the European Union report by PricewaterhouseCoopers reported that the use of mobile health solutions could benefit 185 million users helping them to lead healthier lives. Of these, 141 million users could improve their lifestyle to some extent by improved management of their medical conditions, this could be achieved by addressing one or more lifestyle disorders (61 million users), avoiding the risk of developing a lifestyle disorder (54 million users) or improved management of care and lifestyle in old age (26 million users).⁸ Savings in insurance premiums are likely to follow as providers offer incentives only to those members actively monitoring their health using mobile technologies.^{3,4}

Technology and wellness – present and future

As already discussed, there is a worldwide general shift in progress from centralized models of healthcare to a model more focused on the individual. Self-monitoring is an important part of this shift and will become even more important as technology continues to improve. Although older generations are becoming increasingly comfortable with technology, for younger people it is a way of life. This can be demonstrated by considering smartphone use and app downloads in different age groups (Figure 2). Younger generations are the elderly of the future and technology use in wellness has the potential to show enormous health benefits in years to come. Therefore, both demographics need to be targeted.

Figure 2. Use of smartphones⁹ and app downloads¹⁰ by age group



Ongoing improvements in technology and connectivity will likely mean more capability for self-monitoring and may lead to ever greater health benefits. There are currently thousands of health-related apps available. However, many are suboptimally designed and have a narrow focus. The user needs one system that is comprehensive, accurate and simple to use to monitor their wellness and progress.

The advantages of health scoring

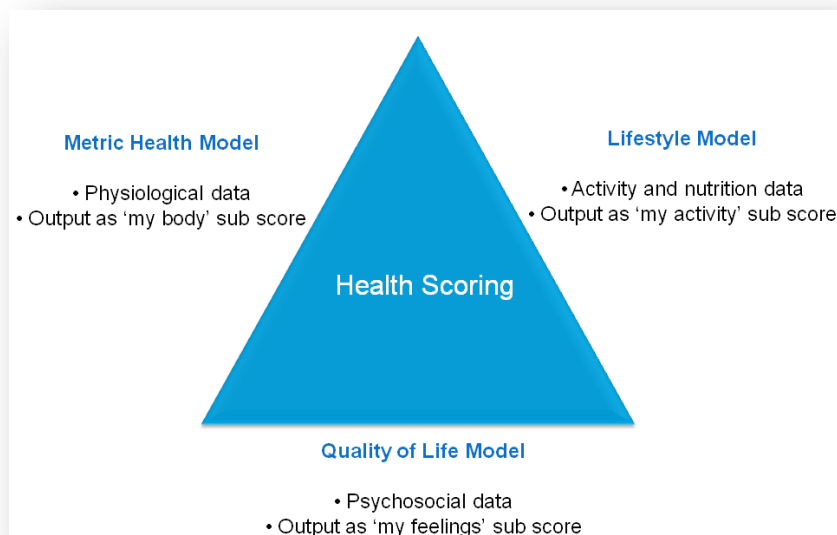
Empowering patients to manage their own health has obvious benefits both to the individual and to the healthcare system as a whole, but is it possible to put a value on health? Quantitative assessments of health by medical professionals are usually estimated by measuring the presence of disease through subjective assessment and physical testing. These evaluations are undoubtedly useful in the diagnosis and treatment of disease but are of little value when considering the overall health of an individual. The World Health Organization defines health as *‘a state of physical, mental and social wellbeing and not merely the absence of disease or infirmity.’*¹¹

Using data on a very wide range of variables, it is now possible to calculate an overall health score. As the components of overall wellness are diverse and interact with each other, the advantage for the user is that their score can be used as a baseline. Furthermore, they can immediately see the overall outcome of their lifestyle and monitor the changes that behaviour modifications could bring, enabling the health score to become an indicator of health and fitness in real-time. This has the advantage that it could prevent the user from focusing on just one or a narrow range of elements, for example a person may take care of their nutrition intake but ignore the effect of exercise. The health score can be broken down into more granular but still simple domains to allow the user to focus on particular aspects of wellbeing as well as working to achieve a higher overall score. Health scores are based on three key areas, physical function (measurable data obtained from the body), emotional (quality of life, sleep and stress) and lifestyle factors (exercise components). Scores can be balanced using algorithms to control for effects of age and sex on quality of life and health outcomes.

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immediately see the overall outcome***

Health scores are being developed by companies such as DACADOO, to help motivate individuals to change their lifestyle and to sustainably improve their health. Health scores help users to track a broad range of factors that contribute to their overall wellness and allow them to monitor this over time. There are three major dimensions to the DACADOO example: a Metric Health Model, a Quality of Life Model and a Lifestyle Model (Figure 3). Models like these are derived from data from large prospective studies and widely used metric health survival models that have been published in the medical literature over the last 30 years and represent a cumulative sample of over 80 million person years.

Figure 3. Health scores can be derived from the combination of three main factors, the Metric Health Model, Quality of Life model and Lifestyle Model



The Metric Health Model quantifies the extent to which a series of measurable physiological parameters, e.g. blood pressure, blood glucose, total cholesterol etc. impact the state of health of an individual, by measuring how such measured parameters affect the risk that the individual will develop a serious medical condition in the future. It also encompasses data and predictive risk models of cardiovascular and cerebrovascular end points and can identify individuals at risk for a wide variety of cancers, or for the risk of conditions from gastrointestinal disorders to Alzheimer's disease. The input for the Quality of Life Model is derived from responses to a user questionnaire. These factors are important in determining a realistic measure of overall health but by their very nature are more difficult to quantify. The factors are self-assessed in recognition of the importance placed on how an individual feels about his or her life and a realistic measure of health.¹²⁻¹⁴ Lastly, the Lifestyle Model estimates the likely future impact on an individual's health as determined from the individual's current lifestyle and the consequent development of lifestyle-related risk factors. It is important to note that these three models are not independent of each other, and their interactions are taken in to account and reflected in an overall health score.

Using the three models described above information can be gathered and hints supplied over time to build a complete profile of the user's wellness. Physical activity can be categorized by providing a list of sports and activities, and the user can select these and input data on the extent of the activity each time. Data can also be gathered automatically from compatible devices. A social network and gaming structure adds motivation and can address the modifiable risk factors in such a way that the health of its users can improve over time as outputs are recorded and the user can see their score change. This enables

users to set goals and challenges for themselves or share data with other users and compete against friends, providing that added motivation that they may need.

In conclusion, it is well recognized that a healthy lifestyle can reduce the risk of morbidity and death and though there are many facets to wellness, the key factors are nutrition, exercise and emotional wellbeing. People now are generally better informed than ever about health issues, however, the promotion of adjustments towards a healthy lifestyle still requires education and the supply of information on how to optimize wellbeing. Positive changes in lifestyle can have wide ranging health benefits but ultimately, change can only be implemented by the individual. Ultimately health scores can be part of the framework upon which individuals can form a plan and be motivated to improve their overall health and wellness. This in turn has long-term significant and broad socioeconomic benefits.

The promotion of adjustments towards a healthy lifestyle still requires education

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