Empowering Citizens for Well-being and Chronic Disease Management With Wellness Diary

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***Abstract*—Chronic conditions closely related to lifestyles are the major cause of disability and death in the developed world. Behavior change is the key to managing well-being and preventing and managing chronic diseases. Wellness diary (WD) is a mobile application designed to support citizens in learning about their behavior, and both making and maintaining behavior changes. WD has been found acceptable, useful, and suitable for long-term use as a part of an intervention. When used independently, however, it does not seem to have enough engaging and motivating features to support adoption and long-term commitment. The main improvement needs identified based on a review of WD-related studies were: personalization of the application to individual needs, increasing motivation during early use, maintaining motivation, and aiding in relapse recovery in long-term use. We present concepts to improve the personalization of WD as well as improvements to the feedback and interpretation of the self-observation data. We also present usage models on how this type of mobile application could be utilized.**

***Index Terms*—Cognitive-behavior therapy, mobile application, self-management, self-observation.**

I. Introduction

LIFESTYLE-RELATED chronic diseases are the main cause of disease burden and deaths in the developed world. Cardiovascular disease alone accounts for 23% of the disease burden and 52% of deaths in Europe, while 70–80% of healthcare expenses are due to chronic conditions [1]. The costs are mainly incurred from complications due to poor treatment compliance, not from the chronic conditions *per se* [2]. Lifestyles play a major role in the onset and progression of these diseases, and therefore, behavior modification, e.g., smoking cessation and weight loss, is central in the prevention and management of chronic diseases.

In Europe, nearly 60% of the disease burden is associated with seven leading lifestyle-related risk factors, e.g., tobacco, alcohol, overweight, poor nutrition, and physical inactivity [1]. The prevalence of these risks is high, as 28–79% of adults in the World Health Organization European Region are overweight (body mass index; BMI $\geq$ 25 kg/m^2) [3] and nearly 30% smoke [4]. These risk factors tend to cluster in individuals and interact multiplicatively in causing diseases [1]. This implies that the risk factors also need to be managed together. As the mixture of health risks and comorbidities varies from one individual to another, personalized prevention and management strategies are needed.

Behavior modification is an effective method for the prevention and management of diseases, but only if maintained [5], [6]. Maintenance of lifestyle changes has been found to be challenging, e.g., only 20% of people succeed in long-term weight loss maintenance [7]. Lack of information on healthy lifestyles is one reason for the high prevalence of health risks, but the knowledge-behavior gap is probably an even more significant factor [8]. Psychological theories of behavior change, such as the cognitive-behavioral therapy (CBT) [9], transtheoretical model (TTM) [10], and motivation theories [11], [12] provide an understanding of the process and mechanisms of behavior change and are applicable to most behavioral problems. Thus, methods derived from these theories are suitable for supporting people in the management of their individual mixture of health risks and diseases.

The healthcare system does not have sufficient resources to support long-term and personalized interventions at an early enough stage. Current disease management models do not reach all those who need them, e.g., in hospital-based supervised cardiac rehabilitation, participation rates of only 14–43% are reported [13]. People must be empowered to take responsibility for their own health and well-being, and new models of chronic disease management and rehabilitation need to be devised. Due to the scale of the problem, the support must be inexpensive, available to large numbers of people, and effective for at least a significant portion of them. Optimally, the methods should extend smoothly from the management of well-being and health risks to the prevention and management of chronic diseases, and enable both independent use and collaborative care models.

Mobile devices provide a promising platform for personal health and disease management, and offer advantages over personal computers and the Internet. These devices are available 24/7 and carried along everywhere, acting as pervasive reminders of wellness management. This enables fast and easy usage at the times most convenient to the user, integrating health management into the daily life.

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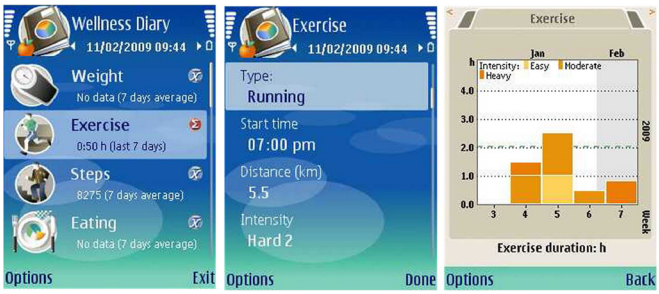


Fig. 1. WD: main view (left), exercise input form (middle), and exercise diagram (right).

TABLE I
SUMMARY OF STUDIES WITH WD

Purpose	WD	Population	N	Duration
Weight management [15]	Alone	Working-age, healthy	30	12 wk
Occupational rehabilitation [15]	In PHS	Working-age, stress problems	17	12 wk
Occupational health promotion [16],[17]	In PHS	Working-age, multiple risks	118	12 mo
Psychophysiological wellbeing [20]	In PHS	Working-age, stress/depression	37	10-14 wk
Cardiac rehabilitation [19]	In PHS	Cardiac patients, in Australia	80	7 mo
Wellness management [18]	Alone	Working age, in Finland and India	16	2 wk

WD column indicates whether WD was used alone or as a part of a PHS. N denotes the number of subjects that participated in each study.

Wellness Diary (WD) is a mobile application for personal wellness management (see Fig. 1) [14], [15]. WD supports two important mechanisms of CBT: self-observation and feedback. WD enables recording of health and behavior-related self-observations, such as weight, physical activity, sleep, stress, smoking, alcohol consumption, and blood pressure, and automatically generates graphical feedback to the user based on the entries. WD has been and is currently involved in several studies, both as a stand-alone application and as a part of a larger personal health system (PHS) (see Table I) [15]–[20]. WD has been found useful in wellness management and suitable for long-term use, especially when connected to an intervention. However, it seems to have some shortcomings in engaging and motivating users, and thus, does not optimally support independent usage [18].

In this paper, we present concepts for improving WD. We first present findings from earlier studies and analyze their implications to future WD design. We then present design factors derived from psychological theories and propose improvements to the WD concept.

II. WD STUDIES AND IMPLICATIONS

WD has been studied in several different settings, as a sole stand-alone application and as a part of a PHS containing also other technologies, in intervention studies, and with independent volunteers. We present a summary of the key findings and their implications to WD.

A. Intervention Studies

Mattila *et al.* [15] studied WD in two 12-week user studies with adults aged 30 to 60. In the first study, 30 subjects used WD in connection with a weight management intervention and in the second study, 17 subjects used WD as a part of a PHS in an occupational rehabilitation intervention. Both groups found WD easy to learn and use despite the differences in their ages and backgrounds. Both groups used WD actively (>5 entries/day) throughout the study. For the subjects, weight and exercise were in the top three most important variables in both studies. In addition, the steps variable was considered very important in the first study and blood pressure in the second study. The subjects felt that WD helped them manage their weight, be more physically active, and observe their eating behavior. Twelve subjects lost weight (−3 kg, SD: 2.7 kg), and the rest more or less maintained their baseline weight (0.2 kg, SD: 1.0 kg). The subjects appreciated the privacy of the application, but some wished for expert feedback, peer support features, or more advanced analysis on a PC.

WD was included, together with its Web-based counterpart Wellness Diary Connected (WDC), in a PHS consisting of mobile, Web, and measurement technologies [16]. The PHS was used to support a multifactor, face-to-face health risk management intervention in a one-year randomized controlled trial. The subjects were allowed to freely choose which health risks to address (such as overweight, lack of exercise, stress, sleep problems, smoking, or alcohol use), as well as the technologies to be used. According to preliminary user experience results after 2–3 months of use [17], WD was the most actively used mobile application in the PHS, with 53% of the respondents using it at least weekly. 67% of respondents felt that WD included functions that were appropriate for them, 59% felt that it motivated them to maintain or improve their well-being, and 56% intended to keep using it. WD's ability to provide feedback on the long-term progress of the different variables was considered an important motivational factor. Some subjects commented that WD would be more appropriate for cyclic rather than long-term continuous usage. The main barriers to using the applications were forgetfulness and being too busy, and many people stopped using them during holidays.

B. Studies With Independent Users

In a cross-cultural user study, Ahtinen *et al.* [18] used WD in identifying design factors for culturally sensitive wellness applications. The subjects were 16 adults aged 25 to 50 in Finland and India, who used WD for two weeks. WD was used daily by six (out of eight) Finnish and seven (out of eight) Indian subjects. The subjects recorded their self-observations either immediately after each event over the course of the day or only once a day. Exercise was perceived as the most important variable; all the subjects used it. The weight variable was used by 8 subjects, and eating by 11. While WD was generally considered to be easy to use, the subjects were not willing to invest the effort to enter data only for the diagrams in the current version of WD. The subjects felt that WD was "one way," i.e., the effort it requires outweighs the benefits. Both groups wanted feedback

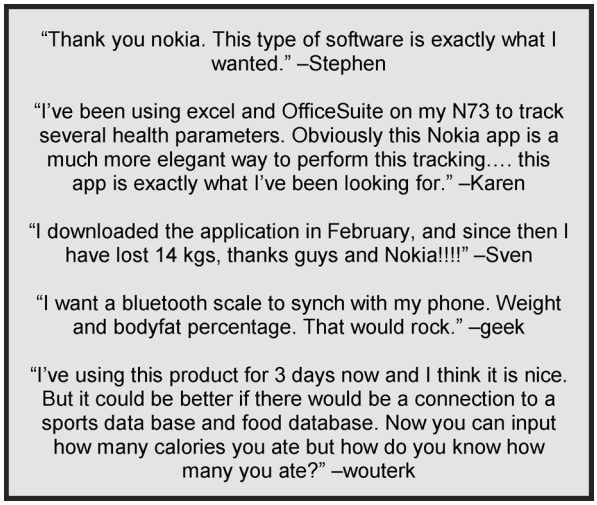


Fig. 2. Some representative examples of comments from Internet discussions [21] related to WD, evidencing success stories of its use totally independently.

on the concrete impact of their efforts. Although many Finnish participants saw the value of long-term self-observations and feedback, they thought they would get bored and stop using the application before reaching that state. The subjects wanted a more interactive, exciting, joyful, and lively approach with more features to keep their usage motivation high. They felt that they would stick with the application if it would prompt them to exercise or provide them with alarms, rewards, analysis, or other such motivational features.

Finns were more eager to set numerical goals in WD, but this was a new way of thinking for the Indian subjects—some of them stated that goals could be beneficial, but would create yet another cause of stress in their lives.

Since its release as a freeware application on the Internet in January 2007, reviews reflecting the views of independent users have been posted on discussion boards (see Fig. 2). The success stories among the reviews suggest that some users have clearly experienced WD as a valuable wellness management tool.

C. Implications From the Studies

These findings suggest that WD works rather well when used in an intervention setting, i.e., when the subjects get attention from experts and are properly introduced to the benefits of self-observations and the usage of WD. The intervention program probably provides the initial motivation and engagement enabling users to reach the "long-term" stage where the benefits of WD become visible. The experiences also suggest that WD provides a good fit for such settings.

Despite several success stories from independent users, WD does not seem to provide optimal support for many of them. The main problem is the lack of sticky features for use in the early phase and for maintaining long-term interest in a setting without external support and motivation. Even when external support is available, it is desirable to have features that engage users, maintain their motivation, aid relapse recovery, and provide more elaborate feedback. Simple personalization of WD to the needs of each specific user group and different modes of self-observation would improve its fit to the wide range of user needs.

Most of the improvement needs were related to motivational issues, such as engagement, support, and interactivity. To identify mechanisms to improve the WD concept and tackle the aforementioned shortcomings, we took a closer look at the psychology of behavioral change and motivation.

III. Design Factors to Support Behavior Change

Behavior change is an active process, requiring long-term commitment and learning in order to achieve the ultimate goal—permanent behavior change. Theories and models of behavior change and motivation provide a sound and evidence-based foundation for supporting self-management.

WD was designed to support CBT, which aims to help individuals to identify and change their problematic behaviors. CBT has been widely applied and found effective in addressing various health problems, e.g., eating disorders, weight management, insomnia, and depression [22]–[24]. WD is a self-monitoring journal, a tool for recording self-observations on behaviors and health, which is a key method in CBT and other behavioral therapies [9], [25]. Self-monitoring, especially when performed on a regular basis, has been found efficient in behavior change and its maintenance [25], [26]. The effect may be increased by mentoring or peer support, because knowing that one's self-observations will be seen by others may steer behavior to the desired direction [25].

A central element in CBT is learning through self-observing, which is based both on the cognitive processes related to self-observing *per se* and on getting feedback connecting the behavior to its consequences. In general, humans are poor at learning from their experiences if the consequences of an action only become clear much later (e.g., neglecting proper diet and exercise causes increased risk of cardiac disease after 20 years) or the feedback is ambiguous or indirect (e.g., that taking antihypertensive medication reduces risk of cardiac disease) [27]. Hence, the response time, clarity, and personal relevance of the feedback are important.

Motivation, self-efficacy, and empowerment have been associated with successful and maintained behavior changes [28]–[30]. Autonomous or intrinsic motivation means doing something for reasons emanating within oneself or because it is inherently enjoyable [11]. Self-efficacy refers to the belief that one is able to achieve desired outcomes by one's own actions [31]. Ahtinen *et al.* [18] summarize the methods of promoting intrinsic motivation, proposed by Malone and Lepper [12], and discuss their implications to wellness applications. Social support (*cooperation, competition, recognition*) can motivate behavior change, and can be naturally implemented using the messaging and data sharing features of the mobile phone. Modeling and encouragement can also increase motivation and boost self-efficacy [31]–[33].

The current version of WD provides feedback on long-term progress, but the sense of *challenge* and *control* [12], [18] could be further increased by, e.g., immediate feedback accentuating

changes and the cause-and-effect relationships between behaviors and health. Highlighting the successes may also increase self-efficacy [31]. Prompts, alarms, and rewards attract *attention* and *curiosity*, and could be realized using, e.g., ring tones or vibration, or the wallpaper on the stand-by screen of the mobile phone [34].

Stages of change theories present the process of behavior change as a series of stages. TTM [10] defines six stages of change: *precontemplation, contemplation, preparation, action, maintenance*, and *termination*. TTM suggests that different methods are needed to optimally support progression from one stage to the next. Relapse is acknowledged as an inherent part of the change process. Automatically detecting the user's stage and adapting to it might not be feasible, because people seeking to manage multiple health risks might be in several different stages regarding each health risk. However, the existence of different phases should be acknowledged. Currently, WD mainly supports the action phase. To support uptake, a learning mode could be added to educate the user on the usage of WD, and the principles of self-observations and feedback as mechanisms to manage health and wellness; to highlight and demonstrate the benefits of self-observation, and to provide information and quizzes on healthy behaviors and health, such as RealAge [35].

Personal goals may boost commitment to change, as long as they are truly personal and intrinsic [36]. The current version of WD enables setting numerical targets for most of the variables, and checks them against medical recommendations, e.g., to ensure that the weight target does not lead to underweight and is not unrealistic (weight loss more than 10%). It could also be useful to set intermediate goals on the way to the ultimate goal, e.g., it may be demotivating to immediately try to increase physical activity from 0 to 3 h a week.

In the active usage phase, it is challenging to maintain motivation and stay on track during one's busy daily life. In this phase, it is essential to show the impact of behavior changes. Rewards for meeting goals have been found to be motivating [32], [34].

Relapse detection and recovery methods would be important in long-term use. This could be done, e.g., by noticing a significant change in the usage pattern, e.g., no entries for several days for a usually active user, asking the user whether he or she has relapsed, and then, offering recovery options, e.g., starting to monitor something more closely to get back on track, selecting a holiday mode with only infrequent prompts to enter self-observations, or taking a break with a reminder later on.

IV. Concepts to Improve WD

On the basis of the findings from different studies with WD and the methods presented in the previous section, we have designed the following features to improve the WD concept.

A. Profiles, Defaults, and Personalization

Personalization and profiling should be included in WD to enable tailoring of the application to individual self-management needs or personal preferences; the requirements of a specific intervention or disease management program; or different cultural features.

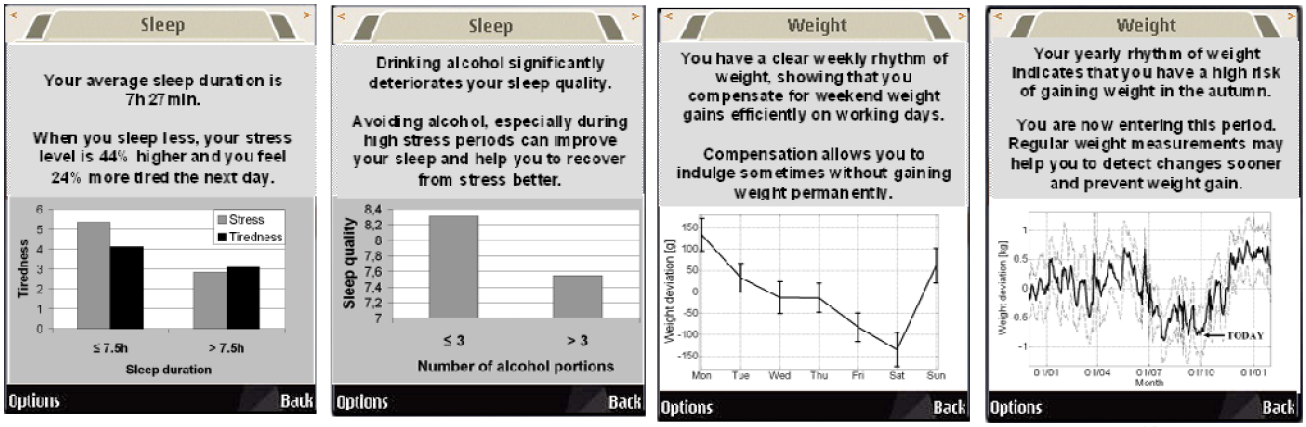
The application should provide a set of predefined user profiles, e.g., for independent users interested primarily in weight loss or exercise, or participants of a cardiac rehabilitation program. These profiles should also be culturally sensitive, e.g., follow the national health guidelines, terminology, and semantics of the target country. New profiles should also be easy to make, e.g., by different service providers or the user communities themselves. The application must be easily modifiable at any time by the user, or if available, his or her mentor or a healthcare expert.

Well thoughtout default settings, both in variable selection and goal setting, may be very influential in changing behaviors [27], and therefore, such profiles should be carefully created for each target group. For example, a weight management application should include variables for monitoring weight, physical activity, and nutrition, and the goals should be based on national nutrition and exercise recommendations. An independent user would be able to select from a range of predefined profiles or use a wizard to help identify his or her optimal profile. In addition, modeling could be leveraged in goal setting. For example, default goals based on statistical data could be used, e.g., how much does an average person of the user's age exercise, as long as these defaults are better than the user's current level. Very easy goals could be set in the beginning, but the challenge level could be ramped up incrementally over time [27]. For participants of a disease-specific program or intervention, goal setting should be based on clinical guidelines (e.g., healthy blood pressure or blood glucose limits) and expert evaluation.

Different self-observation options should be available, ranging from fairly detailed to very simple. For example, in diet monitoring, a detailed mode based on food database with rich feedback might be educational in the beginning. After a couple of weeks, a simpler and faster mode, such as recording the meal rhythm and self-assessed healthiness of diet could be used.

B. Easier Entry, Better Feedback, and Decision Support

Although the manual entry of self-observations is simple to perform, it has been found to be laborious. Automatic transmission may facilitate data entry, especially in the case of data-intensive measurements. Currently, WD supports automatic retrieval of step count data from the Nokia Step Counter application, which utilizes the inbuilt accelerometer of the mobile phone [19], [37]. For external measurement devices, data transmission will become more feasible in the coming years due to the standardization work of Continua Health Alliance [38] and the emergence of suitable monitoring devices that support standard interfaces. However, automatic data transfer must be carefully designed in order to maintain the user's situation awareness and the impact of self-observations [39]. The mobile phone also enables other input modalities, such as voice, photos, and even tactile input based on accelerometers. Photo input is implemented in the current version of WD and this feature is being used in cardiac rehabilitation, where photos taken with the phone's inbuilt camera can be automatically associated with self-observation entries, e.g., in nutrition mentoring [19].



(a) (b) (c) (d)

Fig. 3. Examples of advanced feedback and analysis, illustrating the data of a case subject. (a) Feedback on the effect of short sleep on stress and tiredness. (b) Illustrating the well-known effect of alcohol consumption on sleep quality. (c) Positive feedback based on the weekly rhythm of weight. (d) A warning of an approaching high-risk period based on the yearly rhythm of weight.

As mentioned earlier, feedback is crucial for changing behaviors, learning, and staying motivated [12], [27]. In order to engage a new user, valuable feedback should be provided right from the onset. WD should provide in-depth analyses and reveal aspects of the data that are not visible from the basic time series diagrams. For example, automatic detection and visualization of connections between different variables or patterns in the data, combined with decision support (DS) and clinical guidelines would amplify the value of general health guidelines and make the feedback more personal. As an example, Fig. 3 illustrates the feedback related to the connections of sleep, stress, and alcohol, as well as weekly and yearly weight rhythms based on the data of a male subject who has been using WD for four years. In this example, personal patterns and statistically significant correlations between the variables are visualized and enhanced by context-sensitive guidelines [40]–[43]. As shown in Fig. 3, combining WD with a DS system based on evidence-based clinical data would enhance the feedback by providing rule-based interpretation of the data. The Finnish Medical Society Duodecim has developed a DS system called evidence-based medicine electronic decision support (EBMeDS) [44]. The system combines medical knowledge with individual patient data and provides user-specific reminders, prompts, alerts, and individual guidance [45]. The current scripts are mainly targeted at healthcare delivery and decision making for professionals, but the EBMeDS system also enables the creation of new scripts from any structured data, such as WD data. The EBMeDS system was tested by integrating it with the WDC Web-based service. A single rule was implemented to warn the user about elevated risk for type II diabetes. The warning was given if the user's BMI exceeded 30 kg/m^2, and the user was advised to check his or her blood sugar level from time to time. This proof of concept shows that this technology could be extended to a large variety of conditions, from chronic disease management to health risk management and illness prevention. This type of feedback might be valuable in helping the user identify potential health risks and even detect changes in their chronic diseases by alarming the user when the thresholds for certain risks are exceeded. The future challenge lies with the robust analysis of self-observation data and the creation of evidence-based guidelines for its interpretation, since WD data, consisting of self-observations and simple measurements in uncontrolled conditions, may be sporadic, less reliable, and noisier than data obtained in a clinical setting by professionals.

C. Usage Models

WD is personal and private, which many users appreciate. However, it would be desirable to introduce optional mentoring or peer support features to add value and increase the stickiness of the application. This is supported by the observation that WD seems to work well in connection with an intervention program or mentoring. Considering cost efficiency and scaling to large-spread use, close health professional involvement and personal mentoring is probably feasible only in the case of chronic diseases, where direct savings can be achieved through decreased travel and expert working time. Therefore, new usage and business models supporting minimal, but efficient expert support and health coaching are needed.

Technically, WD already enables wireless transmission and two-way synchronization of data with WDC, which enables mentoring [16], [19]. A mobile phone also offers other social features, such as sharing of personal data, comparing one's results with the peer group's data, and sending messages, as was done in [32], [33]. WDC is a Web-based service for recording personal health records with WD. The parameters supported by the service are largely the same as those in the mobile application [19]. WDC consists of three parts: end user view, professional view, and administrator view. *End user view* consists of several views, such as a customizable dashboard (main view), charts, entry list, goal settings, calendar, images, and messaging. The feedback and motivation methods include traffic light indicators, a simple measure of physical activity, goal setting, and verbal feedback. The feedback is based on simple "hard-coded" rules programmed into the system. As mentioned earlier, a DS system based on clinical guidelines has also been

demonstrated with WDC. *Professional view* (ProView) is a separate interface for professional users (e.g., mentors or health coaches). Its functionalities enable user management, intervention support, and research support. ProView allows management of groups, patient monitoring and analysis, news postings, and system-wide messaging with attachments. It enables professionals to make searches on users, create questionnaires, and access the users' data. *Administrator view* (AdminView) is meant for system administrators and is intended for creating and managing user groups and providing Admin and Proview rights.

A typical chronic disease management model based on mentoring and WD is described in [19]. This model uses WD and WDC in a home-based care model for cardiac rehabilitation patients. The patients use WD to collect health and exercise data either through self-observations or by using simple measurement devices such as weight scales. Physical activity is measured with the inbuilt accelerometer in the mobile phone and the Step Counter [37] software. The WD client reads the measured daily steps from the Step Counter. All patient data are collected through the WD mobile client and synchronized with the WDC service a few times a week. A trained mentor can access the patients' data on the WDC service and evaluate their progress and current status in relation to the goals. Every week, the mentor calls each patient, and together they review the progress related to previous goals, discuss opportunities for improvements, and set new personal exercise and lifestyle goals for the next week. The care model is based on weekly themes focusing on different aspects of lifestyle improvements and issues important to cardiac patients. The mentoring sessions are amended with daily motivational short message service messages as well as multimedia and audio material stored in the patients' phones (see Fig. 4). The data sharing routine and personal contact with the mentor, including weekly evaluations of the information, are expected to motivate and encourage the patients to sustainably use WD and WDC. The WDC portal provides objective and relevant data to the mentors in a simplified format, which will help them to quickly address the issues important to each individual patient and understand their personal progress better than they would by merely conducting a telephone interview. This model could be extended to the management of other chronic diseases, where use of active remote mentoring would be potentially cost-efficient.

Guidance, coaching, and mentoring, and even minimal support for self-management may be crucial to the uptake and use of self-management technologies [46]. Therefore, sustainable and cost-efficient services and business models for health risk and wellness management should be developed. Potentially, employee health promotion and occupational healthcare settings may provide an early business model and domain for these applications [16]. In the employee health domain, group interventions and health promotion programs could be combined with technology support to foster maintenance of the intervention effects [16]. Although the evidence for the cost-efficiency of these programs is still uncertain, some employers are already launching such programs as part of their human resources management policies.

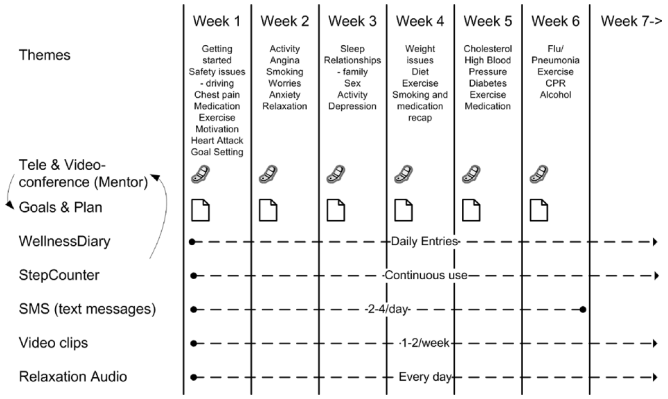


Fig. 4. Home program schedule used in [19], including weekly mentoring and goal review via telephone and daily use of technologies.

Finally, models supporting independent and personal use should be developed. In these models, in contrast to the aforementioned models, the service would be paid mostly by the individuals themselves. Some Web-based services already provide health coaching and feedback, as well as personalized action plans for an initial and/or monthly fee. As mobile phone plans allow straightforward implementation of the payment mechanisms to subscribe to such services, their implementation would be possible with WD. To better support this, WD could include better tools for planning and goal setting, as well as better integrated messaging with health coaches. External motivation can also be provided. For example, the Commitment Savings for Smoking Cessation (CARES) program [27], [47] is based on "self-betting," i.e., voluntary commitment to reaching certain goals by making a monetary "bet". In CARES, participants commit to smoking cessation by making weekly payments to the program. At the end of the program, they are tested for smoking, and if they fail the test, they lose their bet; if they succeed, they get their bet back. This program has reported successful outcomes [47]. Although the study was not strictly scientific, the idea could be extended to concepts such as WD, where weekly payments could be associated with certain health goals and goal monitoring would be embedded in self-monitoring variables.

V. Discussion and Conclusion

WD is a mobile application for personal health and disease management. It has been found easy to use and useful in well-being management, and it has been actively used for several months in intervention studies. In this paper, we presented a summary of findings from earlier studies with different user groups, and proposed new concepts to improve WD to make it more useful, engaging, and motivating for independent and supported users alike. These findings are also relevant to other, especially mobile and wellness applications.

The goal of WD is to enable sustained behavior change and learning through self-observations and feedback. To promote learning and support decision making, it is essential to enhance feedback and analysis of self-observation data, revealing the cause-and-effect relationships between behavior and health. Feedback should be timely and focus primarily on the factors

and behaviors that the individual is able to change. DS systems and evidence-based clinical guidelines, developed specifically for self-management of health or chronic illnesses, can further enhance the usefulness of the concept.

Challenges related to different usage phases were encountered in the studies [17], [18]. In the beginning, the lack of motivation and engagement was a major barrier for the usage of WD. Later on, busy everyday life and holidays caused breaks in WD usage. The benefits of WD should be made evident to the user from the very beginning by taking a more interactive approach with the help of, e.g., a learning mode, quizzes, and immediate feedback. Relapses should be recognized early on, and coping mechanisms should be provided. Long-term motivation could also be promoted with social support features, such as data sharing and encouraging messages, as well as simple and pervasive rewards [32]–[34].

Personalization, profiles, and different usage modes for WD would improve its fit to the widely varying needs of the users. Providing preset and easily modifiable profiles for different purposes, e.g., weight management, would facilitate the independent usage of WD. Profiles should also be provided for goal setting, as goals may be culturally sensitive [18]. Currently, WD supports numerical goals set by the user. Although the goals are checked by the application, they are static and do not change over time unless manually modified. More engaging and dynamic options should be developed.

WD has been found to work well with expert support or intervention, and along with WDC, it seems to provide a good fit for intervention and mentoring settings. These features could be further improved with disease or intervention specific profiles and goal setting, as well as flexible modification options for healthcare experts and mentors.

WD is a promising and extendable wellness management concept to support both independent users and individuals participating in an intervention. We believe that the key success factors of WD are its simplicity and mobility, allowing fast and easy usage independent of location and time. These factors should be carefully maintained, whenever possible, when upgrading the concept.

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