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ORIGINAL ARTICLE

Differences Between Diabetes Patients Who Are Interested or Not in the Use of a Patient Web Portal

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Abstract

Objective: A patient Web portal allows patients to access their personal health record through the Internet. It may improve diabetes outcomes, but the adoption is unsatisfactory. We examined the differences between patients with and without a login in order to optimize its use.

Patients and Methods: A survey was conducted among patients from 62 general practices and one outpatient clinic that all use a diabetes Web portal. Between November 2011 and March 2012 questionnaires were sent to 1,500 patients with and 3,000 patients without a login. Patient groups were stratified according to type of diabetes. Demographic and diabetes-related variables were analyzed with multivariable regression analysis.

Results: The total response rate was 67%. Fewer than 50% of the patients did request a login. Among 128 patients with type 1 diabetes mellitus, those with a login (89.8%) were younger and more frequently treated by an internist. In 1,262 patients with type 2 diabetes mellitus, fewer patients had a log-in (41.0%), and the likelihood of having a login was independently associated with younger age, male gender, higher educational level, treatment by an internist, longer duration of diabetes, and polypharmacy (all $P < 0.001$).

Conclusions: Patients with type 1 diabetes request a login more frequently than patients with type 2 diabetes, and patients with a login are strikingly different than patients without. The healthcare provider seems to play an important role in patients' Web utilization. Simply promoting use of electronic healthcare methods does not make sense. It is important to address disparities between patient groups to optimize the use of a Web portal.

Introduction

Patients with type 2 diabetes should be monitored four times a year.[1] To cope with the rising numbers of people with diabetes in the future[2,3] and the increasing workload of healthcare personnel, the organization of diabetes care may need to change. One of the possibilities is to promote information exchange between patients and healthcare professionals that might facilitate a substantial increase of self-care.

Electronic health care (e-health) is such a method, and there are many forms of e-health,[4] ranging from general health information on the Internet to specific healthcare systems. One type of e-health is a patient Web portal, an online application that allows patients to interact and communicate with their physicians.[5] These portals have a positive effect on diabetes outcomes, such as hemoglobin A1c (HbA1c) and cholesterol,[6–10] and on self-efficacy.[11]

However, many patients do not use the patient portal.[12,13] This may be associated with limited health literacy,[12,14] social disparities,[15] the digital divide,[16] age,[17,18] lack of information like enrollment instructions,[17] or lack of motivation.[17] However, other studies indicate that elderly patients with diabetes effectively use the Internet[19] and are interested in patient portals.[19,20] One of the limitations of the existing evidence is that most of the studies about patient portals have been conducted in the general population instead of in a population of only diabetes patients.[16,21] The few studies carried out in a diabetes population did not differentiate between types of diabetes or treatment settings.[14,15]

In The Netherlands 96% of all inhabitants have access to the Internet, of which 84% is broadband access. Of the people with Internet access, 87% use it daily, and 11% use it at least once a week. Men and women have equal access, and over 95% of the people up to 65 years of age have access. Above the age of 65 years the access rate is lower (81%). Internet access ranges from 90% in lower education groups to 99% in the groups with the highest education. There is no digital divide due to cost of Internet access. Therefore, patient portals can

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theoretically be used by most of the patients with diabetes mellitus in The Netherlands.[22]

We hypothesize that, with increasing use of a patient portal, patients may become more involved in their treatment.[23] This may lead to less diabetes-specific distress and an increase in self-efficacy,[11] diabetes knowledge, treatment satisfaction,[24] and health status. Healthcare providers should be supported to identify groups of patients who need more attention in order to increase their portal use.

The aim of the present article is to study the characteristics, the health status, the self-efficacy, the diabetes knowledge, and the treatment satisfaction of patients with both type 1 and type 2 diabetes who do and do not have a login for a patient Web portal.

Patients and Methods

Study design

We conducted a survey in a sample of 12,793 diabetes patients, of whom 3,002 patients (23.5%) had a login to the Web portal and 9,791 (76.5%) had never requested a login. We randomly selected patients 18–85 years old: 1,500 from the login group and 3,000 from the non-login group. The rationale for this ratio is that we anticipated a lower response from the non-login group. Patients were sent an information letter together with a set of questionnaires. A reminder was sent twice in 3-week intervals. Patients who did not want to participate could declare the reason for non-participation. The survey was conducted between November 2011 and March 2012. The study was approved by the Medical Research Ethics Committee of the University Medical Center Utrecht (protocol number 11-296/C).

Study setting

Diamuraal is an organization that coordinates the diabetes care in a defined geographical area in the center of The Netherlands. It comprises 62 independent primary care practices and one outpatient clinic of the regional hospital. All physicians and nurses who participate in the care of patients with diabetes collaborate in the same electronic health record.

Since 2006, all diabetes patients in Diamuraal can request a login to access their personal electronic health record, on the condition that their healthcare providers give their consent. They get access by means of a Web-based patient portal (www.digitaallogboek.nl). The information system of this portal was developed by Diamuraal and is copyrighted by Portavita B.V. (Amsterdam, The Netherlands). After login, patients have access to their medical records, which include the information provided by their healthcare provider during medical consultation, such as physical examination, laboratory results, problem lists, and treatment goals. Well-prepared patients could be aware of their results before meeting their care provider. The patient portal also provides access to general diabetes information and an overview of all examinations and diabetes visits that are needed according to guidelines. Patients can upload the glucose levels measured at home and seek contact with their care provider through secured electronic messaging. The portal is additional; patients who have not requested access receive usual diabetes care according to the Dutch guidelines.[1]

Study measures

Patients' self-reported characteristics. We used a questionnaire for patient characteristics. It contained questions about educational level (no education or completed primary school [low]; completed secondary school or university [high]), ethnicity (born in Europe [white]; Suriname, the Antilles, Turkey, Morocco, or other [white]), living status (alone and independent or with supportive care [alone]; together with partner or family or in residential community [with others]), employment (having a paid job, being retired, or otherwise [studying, disabled, or unemployed]), medication, polypharmacy (the use of five or more medications), and self-reported nonadherence, smoking (current [yes]; never or ex-smoker [no]), drinking alcohol, being physically active at least five times a week for 30 min, fluency in Dutch language, access to the Internet, and having a computer.

Validated questionnaires. To measure satisfaction with diabetes treatment, the Diabetes Treatment Satisfaction Questionnaire[25] was used. It measures satisfaction with treatment regimen (six items) and perceived frequency of hyperglycemia (one item) and hypoglycemia (one item). The score ranges from 0 (very dissatisfied) to 36 (very satisfied).

To measure diabetes-specific distress, the Problem Areas in Diabetes questionnaire[26] was used, assessing the general emotional burden of diabetes and distress related to treatment, food choices, and social support. The 20 items are scored on a 5-point Likert scale yielding a sum score (range, 0–100), with higher score representing higher distress. The Dutch Problem Areas in Diabetes scale has good convergent and discriminating validity and high internal consistency.[27]

Health status was measured with the validated Dutch version of the European Quality of Life scale with five dimensions (range of −0.59 to 1, where 1 indicates perfect health). It covers five domains of health (mobility, self-care, daily activity, pain, and anxiety/depression). Each question has three levels of functioning: level 1, no problems; level 2, some problems; and level 3, severe problems. Additionally, general well-being was measured by the European Quality of Life scale visual analog scale (score range of 0–100, where 100 represents the best imaginable health status).[28]

Self-efficacy was determined with the Diabetes Management Self-Efficacy Scale, which is a 20-item scale. The stem phrase "I am confident that…" was used to precede the 20 items, and answers were scored using a 5-point Likert scale (from "Probably Not" to "Definitely Yes") yielding a sum score (range of 20–100), with higher score representing a higher self-evaluation of self-efficacy skills.[29]

Additional diabetes knowledge test. To test diabetes knowledge we used the Brief Diabetes Knowledge Test used in both type 1 and type 2 diabetes patients in The Netherlands.[30,31] The test includes 23 questions, with 14 general items and nine additional ones about insulin use. It is a multiple-choice test, with one correct answer per question. We added seven questions about diabetes topics that specifically refer to the content of quarterly or annual monitoring consultations that all diabetes patients receive. These questions test their knowledge about the consequences of smoking and alcohol use, hypoglycemic symptoms, eye examination, physical exercise, normal value of

blood pressure, and the association of diabetes mellitus and vascular disease. We scored the percentage of all questions answered correctly, both for the standard questions, including the added questions, and for the insulin questions. In case of no answer to a question, we scored that question as wrong.

Patients' medical records. We collected possible determinants for portal use from the patient's electronic health record, such as gender, age, type of diabetes, duration of diabetes, and setting of diabetes treatment (general practice or outpatient clinic). In addition, we extracted data about body mass index, blood pressure, and laboratory values (HbA1c, total cholesterol, high-density lipoprotein-cholesterol, and low-density lipoprotein-cholesterol) and the presence of retinopathy, neuropathy, nephropathy, cardiac complications (angina pectoris or myocardial infarction), cerebral complications (stroke or transient ischemic attack), and peripheral arterial vascular disease from the records.

Statistical analysis

Data were analyzed using SPSS for Windows software (version 20; SPSS Inc., Chicago, IL). Type 1 and type 2 diabetes were analyzed separately. Patients who requested login to the Web portal were compared with patients who did not. Categorical variables were expressed as percentages, and normally distributed continuous variables were given as mean values with SD or with median and interquartile range when not normally distributed. We used χ^2 tests for all categorical variables, unpaired t test for all normally distributed continuous variables, and the Mann–Whitney test for non-normally distributed continuous variables. We calculated socioeconomic status based on zip codes. The Netherlands Institute for Social Research[32] calculated for each zip code a score for socioeconomic status based on income, employment, and level of education of the population. The higher the score, the lower the status. For patients with type 1 diabetes mellitus, we could not perform this analysis with a reliable outcome because of the low number of patients with type 1 diabetes who were treated by an internist.

Univariate logistic regression analysis was used to determine the association between requesting a login and possible determinants. Because of the low number of patients with type 1 diabetes mellitus, we could not perform a multivariable logistic regression analysis to determine which variables were independently associated with the login request. For patients with type 2 diabetes mellitus, we used a value of $P < 0.2$ in the univariate analysis to select variables for further multivariate analysis. Multivariable regression analysis, using the enter method, was used to identify which of the determinants was independently associated with the use of a Web portal. These determinants were expressed as odds ratios and their corresponding 95% confidence intervals. In the variable medication use, we used oral drugs as reference group instead of no medication because this best represents the clinical situation and has sufficient size to serve as a stable reference group. Among patients who completed the validated questionnaires, there were occasional missing items due to skipping of questions (Problem Areas in Diabetes, 20%; Diabetes Treatment Satisfaction Questionnaire, 9%; European Quality of Life scale with five dimensions visual analog scale, 6%; and Diabetes Management Self-Efficacy Scale, 23%). In order to complete the score on these questionnaires, we used single imputation for these missing items. In the other questionnaires 16 variables had occasional missing values (range, 0.5–13%). We used the multiple imputation method to impute the missing values on patient characteristics and diabetes-related variables. Simply excluding these participants would have provided biased results because missing data may not occur completely at random.[33] We generalized five imputed datasets and used Rubin's rules to combine the estimates of the parameters.[34]

Results

From the 4,500 questionnaires, 101 questionnaires were undeliverable: 33 patients were deceased, and for 68 the correct address could not be traced. From the remaining 4,399 patients who were sent a questionnaire 2,931 (66.6%) patients responded. In total, 1,390 (31.6%) patients were eligible for analysis because they returned a completed questionnaire and a signed consent form to access the database for further extraction of data ("participants"). Another 1,541 (35.0%) people declared that they did not want to participate ("non-participants"), and 1,468 (33.4%) people never responded ("non-responders").

The mean age of the participants was 63.9 ± 12.2 years, significantly different from that of the non-participants (69.3 ± 11.0 years; $P < 0.001$) and non-responders (59.6 ± 14.7 years; $P < 0.001$). Among the participants, 59.4% were male; among the non-participants, 46.6% were male; and among the non-responders, 55.9% were male ($P < 0.001$ and $P < 0.06$, respectively).

Reasons for non-participation included lack of interest or time (18.1%), questionnaire too difficult (6.6%), questions too personal (3.0%), other reasons (22.0%), and no reason given (53.9%). Several people gave more than one reason.

Of the participants, 632 (45.5%) patients had a login, and 758 (54.5%) did not. The participants with a login were younger compared with those without (59.7 ± 13.2 years vs. 67.4 ± 10.0 years; $P < 0.001$). Of the participants with a login, 63.1% were male compared with 56.5% of the group without ($P < 0.01$).

Type 1 diabetes

Of the 1,390 participants, 128 patients were diagnosed with type 1 diabetes, of whom 115 (89.9%) had a login, and 13 (10.1%) did not. Patients with a login were younger and had a higher education level (Table 1). Following the guidelines, most type 1 diabetes patients were treated by an internist; however, patients without a login were more frequently found to be treated in a general practice. No difference in diabetes-related medication was present, but patients with a login used other drugs less frequently. Patients with a login had a better systolic blood pressure, and they were less likely to have neuropathy (Table 2). On the additional validated questionnaires, there were no significant differences between patients with and without a login, except for the diabetes knowledge test. Patient with a login scored higher on insulin-related questions than patients without a login (70.9% correct vs. 57.4% correct; $P < 0.02$).

Table 1. Patient-Related Characteristics in Requesting a Login to the Patient Web Portal

	Type 1 diabetes mellitus					*Type 2 diabetes mellitus*				
	Patients with login (n=*115*)		*Patients without login* (n=*13*)			*Patients with login* (n=*517*)		*Patients without login* (n=*745*)		
	n	n *(%)*	n	n *(%)*	P *value*	n	n *(%)*	n	n *(%)*	P *value*
Age (years)[a]	115	45.3±14.5	13	54.3±11.6	0.03	517	62.9±10.5	745	67.6±9.8	<0.001
Gender (male)	115	64 (55.7)	13	9 (69.2)	0.35	517	335 (64.8)	745	419 (56.2)	<0.01
White	114	109 (95.6)	13	13 (100)	>0.99	511	471 (92.2)	717	639 (89.1)	0.07
Educational level (high)	113	57 (50.4)	13	3 (23.1)	0.06	507	215 (42.4)	710	201 (28.3)	<0.001
Living arrangements (alone)	113	22 (19.5)	13	1 (7.7)	0.46	511	79 (15.5)	733	192 (26.2)	<0.001
Working status	114		12		0.20	511		731		<0.001
Paid job		75 (65.8)		6 (50.0)			196 (38.4)		151 (20.7)	
Retired		11 (9.6)		3 (25.0)			247 (48.3)		476 (65.1)	
Other		28 (24.6)		3 (25.0)			68 (13.3)		104 (14.2)	
Fluency in Dutch (yes)										
Speaking	114	113 (99.1)	13	13 (100)	>0.99	511	503 (98.4)	734	682 (92.9)	<0.001
Reading	114	112 (98.2)	12	12 (100)	>0.99	509	497 (97.6)	736	675 (91.7)	<0.001
Computer access	115	115 (100)	13	13 (100)	—	517	517 (100)	732	512 (69.9)	<0.001
Internet access	115	115 (100)	13	13 (100)	—	517	517 (100)	596	503 (84.4)	<0.001
Treatment setting	115		13		0.01	517		745		<0.001
Primary care physician		3 (2.6)		3 (23.1)			297 (57.4)		663 (89.0)	
Internist		112 (97.4)		10 (76.9)			220 (42.6)		82 (11.0)	

[a]Age is expressed as mean±SD values.

Type 2 diabetes

Of the 1,262 participants with type 2 diabetes mellitus, 517 (41.0%) had a login, and 745 (59.0%) did not. Patients with a login differed on many characteristics from those without (Table 1). They had been diagnosed with diabetes for a longer time, and they used insulin more frequently and also used more other drugs. With the exception of HbA1c, they were better controlled. However, they displayed fewer required health behaviors (Table 2). Patients with a login perceived more diabetes-related distress (30.6±13.5) than patients without (27.7±12.7) and more hyper- and hypoglycemic episodes (hypoglycemia, 2.3±1.9 vs. 1.5±1.7; hypoglycemia, 1.6±1.6 vs. 1.1±1.5) but also more self-efficacy (79.5±15.8 vs. 72.7±17.8) and better diabetes knowledge (standard questions, 73.8 % vs. 62.1% correct; insulin questions, 55.7% vs. 40.8% correct). All differences are significant ($P<0.001$). There was no significant difference in quality of life and general treatment satisfaction. There is no socioeconomic difference between the patients with type 2 diabetes mellitus treated by a general practitioner and patients treated by an internist (mean, −0.25±0.82 vs. −0.29±0.90; $P=0.48$).

Multivariate analysis showed that with increasing age, the odds of requesting a login decreased (Table 3). With respect to demographics, the odds of requesting a login increases in males, in patients with a higher education level, in patients who speak Dutch fluently, and in patients with a paid job, whereas the odds decreased in patients treated by a primary care physician or living alone. With the diabetes treatment and diabetes-related variables, the odds of requesting a login increased with the use of polypharmacy and alcohol and decreased with smoking. In addition, with insulin use, the odds of requesting a login increased compared with patients who use only blood glucose-lowering drugs. Duration of diabetes and HbA1c levels barely influenced the login request independently, as did the scores on patient-reported outcomes and diabetes knowledge.

Discussion

This study shows that there are many differences between patients who requested a login for a diabetes Web portal and those who did not. Furthermore, there are differences between patients with type 1 and type 2 diabetes mellitus. Patients with type 1 diabetes requested a login more frequently than patients with type 2 diabetes; this difference may be of interest in the further development of diabetes Web portals.

Type 1 diabetes mellitus

To our knowledge, this is the first study that compares the characteristics of adult patients with type 1 diabetes mellitus with regard to their logging in on a diabetes Web portal. Patients with a login were younger and had received a higher level of education. Younger and better educated patients might have more exposure to computer and Internet programs and show an earlier interest in e-health[35] and new technologies.

The majority of the patients with type 1 diabetes mellitus in our study had requested a login. Almost all of them were treated by an internist, which is the normal situation in The Netherlands. Even with the low number of patients treated by a general practitioner, treatment setting seemed to play a role in requesting a login. In type 2 diabetes we could demonstrate that treatment setting was an independent predictor of requesting a login. Patients are informed about the option of the portal by their healthcare provider, and these providers need to give their consent before patients can receive a login. This can be a barrier in itself. In the United States, family physicians were relatively unfamiliar with electronic patient health

Table 2. Diabetes-Related Characteristics in Requesting a Login to the Patient Web Portal

	Type 1 diabetes mellitus					*Type 2 diabetes mellitus*				
	Patients with login (n = *115*)		*Patients without login* (n = *13*)			*Patients with login* (n = *517*)		*Patients without login* (n = *745*)		
	n	*Mean ± SD or* n *(%)*	n	*Mean ± SD or* n *(%)*	P *value*	n	*Mean ± SD or* n *(%)*	n	*Mean ± SD or* n *(%)*	P *value*
Duration of diabetes (years)	115	18.4 (11.4–31.3)[a]	13	27.4 (18.9–32.7)[a]	0.20	517	9.7 (4.9–15.4)[a]	739	7.3 (3.7–11.4)[a]	<0.001
BG-lowering drugs	115		13		0.53	516		742		<0.001
No drugs		1 (0.9)[b]		0 (0.0)			41 (7.9)		91 (12.3)	
Oral BG-lowering drugs		1 (0.9)[b]		0 (0.0)			227 (44.0)		507 (68.3)	
Oral BG-lowering drugs + insulin		16 (13.9)		3 (23.1)			149 (28.9)		90 (12.1)	
Insulin		97 (84.3)		10 (76.9)			99 (19.2)		54 (7.3)	
Other drugs										
Antihypertensive drugs	108	37 (34.3)	12	7 (58.3)	0.12	474	307 (64.8)	624	336 (53.8)	<0.001
Lipid-lowering drugs	108	28 (25.9)	12	5 (41.7)	0.31	474	305 (64.3)	624	345 (55.3)	<0.01
Antidepressant drugs	108	6 (5.6)	12	1 (8.3)	0.53	474	25 (5.3)	624	21 (3.4)	0.12
Polypharmacy (yes)	108	25 (23.1)	12	6 (50.0)	0.08	474	271 (57.2)	624	271 (43.4)	<0.001
BMI (kg/m^2)	114	25.6 ± 4.6	13	27.2 ± 4.6	0.24	514	29.3 ± 5.3	722	29.3 ± 5.2	0.98
HbA1c (mmol/mol)	115	60.9 ± 11.3	13	62.8 ± 13.8	0.58	516	52.0 (46.0–60.0)[a]	737	49.0 (44.0–56.0)[a]	<0.001
Blood pressure (mm Hg)										
Systolic	115	126.3 ± 14.2	13	136.9 ± 20.3	0.02	516	133.8 ± 16.1	735	135.9 ± 15.4	0.02
Diastolic	115	74.2 ± 8.7	13	75.0 ± 8.4	0.75	516	77.2 ± 9.5	735	78.2 ± 9.8	0.09
Total cholesterol (mmol/L)	115	4.6 ± 0.8	13	5.0 ± 1.2	0.21	513	4.3 ± 1.0	723	4.4 ± 1.0	0.03
HDL-cholesterol (mmol/mol)	115	1.7 ± 0.5	13	1.5 ± 0.6	0.23	513	1.3 ± 0.39	720	1.3 ± 0.34	0.72
LDL-cholesterol (mmol/mol)	115	2.5 ± 0.8	12	2.8 ± 1.1	0.15	506	2.2 ± 0.9	712	2.3 ± 0.9	0.06
Complications (yes)										
Retinopathy	36	10 (27.8)	3	0 (0.0)	0.56	222	15 (6.8)	354	19 (5.4)	0.49
Nephropathy	49	25 (51.0)	7	6 (85.7)	0.12	422	153 (36.3)	555	230 (41.4)	0.10
Cerebral complications	49	4 (8.2)	7	0 (0.0)	> 0.99	429	30 (7.0)	565	53 (9.4)	0.18
Cardiac complications	49	5 (10.2)	7	0 (0.0)	> 0.99	429	100 (23.3)	565	131 (23.3)	0.96
Peripheral arterial disease	49	1 (2.0)	7	0 (0.0)	> 0.99	429	28 (6.5)	565	37 (6.5)	0.99
Neuropathy	99	20 (20.2)	10	5 (50.0)	0.05	396	132 (33.3)	537	161 (30.0)	0.28
Health behavior										
Nonadherence (yes)	115	21 (18.3)	13	3 (23.1)	0.71	488	109 (22.3)	700	122 (17.4)	0.04
Smoking (yes)	114	14 (12.3)	13	2 (15.4)	0.67	506	67 (13.2)	695	114 (16.4)	0.13
Alcohol (yes)	108	67 (62.0)	9	6 (66.7)	> 0.99	491	242 (49.3)	680	288 (42.4)	0.02
Physical active (yes)	115	43 (37.4)	12	6 (50.0)	0.54	506	190 (37.5)	726	273 (37.6)	0.99

Normally distributed data are mean ± SD values. Continuous variable are total number (percentages).
[a]Non-normally distributed data are median (interquartile range [25th–75th percentile]).
[b]A patient with latent autoimmune diabetes in adults.
BG, blood glucose; BMI, body mass index; HbA1c, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Table 3. Multivariate Analysis of Predictors of Requesting a Login in Patients with Type 2 Diabetes

	OR (95% CI)	P *value*
Age	0.96 (0.95–0.97)	<0.001
Male gender	1.32 (1.15–1.51)	<0.001
Higher education	1.63 (1.43–1.86)	<0.001
Living alone	0.55 (0.47–0.64)	<0.001
Work status		
Other	Reference	—
Paid job	1.55 (1.26–1.90)	<0.001
Retired	1.17 (0.93–1.47)	0.19
Fluency in speaking Dutch	3.06 (2.09–4.48)	<0.001
Treatment setting: general practitioner	0.32 (0.27–0.38)	<0.001
Duration of diabetes	1.02 (1.01–1.04)	<0.001
BG-lowering drugs		
No drugs	1.38 (1.10–1.72)	0.01
Oral BG-lowering drugs	Reference	—
Oral BG-lowering drugs + insulin	1.70 (1.39–2.08)	<0.001
Insulin	1.37 (1.07–1.75)	0.01
Polypharmacy	1.52 (1.33–1.73)	<0.001
HbA1c	0.99 (0.98–0.99)	<0.001
Total cholesterol	0.87 (0.82–0.93)	<0.001
Current smoking	0.60 (0.51–0.71)	<0.001
Current alcohol use	1.16 (1.02–1.32)	0.03
PAID	1.02 (1.01–1.02)	<0.001
DTSQ hyperglycemia	1.08 (1.04–1.12)	<0.001
DTSQ hypoglycemia	0.95 (0.91–0.99)	0.02
DMSES	1.01 (1.01–1.02)	<0.001
BDKT standard	1.01 (1.01–1.02)	<0.001
BDKT insulin	1.01 (1.01–1.01)	<0.001

BDKT, Brief Diabetes Knowledge Test; BG, blood glucose; CI, confidence interval; DMSES, Diabetes Management Self-Efficacy Scale; DTSQ, Diabetes Treatment Satisfaction Questionnaire; HbA1c, hemoglobin A1c; OR, odds ratio; PAID, Problem Areas in Diabetes Questionnaire.

records and their potential benefits, which may slow adoption.[36] We do not know whether this holds for Dutch general practitioners or not. Besides, the outpatient setting with diabetes nurses who are focused entirely on one disease and working according to a strict outpatient clinic protocol might explain the difference between the number of patients with a login and without in primary care and secondary care.

Patients who requested a login scored better on the diabetes knowledge test, especially on the items about insulin. This might partly be because they were more highly educated, but it also might be because of the possibility to upload their glucose levels and the subsequent response of the physician.

Type 2 diabetes mellitus

The majority of patients with type 2 diabetes mellitus did not request a login. Age, gender, educational level, and work status all play an important role. Patients in our study who do use the patient portal are on average above 60 years old, which is higher than previously found.[19,20] This is in line with the increasing use of the Internet by the elderly in recent years.[37] Therefore we expect that in the near future this age gap will level off. Physicians and nurses who would like to promote the use of a patient Web portal should pay special attention to elderly people, to women, and to diabetes patients who received a lower level of education. A second group of patients who are less likely to request a login are those who do not meet their treatment goals and display fewer of the required health behaviors. We previously demonstrated that not all patients want to take responsibility for their diabetes or are willing to take medication to attain treatment targets.[38] These patients may be not interested in the use of a patient portal to improve their outcomes. Further studies are warranted to examine the best manner to stimulate these patients and to investigate in getting them both taking responsibility and increasing self-care. Patients who are treated at the outpatient clinic, who use insulin, who use more than five different drugs for comorbid conditions, and who perceive more diabetes-related distress, but also those who have a better knowledge about the disease and a higher self-efficacy, are more likely to request a login. Because this study had a cross-sectional design, it is not possible to determine whether these variables are really causative factors. We can speculate that some of the variables that were found to be predictors are in fact markers of the portal use. For example, with the use of five or more medications, there are increasing odds of requesting a login. Apparently, patients who need more medication see the usefulness of the additional use of a patient Web portal. On the other hand, the use of the Web portal might result in polypharmacy. Considering the variables as determinants, there are several possible reasons why they may determine the request of a login. First, healthcare providers might select people because they think the patient will benefit from this portal and therefore recommend its use. Second, because of their more complex disease control, the patients themselves may feel the need to increase their partnership in the disease control, which the portal could facilitate. In this respect it is meaningful that there were no socioeconomic differences between those patients who see an internist and those who see a general practitioner. Previous studies have shown that the use of diabetes Web portals can lead to improvement of diabetes outcomes,[6–10] which means that HbA1c might be a marker of the portal use. Participating in a patient Web portal may lead to a significant decline in diabetes-related stress, which could lead to better glycemic control.[38] Definitely distinguishing determinants and markers would request a longitudinal design with a baseline situation.

Finally, in the univariate analysis higher HbA1c levels were associated with a higher odds of requesting a login, but in the multivariate analysis this effect was reversed, although the association of HbA1c with login request was only small.

Study strengths include a large and representative population of patients with diabetes and the evaluation of a diabetes Web portal that is already 5 years in use instead of a Web portal used for study purposes. Furthermore, to our knowledge, this is the first study to examine demographic and clinical factors of adult patients with type 1 diabetes mellitus and the request of a login to a diabetes-specific patient Web portal. Finally, this study included a comprehensive set of potential determinants, some of which not previously investigated in patients with diabetes, like diabetes-related distress, treatment satisfaction, self-efficacy, and diabetes knowledge.

Nevertheless, there are limitations. First, the cross-sectional design makes it difficult to distinguish cause and effect. We have found that some variables are associated with requesting a login to the Web portal; however, a strict distinction

between markers and causative factors for portal use cannot be made based on this study because we do not know the baseline situation. A second limitation was the response rate of 66.6%, including patients who expressed that they did not want to participate. However, the response rate is comparable with that[14] or even higher than that[19] in other studies. Our participants were younger than non-participants. We found that a younger age was one of the determinants of requesting a login; therefore, in the general population there will be fewer people with a login than found in our study. However, the non-responders were younger than the participants, which can point to an opposite situation. It is unclear if the percentage of people with a login is an over- or underestimation. The participants were more frequently male compared with the non-participants, but this did not differentiate from non-responders. Because we found that male gender was one of the determinants in requesting a login, we might have found an overestimation of login requests in our study. We do not have information about the type of diabetes of the non-participants and non-responders; therefore it is uncertain how diabetes type has influenced the participation and response rates. A third study limitation is that the low number of patients with type 1 diabetes mellitus did not allow a multivariate analysis to determine which variables are associated with the use of a Web portal. As is common in studies with questionnaires, not all patients filled in all items of the questionnaire. This was also the case in the electronic health records. There were missing data on several determinants. We corrected this with imputation methods.

In conclusion, we observed many differences between the patients who requested a login and the patients who did not. Simply promoting e-health does not make sense. It is important to address these differences in order to maximize the use. If neglected, the groups of patients who could benefit, like the patients who do not meet their treatment goals or display fewer of the required health behaviors, will fall further behind, especially those patients need the extra attention to their treatment. In the future, we think that patient Web portals might be used to reduce clinic visits without compromising quality of care, but before that to happen we need further information on the use of the Web portals by patients and healthcare professionals.

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Author Disclosure Statement

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