

# Exploring and improving treatment adherence in patients with type 2 diabetes mellitus using eHealth

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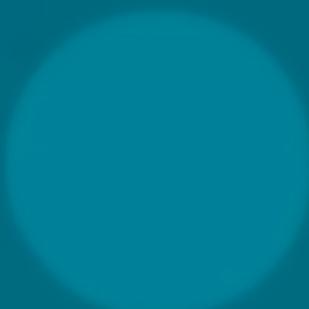
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# Valorization Addendum



The main aim of this dissertation was to provide insight in the effectiveness of the newly developed web-based computer-tailoring program 'My Diabetes Profile' that aims to improve treatment adherence of patients with T2DM to core treatment behaviors, i.e. physical activity, healthy dietary patterns and medication taking. Formative research, conducted prior to the development and effectiveness study of the program, was directed at providing insight in the scope of treatment (non)-adherence and its determinants in Dutch patients with T2DM.

The results of the studies presented in this dissertation show that treatment adherence in patients with T2DM is subject to improvement and that patients generally show non-adherence in multiple treatment behaviors simultaneously. As non-adherence is associated with considerable adverse outcomes on personal, societal, and economical levels, it is highly relevant to pursue improvements in patients' adherence. In chapter 6 we demonstrated that the newly developed eHealth program, My Diabetes Profile, has the potential to be an effective intervention to improve patients' overall adherence to T2DM treatment recommendations.

This chapter elaborates on the relevance and value of the findings from this dissertation and addresses valorization opportunities for the individual, the health professional, and research.

## **Relevance**

Findings from our formative work are consistent with results from existing research regarding co-occurring treatment non-adherence in patients with T2DM. Results from our qualitative formative research study already suggested that non-adherence to treatment behaviors often co-occurs. Our baseline measurement from the conducted trial confirmed this finding and showed that, on average, patients could improve on three of the four treatment recommendations that were examined. Former research already showed an increasing negative trend towards co-occurring treatment non-adherence. Only 3.5% of the studied patients with T2DM adhered to all five key recommendations related to the treatment of T2DM, while this percentage was almost three times as high in prior observations (25). Results from former research demonstrated that almost 85% could improve adherence to two or more recommendations, while earlier research showed that this percentage was near 75%, also indicating a negative trend. With an increasing prevalence of T2DM, more patients are at risk for the multifaceted adverse consequences related to the disease and treatment non-adherence. Moreover, the increasingly common co-occurrence of treatment non-adherence may result in greater adversity on health and related outcomes (198). In the first place for the patient, but also from a societal and economical perspective, it is therefore evident to target improvements in patients' adherence and by doing so from a multi-behavior perspective.

Current Dutch guidelines with regard to diabetes care describe that discussing and promoting treatment adherence should be one of the standard discussion topics in encounters between

the patient and the health professional (14). Increasing care demands, time constraints, and scarce encounters between patient and professional may however impede addressing treatment adherence to a sufficient extent, as well as the adequate application of multiple factors which seem to determine successful treatment adherence. Findings reported in this dissertation, but also lessons learned from earlier work in which nurses reported to struggle providing effective lifestyle counselling, ask for new avenues to address and improve treatment adherence (63). Discussing treatment adherence in medical encounters could serve as a starting point for extended treatment adherence enhancing activities outside the healthcare setting. An example of such an activity could be to partly outsource the process of assessing and improving treatment adherence to the context of the Internet. The added value for the professional is that this could be useful given the presumed time and know-how shortage on how to promote health behavior change. In addition, the professional could be updated on the progress of the behavior change of the patient periodically, thereby integrating the online intervention into the healthcare context. For instance, like in the My Diabetes Profile program, the professional could get access to a summary of the activities a patient has done in the program and the progress in improving treatment adherence. Moreover, this way, professionals could devote more attention to other, more acute discussion topics such as the patient's latest blood glucose levels. Especially as traditionally healthcare systems were developed to deal with acute conditions rather than chronic illnesses, it is not surprising that professionals experience difficulties and barriers in discussing and promoting treatment adherence amongst their chronic ill patients (105). For the patient, personalized advice as provided in the eHealth context, has the advantage that it can be accessed at any time and in a desired pace.

The effectiveness study in the second part of this dissertation suggested that such an intervention delivered through the Internet, i.e. the newly developed My Diabetes Profile program, can be an effective way to improve patients' overall adherence. Besides the general attributes of Internet interventions, such as its broad reach, constant accessibility, and potential to temper pressure on health care systems, the program also has its unique features. Compared to the vast majority of existing eHealth interventions targeting adherence improvements in patients with T2DM, the My Diabetes Profile program provided patients with personally relevant tailored content, applied a sound theoretical base, incorporated largely visual content, and was developed with input from patients and professionals. These attributes are well-known to enhance the likelihood of a program to be successful in improving treatment adherence, and it is likely that its application has resulted in the positive effects of My Diabetes Profile. However, future studies could investigate if indeed the application of the known success factors led to the positive results as observed in the effectiveness evaluation.

## Innovation

The My Diabetes Profile shows some level of innovation in relation to existing computer-tailored interventions, as well as in its strategy to improve patient adherence. Firstly, the field of computer tailoring technology and eHealth has evolved tremendously in recent decades. First generation tailored strategies applied print materials to bring about individualized health messages. In recent years, the Internet has increasingly emerged as mode for the delivery of tailored interventions to improve for instance adherence to treatment strategies, referred to as computer-tailoring technology (72, 81, 239). Most previous web-based computer-tailored interventions focusing on T2DM treatment adherence did not apply a solid theoretical framework, were generally mono-behavior oriented, included little interactive content, and were largely text-based (154). The My Diabetes Profile program not only builds on a solid theoretical framework, i.e. the I-Change Model, it also aims to improve patient adherence from a multi-behavior perspective, applying strategies towards both healthy lifestyle adaptations and medical intervention adherence. As disease and glycemetic control are impacted by all these treatment behaviors, and as treatment non-adherence often co-occurs, it seems that a multi-behavior strategy is most relevant. The interactivity of the My Diabetes Profile program is reflected in the content that is assessment based, tailored to the behavior change phase an individual is in, and segmented to a high, medium, or low score on related determinant scales. In addition, at the level of beliefs, tailored advice is provided to e.g. persuade an individual of a certain advantage of carrying out a behavior, or to strengthen self-efficacy in a particular difficult situation. Advice is provided instantly and accessible at a preferred pace, contrary to e.g. the computer-tailored letters sent within weeks to months following the assessment in earlier work (239). Many of the interactive pathways applied in My Diabetes Profile are delivered through video-tailored advice. People with a low education level, which is common in people with T2DM, may be less text-oriented which in turn could inhibit the use and effectiveness of such programs (240). Video-tailoring is an innovative mode to bring about health promotion messages that can deliver content in a more interactive way compared to text-tailoring. Further, video-tailoring for example enables to demonstrate skills to patients, reduces cognitive processing of information, and can lead to better appreciation and attention, compared to text-tailored content (241). Moreover, it is suggested that the application of video-messages in order to deliver health promotion interventions, may particularly suit low-educated patients, given their generally low-literate skills and difficulty of translating abstract text into concrete actions (242-244).

Secondly, rather than aiming to reach the recommended norms of those behaviors, as has been the case in previous similar work (52, 245), our program aimed for improvements in all of our targeted behaviors, i.e. physical activity, medication adherence, and a decrease in caloric intake from unhealthy snacks, from a continuous perspective. An increase from two to twenty-nine minutes of daily physical activity would not have counted as a successful behavior change in programs that aim for patients reaching the norm, while an increase from

twenty-nine minutes of daily physical activity to thirty minutes would actually have. Recent Dutch and international guideline targets on physical activity conclude that any increase, and especially an increase in activity levels from zero to any activity, can have an enormous impact on health and related outcomes (191). Moreover, if a certain norm was reached but an in- or decrease was still possible, our program aimed for these improvements as e.g. it is known that additional activity beyond the norm of 150 weekly minutes is desirable. Therefore, if feasible, future interventions should carefully consider whether aiming to reach the norm and only reaching the norm is sufficient to grasp behavioral improvements below or beyond those norms, and rather aim for continuous improvements instead. Moreover, by promoting small steps, it is also easier to provide reinforcing feedback in the challenging trajectory of behavior change among patients with T2DM (116).

## **Target groups**

### **Patients with type 2 diabetes mellitus**

First and foremost, the results of this dissertation are of great value for the initial target group of the intervention, i.e. Dutch patients with T2DM. It is conceivable that patients with T2DM beyond the age restrictions applied in the trial could benefit from the intervention, as the presence of T2DM is increasingly common in those aged <40 and >70 (246). However, if the program would be made available for youngsters, young adults, or elderly above the age of 70 with T2DM, it is likely that the program requires some form of adaptation towards specific beliefs and target goals of those groups. Similar formative research as reported in the early chapters of this dissertation could yield information on if and how the program should be adapted to align with needs and salient beliefs present in those target groups (247). In addition, the program modules targeting improvements in healthy lifestyle behaviors could be of interest for people suffering from other lifestyle related diseases or for people at risk of developing T2DM. As the onset as well as the treatment of T2DM largely involves energy balance-related behaviors such as physical activity and dietary choices, those at risk could contribute to a decreased chance of developing T2DM by improving healthy lifestyle adherence. Internationally, the program could be of impact as T2DM is known to be a global epidemic, however, again the context and content should be fine-tuned to those countries or regions it is implemented to.

### **Health professionals**

Another relevant target group to potentially benefit from current findings are health professionals, especially those directly involved in diabetes care of patients, i.e. nurses and physicians. First, a discrepancy seems to exist in perceptions of patients and their health professionals with regard to whether patients adhere to distinct treatment recommendations (28). Therefore, it is at least of relevance to raise awareness in professionals and patient that their views on patient adherence may deviate and that advice provided by health professionals

accordingly may be perceived as irrelevant by patients. Second, the My Diabetes Profile program includes a certain level of blended care as the program is proposed to patients in medical encounters, and as professionals get access to a summary of patients' activity in the program. In blended care interventions, therapeutic guidance is complemented with online care. A combination is recommended, as stand-alone online interventions struggle with disappointing compliance rates (248, 249). However, it remains unclear what the best way and quantity is to integrate these two delivery modes. A trend is observable towards a declining share of the health professional in interventions that have been developed at our university in recent years that aimed for self-management support or improvements in healthy lifestyles. On the contrary, technology is more and more integrated in routine care to complement or partly replace the work conducted by nurses. In the work of Koelewijn and colleagues, primary care nurses were trained to deliver risk and motivational counseling to improve patients' lifestyle related to cardiovascular risk management (250). It is concluded that nurses should support patients in their attempts to improve their lifestyle, but that only nurse-support does not seem to be sufficient (251). A project to improve the daily functioning of patients with T2DM by the implementation of a nurse-led intervention for integrated self-management support in routine care, showed limited effects. A process-evaluation showed that practice nurses felt restricted in time and expertise to adopt the intervention, and patients did not expect a discussion about psychosocial problems but rather saw their nurse as a specialist regarding the biomedical management of their T2DM (252). More recent work was pointed at assisting practice nurses on how to best deliver goal setting and action planning with regard to self-management support in chronically ill patients. Nurses seemed to experience difficulties in setting goals and action plans with regard to self-management support. Their focus was merely on solving medical problems, and patients were characterized as rather passive collaborators in this process, as has been established earlier (28, 253). Furthermore, nurses indicated to struggle to integrate the approach in routine care and to apply it in a tailored way, and characterized the process as time consuming and complex (254). Verwey and colleagues aimed to improve physical activity levels in patients with T2DM and acknowledged that mere advice from a practice nurse would not result in significant improvements in activity levels. Patients visit their practice nurse a couple times a year, while behavior change may require day-to-day attention. Therefore, a technological support tool was developed for patients to complement the process of risk communication, motivational interviewing and goal setting by nurses (237). A summary of activity levels monitored by the tool was sent to the practice nurse automatically, similar as in the My Diabetes Profile program. The feedback tool, if embedded into a counseling protocol, was an effective instrument to improve physical activity levels of patients with T2DM, while mere counseling was not effective (255). In sum, it seems that efforts of nurses alone are often not enough to realize sufficient behavior change in patients, partly through time constraints, the infrequent occurrence of medical encounters, know-how insufficiencies, and passive patient involvement. Especially in attempts to improve multiple behaviors, the integration of routine care with online interventions where patients can access advice on a daily basis seems evident. The counseling process, for example

risk communication, motivational messages and goal-setting and action planning, can be outsourced to the context of the Internet. Future studies need to explore how to best attune the face-to-face counseling process with tailored eHealth methods.

## **Researchers**

Results from this dissertation also provide relevant knowledge and opportunities for researchers. An important step in developing health promotion programs is the phase of testing the program on its effectiveness and if results are positive, subsequently the dissemination of successful programs in order to increase its exposure and impact (256). In the trial that was conducted as part of the effectiveness study, patients were recruited by their health professional, i.e. practice nurses and diabetes nurses in the primary and secondary care setting. Beforehand, all nurses intended to recruit at least eight patients with T2DM to our trial. However, trial data showed a broad range of recruitment success of nurses, ranging from 0-32 recruited patients. It is widely acknowledged that for instance for health promotion behaviors, a positive intention towards behavior change does not warrant subsequent success (56). It seems that recruitment behavior of nurses in our trial was subject to a similar intention-behavior gap, and that nurses' recruitment behavior in general follows similar pathways as how health behavior can be explained in the I-Change Model. Therefore, researchers need to be aware that not all nurses who intent to recruit patients will actually do so, and may drop-out during the recruitment period.

Researchers may, however, be able to influence the process of recruitment by health professionals. After conducting a qualitative exploration of factors influencing recruitment success among nurses it seems that there is a wide variety of factors that influences recruitment success including, and foremost, cognitions of recruiters themselves seem to have an impact on the outcome. A personalized approach seems to be the primary method once a nurse has expressed the willingness to participate. For instance, in some nurses the expressed intention is followed-up by clear action plans, coping strategies towards barriers, and goals regarding the intended number of recruited patients. Others seem to have expressed their willingness without actually having sufficient study and trial knowledge and sufficient motivation to recruit patients. It is yet to become clear how researchers can optimally support recruiters through a personalized approach to stimulate their recruitment efforts and related outcomes. For now, it is suggested that researchers could assess recruiters' trial and study knowledge, motivation and willingness to recruit study subjects, and align their efforts in assisting recruiters towards their needs, in order to increase the likelihood of recruitment being successful. More research in this area, however, is required to substantiate the suggested initiatives.

## Feasibility and dissemination of My Diabetes Profile

Program impact not merely depends on its effectiveness, but also on its reach and implementation by its users (257). In order to be of impact, the reach of the successful My Diabetes Program should be increased beyond the trial setting in which its effectiveness was examined. One needs to be aware that this is the first version of the My Diabetes Profile program, and although overall effectiveness has been shown, further refinement may be needed. First, largely the program was developed with input from local stakeholders, i.e. patients and professionals were interviewed as described in chapter 2, and a program committee was formed prior to program development to accumulate input. Although to some extent attention has been paid to co-creation, it is relevant to involve national stakeholders such as patient associations, health insurance companies and national diabetes federations to further attune the program and to create a supportive base for the program. As described earlier, further research should also be conducted on how to optimally integrate the program with face-to-face counseling.

Subsequently, this information may help researchers to optimize the program and ultimately, a My Diabetes Profile program 2.0 version could be tested in a similar trial to examine if enhanced success is achieved, before widespread implementation is initiated. Subsequently, if researchers would aim for broad implementation of the My Diabetes Profile program, implementation challenges may need to be explored. For instance, researchers could explore if the delivery format of the My Diabetes Profile program through nurses in consultations is in fact a feasible delivery strategy, and if and how the eHealth program can be integrated in the multitude of information systems used in Dutch healthcare. Moreover, prolonged use as well as long-term effects and cost-effectiveness need to be researched to increase the marketing of the program. In sum, it can be concluded that the My Diabetes Profile program in its current version was an effective and feasible program to improve overall treatment adherence in patients with T2DM. However, the program may need further refinement before widespread implementation is initiated.

## Lifestyle medicine and prevention

The aims of My Diabetes Profile program are consistent with the vision of the Dutch ministry of Public Health, Welfare and Sports as stated in the recently published Dutch prevention agreement (258). Maintaining or improving healthy lifestyles are not only part of the prevention and treatment of T2DM, but are also urgent for Dutch society as in 2017 almost half of the people aged  $\geq 20$  was at least overweight. This number of overweight and obese people is increasing rapidly, which in turn are important risk factors for the onset of T2DM. Energy balance related behaviors, such as healthy dietary choices and sufficient physical activity, are key behaviors in the prevention of obesity and T2DM. Lifestyle medicine and

disease prevention have therefore gained ground in recent years, and are elaborated in the Dutch prevention agreement. However, few attention has been paid to eHealth as method to bring about improvements in healthy lifestyle behaviors. In addition, many initiatives stated in the agreement to target a complex problem of overweight and obesity, focus on the environment and to a smaller extent on cognitions, i.e. personal determinants such as the individual's knowledge and motivation. The My Diabetes Profile program showed that eHealth as medium and intervening in the personal determinants was a successful strategy to decrease caloric intake from unhealthy snacks. Given the expectation that by 2040 over 60% of the Dutch population will at least be overweight as well as the expected increase of T2DM, My Diabetes Profile can be a valuable tool to support patients with T2DM and potentially those with overweight, in effective, personalized and broad reach healthy lifestyle changes.