



## E-Health

## Evaluation of the web-based Diabetes Interactive Education Programme (DIEP) for patients with type 2 diabetes

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## ABSTRACT

**Objective:** The objective in this study was to evaluate a web-based type 2 diabetes self-management education programme aimed at improving knowledge, encouraging active patient participation and providing supportive self-management tools.

**Methods:** (1) An effect evaluation was conducted using a randomized controlled trial with a pre-test and post-test design ( $n = 99$ ) and a knowledge questionnaire. (2) A user evaluation was conducted using an online questionnaire ( $n = 564$ ) and one-on-one interviews ( $n = 11$ ) to examine the perceived quality, use of functionalities and use of the programme as a supportive tool in education.

**Results:** The effect evaluation showed a significant intervention effect ( $p < 0.01$ ) on knowledge. The user evaluation showed high satisfaction with the programme's content, credibility and user-friendliness. However, functionalities and self-management tools were used by less than half of the participants.

**Conclusion:** The programme can improve knowledge, but it is not fully used as intended. A more optimal use of the programme is necessary for higher efficacy.

**Practice implications:** The use of mostly spoken text instead of written text was highly appreciated and could be used more often for educational websites. Furthermore, health care practitioners need support in implementing new educational programmes during consultations.

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### 1. Introduction

Diabetes type 2 (DM2) is a chronic condition with a fast increasing prevalence. The WHO estimated a rise of the total number of people with DM from 171 million in 2000 to 366 million in 2030 [1], of which approximately 90% will have DM2. Self-management is a complex but essential component of the management of chronic illnesses such as diabetes, since it can limit the impact of chronic illness on patient and societal level [2–5]. Several studies indicate that patients experience difficulties with self-management [6–8] and together with the increase in the number of diabetic patients the demand on the health care system and health care professionals (HCPs) increases. Therefore, to limit the consequences of the 'diabetes epidemic', supportive tools for adequate self-management are urgently needed.

The first prerequisite for self-management is that patients have enough knowledge to make informed decisions [8–10] and to work together with their HCPs [11,12]. Studies have shown that knowledge, preparation for consultations, active patient participation during consultations, lifestyle changes, and patients' involvement in goal setting are important requirements for self-management [13–16].

Although these different valuable strategies are known, education materials in DM2 care in the Netherlands primarily consist of written materials, mostly focused on didactic teaching. Moreover, different organizations and companies distribute different education materials through HCPs. To our knowledge, there was no nation-wide programme in the Netherlands that could be used by different HCPs and also by patients with DM2 that provided information *and* tools for self-management, could be used at their convenience and that was adaptive to specific needs.

Reviews of previous studies on self-management education programmes have shown that educational interventions often consist of face-to-face education in both one-on-one and group sessions [17–19]. Although these interventions may be effective in improving patients' understanding of diabetes, they do not relieve HCPs' workload. Internet and information technology offer

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opportunities for diabetes education and care and this technology is becoming increasingly important because of the advantages of the Internet and because of trends in diabetes care [20]. Patients want to be engaged in health care decisions and outcome monitoring [21,22], which is possible through the widespread, low-cost Internet access that is erasing geographic, economic and demographic barriers. Moreover, the number of people using the Internet for information about health is growing [23], websites are available at any moment, interactive features can be applied and information can be tailored to individual needs [20]. Boren and colleagues reviewed 21 computerized learning technology interventions that can empower patients in the self-management of diabetes and support diabetes education over a distance. They distinguished three approaches: assessment and instructions, assessment with individual counselling and feedback, and games or simulation [24]. Most evidence showed advantageous effects of these computerized interventions on immediate outcomes (learning); less evidence was found for long-term outcomes (health status). The research area of the Internet and information technology is relatively young, and the benefits and applicability in daily practice need further exploration.

To support patient education and thereby self-management, we developed a web-based education programme (Diabetes Interactive Education Programme; DIEP) for patients with DM2. DIEP was developed in close cooperation with potential users and is based on national guidelines for diabetes care. The programme aims to (a) increase understanding of DM2; (b) encourage active patient participation; and (c) provide tools to support adequate self-management. A separate article has been published about the developmental process (based on intervention mapping [25]) and content of DIEP [26], but a short description of DIEP can be found below.

The current article describes two evaluations that were performed in different samples. (1) An *effect evaluation* was done to determine whether the DIEP Internet-based education programme has the potential to increase DM2 knowledge. The efficacy of DIEP depends on the use of the programme and its functionalities by HCPs and patients, and on how well it fits the needs and preferences of the HCPs and patients. Therefore, (2) a *user evaluation* was performed among patients and HCPs to assess the programme's perceived quality, the use of functionalities and the use of DIEP as a supportive tool in education.

### 1.1. [www.DIEP.info](http://www.DIEP.info)

To increase understanding of DM2, DIEP gives an overview of DM2 in seven chapters, see Table 1. Information is provided on different levels: basic information (e.g. where insulin is produced) and additional information (e.g. relation between insulin and blood glucose). Each chapter closes with questions to the patient, e.g. 'What is your strategy to prevent hypoglycaemia?' The information is mostly presented in spoken language, supported by headlines, images, video and real patient experiences on different topics.

**Table 1**  
Knowledge scale topics.

Chapter	Number of items
Background information about DM	5
Hyperglycemia (consequences & treatment)	4
Diabetes and lifestyle	8
Treatment & management of the disease	5
Hypoglycemia	3
Blood glucose monitoring	2
Living with diabetes (managing specific situations)	2
Total	29

Besides chapters with information, the following additional tools are added to encourage patient participation and support adequate self-management: Each chapter has a *workbook* where patients can register the information they have consumed and note down questions they would like to discuss with the HCP. This workbook also provides *goal setting forms* for detailed self-management plans and *checklists on specific self-management behaviours*, e.g. foot care.

## 2. Methods

### 2.1. Study 1: effect evaluation

#### 2.1.1. Design

In a randomized controlled trial with a pre-test (T0) and one post-test after two weeks (T1) participants were allocated to the experimental group (A), the control group (B) or the post-test only control group (C). The latter was included to assess possible test effects of completing the pre-test on post-test knowledge scores. Only the experimental group (A) had access to DIEP for two weeks. Both control groups received access after the post-test.

#### 2.1.2. Participants and procedures

Patients with DM2 were recruited through an announcement in a free DM magazine, in local door-to-door papers and on two websites, where patients were informed that they could email for more information. After informed consent was obtained, patients were allocated to one of the three groups. Inclusion criteria were diagnosis of DM2 and age 40–70. Patients were excluded from participation if they already used DIEP. The questionnaires were sent by email and participants in the experimental group (A) received a login code for DIEP. The 'number of website visits' and 'total time spent on the website' were registered.

#### 2.1.3. Knowledge questionnaire

We developed a new knowledge questionnaire because to our knowledge there was no validated questionnaire applicable to the Dutch situation. The questionnaire was based on the content of DIEP, see Table 1, and contained 29 multiple-choice knowledge items with three options, only one of which was correct (values: 1 = correct, 0 = incorrect). Knowledge scores were calculated by summing all item scores with a maximum of 29. Both theoretical knowledge and practical knowledge were measured, see Table 2. Furthermore, additional information was obtained about sex, age, educational level, time since diagnosis and medical treatment.

The reproducibility of our knowledge questionnaire was determined by assessing the agreement (*Intraclass Correlation Coefficient*; two-way random model with participants and moments of measurement as random factors) and reliability (*Pearson's r*; test-retest method) using pre-test and post-test scores of the control group (B). Both, ICC<sub>agreement</sub> and Pearson's *r* were 0.85,  $p < 0.001$ , indicating high reproducibility. Furthermore, an indicator of construct validity was the expected relationship between baseline scores and educational levels ( $\beta = 0.315$ ;  $p = 0.002$ ) and time since diagnosis ( $\beta = 0.215$ ;  $p = 0.027$ ) rather than between baseline scores and age or gender [27].

#### 2.1.4. Data analysis

Independent-sample *t*-tests and logistic regression analyses were used for attrition analysis. To test whether randomization was successful, Chi-square, one-way ANOVAs and independent-sample *t*-tests were used. An independent-samples *t*-test (between the two control conditions) was used to assess whether the pre-test had an effect on post-test knowledge scores. A multiple linear regression analysis was used to examine the relation between demographic characteristics and baseline knowledge scores.

**Table 2**  
Examples of practical and theoretical knowledge questions.

Theoretical knowledge	Practical knowledge
Eating foods lower in fat decreases your risk for	Imagine you are at a birthday party and you drink two glasses of red wine. Your blood glucose initially will
(a) nerve disease	(a) increase
(b) kidney disease	(b) decrease
(c) heart disease	(c) stay the same

Within-group analyses on knowledge were conducted using a paired *t*-test. The efficacy of the intervention was further tested with a multiple linear regression analysis. The significance of the effects is reported ( $p < 0.05$ ) as well as the magnitude of the effect size (Cohen's *d*) [28].

To determine if a relation exists between 'total time spent on the website' and 'change in knowledge', a Spearman correlation analysis was done because 'total time spent' was not distributed normally.

Participants with an outlying (outside three standard deviations from the mean) 'total time spent on the website' or 'number of website visits' were excluded from the analyses with these variables.

## 2.2. Study 2: user evaluation

An online questionnaire was used for the user evaluation. More explanatory information was obtained in eleven semi-structured one-on-one interviews.

### 2.2.1. Participants and procedures

All DIEP visitors were asked to fill in an *online questionnaire* when they closed the programme. Only the data of visitors with DM2 were included in the analyses. The questionnaire was available for two years (July 2006–July 2008).

For the *interviews*, patients with DM2 as well as HPCs (nurse practitioners and diabetes nurses) using DIEP were approached. HPCs were included because optimal use of DIEP as an education tool partly depends on the use by HPCs. The snowball method was used for recruitment; a HCP working with DIEP was asked to name other HCPs working with DIEP, and HCPs were asked to recruit patients. Informed consent was obtained prior to the interviews.

### 2.2.2. User evaluation measurements

The *online questionnaire* consisted of mostly multiple-choice questions, addressing the perceived quality of the website and the use of functionalities. Table 3 gives an overview of the number of

items per topic and examples of questions. Open-ended questions were used for (a) clarification of information lacking in the programme and (b) suggestions for improving the programme.

For the *interviews*, a topic guide was generated based on previous research on quality aspects of websites [29–32]. The main topics were (a) programme content; (b) user-friendliness and programme features; and (c) programme goals (see Table 4).

### 2.2.3. Data analysis

Concerning the *online questionnaire*, logistic regression analyses were used to analyze the relationship between the use of functionalities and demographics.

The *interviews* were all tape-recorded and transcribed verbatim. An analysis was conducted on the original transcripts, facilitated by using QSR NVivo 2.0.

## 3. Results

### 3.1. Study 1: results of the effect evaluation

#### 3.1.1. Response, baseline characteristics and test effect

The majority (87%) of people that wanted more information about this study ( $n = 190$ ) gave informed consent ( $n = 166$ ). Thirteen participants were excluded from all analyses because they had already used the website before the study. Nine participants dropped out before the start of the study (no data available), and another nine before the post-test (experimental group (A)  $n = 7$ ; control group (B)  $n = 2$ ).

There were no significant differences in gender, age, BMI, time since diagnosis, educational level or baseline knowledge score between the three groups. Table 5 gives a description of the participants' characteristics ( $n = 135$ ). Participants with a longer time since diagnosis ( $\beta = 0.215$ ;  $p = 0.027$ ) or a higher educational level ( $\beta = 0.315$ ;  $p = 0.002$ ) had a higher baseline knowledge score than participants with a shorter time since diagnosis or a lower educational level. Baseline knowledge did not depend on age or gender.

No test effects on knowledge scores were found when the post-test knowledge scores of the control group (B) were compared with the post-test only control group (C) ( $t = 0.01$ ;  $df = 90$ ;  $p = 0.99$ ).

#### 3.1.2. Intervention effects

Within the experimental group (A), post-test knowledge scores were significantly higher compared to the baseline ( $p < 0.05$ ;  $ES = 0.40$ ). No changes were observed in the control group (B).

Compared to the control group (B), the experimental group (A) had higher knowledge scores on T1 ( $\beta = 0.18$ ) with adjustment for knowledge at T0. This difference did not change after adjustment

**Table 3**  
User evaluation online questionnaire topics.

Topic	Number of items	Example
Content	5	How satisfied are you with the information you have found? (a) very satisfied, (b) satisfied, (c) not satisfied or unsatisfied, (d) unsatisfied, (e) very unsatisfied
User-friendliness	4	What do you think of the website's user-friendliness? (a) very good, (b) good, (c) not good or bad, (d) bad, (e) very bad
Use of sound	2	Do you have the sound turned on when you visit the website? (a) yes, (b) no, (c) no, because my computer has no sound
Use of functionalities	4	Have you ever looked at the additional information? (a) yes, (b) no
Revisit	2	Are you planning to revisit the website? (a) yes, (b) no
Suggestions	1	Do you have suggestions for improving the website?
Background info (demographics, duration of DM2, website visit)	4	–
Total	22	

**Table 4**  
Examples of one-on-one interview questions.

Topic	Example
Programme content	What is your opinion about the content of the website? What information could you not find?
User-friendliness	What do you think about the user-friendliness of the website? What do you think could be improved?
Programme goals	What do you think the website's goal is? Do you think that these goals are achievable?

for age, gender, educational level and time since diagnosis, see Table 6. The effect of the group on knowledge was medium with an ES of 0.54 [33]. Furthermore, older participants had a lower post-test knowledge score than younger participants. The group  $\times$  age interaction effect was not significant.

Within the experimental group (A), the mean number of website visits was 3.56 (SD = 2.66) and the total time spent on the website was 58 min on average (SD = 56.08). The correlation between total time spent on the website and increase in knowledge was not significant ( $p = 0.42$ ). Furthermore, there was no significant relation between total time spent on the website and baseline knowledge, sex, age, educational level and time since diagnosis.

### 3.2. Study 2: results of user evaluation

#### 3.2.1. Participants

**Online questionnaire.** Of the 3961 people asked to participate, 3122 refused and 275 were excluded from further analysis, because they were not patients with DM2. Finally, 564 patients were included in this study. The average age was 57 years (SD = 9.96), see Table 5 for a description of participants' characteristics.

For 84% of the participants, it was their first visit to DIEP. Most participants (61%) were advised to visit DIEP by their HCP and 23% had heard of this website and were curious. Another 10% had specific questions about DM2. Almost all (99%) participants intended to revisit DIEP.

**Interviews.** Six HCPs and five patients were interviewed. Three HCPs had been using DIEP for several months, the other three for longer than one year. Two patients had also used DIEP for longer

than one year, two had used it for a couple of months and one patient had only recently been introduced to DIEP.

#### 3.2.2. Evaluation of the programme

**Content.** The respondents to the questionnaire evaluated the content of DIEP positively; 85% found all the information they were looking for. Furthermore, 94% was satisfied or very satisfied with the information, 91% acquired new knowledge by visiting DIEP and 99% reported that DIEP was interesting in general. All respondents regarded the DIEP information as credible. Critical notes were made about it being difficult finding information on medication and on certain aspects of diet. Moreover, participant mentioned that the amount of information about diet should be increased. The interviews mainly supported these outcomes on satisfaction with content, although some participants would like to see more specific information (e.g. specific diets). Furthermore, all interview participants estimated the content as credible. Some participants said that they found it reliable because of the involvement of an academic hospital. Almost half of the participants perceived the content as up to date; the other participants said this was difficult to assess.

**User-friendliness.** Almost all (98%) respondents to the questionnaire described user-friendliness as good to very good. Furthermore, all respondents agreed that the chapter division is clear and 95% reported that it was easy to very easy to navigate through DIEP. Almost all (96%) respondents answered that the language use was good. Participants in the interviews explicated that the use of colours in the website contributed to the clarity of the programme, and that the illustrations helped to understand the information. The distinction between basic information and additional information was highly appreciated and according to HCPs, it protects patients from information overload.

**Use of sound.** Of the respondents to the questionnaire, 91% was pleased to very pleased by the information being delivered in spoken text. Some respondents would like to be able to import their medical information. Data from the interviews showed that most participants (patients as well as HCPs) strongly appreciated the spoken text, although HCPs did not know how to switch off the sound while using the programme during their consultations.

**Use of functionalities.** Of the respondents to the questionnaire, 41% used the search function, 28% answered the questions at the end of a chapter, 60% looked at the additional information and 13%

**Table 5**  
Participants characteristics of the effect evaluation and online user evaluation.

Variable	Effect evaluation			User evaluation (n = 564)
	Exp group (A) (n = 43)	Control group (B) (n = 56)	Control group (C) (n = 36)	
Sex; % female	56	48	53	40
Mean age	56 ( $\pm 7$ )	56 ( $\pm 7$ )	59 ( $\pm 6$ )	57 ( $\pm 10$ )
Educational level				
% Low	35	43	25	34
% Middle	35	30	28	38
% High	30	27	47	24
Time since diagnosis				
% <2 years	19	21	31	44
% 2–4 years	16	27	14	20
% $\geq 4$ years	65	52	55	36
Treatment				
% None	7	4	0	–
% Oral medication	56	70	61	–
% Insulin	23	9	14	–
% Oral med. & insulin	14	18	25	–
Baseline knowledge score <sup>a</sup>	24.56 ( $\pm 2.38$ )	24.50 ( $\pm 2.84$ )	–	–
Post-test knowledge score <sup>a</sup>	25.26 ( $\pm 2.11$ ) <sup>b</sup>	24.29 ( $\pm 2.96$ ) <sup>c</sup>	24.28 ( $\pm 3.18$ )	–

$\pm$  = SD.

<sup>a</sup> Maximum score = 29.

<sup>b</sup> Significant improvement within group (A).

<sup>c</sup> No significant change within control group (B).

No significant baseline differences between group A, B and C were found.



**Table 6**  
Results of linear regression on knowledge at post-test ( $n=99$ ).

Variable	$\beta$	$p$
Group	0.18	0.005
Knowledge T0	0.79	0.000
Sex	-0.03	0.611
Age	-0.13	0.047
Educational level	-0.04	0.583
Time since diagnosis	0.04	0.505

$R^2=0.67$ .

had printed out spoken text at least once. There was no influence of age or time since diagnosis on the use of these functionalities. However, men were more likely to look at the additional information than women (55% versus 64%, OR = 1.508; 95% CI = 1.02–2.20;  $p < 0.05$ ), and respondents with a low educational level were less likely to answer questions at the end of a chapter than respondents with a middle (OR = 1.884; 95% CI = 1.19–2.99;  $p < 0.05$ ) or high (OR = 1.824; 95% CI = 1.09–3.06;  $p < 0.05$ ) educational level, at 20% versus 33% and 31% respectively. Of the participants of the interviews, only two HCPs used the workbook intensively and the other four only distributed workbooks to their patients. Only two patients used the workbook to write down their questions to discuss these with their HCP.

**Programme goals.** Regarding the intended goals of DIEP (to improve self-management and encourage patient activation), three HCPs said that DIEP can improve self-management, and after probing another two agreed. However, DIEP was primarily seen as an additional information tool in education. Several HCPs argued that on its own DIEP is not sufficient to achieve better contact and better self-management; individual contact remains crucial. According to patients, DIEP's main goal is to provide information. And according to three patients, the website contributes to problem solving. All patients shared the view, when specifically asked, that the website can potentially improve communication and self-management.

## 4. Discussion and conclusion

### 4.1. Discussion

We investigated whether an Internet-based education programme has the potential to contribute to self-management by improving knowledge in patients with DM2. Even though baseline knowledge scores were relatively high and the programme was only made available to participants for two weeks, we found a positive intervention effect due to a significant improvement of knowledge scores in the experimental group (A). The relatively high baseline scores could be explained by the fact that more than half of all participants had had diabetes for over four years. It is likely that these participants already received DM education as part of their treatment. Our knowledge questionnaire might have been relatively easy for the participants. Although theoretically, patients with recently diagnosed diabetes or patients with a low educational level may benefit most from the programme because they had the lowest baseline scores, we did not find a higher increase in knowledge among these patients. Improvements in knowledge were independent of the total time spent on the website, indicating beneficial effects even after viewing only a small part of the total programme.

The importance of educating patients for a better understanding of the disease has been stressed earlier [34]. Puder and colleagues emphasized the necessity of education to enable patients to make informed choices concerning health-related behaviour and to implement a self-care plan with individual goals [35]. We believe, therefore, that DIEP can contribute to better self-

management by increasing knowledge about DM2. Conversely, the relevance of knowledge as an outcome of patient education has been disputed [36]. Knowledge may not directly lead to better self-management, but patients with chronic conditions need sufficient understanding of the disease to make day-to-day decisions about their illness [8,10,17,37].

In addition to the effect evaluation, we assessed the perceived quality of the programme, the use of its functionalities and the use of DIEP as a supportive tool in education in a second study by means of a questionnaire and interviews. The majority of participants evaluated the quality of the programme positively; they were satisfied with the content, the design and user-friendliness. Also, the spoken text was highly valued. We believe that this rather unique aspect of the programme has contributed to the positive evaluation. The results were supported by the fact that almost everyone expressed the intention to revisit the website. Useful suggestions were to extend the information, especially about diet and to make it easier for HCPs to turn off the sound.

Although the programme was positively evaluated, only a minority used the functionalities as intended, including the workbook. Furthermore, according to HCPs and patients the programme is primarily an informative education tool, and no use is made of the self-management supporting features. However, after probing, participants recognized the capacity of the programme to improve communication and self-management. We hypothesize that if the functionalities are used more efficiently, by both patients and HCPs, the efficacy of DIEP might increase. For example, if workbooks are used for goal setting and discussed with HCPs, this might help patients achieve self-management goals [17,38,39].

HCPs had difficulties recruiting patients to participate in the one-on-one interview, often because they did not know whether a patient had worked with DIEP or not. HCPs admitted that they only pointed out the existence of the programme to some patients, indicating the absence of structural use of DIEP during consultations. For optimal efficacy, a more adequate implementation and use of the programme is necessary. An active role of HCPs is required for a better implementation; self-management behaviours as outcome measures for evaluating DIEP may then become relevant.

The present study has some limitations. Self-management outcomes were not measured because no improvements could be expected since the experimental group had only had access to the programme for two weeks. Future research should investigate the long-term effects of DIEP on self-management. Furthermore, in diabetes care, education is an ongoing process in which patients should have access to education at their convenience. The short access period, together with the high baseline scores may have led to the limited (+0.7), but significant, increase in knowledge. Another limitation is the number of interviews for the user evaluation. However, these interviews with patients and HCPs were used to obtain more explanatory information in addition to the information from the online questionnaire among patients. The high number of non-responders to the user evaluation questionnaire, on which we have no data, should be taken into account in the interpretation of the results. The low acceptance rate in this particular study may have been caused by the fact that patients were asked to participate after they had decided to exit the programme. It is likely that people who appreciated our programme were more likely to participate in our study than people who were dissatisfied with the programme which may have led to an overestimation of the appreciation of our programme. However, because of the large number of participants ( $n = 564$ ) we believe our evaluation is valuable, especially the part of the evaluation about the use of the programme.

Despite these restrictions and the limited effects on knowledge, this web-based education tool has high potential. The perceived high quality of DIEP is not only shown in the current study, but also by reactions from people in the field of diabetes care in the Netherlands. After being nominated by representatives of inter-nists, general practitioners, diabetes nurses and patients with DM2, DIEP won the 2005 quality award for diabetes care. Furthermore, in 2006 the Netherlands Institute for Health Promotion and Disease Prevention assessed the quality of diabetes education materials in the Netherlands and described DIEP as a highly promising tool [40].

#### 4.2. Conclusion

DIEP can improve knowledge and, thereby, has the potential to contribute to self-management. Furthermore, participants were highly satisfied with the content, credibility and user-friendliness of the programme. However, the programme is merely seen as an information tool instead of an education tool that offers the opportunity to encourage patient activation and self-management and therefore needs a better implementation plan.

Online education is easily accessible, can be interactive and can be adapted to individual characteristics based on, for example, learning needs or educational level [41,42]. DIEP could be further developed into a more comprehensive source, with more interactive features and tailored information.

#### 4.3. Practice implications

- Participants appreciated the spoken text instead of only written text. Educational websites could use this Internet option more often.
- When developing new interventions, close cooperation with the target group and stakeholders should be assured for a high perceived quality of the programme.
- Adequate implementation and use of a new education programme requires an active role of and clear instructions for HCPs. Therefore, training for HCPs in how to use the programme in diabetes care has been developed: DIEP@work.
- Continuous development of the programme is necessary for up-to-date information and for processing suggestions for improvement. Therefore, the DIEP-foundation was established. DIEP could also be used as framework for programmes in other countries, as it has in Belgium, and for other chronic conditions in which self-management plays an important role.

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#### References

- [1] Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes. Estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27:1047–53.
- [2] Adler AI, Stratton IM, Neil HA, Yudkin JS, Matthews DR, Cull CA, et al. Association of systolic blood pressure with macrovascular and microvascular complications of type 2 diabetes (UKPDS 36): prospective observational study. *Brit Med J* 2000;321:412–9.
- [3] Barlow J, Wright C, Sheasby J, Turner A, Hainsworth J. Self-management approaches for people with chronic conditions: a review. *Patient Educ Couns* 2002;48:177–87.
- [4] Norris SL, Lau J, Smith SJ, Schmid CH, Engelgau MM. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. *Diabetes Care* 2002;25:1159–71.
- [5] UK Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;352:837–53.
- [6] Vermeire E, Wens J, Van Royen P, Biot Y, Hearnshaw H, Lindenmeyer A. Interventions for improving adherence to treatment recommendations in people with type 2 diabetes mellitus. *Cochrane Database Syst Rev* 2005. Art. No.: CD003638. doi:10.1002/14651858.CD003638.pub2..
- [7] Jerant AF, Von Friederichs Fitzwater MM, Moore M. Patients' perceived barriers to active self-management of chronic conditions. *Patient Educ Couns* 2005;57:300–7.
- [8] Clement S. Diabetes self-management education. *Diabetes Care* 1995;18:1204–14.
- [9] Funnell MM, Anderson AM. Empowerment and self-management of diabetes. *Clinical Diabetes* 2004;22:123–7.
- [10] Funnell MM, Anderson RM. Working toward the next generation of diabetes self-management education. *Am J Prev Med* 2002;22:3–5.
- [11] Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A. Improving chronic illness care: translating evidence into action. *Health Affairs* 2001;20:64–78.
- [12] Wagner EH, Bennett SM, Austin BT, Greene SM, Schaefer JK, Vonkorff M. Finding common ground: patient-centeredness and evidence-based chronic illness care. *J Altern Complement Med* 2005;11:S7–15.
- [13] Williams GC, McGregor HA, Zeldman A, Freedman ZR, Deci EL. Testing a self-determination theory process model for promoting glycemic control through diabetes self-management. *Health Psychol* 2004;23:58–66.
- [14] Williams GC, McGregor H, Zeldman A, Freedman ZR, Deci EL, Elder D. Promoting glycemic control through diabetes self-management: evaluating a patient activation intervention. *Patient Educ Couns* 2005;56:28–34.
- [15] Clark M, Hampson SE, Avery L, Simpson R. Effects of a tailored lifestyle self-management intervention in patients with type 2 diabetes. *Br J Health Psychol* 2004;9:365–79.
- [16] Heisler M, Bouknight RR, Hayward RA, Smith DM, Kerr EA. The relative importance of physician communication, participatory decision making, and patient understanding in diabetes self-management. *J Gen Intern Med* 2002;17:243–52.
- [17] Wens J, Vermeire E, Hearnshaw H, Lindenmeyer A, Biot Y, Van Royen P. Educational interventions aiming at improving adherence to treatment recommendations in type 2 diabetes: A sub-analysis of a systematic review of randomised controlled trials. *Diabetes Res Clin Pract* 2008;79:377–88.
- [18] Norris SL, Engelgau MM, Narayan KM. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. *Diabetes Care* 2001;24:561–87.
- [19] Heinrich E, Schaper NC, De Vries NK. Self-management interventions for type 2 diabetes: a systematic review. *Eur Diabetes Nurs* 2010;7:71–6.
- [20] Kaufman F. Internet and information technology use in treatment of diabetes. *Int J Clin Pract Suppl* 2010;166:41–6.
- [21] Coulter A. Do patients want a choice and does it work? *Brit Med J* 2010;341:c4989.
- [22] Coulter A, Jenkinson C. European patients' views on the responsiveness of health systems and healthcare providers. *Eur J Public Health* 2005;15:355–60.
- [23] Kaiser Family Foundation. E-Health and the elderly: How seniors use the Internet for health - Survey. Retrieved September 12, 2008, from <http://www.kff.org/entmedia/entmedia011205pkg.cfm>. 2005
- [24] Boren SA, Gunlock TL, Peeples MM, Krishna S. Computerized learning technologies for diabetes: a systematic review. *J Diabetes Sci Technol* 2008;2:139–46.
- [25] Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs. An intervention mapping approach, 2nd ed., San Francisco: Jossey-Bass; 2000.
- [26] Heinrich E, Schaper NC, De Vries NK. Development of the web-based type 2 diabetes education programme: DIEP. *Eur Diabetes Nurs* 2009;6:51–6.
- [27] Fitzgerald JT, Funnell MM, Hess GE, Barr PA, Anderson RM, Hiss RG, et al. The reliability and validity of a brief diabetes knowledge test. *Diabetes Care* 1998;21:706–10.
- [28] Cohen J. Statistical power analysis for the behavioral sciences. Hillsdale, New York: Lawrence Earlbaum Associates; 1988.
- [29] Kerr C, Murray E, Stevenson F, Gore C, Nazareth I. Internet interventions for long-term conditions: patient and caregiver quality criteria. *J Med Internet Res* 2006;8:e13.
- [30] Silberg WM, Lundberg GD, Musacchio RA. Assessing, controlling, and assuring the quality of medical information on the Internet: Caveat lector et viewer – let the reader and viewer beware. *J Am Med Assoc* 1997;277:1244–5.
- [31] Eysenbach G, Powell J, Kuss O, Sa ER. Empirical studies assessing the quality of health information for consumers on the world wide web: a systematic review. *J Am Med Assoc* 2002;287:2691–700.
- [32] Wyatt JC. Commentary: measuring quality and impact of the World Wide Web. *Brit Med J* 1997;314:1879–81.
- [33] Lipsey MW. Design sensitivity: statistical power for experimental research. London, New Delhi: Sage Publications; 1990.
- [34] Assal JP, Jacquemet S, Morel Y. The added value of therapy in diabetes: the education of patients for self-management of their disease. *Metabolism* 1997;46:61–4.
- [35] Puder JJ, Keller U. Quality of diabetes care: problem of patient or doctor adherence? *Swiss Med Wkly* 2003;133:530–4.
- [36] Cooper H, Booth K, Fear S, Gill G. Chronic disease patient education: lessons from meta-analyses. *Patient Educ Couns* 2001;44:107–17.
- [37] Van den Arend IJM, Stolk RP, Krans HMJ, Grobbee DE, Schrijvers AJP. Management of type 2 diabetes: a challenge for patient and physician. *Patient Educ Couns* 2000;40:187–94.

- [38] Hurn J, Kneebone I, Cropley M. Goal setting as an outcome measure: a systematic review. *Clin Rehabil* 2006;20:756–72.
- [39] Van Dam HA, Van der Horst F, Van den Borne B, Ryckman R, Crebolder H. Provider–patient interaction in diabetes care: effects on patient self-care and outcomes: a systematic review. *Patient Educ Couns* 2003;51:17–28.
- [40] Looise BJ, Van der Poel FP, Bos V. Diabeteseducatie in Nederland. State of the art van methoden en materialen. Woerden: NIGZ; 2006.
- [41] Benigeri M, Pluye P. Shortcomings of health information on the Internet. *Health Promot Int* 2003;18:381–6.
- [42] Atack L, Luke R, Chien E. Evaluation of patient satisfaction with tailored online patient education information. *Comput Inform Nurs* 2008;26:258–64.