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Diabetes Lifestyle (e)Coaching 50 Weeks Follow Up; Technology Acceptance & e-Relationships

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Diabetes Lifestyle (e)Coaching 50 Weeks Follow Up; Technology Acceptance & e-Relationships

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Abstract We report on the 50 weeks follow up results from a healthy lifestyle pilot (High Intensity Nutrition, Training & coaching), conducted with 11 insulin-dependent Type 2 Diabetes Mellitus (DM2) patients. Hybrid eHealth support was given, with electronic support plus a multi-disciplinary health support team.

Regarding the pilot goal of long term healthy lifestyle adoption in senior DM2 patients, challenges were: low ICT- and health literacy. This exploratory design analysis formulates design lessons based on 50 weeks follow up.

The first 12 weeks contained intensive face-to-face and eSupported coaching. After that, patient self-management and eTools were key. After 50 weeks, attractiveness and feasibility of the intervention were perceived as high: recommendation 9.5 out of 10 and satisfaction 9.6 out of 10. TAM (Technology Acceptance Model) surveys showed high usefulness and feasibility.

Acceptance and health behaviours were reinforced by the prolonged health results: Aerobic and strength capacity levels were improved at 50 weeks, plus Health Related Quality of Life (and biometric benefits and medication reductions, reported elsewhere). We draw three types of conclusions. First, patients’ health literacy and quality of life improved strongly, which both supported healthy behaviours, even after 50 weeks. Second, regarding eHealth theory, iterative growth cycles are beneficial for long term adoption and e-relationships. Third, a design analysis was conducted regarding long term service mix efficacy in relation to key requirements for designing ICT-enabled lifestyle interventions. Several suggestions for long term lifestyle eSupport are given.

Keywords: • Type 2 Diabetes (DM2) • eHealth • Lifestyle • Monitoring • Coaching • Blended Care • Service Design •
Introduction

Our Western lifestyle plays a large role in the onset and progression of DM2: type 2 Diabetes Mellitus (Lim 2011). Several lifestyle interventions improved outcomes in type 2 diabetes patients on insulin therapy, most notably: lower blood sugar and lower medication needs (Jenkins 2008; Esposito 2009). However, these are often costly, highly controlled interventions. Moreover, the longer term (> 6 months) sustainability of behaviour changes is limited.

The question is: can we do this on a more ‘Do-It-Yourself’ and e-Supported basis? This would have two advantages. First, since behaviour improvements are implemented within patients’ lives, it improves the chances of sustained health behaviour (Simons 2013). Second, it is cheaper. Since 2010 the Health Coach Program has been used to improve lifestyle and metabolic outcomes (including reduced insulin needs for type 2 diabetes (DM2) patients), via eSupport, improved self-management and rapidly improved health behaviours (Simons 2010, Simons 2015).

To promote rapid health results, a HINTc (High Intensity Nutrition, Training & coaching) intervention of 12 weeks was developed for this patient population, plus lightweight eSupport and mostly self-management in weeks 13 - 50. The intervention combines improving health literacy with active behaviour change support.

This paper discusses follow up results and design lessons after 50 weeks, as part of a larger biomedical study. An important goal of the biomedical pilot study was to promote long term (> 6 months) healthy lifestyle adoption in senior DM2 patients. Even in well-facilitated settings, a majority of interventions lack sustained health effects after 6 months (Verweij 2011). Moreover, in eHealth initiatives, there is always the risk of falling victim to the ‘eHealth law of attrition’ (Eysenbach 2005): meaning that 90% of users are often already lost within a few usage instances.

In this study population, there were additional challenges due to their low average ICT-and health literacy. This exploratory design analysis formulates design lessons based on 50 weeks follow up. We focus on feasibility and attractiveness of the HINTc e-supported lifestyle intervention, plus on formulating design lessons. Given the desire to develop cost-effective long term eHealth support relationships with these types of patient groups, a focus is on long term e-relationship support lessons. Medical results will be discussed in another paper.

Research Questions:

- What are the 50-weeks-follow-up feasibility and attractiveness of the HINTc e-supported lifestyle coaching program; and what are the effects on quality of life?
- What design lessons emerge for long term eHealth and e-relationship support?
As part of the design analysis we address: efficacy of the service mix deployed in eSupported lifestyle interventions. We combine the 50-week results from our measurements with a design analysis based on an evaluation framework of requirements for ICT-enabled healthy lifestyle interventions.

2 Theory

The eSupported lifestyle program combines coach sessions with electronic dashboarding and self-management. Hybrid programs (face-to-face plus tele-support) have been indicated to be attractive for some time (Demark-Wahnefried 2007, 2008). Finding the right mix between offline and online contacts is an ongoing design research challenge (Pekmezi 2011). In summary, a hybrid or multi-channel service mix is recommended (De Vries 2008, Sperling 2009, Simons 2002, 2006, 2010, 2010b), combining electronic and face-to-face interactions. Still, there are many design challenges, given the multitude of options. For a more extensive discussion, see Simons (2014).

Key functionalities to increase health motivations and behaviours in this eSupported lifestyle program are (Simons 2010, 2014 and 2016):

- Daily logging of insulin and blood sugar levels: for close progress monitoring of the health coaches, physicians and participants themselves.
- Close cooperation with physicians, for rapid medication adjustments initially (avoiding dangerously low blood sugars when insulin dosage is not reduced rapidly enough in the first days), plus medical monitoring/coaching in the following weeks.
- A personal online health dashboard with graphs of progress towards adherence targets on the various health behaviours;
- Automated feedback on lifestyle aspects where positive scores have been achieved (nutrition, physical activity, stress management or an overall score);
- (Tele)coaching by a health coach, generating online reports on progress towards adherence targets in the personal dashboard;
- The (tele)coaching sessions can be flexibly planned, based on convenience and participant preference: during in-clinic visits or phone based from home;
- Options to ask questions to the coach: via messaging within the dashboard or via email;
- Online schedule indicating upcoming events: group sessions, individual coach sessions (when and where), physical measurements, surveys;
- A micro-learning Health Quiz accessible via smartphone, mail and/or web;
- Reading materials in the mail;
- Weekly tips via email on health, motivation and self-management;
- Besides individual coaching, group sessions are also used in order to stimulate group support, mutual inspiration and encouragement, plus peer education.
It was theorized and tested elsewhere that the design challenge of persuasive technology (Fogg 2002, 2009) for health is not just located in the ICT design, but also in the design of the overall service scape, including health effects and coach relationship (Starr 2008, Simons 2014b). It should generate positive, mutually reinforcing service experiences across communication channels and activate long term health motivation and behaviours, in order to deliver long term health results. This is reflected in the following design evaluation framework for health improvement ICT solutions (Simons 2014), see Figure 1.

![Figure 1: Basic requirements when designing ICT-supported healthy lifestyle interventions](image)

Figure 1 addresses three evaluation domains: health effectiveness, coaching performance and ICT value adding. It helps evaluate the impact of ICT-enabled interventions and will be used as analysis framework for section 4, Results.

3 Methods, Study Design, Intervention

This is a non-randomized, one arm, pilot intervention study of 12 weeks Sept-Nov 2015, plus effect measurement at 50 weeks follow up; approved by the Leiden University Medical Center (LUMC) Ethics Board. The biomedical results will be addressed in a separate paper. The study participants were 11 insulin-dependent Diabetes Mellitus Type-2 patients. Patients were volunteers and provided written informed consent prior to the study. They were recruited by LUMC from the larger Leiden area in the Netherlands. They were 8 men and 3 women, ages 39-70 years, with widely varying levels of education (although skewed towards the lower end) and of comorbidity.

Challenges regarding design of individual training schedules were posed by all the physical constraints in this group: 7 had significant movement restraints (knee- and hip-replacements, cardiovascular blood flow constraints, stents), 5 had neuropathy, and 7 had cardiovascular disease. On average they had been a Type 2 Diabetes (DM2) patient for more than 10 years and they were motivated for trying lifestyle improvements.
TAM surveys (Technology Acceptance Model, Venkatesh 2000) were used at weeks 4 and 12 to assess intervention feasibility and attractiveness. In this study, TAM is only used qualitatively, as a tool for user evaluation, not to make technology acceptance calculations or predictions. For this purpose, its eight dependent variables provided us with ample user evaluation insights, compared to the four dependent variables of UTAUT (Venkatesh 2003).

Furthermore, user satisfaction evaluations were user plus the RAND SF-8 Health Related Quality of Life survey (Ware 1998). Besides, a standardised sit/stand test is used to assess strength (Csuka 1985) and an Astrand test (1976) for endurance.

Study inclusion criteria

- Type 2 diabetes mellitus treated by insulin therapy with or without oral blood glucose lowering drugs.
- BMI $\geq 25$ kg/m$^2$
- Age 30-80 yrs
- Dutch language and basic computer competence (for use of email and web based dashboard)

Exclusion criteria

- Recent (< 3 months) myocardial infarction
- Uncontrolled blood pressure (SBP $> 170$ mmHg and/or DBP $> 100$ mmHg, 2 out of 3 measurements)
- Any chronic disease other than type 2 diabetes hampering participation (at the discretion of the investigator)
- Low motivation to participate (score 2 ‘weak’ or 1 ‘very weak’ on a 5-point scale).
- Alcohol consumption of more than 28 units per week at present or in the past
- Psychiatric disease (as defined by DSM-V)
- Claustrophobia
- Metal implants or other contraindications for MRI

The eSupported lifestyle intervention HINTc (High Intensity Nutrition, Training and coaching)

An extensive eSupported lifestyle program is offered, which combines coach sessions with electronic dashboarding and self-management, plus electronic health tips and a digital health quiz game. Intensive coaching is offered for 4 weeks with the purpose of generating self-propelling behaviours and capabilities. In week 1 a low-calorie approach is taken to enable rapid alleviation of fatty liver conditions. The support in weeks 5-12 is more lightweight, with group sessions at the end of weeks 6, 8 and 12, weekly electronic
tips and a digital health game. The support in weeks 13-50 is: sustained eTool support, plus 6-weekly group coach sessions for sharing and discussing each other’s progress and challenges, for reinstating health literacy lessons and for social group support.

As an umbrella overarching the personalized coaching per participant, the general lifestyle advice follows the guidelines of the Harvard Epidemiology and Nutrition Group for nutrition and physical activity, with specific modifications for diabetics. The guidelines are to increase intake of vegetables and low sugar fruits (each 2.5 servings/day or more), to choose whole grains instead of refined grains, to limit sugar and other high glycaemic load foods, to have one daily serving of nuts and/or legumes, to limit intake of red meat and processed meat, to limit intake of trans and animal fats, and to have no more than 2 (male) or 1 (female) alcoholic beverages/day. Physical exercise guidelines are: at least 60 min/day moderate intensity activity (like walking or gardening) and at least 3x30 min/week intensive activity, which was also supported with group training sessions at the LUMC location three times per week (Borg level 12-14). Stress management guidelines are: relaxation exercises for >10 min/day.

4 Results

We discuss several types of results. We address answers to the first research question: What are the 50-weeks-follow-up feasibility and attractiveness of the HINTc e-supported lifestyle coaching program, including the positive feedback provided by the improvements in quality of life and physiology (insulin medication, blood sugar, physical stamina)? And to answer the second research question (‘What design lessons emerge for long term eHealth and e-relationship support?’), we analyse efficacy of the service mix deployed in eSupported lifestyle interventions, following the framework of Figure 1 from Theory.

First, regarding attractiveness and feasibility, satisfaction and recommendation were not only high after 4 weeks (8.7 and 9.0 out of 10 respectively) and 12 weeks (9.1 and 9.0 out of 10 respectively), but also after 50 weeks: 9.6 and 9.5 out of 10 respectively. This is in contrast with usual patterns where the initial enthusiasm of the first weeks wanes after 3 months. Regarding ‘Health Related Quality of Life’ as measured with the RAND SF-8 an interesting pattern emerged over the 50-week period, as illustrated in Figure 2.
The Physical Health score moved from an average of 50.1 at start to 66.6 at week 4 to 73.1 at week 12, to 62 at week 50, with 76.2 as the Dutch average (Standard Deviation: 13.5). So for Physical Health, we see a steady and significant rise in the first 12 weeks (due to better eating and training), and after that a decline to 62, which is still better than the start. Mental Health went from 68.9 at start, to 82.4 at week 4, to 80.6 at week 12, to 71 at week 50, with 77.6 as the Dutch average (Standard Deviation: 13.7). Experienced Mental Health seems to peak at week 4. This coincides with the large positive surprise that the patients experience in the first 4 weeks: fast improvements in fitness, quality of life, medication, self-efficacy, health literacy, fun and group support, plus a hope for a better future. In the following period between weeks 4 and 12 there is a continued building up of strength and fitness, losing weight, building patterns/habits and gaining longer term self-efficacy. After 12 weeks, group training stops and patients are much more on their own. Patterns diverge, with some continuing to improve further, whereas others decline.

Second, some of the physiological improvements of the first 12 weeks were sustained at 50 weeks (a more detailed analysis will follow in a separate publication, based on more reliable and extensive biometric and clinical measurements): average 8% weight loss (was 9% at 12 weeks), roughly 20% lower fasting glucose and 65% lower insulin medication (was 20% lower and 71% lower respectively at 12 weeks, based on data in self-monitoring tool).

Clearly, the results in the first 12 weeks helped motivate patients and provided positive feedback that they were on the right track. Still, given the goal of long term (50 weeks)
health results, it is positive to see that the 12 week results are largely sustained through to week 50.

The two measures for physical endurance and strength showed interesting differences over time. Endurance measure VO2max first increased +45% at week 12 and was +24% at week 50. Strength (measured via 30 sec sit/stand test) on the other hand was +23% over the 12-week period and further improved to +44% (week 50). Of the 11 participants, 7 have continued intensive exercise in weeks 12-50.

Third, the TAM (Technology Acceptance Model) user evaluations of week 12 and 50 shed some further light on patients’ experience and appreciation of the intervention, see also Table 1.

Table 1: TAM (Technology Acceptance Model) user evaluation
(n=11, weeks 12 and 50)

<table>
<thead>
<tr>
<th>TAM Construct</th>
<th>Week 12 Score (out of 7)</th>
<th>Week 50 Score (out of 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Usefulness</td>
<td>All items ≥ 6.8</td>
<td>All items ≥ 6.6</td>
</tr>
<tr>
<td>2. Effortless</td>
<td>Lowest (5.0): Health Quiz &amp; Lowest (5.0): Food/exercise logging in dashboard 5.3: Food guidelines</td>
<td>Lowest (4.8): Food guidelines 5.1: Food/exercise logging in dashboard 5.2: Week tip in mail</td>
</tr>
<tr>
<td>3. Opinion of social circle</td>
<td>All items ≥ 6.3; except ‘other patients’: 5.4</td>
<td>All items ≥ 6.3; except ‘other patients’: 6.0</td>
</tr>
<tr>
<td>4. Support</td>
<td>All items ≥ 6.0</td>
<td>All items ≥ 6.0</td>
</tr>
<tr>
<td>5. Affect</td>
<td>All items ≥ 6.4</td>
<td>All items ≥ 6.5</td>
</tr>
<tr>
<td>6. Ability</td>
<td>All items ≥ 6.0</td>
<td>All items ≥ 5.7</td>
</tr>
<tr>
<td>7. Trust</td>
<td>All items ≥ 6.2</td>
<td>5.8: Privacy? Rest: 6.5</td>
</tr>
</tbody>
</table>
The TAM (Technology Acceptance Model, Likert scale 1 to 7, strongly disagree to strongly agree, with several negatively coded items) user evaluation at weeks 12 and 50 shows three main patterns. First, these patients were relatively positive at 12 weeks and 50 weeks about all TAM constructs. Aspects that scored particularly high were: usefulness and the support offered by the multidisciplinary health team.

Second, some patients were not ICT-literate and clearly had trouble with eTools like the Health Quiz of food/exercise logging. See Simons (2016) for a more extensive discussion on their differences in ICT adoption, which became apparent in the first 12 weeks.

Third, we observed that over the course of roughly weeks 12 to 50, attention of participants shifted, also visible in their TAM scores. After initial attention on tools and start up challenges, attention later shifted to health literacy, plus sustaining healthy food and exercise patterns. In hindsight (at week 50), participants started appreciating the intensive start menu and start workshop more, the exercise support continued to be highly valued, plus sustaining healthy patterns in weeks 12 to 50 was top of mind: see the high scores for these elements in TAM constructs 8 (Valuation of support elements) and 9 (Future use). On the level of social support and maintaining a healthy lifestyle focus, the group spontaneously organized monthly meetings together, outside of the hospital setting.

The final set of study results regard research question 2, analyses to enable lessons for long term eHealth relationship building. As a basis, we use an efficacy evaluation of the hybrid eSupport mix deployed, at 50 weeks follow up. Table 2 shows the authors’ evaluation using the theory framework of Figure 1.
Table 2: Authors’ design evaluation at 50 weeks follow up, on design requirements from Figure 1 (authors’ opinions, 5-point scale from - - to ++)

<table>
<thead>
<tr>
<th>Health Effectiveness</th>
<th>Coaching Performance</th>
<th>ICT Value Adding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health literacy:</td>
<td>Promoting health actions:</td>
<td>Motivators, triggers, experience:</td>
</tr>
<tr>
<td>+ Better than the low literacy start, but much forgotten at wk 50 by some.</td>
<td>++ (e)Coach mix promoted steps forward for all.</td>
<td>+ Most used one or more eTools in wk 12-50, but large variance.</td>
</tr>
<tr>
<td>- Increased falling back into certain old beliefs at wk 50.</td>
<td>+/- Increasing variance after 12 weeks.</td>
<td>Simplicity:</td>
</tr>
<tr>
<td>Health behaviours:</td>
<td>Supporting self-efficacy:</td>
<td>++ Simple mail reminder for sugar/insulin inputs. (Some were highly ICT-illiterate.)</td>
</tr>
<tr>
<td>+/- After 12 weeks: Improved behaviour, but large variance.</td>
<td>+ Sustained self-efficacy at 50 weeks, except for two patients with major life/health events and low compliance wk 12-50.</td>
<td>- Health Quiz and food logging being complex for some.</td>
</tr>
<tr>
<td>Health outcomes:</td>
<td>Activating intrinsic motivation:</td>
<td>Fit with coach processes:</td>
</tr>
<tr>
<td>++ Biomarkers &amp; medication.</td>
<td>++ Getting results and feeling better. Continued high satisfaction at wk 50.</td>
<td>++ eTools: integral part of coach processes and effectiveness.</td>
</tr>
<tr>
<td>Quality of Life:</td>
<td></td>
<td>+/- Much motivation support still from the coaches, less from tools.</td>
</tr>
<tr>
<td>+ At wk 50 better than start.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 contains several lessons. First, looking at Health Effectiveness, we see mixed results. Biologically, there are large, positive effects for all 11 participants, even at 50 weeks. Even despite the large health, education and psychology differences within the group. However, regarding health literacy and self-management competence, the large differences that were observed at the start, became increasingly pronounced during the 50 weeks follow up. This relates to the second column: Coaching Performance. Promoting health actions and intrinsic motivation worked relatively well. But with those patients that have less self-management skills, it is hard to maintain coaching effectiveness in the 12 to 50 weeks period. Third, regarding ICT Value Adding, it was good that there was a variety of eTools, given the large differences in the patient group regarding ICT literacy and preferences. The simple mail based tool for sugar/insulin monitoring was highly valued by all. And for the multi-disciplinary coach team the eTools were very useful for progress monitoring and pro-active coaching. See section 5.1, design lessons and implications for practice, for further reflection and improvement ideas on eTools.

5 Design Lessons and Implications for Practice

Several lessons can be learned from this study in relation to the intensive healthy lifestyle approach and in relation to the suitability of hybrid eHealth support. Plus, we will address options for improvement.
First, it is interesting to see in this HINTc intervention that satisfaction is high initially (at 4 & 12 weeks) and stays high or even seems to grow (during at least the first 50 weeks), even though large lifestyle changes are requested from the participants. Our interpretation is that contributing factors for this satisfaction are: gains in self-efficacy and health literacy, seeing results plus feeling results, which activates intrinsic motivation. In other words: the large and growing benefits that patients experience. The benefits, besides medication reduction, are also clearly visible in the increased scores on the Physical and Mental Health dimension of the RAND SF-8 Quality of Life survey.

Second, based on qualitative feedback from the participants, it appears that several new, healthier food and exercise patterns started to become ‘the new normal’ already after 4 weeks into the intervention, remaining ‘normal’ for participants at week 12 and 50 as well.

Third, opinions varied regarding the suitability of most of the eTools provided (like the health quiz, the email week tips, food and exercise logging). In the short term of the first few weeks, virtually all tools were used by virtually all patients. After several weeks, usage patterns diverged. Two factors appeared important in determining adoption and use of these tools: availability of time, plus ICT literacy (with the latter appearing most important: four participants expressed aversion at using computers. On top of that, individual preferences are important. For example, one participant continued daily food logging for over 50 weeks (whereas all others stopped after week 12), because he liked this form of explicit monitoring. Two other participants continued using the Health Quiz throughout the 50 weeks (the rest did not). Several others continued reading week tips and other health content during the 50 weeks follow up. Clearly, user preferences for the various eSupport tools differed.

Fourth, the exception to this varied eTool adoption pattern was the simple, daily mail reminder Tool for sugar/insulin inputs, also described in Simons (2016). This tool was used daily again by the patient group in weeks 48 - 50 to assemble user pattern data. (The tool was not used in between, since care was handed over to their General Practitioners). We think that the combination of high simplicity with high usefulness was the key to its high adoption. The tool was an important basis for the coaching from the multidisciplinary support team. In conclusion: eSupport was not only useful for the patients, but especially for the care givers, providing them with much more extensive views on the users.

Fifth, besides eTool support, the group effects and the multidisciplinary support team were highly valued. The patient group arranged several social events together during the weeks 12 – 50 period and every 6 weeks there was a 1-hour gathering at the hospital again with the support team. The hospital team meeting was valued socially, but also for health literacy and practical support. These group effects fostered high levels of interpersonal commitment, which is important for long term relationships and something that is more challenging to achieve with eTools.
Finally, if we look at future improvement suggestions, several innovation opportunities emerge. First, in the coaches’ professional opinion, strength and endurance improvements could have been significantly larger with more effective training. Thus, in the next diabetes lifestyle project better training equipment will be used. Second, the training progress feedback loop will be used more, with a mail based self-management monitoring tool similar to our sugar/insulin tool. So that even after completion of the group training period together, the coaches can continue monitoring and guiding patients better on their exercise progress.

Third, regarding building long term e-relationships, it would not be correct to label the phase of 12 to 50 weeks as ‘maintenance’. Patients are continuously renewing their patterns, experiences and lessons. All in relation to health literacy and health competence. Better (e)Support is needed for these renewed learning processes. Within long term support relationships, there clearly are patient needs for continued learning, growth and discovery. Hence, more functionality will have to be developed to stimulate online, effective search-, interaction- and question/answer behaviours of patients. Both in relation to health literacy questions as well as in relation to health routines, goals and competencies.

6 Implications for Theory

As stated before (Simons, 2016) for several of the patients in this group, their learning styles were highly non-cognitive. An (apparent) understanding of health cause and effect seemed to have less impact than experiencing cause and effect. Daily feedback loops between behaviours and (negatively high) sugar values were useful in this regard. For this group, learning is not very much about explicit awareness, intentions, goals, behaviour and maintenance plans, as postulated in models like HAPA (Health Action Process Approach) and i-change (Schwarzer 2010, Wiedeman 2011). This appears to resemble mental models of impulse purchasing in marketing: first acting, then experiencing and opinion forming (Vohs 2007).

Next, the term ‘maintenance’ (as used in HAPA for example) seems a miss-qualifier for the longer term phase of health behaviours observed here (12 to 50 weeks). What we observed was closer to processes of: iterative circles, continuous renewal, re-interpretation and discovery. These processes of course include pitfalls for those who have fragile health literacy. The latter group easily tend to fall prey to misbeliefs and misadvice from others around them (patients, family of popular press). Thus, finding effective and efficient formats for continued (e)coaching is very valuable for long term support as part of long term e-relationships with patients.

Finally, four of the eleven participants simply disliked using ICT (whether laptop, smart pad or smartphone) for either reading, checking mail or inputting data. Still, the overall-attractiveness of the intervention was rated high, because of a) the large benefits and b) the extensive practitioner- and group support. Thus, the eHealth law of attrition
(Eysenbach 2005) was bypassed, partly thanks to (social) benefits in the context of the ICT. Plus, some cognitive dissonance may have worked to our advantage: if something is a challenge, then people may appreciate their own achievements and results more. This appears to have helped increase motivation for ICT-adoption as well as the extensive lifestyle improvements. Especially in the longer run, their increased self-appreciation and self-efficacy appears to have helped.

7 Conclusion

Summarizing from this study, we can conclude a few key points. First, the 12 weeks of intensive training and coaching sustainably (for 50 weeks at least) improved patients’ health awareness, health behaviours, health outcomes and quality of life. Second, a virtuous cycle was started (as noted earlier in other lifestyle eHealth settings, see Simons 2014): better health literacy & behaviours -> better results -> better health literacy & behaviours. This helped patients reverse type 2 diabetes (DM2) progression, lowering all from a very high level of insulin therapy to on average 65% lower levels 50 weeks later, with two patients able to stop insulin therapy. Third, this is a challenging patient group with some being relatively low in health- and ICT literacy. Following the design analysis, the highly simplified solution we created for secure, daily eLogging for sugar/insulin for this group was relatively useful. All patients used it well and it enabled everybody involved to closely monitor progression. Regarding other eTools, appreciation and use varied, and future work is needed to increase long term effectiveness and e-relationship building.

This preliminary analysis has several limitations. First, this is only a pilot study with 11 participants. Second, the 50-week data analyses are not complete yet; more biometric and behaviour data analyses still need to be done. Third, regarding external validity, these study results may only apply to motivated individuals, who volunteer for lifestyle training. Fourth, it can be argued that TAM is not the only suitable instrument for evaluating technology adoption. For example, UTAUT (Venkatesh 2003) is also viable. However, UTAUT was developed and validated in organisation contexts, where functional aspects of information systems adoption (like performance and effort expectations) are relatively important. In consumer contexts, items regarding ‘Attitude towards Use’ are relevant as well (Carlsson 2006), and those are part of TAM.

Still, on the positive side our results (biological, behavioural, TAM) prove relatively robust across the 11 participants, even though they are diverse in background (education, gender, age, insulin medication levels and co-morbidity, health literacy, coping and learning styles). And this pilot provided an opportunity for design analysis regarding the hybrid service mix deployed and opportunities for long term e-relationship building.

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