

Evaluation Framework for Personal Health Services: Assessment of a Wellness Index

Mariana V. Simons and Georgio Mosis^a

^a Department of Healthcare Systems Architecture, Philips Research Europe, Eindhoven, the Netherlands

Abstract

We propose a Wellness Index (WI) as an objective measure of a patient's health status. The WI indicates a probability of developing a disease over time and a patient's compliance to guidelines, protocols and medical advices. In addition, the WI has a predictive capacity on the patient's readiness for behavior change. The WI is derived from a series of observed health facts and reveals relative changes as a function of time. It is applicable in a variety of personal health domains such as cardiovascular disease management, diabetes management and weight management.

Keywords: Personal Health Services, Wellness Index, Evaluation Framework, Patient empowerment

Introduction

This paper proposes a Wellness Index (WI) as a tool for patient empowerment in personal health management. The WI is a score comprising both present health status and the likelihood of developing serious health conditions. Thus, beyond scoring and profiling specific health issues, the WI contains information about health variables that influence the current health status. On one hand, this information is indicative for the behavior changes patients need to improve their health. On the other hand, this information can be used to individualize and personalize the user's recommendations for health improvements. The general WI framework is described in the method section of this paper. In the results section we construct a WI for a specific application domain, namely weight management.

Method

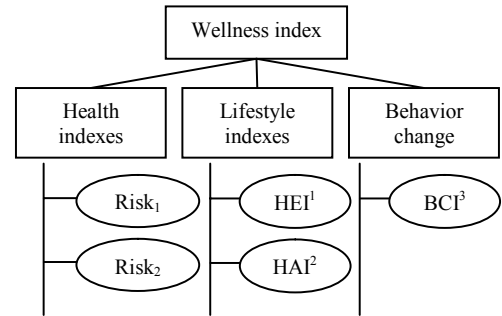
The WI can be either *a priori* (theoretically) defined or *a posteriori* (empirically) derived. Usually, a priori defined WI index is a sum of other indexes whose relevance is based on a state-of-the-art theory, e.g., scientific studies or worldwide/national health guidelines and recommendations. A posteriori defined WI is based on statistical methods like factor and cluster analysis to generate patterns from collected health data.

We propose an a priori defined WI, i.e., it is a sum of other indexes I_j weighted by their importance ω_j as indicated in Equation (1).

$$WI = \sum_{j=1}^n \omega_j I_j \quad (1)$$

We choose each index I_j to be in the range [0,100]% and the sum of the weight factors ω_j equals to 1 for purpose of normalization. Therefore, the range of the WI is also [0,100]%. The values of the weight factors ω_j can be derived from clinical studies in the literature or based on rationales in current worldwide and national healthy guidelines.

We distinguish three types of indexes, namely, health, lifestyle and behavior change indexes, depicted in Figure 1.



¹ -HEI -Healthy Eating Index; ² -HAI - Healthy Activity Index; ³ -BCI - Behavior Change Index

Figure 1 - The Wellness Index framework consists of Health, Lifestyle and a Behavior Change Indexes

The health indexes represent the risk of developing a certain disease given the presence of a predefined set of risk factors. These risk factors are based on the current patient's health status and family health history. The lifestyle indexes represent the compliance with lifestyle guidelines such as nutrition, physical activities, smoking and alcohol consumption. The behavior change index measures the patient's readiness for change.

In general, we construct the WI using the following algorithm:

- Step 1: Select indexes I_j from a set of health indexes, lifestyle indexes and behavior change index;
- Step 2: Map input items into indexes;
- Step 3: Choose indexes cut-off value;
- Step 4: Quantify indexes;
- Step 5: Choose weight factors ω_j for the indexes;

Step 6: Use Equation (1) to calculate a WI.

The type and number of indexes used in the overall WI depends on the application domain the WI is applied to.

Results

We applied the general WI framework to an application specific domain, namely, weight management.

The golden rule in weight management is: burn off more energy with daily physical activity than you consume through food. This equation reveals two of the main items involved in the WI for weight management, namely nutrition and physical activity. In addition, we consider the influence of behavior change strategies on a person's health status. We address these items by a Healthy Eating Index (HEI), a Healthy Activity Index (HAI), and a Behavior Change Index (BCI), respectively. These three indexes form the WI for weight management and they are briefly considered below. Note that we do not include a health index in the current version of the WI for weight management.

The HEI measures a patient's conformance to the Dietary Guidelines for Americans [1]. In brief, the HEI consists of 10 different components. The first five components are food groups - grains, vegetables, fruits, milk and meat. The other four components are macronutrients such as total and saturated fat, cholesterol and sodium and the last component is a food variety. The HEI is computed as the sum of the scoring of all 10 components, each of them in the range [0,10]. Further, HEI classifies a person's nutrition as "Good", "Needs Improvement" and "Poor" if HEI is "greater than 80", "between 50 and 80" and "less than 50", respectively.

The HAI is calculated as an average of two components related to a person's Physical Activity Level (PAL) and a Physical Activity Norm (PAN). The PAL is calculated by dividing person's Total Energy Expenditure (TEE) by Basal Metabolic Rate (BMR). The PAN addresses the duration and intensity of physical activities, e.g., low, medium and high. The HAI classifies persons in the same way the HEI does.

The BCI is calculated based on a user's Readiness for Change (RfCh) score, which is a quantification of the Tran Theoretical Model (TTM) [2] of intentional behavior change. The TTM has five stages of change, namely, precontemplation, contemplation, preparation, action and maintenance. We use URICA [3] questionnaire to get input from the user and based thereon we compute a user's RfCh score.

Having all three indexes HEI, HAI and BCI, we define the WI for weight management by Equation (2).

$$WI = \omega_1 HEI + \omega_2 HAI + \omega_3 BCI \quad (2)$$

We choose the weight factors ω_1 , ω_2 and ω_3 adaptively based on the user's TTM stage of change.

Discussion / Conclusions

One of the main challenges in the emerging area of personal healthcare services is to create quantifiable scores that measure a patient's health outcomes. In this paper we address this challenge by the WI framework describing the correlations between 1) disease management elements, e.g., personal health status, family health history and risk of developing disease, 2) lifestyle choices, e.g., physical activity, nutrition, smoking and alcohol consumption and 3) behavioral elements, e.g., emotional and mental elements such as motivation, confidence, knowledge and readiness for change. Combining these elements into an overall index based on a holistic approach is the first innovation in this paper. Further research is required to determine the quality of this overall index by carrying out correlation analysis on data gathered in different user's trials.

Another innovation is the adaptive weighting of indexes contributing to the WI based on the user's TTM stages of change. Our rationales for this choice are that a user in the precontemplation and contemplation stages has often unhealthy lifestyle habits resulting in a very low health and lifestyle indexes. In these stages it is important to help the users to understand their problem and focus on behavior change. Therefore, the BCI will have the highest weight compared with the other indexes. In a contrast, a user in the action and maintenance stages has already proper behavior towards solving the problem and then the importance of the health and the lifestyle indexes grows resulting in higher weights.

We consider the WI as a tool that empowers both - the patients in improving their health and the care providers in identifying the patients that most need health interventions.

In the light of patient empowerment, the WI provides a single number, which synthesizes a great amount of information. The WI can help educating and motivating patients to adopt healthy lifestyle. It can be seen as a motivational factor in a personal health management.

References

- [1] USDA Dietary Guidelines for Americans, <http://www.health.gov/DietaryGuidelines/>
- [2] Prochaska, J. O., Redding, C. A., & Evers, K. E. (2002). The transtheoretical model and stages of change. In K. Glanz, B. K. Rimer & F. M. Lewis (Eds.), *Health Behavior and Health Education* (3rd ed.). San Francisco: Jossey-Bass.
- [3] University of Rhode Island Change Assessment (URICA), <http://www.uri.edu/research/cprc/Measures/urica.htm>

Address for correspondence

Dr. Mariana V. Simons, Philips Research Lab
High Tech Campus 37, WY 7, 5656 AE Eindhoven, NL
e-mail:mariana.simons@philips.com

