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ORIGINAL RESEARCH ARTICLE

The Impact of Video-Based Educational Materials with Voiceovers on Preferences for Glucose Monitoring Technology in Patients with Diabetes: A Randomised Study

Ian P. Smith[1] · Chiara L. Whichello[2,3,4] · Esther W. de Bekker-Grob[3,4] · Maureen P. M. H. Rutten-van Mölken[4] · Jorien Veldwijk[1,3,4] · G. Ardine de Wit[1]

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Abstract

Introduction Ensuring patients have enough information about healthcare choices prior to completing a preference study is necessary to support the validity of the findings. Patients are commonly informed using text-based information with supporting graphics. Video-based information may be more engaging for the general patient population. This study aimed to assess (1) the impact that educating patients using video-based educational materials with a voiceover has on patient preferences compared to traditional text, and (2) whether this impact is consistent between two countries.

Materials and Methods A video-based educational tool was developed to inform patients prior to completing a discrete choice experiment assessing preferences for glucose monitors. Patients with diabetes from the Netherlands and Poland were recruited through an online research panel. Respondents were randomised to receive information in either a text or a video with animations and a voiceover. Data were analysed using a mixed-logit model.

Results $N = 981$ completed surveys were analysed from the Netherlands ($n = 459$) and Poland ($n = 522$). Differences were found between the countries, but no interpretable pattern of differences was found between the two types of educational materials. Patients spent less time in the educational material than would be necessary to fully review all of the content.

Conclusions Simply providing educational material in a video with animations and voiceovers does not necessarily lead to better engagement from respondents or different preference outcomes in a sample of diabetes patients when compared to text. Increasing engagement with educational materials should be a topic of future research for those conducting patient preference research as no amount of educational material will be helpful if respondents do not access it.

Key Points for Decision Makers

Patients are often informed before a DCE using text-based information material, but video-based information may be more accessible to the general patient population.

In a multi-country study of diabetes patient preferences for glucose monitors, no identifiable pattern of differences in preferences was found that could be associated with the way educational material was presented.

Ways to make educational materials more relevant and increase engagement with these materials need to be studied in order to ensure preferences are informed.

Extended author information available on the last page of the article

1 Introduction

Patient preference information (PPI) is an increasingly used source of information to help develop and assess medical products before, during and post-product development [1–4]. One of the most commonly used methods to elicit patient preferences are discrete choice experiments (DCE) [5, 6]. Discrete choice experiments are based on Random Utility Theory (RUT) [7]. In DCEs, respondents complete multiple-choice tasks in which two or more treatment alternatives (described using specific attributes with varying in levels) are presented and the respondent needs to choose the treatment alternative that represents the greatest amount of utility for them [8–11]. The relative importance of these attributes and their individual levels can then be calculated using econometric models [12].

Fundamental to the validity of DCE outcomes is that respondents are informed about the health choice context and the included attributes and attribute levels as intended by the researchers [13, 14]. Good research practices suggest that an educational information section should be included prior to preference elicitation, which presents the overall context of the study, describes the attributes and levels, and instructs the respondent on how to complete the choice task [14–16]. This promotes a uniformity in understanding of the context and alternatives presented in a choice task [17], which is needed especially in contexts where there is no interviewer input during the DCE [18, 19]. If patients are not informed or there is no uniformity in understanding, then the preference outcomes generated in these studies may not be comparable and cannot be said to accurately reflect the informed preferences of the respondents, threatening their use and application [14, 17].

Little guidance regarding how educational information should be delivered to participants completing a DCE has been given to date, so researchers often use a simple educational text prior to the choice tasks [20, 21]. However, low levels of health literacy have been identified as a major hurdle in the understanding of text-based health information [22, 23]; thus, the traditional text format may not be suitable for a significant part of the population [22–26]. In order to overcome this hurdle, the use of educational videos has been proposed as a means to educate those with low levels of health literacy [27–30].

Recent studies have compared preference outcomes when information is presented in standard text versus non-text formats with mixed results [31–33]. They found that using video-based educational material was associated with higher levels of information comprehension [31], consistency in choices [32], or differences in preferences [33, 34]. Further, presenting information in video format instead of text has been found to make completing choice tasks easier for respondents [35]. These results imply that presenting educational material in non-text formats may have an impact on patient preferences, but questions remain about the generalisability of these findings and whether this impact can be replicated in multiple populations.

This study aimed to assess (1) the impact that educating patients using video-based educational materials with a voiceover has on patient preferences compared to traditional text and (2) whether this impact is consistent between two countries.

2 Methods

A case study assessing diabetes patient preferences for glucose monitoring technology in self-monitoring of blood glucose (SMBG) was used for this study. This case study was identified as suitable for a study of educational materials as poor diabetes knowledge and low levels of health literacy are often reported in diabetes patient populations and are often found to be associated with poor glycaemic control [36–43]. The need for education in these areas was further highlighted by clinical experts and patient representatives during the development of the DCE who reported concerns about whether patients were informed enough about diabetes complications and the need for SMBG to make an informed decision.

2.1 Study Sample and Ethics

Respondents were recruited in the Netherlands (NL) and Poland (PO) through an online panel provider (SurveyEngine) from January to March 2020. The Netherlands and Poland were chosen as examples of 'Western' and 'Eastern' European countries with partial and no reimbursement for glucose monitoring devices at the time of data collection (respectively) [44–46], allowing for the inclusion of a cost attribute in the DCE. Inclusion criteria for the study were self-reported diagnosis of diabetes (Type 1, Type 2, or Other), aged ≥18, residing in NL or PO, able to read and understand Dutch or Polish, and with access to an internet-connected laptop or computer. This study was approved by the Medical Research Ethics Committee of the UMC Utrecht (WAG/mb/19/045208) and was conducted according to the principles of the Declaration of Helsinki. All respondents provided written informed consent prior to participating in the study.

2.2 DCE Development

The DCE attributes and levels were developed according to best practices in a three-fold process. First, a scoping literature review was done to identify relevant attributes of glucose-monitoring technology from previously published studies. Results of this review were used to develop an interview guide for use in interviews with diabetes patients in NL (N = 9), a focus group with patients in PO (N = 10), as well as interviews with clinical diabetes experts ($n = 5$), patient organisation representatives in NL and PO ($n = 2$), and pharmaceutical industry representatives involved in glucose monitoring device development ($n = 4$). The resulting list of 12 potentially relevant attributes were discussed by the research team and reduced based on relevance, completeness, non-redundancy, operationality, and preferential independency to a final list of 7 attributes with 2 to 4 levels (see Table 1). The information on the attributes and levels were developed by the researchers according to best practices [15, 16]. One attribute ('Monthly costs') was standardised between the two countries using purchasing power parity weights to assure that the relative value of the levels

was similar given the differences in wealth between the two countries [47].

2.2.1 DCE Design

A Bayesian D-efficient design with 3 blocks of 12 choice tasks was developed using NGene 1.0 software. Initial priors were derived using best-guess estimates based on the available literature, interviews, and researcher knowledge. In each choice task, patients were instructed to imagine that their doctor had told them to check their blood glucose levels at least four times per day, and gave them device options to choose from. Respondents had to choose between two hypothetical glucose monitor alternatives. After this, they were offered the opportunity to use the alternative option or opt-out and use a standard finger-prick test for their care (see Fig. 1) [48, 49]. This design ensured that respondents reviewed the choice alternatives while still reflecting realistic choice scenarios as patients can always choose a standard finger-prick test for SMBG in real life. Each hypothetical alternative was described using the seven attributes with varying levels. The finger-prick test was described using the same seven attributes as the two glucose monitoring devices (see Fig. 1). Additional information explaining the attributes and levels (including an icon array) was available in a pop-up window, which the participant could view during the task by hovering over the attribute. Respondents were given two practice DCE choice-tasks before the main exercise started as a way of familiarising themselves with the task. The DCE design was updated prior to final data collection after a pilot-test of N = 99 NL patients.

2.3 Educational Material Development

The educational material was created using a framework to help researchers develop educational material for preference studies from the PREFER project [50]. The framework consists of a three-step approach [51]. In the first step, the educational needs of the patient population for understanding the choice context and the choice task were identified. Areas considered in this step include aspects of the study population (e.g., age, disease experience, literacy levels), the disease and treatment context (e.g., impact of disease on work/family/social life, disease knowledge), and the preference task (e.g., preference method used, task complexity). The results of this step can be found in the supplementary information. Information on diabetes outcomes, the use of glucose monitors in diabetes self-management, and attributes used in choice task were identified as being relevant information for patients to understand in order to ensure the preferences were informed.

In step 2, the content of the educational material was developed. The content consisted of general information related to uncontrolled blood glucose levels in diabetes, short- and long-term diabetes complications associated with hyper- and hypoglycaemia, and self-management activities including SMBG. Text related to these topics was extracted from clinical patient information sources and patient websites from five countries (The Netherlands, Poland, UK, USA, and Australia), as well as printed educational material available through primary and secondary care facilities and patient organisations in the Netherlands. This text was used as the basis for a narrative script, which illustrated the actions and potential outcomes of diabetes self-management with regard to blood glucose levels and diabetes complications. Attributes and level information was developed by the researchers according to best practices [15, 16]. The text took approximately 11 minutes to read and was written at an 8th grade reading level with a Flesch-Kincaid Grade level of 5.8 and a Flesch Reading Ease score of 69.8 (see supplementary information A) [52, 53]. The content was developed first in English and then translated into Dutch (by native language speaking members of the research team) and Polish (by a professional translation service) using forward-backward translation to ensure comparability of the educational materials between the countries.

In step 3, the features of the educational material were selected based on the information from step 1. Possible features assessed in this step include levels of realism, simulation, immersion, interactivity, and narrative structure. Based on the high impact of diabetes on patients, their high levels of experience with disease and treatment, and the complexity of managing diabetes, educational materials with high levels of narration, realism, and interactivity was recommended.

Based on this framework, a video consisting of an animated storyline with voiceover was used as it could better present an experienced patient population with realistic narratives and prevent potential literacy issues than other formats and features [27, 54–57]. The animation was developed by MindBytes, a Belgian company with experience in developing educational material for patients in clinical and preference elicitation settings (http://www.mindbytes.be) (see Fig. 2, supplementary material for video file). Voiceovers of the text were recorded by native language professional voice actors in the Netherlands and Poland. Risk information for the skin irritation attribute was presented using icon arrays [58]. Respondents were required to access all of the educational material at least once prior to entering the survey. The content of the educational materials was reviewed by a clinical expert (n = 1) and pre-tested with patients (n = 5) in think-aloud interviews. The Dutch version of the video material lasted 9:52 minutes and the Polish version lasted 9:11 minutes. The educational material was well received in pre-testing. Minor revisions were made based on patient suggestions with regard to the usability of the material.

Table 1 Attributes and levels for the discrete choice experiment

Attributes	Level 1	Level 2	Level 3	Level 4
Precision compared to finger-pricking[a]	Low: Less accurate than finger-pricking (higher or lower by 0.6 mmol/L (*10.8 mg/dL)	Medium: Less accurate than finger-pricking (higher or lower by 0.3 (*5.4 mg/dL)	High: Accurate as finger-pricking[§]	–
Average number of finger-pricks per day[b]	4 Ŧ	2	0[§]	–
Effort to check[c]	High effort: you need to measure your glucose levels yourself Ŧ	Moderate effort: you scan a sensor to check glucose levels	Low effort: glucose levels automatically sent to you[§]	–
Probability of getting skin irritation or redness[d]	35% chance of skin irritation or redness	20% chance of skin irritation or redness	5% chance of skin irritation or redness	No chance of skin irritation or redness[§]
Monthly costs[e]	€250 (550 zł)	€175 (390 zł)	€100 (220 zł)	€25 (55 zł)[§]
Glucose information[f]	Current glucose level[§]	Current glucose level and arrow	Current glucose level and a graphic of your level trends over the day	–
Alarms[g]	No [§]	Yes	–	–

[§]Reference level

Ŧ Only used to describe finger-prick

(a–g) Attribute explanations as presented to patients:

[a]Some glucose monitors are more precise than others. Finger-pricking is generally regarded as the most accurate way to measure glucose levels. Measurements from devices that use sensors can be just as accurate, but can also be less accurate than finger-pricking, especially if your glucose levels are very high or very low. For example, if your glucose level is 6 mmol/L and you measure it with a device that is off by 0.6 mmol/L, then this device can say your glucose is anywhere from 5.4 to 6.6 mmol/L

[b]This is how many times you would need to do a finger-prick-test each day on an average day. This number could be higher on days when you feel the need to test more often such as when you're sick, but we want you to picture an average day. Sometimes, this is your only method of measuring your glucose levels. Or, you might need to do finger-prick-tests to confirm the levels from another device

[c]This means how much effort you need to give to check your blood glucose levels. High effort checking means you need to stop what you're doing and concentrate on measuring your levels. You need to wash your hands, get out your device equipment, prick your finger, put blood on a strip, check the results, and then clean everything up. Moderate effort checking means you need to get out a small device and use it to scan the sensor on your body to obtain your glucose levels. Low effort checking means your glucose levels are automatically sent to a device which you can view at any time. This could be a dedicated glucose device, your phone, or a Smartwatch. You do not need to do anything to have your blood glucose levels sent through, just look at the device to check

[d]A chance of skin irritation or redness around a sensor means a redness or itchy rash on the skin around or under the sensor. This is similar to having an itchy allergic reaction and can be rather uncomfortable or irritating. The sensor will need to be removed and replaced in a different spot. This skin irritation and redness usually lasts until after the sensor is replaced. Not all sensors have this side effect so chances of getting the side effect can differ per device If a device gives you a 15% chance, this means that 15 of a 100 people who get this device experience skin irritation and redness while 85 of a 100 people do not experience this

[e]This means the amount of money you need to pay out-of-pocket per month in order to check your blood glucose. Please note that this is money that is not reimbursed by your insurance. This could be money needed to pay for devices, sensors, or strips used

[f]This means the way in which your glucose levels are presented to you. This information could be only your current glucose level (you only see a digital number like 8.3 mmol/L). This could be your current glucose level with an arrow showing how your blood glucose is changing as compared to your previous measurement (increasing, decreasing, stable). It could show your current glucose level with a graphic of your blood glucose levels over the day

[g]Your device will give you a beeping alarm (like a phone notification) any time your blood glucose levels are (getting) too high or too low

zł Polish złoty

2.4 Additional Background and Demographic Questions

Respondents completed sociodemographic questions, questions about diabetes type and history, use of medications, and questions related to their current diabetes self-care regimen. Additionally, two brief measures assessing subjective numeracy (the Shortened Subjective Numeracy Scale [SNS-3]) [59] and health literacy [Brief Health Literacy Screener (Chew 3-Items) [60] were included in the survey. The SNS-3 assesses subjective health numeracy on a 6-point Likert-type scale. On a scale range of 3 to 18,

Imagine that your doctor told you to check your blood glucose levels at least four times per day. To do this, the doctor offers you different hypothetical devices to choose from.

	Device A	Device B
Precision compared to fingerpricking	Less accurate than fingerpricking (higher or lower by 0.3)	Less accurate than fingerpricking (higher or lower by 0.6)
Average number of fingerpricks per day	0	0
Effort to check	Low effort	Moderate effort
Probability of getting skin irritation or redness	5% chance of skin irritation or redness (5 out of 100)	35% chance of skin irritation or redness (35 out of 100)
Glucose information	Current Glucose level	Current Glucose level and arrow
Alarms	Yes	No
Monthly costs	€25	€175
I prefer:	❍	❍

If you have to choose between the device you have chosen above and the traditional fingerprick-test to check your glucose levels, which one would you prefer? (Please note that a fingerprick-test should be done four times a day, requires high effort to check, does not result in skin irritation or redness, will show your glucose levels, doesn't have an alarm and costs €25 per month).

Select only one answer

❍ **I prefer the device I have selected above**	❍ **I prefer the fingerprick-test**

Fig. 1 Example discrete choice experiments (DCE) choice task

a cut-off of 9.83 was used as a population mean level for high (above cut-off) and low (below cut-off) numeracy. The Chew 3-Items assesses health literacy by asking how often patients need help with medical information material. Health literacy is labelled as inadequate if patients report needing help 'sometimes' or 'more often' in one of these three questions. Finally, respondents were asked to rate the length of the survey, ease of understanding the educational material, and ease of understanding and ease of completing the choice tasks based on a 6-point Likert scale.

2.5 Survey Design

Respondents were randomised to arms receiving the educational material in either the standard text format or in the video format (hereafter referred to as NL-T, NL-V, PO-T, PO-V for Dutch/Polish, Text/Video information samples, respectively). All data were collected in a one-time, online survey.

2.6 Statistical Analysis

All analyses were conducted using STATA 14 with the clogit and mixlogit package. Respondents were removed from analysis if the person self-reported as not having diabetes or if the amount of time used to complete the survey was less than 70% of the mean response time for their country and educational material arm. Effects coding was used in which the reference category was coded as −1 for all attributes [61]. A Swait and Louviere test was conducted to identify scale differences across respondents from the two countries and see if the datasets could be combined [62, 63]. Significant differences in parameter estimates were found between the countries ($\chi^2(1) = 30.296$, $p < 0.001$); thus, data from the Netherlands and Poland were analysed separately. A Swait and Louviere test was also conducted to identify potential scale differences between educational tool arms within each country.

Preference estimates for each educational material arm were assessed using a mixed-effects logistic regression with random effects and a normal distribution to account for heterogeneity of preferences, which often exists within patient populations [64]. For robust results, each model was built using 14,000 Halton draws [65]. The following utility model was used:

$$\begin{aligned} U_{Aci} = {} & \beta_0 + \beta_{1i} \times \text{precision}_{0.3} + \beta_{2i} \times \text{precision}_{0.6} + \beta_{3i} \\ & \times \text{pricks per day}_{2x} + \beta_{4i} \times \text{effort}_{\text{moderate}} + \beta_{5i} \\ & \times \text{skin irritation}_{20\%} + \beta_{6i} \times \text{skin irritation}_{35\%} + \beta_{7i} \\ & \times \text{monthly costs}_{€\,100} + \beta_{8i} \times \text{monthly costs}_{€\,175} \\ & + \beta_{9i} \times \text{monthly costs}_{€\,250} + \beta_{10i} \times \text{information}_{\text{arrow}} \\ & + \beta_{11i} \times \text{information}_{\text{trendline}} + \beta_{12i} \times \text{alarms}_{\text{none}} + \varepsilon \end{aligned}$$

$$\begin{aligned} U_{Bci} = {} & \beta_{1i} \times \text{precision}_{0.3} + \beta_{2i} \times \text{precision}_{0.6} + \beta_{3i} \\ & \times \text{pricks per day}_{2x} + \beta_{4i} \times \text{effort}_{\text{moderate}} + \beta_{5i} \\ & \times \text{skin irritation}_{20\%} + \beta_{6i} \times \text{skin irritation}_{35\%} \\ & + \beta_{7i} \times \text{monthly costs}_{€\,100} + \beta_{8i} \times \text{monthly costs}_{€\,175}, \\ & + \beta_{9i} \times \text{monthly costs}_{€\,250} + \beta_{10i} \times \text{information}_{\text{arrow}} \\ & + \beta_{11i} \times \text{information}_{\text{trendline}} + \beta_{12i} \times \text{alarms}_{\text{none}} + \varepsilon \end{aligned}$$

$$U_{\text{Fingerprick } ci} = \beta_{13i} + \varepsilon$$

In this model, the utility (U) of an alternative (A, B, or finger-prick) in a specific decision context (c) for an individual (i) was derived as the sum of the attribute-level estimates indicating the relative importance of each attribute level ($\beta_1 - \beta_{12}$) or the relative importance of the status quo finger-prick glucose monitor (β_{13}). B_0 represents a constant term reflecting a left-right bias when choosing an alternative (i.e., choosing the left alternative when the coefficient is significant and has a positive sign, right if significant and negative). Stochastic factors for this alternative are included in the utility function as a random error term ε.

The preference estimates from the mixed-logit model were used to calculate attribute relative importance scores (RIS) by identifying the attribute with the greatest absolute difference between most and least valued level and using this as the reference [66]. The RIS for each attribute is the quotient of the absolute difference of the most and least valued level of that attribute and the reference value. This results in a normalised scale with the attribute with the greatest difference in level values assigned 1 and all other attributes valued proportionally to it. Feedback on the educational material and meta-data related to time spent in the educational material and time spent in the survey was compared between the educational material arms using t-tests or χ^2 tests where applicable. A significance level of 0.05 was used for all analyses.

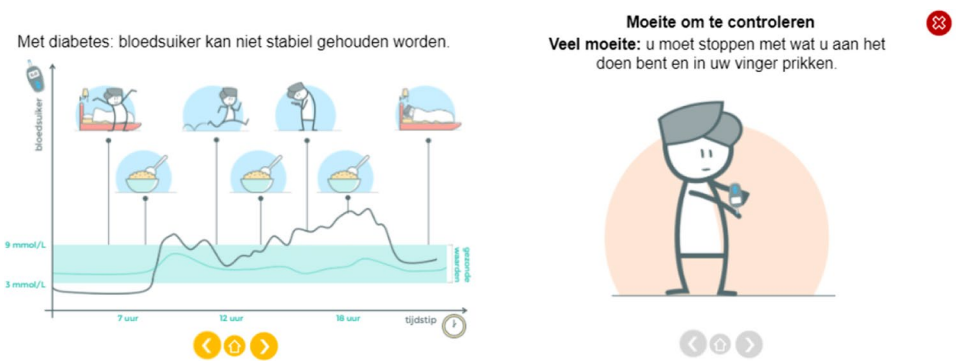

Fig. 2 Example images from the animated storyline showing general diabetes information (left translated from Dutch "With diabetes: blood sugar cannot be kept stable") and attribute information (right translated from Dutch; "Effort to check—High effort: You need to stop what you are doing and prick your finger.")

3 Results

3.1 Sample Characteristics

In total, 981 completed surveys were analysed after $n = 56$ responses were removed for completing the survey too quickly. The Polish responses ($n = 522$) were evenly split between educational material formats (PO-V $n = 261$, PO-T $n = 261$). The Dutch responses ($n = 459$) had slightly more video responses (NL-V $n = 233$) than standard text response (NL-T $n = 226$). The sample demographics can be found in Table 2. Significant differences were found between the countries with the Polish sample being younger, with fewer years of diabetes, and higher levels of education and health numeracy. Significant differences were found within the Netherlands between the two educational information formats for type of diabetes (χ^2 (2) = 8.19, $p = 0.017$). Both survey populations were more highly educated with a higher prevalence of Type 1 diabetes than would be expected from general diabetes population characteristics and the Polish sample was younger than the general diabetes population [67, 68].

3.2 Main Effects Model

The preference estimates of the mixed-effects models can be found in Table 3. A significant left-right bias was found in all arms with respondents tending to choose the left option. For all groups, the coefficients followed logical patterns where "more attractive" levels were valued higher than "less attractive". All attribute-level estimates were significant for at least one level in one of the arms. No significant differences in preferences or scale parameters were found between the text and video educational material arms using the Swait and Louviere test in either NL (χ^2 [1, 459] = 2.492, $p = 0.114$) or PO (χ^2 [1, 522] =1.600, $p = 0.206$). Dominant decision-making behaviour was found for the lowest cost level in all educational material arms (see Table 2); however, there was no significant difference in the amount of dominant decision making between the educational arms within countries (NL: χ^2 [1, 459] = 1.280, $p = 0.258$; PO: χ^2 [1, 522] =1.600, $p = 0.206$). These respondents were not removed for the final analysis as Costs are a major concern of the general patient population and the results need to be understood in relation to this attribute. Preference estimates of mixed-effects models excluding these respondents can be found in supplementary material Table 3A.

For the Dutch sample, *Costs* were the most important attribute. The only attribute that was not significant for the Dutch sample was *Glucose Information*. For the Dutch sample, significant heterogeneity was found in preferences for all attributes and the status quo finger-prick test except for *Effort to Check*, *Alarm* and *Glucose Information*. Differences in heterogeneity of preferences were found between the educational material arms. Heterogeneity was found for a moderate *Chance of Skin Irritation* and the €175 cost level only in the NL-T arm, while heterogeneity of preferences for the €250 cost levels was only found in the NL-V arm.

For the Polish sample, *Costs* were similarly the most important attribute, while improving *Effort to Check* was not significant for the Polish sample. Significant heterogeneity of preferences was found for all attributes and the status quo finger-prick test except for *Chance of Skin Irritation*. Differences in heterogeneity of preferences was only found for the attribute level of *Glucose Information* shown as a daily trend. Here the NL-V arm had significant heterogeneity of preferences, but the PO-T arm did not. Finally, the NL-V arm had a much lower valuation of the status quo finger-prick test compared to all other arms.

3.3 Relative Importance Scores

The RIS for all samples can be seen in Figure 3. *Costs* were 2.7 to 4.3 times more important than the second most important attribute and 15.2 to 56.1 times more important than the least important attribute across the arms. After *Costs*, for all the arms, the attributes could be separated into two tiers with *Precision*, *Number of finger-pricks*, and *Chance of Skin irritation* being the next most important attributes, and *Alarm*, *Glucose information*, and *Effort to check* being the least important attributes. Differences were observed in RIS, but they were relatively small within the tiers (0.02–0.23 in the top tier and 0.03–0.06 in the lower tier). The exception to this was *Precision* for the NL-V arm which was clearly more important than the other in-tier attributes.

3.4 User Experience and Meta-data analysis

Respondent feedback and mean times to complete the educational material can be found in Table 4. Respondent feedback on ease of understanding the educational material was more positive for those who saw the video educational material, although the difference was small. No significant differences were found in reported ease of understanding or completing the DCE. The mean time in educational material ranged from 2.36 to 3.84 minutes. Approximately 20.5% of the text respondents reached the end of the text information in under 30 seconds and 22.6% of video respondents reached the end of the video in under 30 seconds. Significant differences in time spent in the educational material were found for different levels of education for the NL-T arm, and level of health literacy for the NL-T, NL-V, and PO-T arms. A regression analysis on the amount of time spent in the tool found that different patient characteristics were associated with the total time (see supplementary Table 3B). For

Table 2 Sample demographics

Characteristics	Dutch respondents		Polish respondents	
	N = 226	*N* = 233	*N* = 261	*N* = 261
	Text	Video	Text	Video
Age in years* (mean ± SD)	51.6 ± 17.2	50.5 ± 17.8	39.4 ± 13.4	39.0 ± 13.1
Sex (*n*, %)				
Females	116 (51.3)	115 (49.4)	125 (47.9)	131 (50.2)
Males	110 (48.7)	117 (50.2)	134 (51.3)	130 (49.8)
Other	0 (0.0)	1 (0.4)	2 (0.8)	0 (0.0)
Type of diabetes (*n*, %)[Ŧ]				
Type 1	65 (28.8)	59 (25.3)	83 (31.8)	84 (32.2)
Type 2	158 (69.9)	159 (68.2)	167 (64.0)	164 (62.8)
Other	3 (1.3)	15 (6.4)	11 (4.2)	13 (5.0)
Glucose monitor type* (*n*, %)				
CGM or FGM	38 (16.8)	46 (19.7)	39 (14.9)	33 (12.6)
Finger-prick testing only	128 (56.6)	122 (52.4)	211 (80.8)	215 (82.4)
None	60 (26.5)	65 (27.9)	11 (4.2)	13 (5.0)
Number of years having * diabetes (mean ± SD, (median, range))	9.5 ± 9.1 (6.5, 0–60)	10.4 ± 9.4 (8, 0–46)	6.1 ± 7.1 (3, 0–53)	6.3 ± 6.9 (4, 0–50)
Health literacy (*n*, %)				
Adequate	102 (45.1)	103 (44.2)	113 (43.3)	111 (42.5)
Inadequate	124 (54.9)	130 (55.8)	148 (56.7)	150 (57.5)
Health numeracy* (*n*, %)				
High	195 (86.3)	194 (83.3)	243 (93.1)	241 (92.3)
Low	31 (13.7)	39 (16.7)	18 (6.9)	20 (7.7)
Educational level[¥] (*n*, %)				
Tertiary	100 (44.3)	84 (36.1)	134 (51.3)	154 (59.0)
Upper-Secondary/Vocational	114 (50.4)	130 (55.8)	127 (48.7)	107 (41.0)
Secondary or lower	12 (5.3)	19 (8.2)	(0.0)	0 (0.0)
Dominant cost decision making (*n*, %) ***	73 (32.3)	64 (27.5)	57 (21.8)	48 (18.4)

Significant differences between countries at *$p<0.05$, **$p<0.01$, ***$p<0.001$

CGM continuous glucose monitoring, *FGM* flash glucose monitoring

[Ŧ]Significant differences between educational tool formats in the Dutch sample at $p < 0.05$

[¥]Education levels were based on the definitions used by the OECD

Table 3 Attribute-level estimates for the mixed-logit model

Attribute		Netherlands						Poland					
		Text			Video			Text			Video		
		Beta	SE	*p*>|z|	Beta	SE	*p*>|z|	Beta	SE	*p*>|z|	Beta	SE	*p*>|z|
Precision													
High[§]		0.32			0.57			0.47			0.45		
Medium	Mean	0.02	0.06	NS	0.03	0.06	NS	0.09	0.05	NS	0.10	0.05	*
	SD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Low	Mean	0.34	0.08	***	0.60	0.08	***	0.39	0.07	***	0.35	0.06	***
	SD	0.55	0.10	***	0.65	0.09	***	0.60	0.07	***	0.52	0.08	***
Number of finger-pricks per day													
0[§]		0.36			0.23			0.17			0.13		
2	Mean	0.36	0.06	***	0.23	0.05	***	0.17	0.04	***	0.13	0.04	**
	SD	0.46	0.07	***	0.38	0.06	***	0.35	0.05	***	0.35	0.06	***
Effort to check													
Low[§]		0.14			0.15			0.05			0.02		
Moderate	Mean	0.14	0.04	***	0.15	0.04	***	0.05	0.03	NS	0.02	0.03	NS
	SD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chance of skin irritation													
Low[§]		0.36			0.40			0.37			0.35		
Moderate	Mean	0.06	0.07	NS	0.12	0.06	NS	0.02	0.06	NS	0.00	0.06	NS
	SD	0.20	0.08	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
High	Mean	0.30	0.07	***	0.28	0.06	***	0.39	0.06	***	0.35	0.06	***
	SD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Costs													
€25[§]		1.47			1.47			1.41			1.01		
€100	Mean	0.32	0.08	***	0.23	0.07	**	0.42	0.07	***	0.25	0.07	***
	SD	1.57	0.14	***	1.63	0.16	***	2.12	0.15	***	1.67	0.13	***
€175	Mean	0.19	0.08	*	0.04	0.07	NS	0.02	0.07	NS	0.12	0.08	NS
	SD	NS	NS	NS	NS	NS	NS	0.28	0.12	*	0.71	0.09	***
€250	Mean	1.60	0.16	***	1.65	0.15	***	1.81	0.14	***	1.38	0.13	***
	SD	NS	NS	NS	0.19	0.09	0.031	0.32	0.09	***	0.36	0.09	***
Glucose information													
Only current glucose value[§]		0.12			0.09			0.07			0.07		
Current glucose value with arrow	Mean	0.04	0.06	NS	0.02	0.06	NS	0.01	0.05	NS	0.04	0.05	NS
	SD	NS	NS	NS	NS	NS	NS	0.01	0.08	NS	0.08	0.10	NS
Current glucose value with day trend	Mean	0.08	0.06	NS	0.11	0.06	NS	0.06	0.05	NS	0.11	0.05	*
	SD	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.16	0.07	*
Alarm													
Yes[§]		0.15			0.12			0.15			0.08		
No	Mean	0.15	0.04	***	0.12	0.04	***	0.15	0.03	***	0.08	0.03	*
	SD	NS	NS	NS	NS	NS	NS				0.22	0.05	***
Left-right bias		0.40	0.08	***	0.35	0.08	***	0.42	0.07	***	0.27	0.07	***
Status quo finger-prick	Mean	0.63	0.28	0.021	0.26	0.28	0.360	0.23	0.21	0.289	1.42	0.25	***
	SD	4.56	0.42	***	4.60	0.37	***	4.39	0.41	***	4.56	0.35	***

[§]Ref

NS not significant, *Ref* reference, *SD* standard deviation (only shown when SD was found to be significant)

*Indicates $p < 0.05$; ** indicates $p < 0.01$; *** indicates $p < 0.001$

both the PO-T and PO-V arms, being older and female was associated with increased time in the educational materials. For the PO-V arm, continuous glucose monitoring (CGM) use was associated with decreased time in the educational materials. For the NL-T arm, being older and female with more years of having diabetes was associated with increased time in the educational materials. For the NL-V arm, being older and having higher health literacy was associated with increased time in the educational materials, but having type 1 diabetes mellitis (T1DM) and using a finger-prick test or CGM for SMBG were associated with decreased time in the educational materials.

4 Discussion

This was the first kind of study to assess the impact of educational material format in a randomised study in multiple countries. We developed educational materials using an evidence-based framework to address potential gaps in knowledge related to general diabetes information and the use of glucose monitors as a part of diabetes self-management. While some preference differences were found between the arms, no interpretable pattern of differences in the relative importance of attributes could be identified among respondents receiving either the text or video educational material.

These findings replicate, to a certain extent, those found by Bywall et al and Lim et al, but not those found by Vass et al [31–33]. Both Bywall et al and Lim et al found differences between samples when presented with either video- or text-based information. In the current study, differences between samples were identified when comparing the preference estimates and RIS, but these differences were not statistically significant within each country. Lim et al supported their findings through evidence of patients being more informed, but the practical differences in knowledge were relatively small. Thus, the question is whether differences found were related to more informed patients or to heterogeneity of patient preferences often found when comparing patient populations [69–73].

One major issue explaining the lack of differences in the current study is that respondents did not appear to attend to all the content of the educational materials, which limited the exposure needed to cause an effect. Non-attendance to the information is evidenced in the short amount of time that respondents spent on the education material regardless of the format (2.36–3.84 minutes, while the video took over 9 minutes to view entirely, and reading the text-based information was expected to take 11 minutes). The long duration of the educational material may have led to non-attendance, but previous research with educational materials of comparable length has found that patients engage with the educational material when the treatment context was novel to the respondents [31, 74]. The non-attendance in our study could be related to the high levels of disease experience that the sample had. For the Dutch respondents experience with SMBG and more years with diabetes was related to less time in the educational material, but this was not true for the Polish population. Another possible explanation is that the respondents viewed the material as being too general for their needs as it covered a wide amount of information. Previous research has found that patients value information more when it is tailored to their individual informational needs and they may ignore information that they view as not being relevant to them [75–78]. Unfortunately, years of experience with managing diabetes does not necessarily mean that patients are sufficiently educated on the importance of adequate diabetes self-management [42]. This may hold especially for those patients with low levels of health literacy [41–43]. The identified need from clinical experts and patient representatives to inform respondents highlights the difficulties that future researchers may encounter to ensure that respondents who need additional

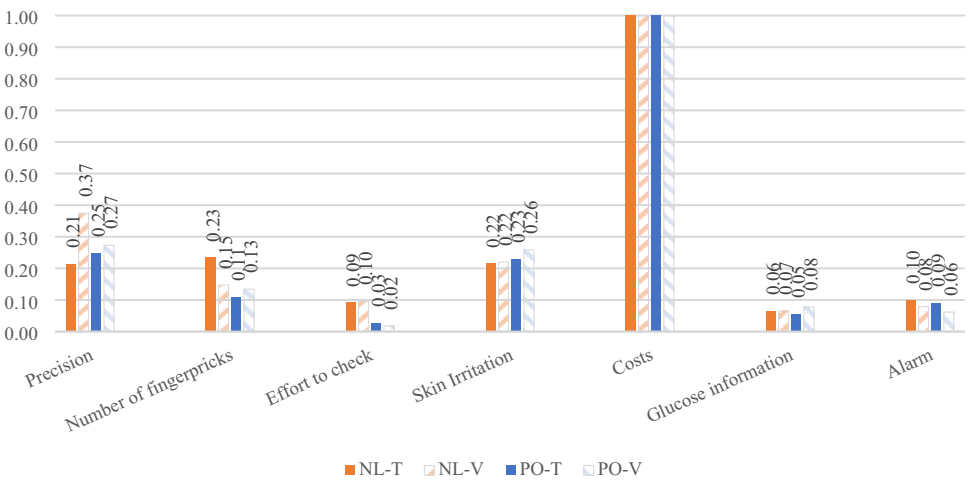

Fig. 3 Attribute Relative Importance Scores by Country and Educational Tool Format. Attribute were standardised to 1 based on the attribute with the largest difference between highest and lowest levels which was cost in all arms (difference between highest and lowest cost level by arm: NL-T = 3.07, NL-V = 3.12, PO-T = 3.39, NL-V = 2.85)

Table 4 User feedback and meta-data regarding time spent in education material by education level, health literacy level, and health numeracy level M (SD)

	Netherlands		Poland	
	Text	Video	Text	Video
Respondent feedback				
Length of survey Mean (SD)	4.02 (0.99)	4.01 (0.99)	3.93 (0.99)*	3.77 (0.96)*
Ease of understanding educational material Mean (SD)	4.63 (1.32)***	5.02 (0.98)***	5.011 (1.10)**	5.29 (1.03)**
Ease of understanding DCE mean (SD)	4.75 (1.38)	4.67 (1.38)	5.00 (1.26)	4.97 (1.23)
Ease of answering DCE mean (SD)	4.64 (1.39)	4.57 (1.33)	4.84 (1.29)	4.84 (1.29)
Time in minutes Mean (SD, range)	2.41 (2.53, 0.20–23.46)	2.93 (3.32, 0.34–12.79)	2.36 (2.36, 0.20–14.99)	3.84 (4.36, 0.8–26.91)
Educational level				
Tertiary	2.16 (3.04)*	3.33 (3.63)	2.15 (2.27)	4.28 (4.98)
Upper-Secondary/vocational	2.43 (1.89)*	2.71 (3.13)	2.47 (2.41)	3.65 (4.06)
Secondary or lower	4.35 (2.57)*	2.62 (3.15)	–	–
Health literacy				
Adequate	2.11 (2.11)*	2.44 (3.11)*	1.99 (2.19)**	3.40 (3.94)
Inadequate	2.78 (2.93)*	3.54 (3.48)*	2.85 (2.49)**	4.47 (4.81)
Health numeracy[T]				
High	2.78 (2.45)	2.96 (3.06)	1.99 (1.52)	3.70 (3.73)
Low	2.36 (2.54)	2.92 (3.38)	2.39 (2.41)	3.85 (4.41)

DCE discrete choice experiments, *SD* standard deviation

[T]The mean sample score was used for the cut-off between high and low groups for the health numeracy measure, SNS-3; *Indicates $p < 0.05$; ** indicates $p < 0.01$; *** indicates $p < 0.001$

information actually engage with the educational material. Clinical experts and patient representatives may have more complete understanding of the relevant information needed for diabetes care and objective insights into the educational needs of patients. However, patients may not recognise that there is a need for additional education and thus view the information provided as not being relevant for them. There is a need for future research to identify ways to communicate that there is a need for further education and that the educational material is relevant to them, in order to increase engagement with the educational material.

One possible way is through tailoring of information. Tailoring of information to the specific needs of the patients would make the information more relevant, which has previously been found to increase engagement with material [75–78]. Aspects such as patient demographics or knowledge questions could be used to tailor the information to the individual patient, reducing the burden on patients and increasing engagement with educational materials. Tailoring of information could also identify the formats that the individual patients respond best to in heterogeneous populations, ensuring that respondents can properly understand the information presented to them. Increasing engagement with educational materials in patient preference studies should be a topic of future research as simply presenting information in a video format does not necessarily mean patients will access it.

4.1 Strengths and Limitations

Despite the study being a multi-country, randomised case study, there are a few study limitations which prevent better understanding of ways in which patients interacted with the educational material. First, the video was embedded on one webpage; thus, the start and stop times were based on the time that a respondent entered and left the page. This limits our ability to see whether there were specific points in the video when patients were more engaged and spent more or less time on. Second, patients were recruited via an on-line panel where respondents register themselves, so it is likely that respondents possess at least a basic level of health and digital literacy, which may not be representative of the entire diabetes population. Hence, it is unclear if the video would have been of more use in a sample of diabetes patients recruited through clinical channels, who may have more difficulty with text or numeric health information and for whom educational information presented in a video format is likely more suitable [27, 54–57]. These panel respondents are also compensated based on completion of the survey so they may have prioritised quick completion.

Further, our patient population had higher levels of education than what you would expect from the general population [68, 79, 80]. Finally, we did not include an objective measure of diabetes knowledge, which would have allowed us to analyse whether the patients were well informed prior to participating in the preference study. Patients could have already been well informed on the information presented, making the educational material unnecessary.

5 Conclusion

Educating respondents prior to a preference study remains a priority for stakeholders who use patient preference information. Simply providing educational material in a video with animations and voiceovers did not result in significant differences in preference outcomes when compared to text. This may have been due to a lack of engagement with the educational materials in our study, as well as a high level of familiarity with the topic of the study in this group of experienced patients. Future research should look at ways to increase engagement with educational materials, as well as ways to better tailor information to the needs of individual patients participating in preference studies.

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Declarations

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Conflicts of interest/competing interests The authors have no conflicts of interest or competing interests to declare with regard to the content of this article in either a financial sense or in a way that could impart bias on the work submitted for publication such as professional interests, personal relationships or personal beliefs (amongst others).

Availability of data and material The data collected and used for this study are available for non-commercial purposes, without breaching participant confidentiality, upon reasonable request to the first authors.

Code availability Not applicable

Author contributions The design of the survey and data collection were primarily conducted by IS and CW under the guidance of EWdBG, MvRM, JV, and GAdW. Data analysis was done by IPS with assistance and guidance from JV. The manuscript was written by IPS with assistance from CW, EWdBG, MvRM, JV, and GAdW.

Ethics approval This study was approved by the Medical Research Ethics Committee of the UMC Utrecht (WAG/mb/19/045208) and was conducted according to the principles of the Declaration of Helsinki. All respondents provided written informed consent prior to participating in the study.

Consent to participate Informed consent for participation in the study was obtained from all participants prior to completing the survey.

Consent for publication Informed consent to use the data collected for academic publications was obtained from all participants prior to completing the survey.

References

1. Whichello C, Levitan B, Juhaeri J, Patadia V, DiSantostefano R, Pinto CA, et al. Appraising patient preference methods for decision-making in the medical product lifecycle: an empirical comparison. BMC Med Inform Decis Mak. 2020;20(1):114. https://doi.org/10.1186/s12911-020-01142-w.
2. Whichello C, Bywall KS, Mauer J, Stephen W, Cleemput I, Pinto CA, et al. An overview of critical decision-points in the medical product lifecycle: where to include patient preference information in the decision-making process? Health Policy. 2020;124(12):1325–32. https://doi.org/10.1016/j.healthpol.2020.07.007.
3. van Overbeeke E, Whichello C, Janssens R, Veldwijk J, Cleemput I, Simoens S, et al. Factors and situations influencing the value of

patient preference studies along the medical product lifecycle: a literature review. Drug Discov Today. 2019;24(1):57–68. https://doi.org/10.1016/j.drudis.2018.09.015.
4. Janssens R, Huys I, van Overbeeke E, Whichello C, Harding S, Kubler J, et al. Opportunities and challenges for the inclusion of patient preferences in the medical product life cycle: a systematic review. BMC Med Inform Decis Mak. 2019;19(1):189. https://doi.org/10.1186/s12911-019-0875-z.
5. Soekhai V, Whichello C, Levitan B, Veldwijk J, Pinto CA, Donkers B, et al. Methods for exploring and eliciting patient preferences in the medical product lifecycle: a literature review. Drug Discov Today. 2019;24(7):1324–31. https://doi.org/10.1016/j.drudis.2019.05.001.
6. Ryan M, Gerard K, Amaya-Amaya M. Using discrete choice experiments to value health and health care. New York: Springer Science & Business Media; 2007.
7. Ryan M, Gerard K, Amaya-Amaya M. Using discrete choice experiments to value health and health care. The economics of non-market goods and resources. Dordrecht: Springer; 2008.
8. Ryan M, Gerard K, Amaya-Amaya M. Discrete Choice Experiments in a Nutshell. In: Ryan M, Gerard K, Amaya-Amaya M, editors. Using discrete choice experiments to value health and health care. The economics of non-market goods and resources. Dordrecht: Springer; 2008. p. 13–46.
9. Lancaster KJ. A new approach to consumer theory. J Polit Econ. 1966;74(2):132–57.
10. Manski CF. The structure of random utility models. Theor Decis. 1977;8(3):229–54. https://doi.org/10.1007/bf00133443.
11. McFadden D. Econometric models of probabilistic choice. Structural analysis of discrete data with econometric applications. 1981;198272.
12. Ryan M, Gerard K. Using discrete choice experiments to value health care programmes: current practice and future research reflections. Appl Health Econ Health Policy. 2003;2(1):55–64.
13. Pearce A, Harrison M, Watson V, Street DJ, Howard K, Bansback N, et al. Respondent understanding in discrete choice experiments: a scoping review. Patient. 2021;14(1):17–53. https://doi.org/10.1007/s40271-020-00467-y.
14. US Department of Health and Human Resources Food and Drug Administration. Patient Preference Information—Voluntary Submission, Review in Premarket Approval Applications, Humanitarian Device Exemption Applications, and De Novo Requests, and Inclusion in Decision Summaries and Device Labeling: Guidance for Industry, Food and Drug Administration Staff, and Other Stakeholders. Silver Spring, MD: U. S. Food and Drug Administration; 2016.
15. Bridges JF, Hauber AB, Marshall D, Lloyd A, Prosser LA, Regier DA, et al. Conjoint analysis applications in health–a checklist: a report of the ISPOR Good Research Practices for Conjoint Analysis Task Force. Value Health. 2011;14(4):403–13. https://doi.org/10.1016/j.jval.2010.11.013.
16. Lancsar E, Louviere J. Conducting discrete choice experiments to inform healthcare decision making: a user's guide. Pharmacoeconomics. 2008;26(8):661–77. https://doi.org/10.2165/00019053-200826080-00004.
17. Brown TC. Introduction to stated preference methods. A primer on nonmarket valuation. New York: Springer; 2003. p. 99–110.
18. de Bekker-Grob EW, Ryan M, Gerard K. Discrete choice experiments in health economics: a review of the literature. Health Econ. 2012;21(2):145–72. https://doi.org/10.1002/hec.1697.
19. Soekhai V, de Bekker-Grob EW, Ellis AR, Vass CM. Discrete choice experiments in health economics: past, present and Future. Pharmacoeconomics. 2019;37(2):201–26. https://doi.org/10.1007/s40273-018-0734-2.
20. Smith IP, DiSantostefano RL, de Bekker-Grob EW, Levitan B, Berlin C, Veldwijk J, et al. Methodological priorities for patient preferences research: stakeholder input to the PREFER public-private project. Patient. 2021;14(5):449–53. https://doi.org/10.1007/s40271-021-00502-6.
21. Louviere JJ, Lancsar E. Choice experiments in health: the good, the bad, the ugly and toward a brighter future. Health Econ Policy Law. 2009;4(Pt 4):527–46. https://doi.org/10.1017/S1744133109990193.
22. Nutbeam D. The evolving concept of health literacy. Soc Sci Med. 2008;67(12):2072–8. https://doi.org/10.1016/j.socscimed.2008.09.050.
23. Andrus MR, Roth MT. Health literacy: a review. Pharmacotherapy. 2002;22(3):282–302. https://doi.org/10.1592/phco.22.5.282.33191.
24. Paasche-Orlow MK, Parker RM, Gazmararian JA, Nielsen-Bohlman LT, Rudd RR. The prevalence of limited health literacy. J Gen Intern Med. 2005;20(2):175–84. https://doi.org/10.1111/j.1525-1497.2005.40245.x.
25. Kutner M, Greenburg E, Jin Y, Paulsen C. The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy. NCES 2006-483. National Center for Education Statistics. 2006.
26. Sorensen K, Pelikan JM, Rothlin F, Ganahl K, Slonska Z, Doyle G, et al. Health literacy in Europe: comparative results of the European health literacy survey (HLS-EU). Eur J Public Health. 2015;25(6):1053–8. https://doi.org/10.1093/eurpub/ckv043.
27. Moran MB, Frank LB, Chatterjee JS, Murphy ST, Baezconde-Garbanati L. A pilot test of the acceptability and efficacy of narrative and non-narrative health education materials in a low health literacy population. J Commun Healthc. 2016;9(1):40–8. https://doi.org/10.1080/17538068.2015.1126995.
28. Ferguson LA. Implementing a video education program to improve health literacy. J Nurse Pract. 2012;8(8):e17–22. https://doi.org/10.1016/j.nurpra.2012.07.025.
29. Bandyopadhyay M, Stanzel K, Hammarberg K, Hickey M, Fisher J. Accessibility of web-based health information for women in midlife from culturally and linguistically diverse backgrounds or with low health literacy. Aust N Z J Public Health. 2022;46(3):269–74. https://doi.org/10.1111/1753-6405.13192.
30. Hart TL, Blacker S, Panjwani A, Torbit L, Evans M. Development of multimedia informational tools for breast cancer patients with low levels of health literacy. Patient Educ Couns. 2015;98(3):370–7. https://doi.org/10.1016/j.pec.2014.11.015.
31. Lim SL, Yang JC, Ehrisman J, Havrilesky LJ, Reed SD. Are videos or text better for describing attributes in stated-preference surveys? Patient. 2020;13(4):401–8. https://doi.org/10.1007/s40271-020-00416-9.
32. Vass CM, Davison NJ, Vander Stichele G, Payne K. A picture is worth a thousand words: the role of survey training materials in stated-preference studies. Patient. 2020;13(2):163–73. https://doi.org/10.1007/s40271-019-00391-w.
33. Bywall KS, Veldwijk J, Hansson MG, Baecklund E, Raza K, Falahee M, et al. Does being exposed to an educational tool influence patient preferences? The influence of an educational tool on patient preferences assessed by a discrete choice experiment. Patient Educ Couns. 2021;104(10):2577–85. https://doi.org/10.1016/j.pec.2021.03.013.
34. Sandorf ED, Aanesen M, Navrud S. Valuing unfamiliar and complex environmental goods: a comparison of valuation workshops and internet panel surveys with videos. Ecol Econ. 2016;129:50–61.
35. Navrud S. Communication devices in contingent valuation surveys—experiments with video. Determining the value of non-marketed goods. New York: Springer; 1997. p. 273–98.

36. Phillips E, Rahman R, Mattfeldt-Beman M. Relationship between diabetes knowledge, glycemic control, and associated health conditions. Diabetes Spectr. 2018;31(2):196–9. https://doi.org/10.2337/ds17-0058.
37. Bukhsh A, Khan TM, Sarfraz Nawaz M, Sajjad Ahmed H, Chan KG, Goh BH. Association of diabetes knowledge with glycemic control and self-care practices among Pakistani people with type 2 diabetes mellitus. Diabetes Metab Syndr Obes. 2019;12:1409–17. https://doi.org/10.2147/DMSO.S209711.
38. Bains SS, Egede LE. Associations between health literacy, diabetes knowledge, self-care behaviors, and glycemic control in a low income population with type 2 diabetes. Diabetes Technol Ther. 2011;13(3):335–41. https://doi.org/10.1089/dia.2010.0160.
39. Colleran KM, Starr B, Burge MR. Putting diabetes to the test: Analyzing glycemic control based on patients' diabetes knowledge. Diabetes Care. 2003;26(7):2220–1. https://doi.org/10.2337/diacare.26.7.2220.
40. Al-Qazaz HK, Sulaiman SA, Hassali MA, Shafie AA, Sundram S, Al-Nuri R, et al. Diabetes knowledge, medication adherence and glycemic control among patients with type 2 diabetes. Int J Clin Pharm. 2011;33(6):1028–35.
41. Marciano L, Camerini AL, Schulz PJ. The role of health literacy in diabetes knowledge, self-care, and glycemic control: a meta-analysis. J Gen Intern Med. 2019;34(6):1007–17. https://doi.org/10.1007/s11606-019-04832-y.
42. Murata GH, Shah JH, Adam KD, Wendel CS, Bokhari SU, Solvas PA, et al. Factors affecting diabetes knowledge in type 2 diabetic veterans. Diabetologia. 2003;46(8):1170–8. https://doi.org/10.1007/s00125-003-1161-1.
43. Zowgar AM, Siddiqui MI, Alattas KM. Level of diabetes knowledge among adult patients with diabetes using diabetes knowledge test. Saudi Med J. 2018;39(2):161–8. https://doi.org/10.15537/smj.2017.2.21343.
44. Hohendorff J, Gumprecht J, Mysliwiec M, Zozulinska-Ziolkiewicz D, Malecki MT. Intermittently scanned continuous glucose monitoring data of polish patients from real-life conditions: more scanning and better glycemic control compared to worldwide data. Diabetes Technol Ther. 2021;23(8):577–85. https://doi.org/10.1089/dia.2021.0034.
45. Głowińska-Olszewska B, Tobiaszewska M, Łuczyński W, Bossowski A. Monthly use of a real-time continuous glucose monitoring system as an educational and motivational tool for poorly controlled type 1 diabetes adolescents. Adv Med Sci. 2013;58(2):344–52.
46. Heinemann L, Franc S, Phillip M, Battelino T, Ampudia-Blasco FJ, Bolinder J, et al. Reimbursement for continuous glucose monitoring: a European view. J Diabetes Sci Technol. 2012;6(6):1498–502. https://doi.org/10.1177/193229681200600631.
47. OECD: OECD (2022), Purchasing power parities (PPP) (indicator). doi: https://doi.org/10.1787/1290ee5a-en (Accessed 10 Feb 2022)
48. Ghijben P, Lancsar E, Zavarsek S. Preferences for oral anticoagulants in atrial fibrillation: a best-best discrete choice experiment. Pharmacoeconomics. 2014;32(11):1115–27. https://doi.org/10.1007/s40273-014-0188-0.
49. Veldwijk J, Lambooij MS, de Bekker-Grob EW, Smit HA, de Wit GA. The effect of including an opt-out option in discrete choice experiments. PLoS ONE. 2014;9(11): e111805. https://doi.org/10.1371/journal.pone.0111805.
50. The PREFER consortium. PREFER Recommendations—why, when and how to assess and use patient preferences in medical product decision-making. 2022.
51. Verschueren S, Buffel C, Vander SG. Developing theory-driven, evidence-based serious games for health: framework based on research community insights. JMIR Serious Games. 2019;7(2): e11565. https://doi.org/10.2196/11565.
52. Flesch R. A new readability yardstick. J Appl Psychol. 1948;32(3):221–33. https://doi.org/10.1037/h0057532.
53. Kincaid JP, Fishburne Jr RP, Rogers RL, Chissom BS. Derivation of new readability formulas (automated readability index, fog count and flesch reading ease formula) for navy enlisted personnel. Naval Technical Training Command Millington TN Research Branch; 1975.
54. Calderon JL, Shaheen M, Hays RD, Fleming ES, Norris KC, Baker RS. Improving diabetes health literacy by animation. Diabetes Educ. 2014;40(3):361–72. https://doi.org/10.1177/0145721714527518.
55. McCarthy DM, Waite KR, Curtis LM, Engel KG, Baker DW, Wolf MS. What did the doctor say? Health literacy and recall of medical instructions. Med Care. 2012;50(4):277–82. https://doi.org/10.1097/MLR.0b013e318241e8e1.
56. Meppelink CS, van Weert JC, Haven CJ, Smit EG. The effectiveness of health animations in audiences with different health literacy levels: an experimental study. J Med Internet Res. 2015;17(1): e11. https://doi.org/10.2196/jmir.3979.
57. Sheridan SL, Halpern DJ, Viera AJ, Berkman ND, Donahue KE, Crotty K. Interventions for individuals with low health literacy: a systematic review. J Health Commun. 2011;16(suppl 3):30–54. https://doi.org/10.1080/10810730.2011.604391.
58. Visschers VH, Meertens RM, Passchier WW, de Vries NN. Probability information in risk communication: a review of the research literature. Risk Anal. 2009;29(2):267–87. https://doi.org/10.1111/j.1539-6924.2008.01137.x.
59. Fagerlin A, Zikmund-Fisher BJ, Ubel PA, Jankovic A, Derry HA, Smith DM. Measuring numeracy without a math test: development of the Subjective Numeracy Scale. Med Dec Making. 2007;27(5):672–80. https://doi.org/10.1177/0272989X07304449.
60. Chew LD, Bradley KA, Boyko EJ. Brief questions to identify patients with inadequate health literacy. Fam Med. 2004;36(8):588–94.
61. Bech M, Gyrd-Hansen D. Effects coding in discrete choice experiments. Health Econ. 2005;14(10):1079–83. https://doi.org/10.1002/hec.984.
62. Swait J, Louviere J. The role of the scale parameter in the estimation and comparison of multinomial logit models. J Mark Res. 1993;30(3):305–14. https://doi.org/10.2307/3172883.
63. Janssen E, Keuffel EL, Liden B, Hanna A, Rizzo JA. Patient preferences for mitral valve regurgitation treatment: a discrete choice experiment. Postgrad Med. 2022;134(2):125–42. https://doi.org/10.1080/00325481.2021.2020571.
64. Hensher DA, Greene WH. The mixed logit model: the state of practice. Transportation. 2003;30(2):133–76. https://doi.org/10.1023/a:1022558715350.
65. Train KE. Drawing from densities. In: Train KE, editor. Discrete choice methods with simulation. 2nd ed. Cambridge: Cambridge University Press; 2001. p. 205–36.
66. Gonzalez JM. A guide to measuring and interpreting attribute importance. Patient. 2019;12(3):287–95. https://doi.org/10.1007/s40271-019-00360-3.
67. Volksgezondheidenzorg.info: Diabetes mellitus→Cijfers & Context→Huidige situatie. https://www.volksgezondheidenzorg.info/onderwerp/diabetes-mellitus/cijfers-context/huidige-situatie#node-prevalentie-diabetes-huisartsenpraktijk-naar-opleiding (2021). Accessed 19 Jan 2021.
68. Polakowska M, Piotrowski W. Incidence of diabetes in the Polish population. Results of the multicenter polish population health status study—WOBASZ. Polish Arch Internal Med. 2011;121(5):156–63. https://doi.org/10.20452/pamw.1047.
69. Hole AR. Modelling heterogeneity in patients' preferences for the attributes of a general practitioner appointment. J Health Econ.

2008;27(4):1078–94. https://doi.org/10.1016/j.jhealeco.2007.11.006.
70. Hiligsmann M, Dellaert B, Dirksen C, Van DW, Watson V, Goemaere S, et al. Are Patients' preferences transferable between countries? A cross-European discrete-choice experiment to elicit patients' preferences for osteoporosis drug treatment. Value Health. 2014;17(7):A385. https://doi.org/10.1016/j.jval.2014.08.2642.
71. Kievit W, Tummers M, van Hoorn R, Booth A, Mozygemba K, Refolo P, et al. Taking Patient Heterogeneity and Preferences into Account in Health Technology Assessments. Int J Technol Assess Health Care. 2017;33(5):562–9. https://doi.org/10.1017/S0266462317000885.
72. Ludwig K, Ramos-Goni JM, Oppe M, Kreimeier S, Greiner W. To what extent do patient preferences differ from general population preferences? Value Health. 2021;24(9):1343–9. https://doi.org/10.1016/j.jval.2021.02.012.
73. Kaltoft MK, Turner R, Cunich M, Salkeld G, Nielsen JB, Dowie J. Addressing preference heterogeneity in public health policy by combining cluster analysis and multi-criteria decision analysis: proof of method. Health Econ Rev. 2015;5(1):10. https://doi.org/10.1186/s13561-015-0048-4.
74. van Overbeeke E, Hauber B, Michelsen S, Peerlinck K, Lambert C, Hermans C, et al. Patient preferences for gene therapy in haemophilia: results from the PAVING threshold technique survey. Haemophilia. 2021;27(6):957–66. https://doi.org/10.1111/hae.14401.
75. Raynor DK, Blenkinsopp A, Knapp P, Grime J, Nicolson DJ, Pollock K, et al. A systematic review of quantitative and qualitative research on the role and effectiveness of written information available to patients about individual medicines. Health Technol Assess (Winchester, England). 2007;11(5):iii. https://doi.org/10.3310/hta11050 (**1–160**).
76. Young A, Tordoff J, Smith A. "What do patients want?" Tailoring medicines information to meet patients' needs. Res Social Adm Pharm. 2017;13(6):1186–90. https://doi.org/10.1016/j.sapharm.2016.10.006.
77. Dickinson R, Hamrosi K, Knapp P, Aslani P, Sowter J, Krass I, et al. Suits you? A qualitative study exploring preferences regarding the tailoring of consumer medicines information. Int J Pharm Pract. 2013;21(4):207–15. https://doi.org/10.1111/j.2042-7174.2012.00252.x.
78. Grime J, Blenkinsopp A, Raynor DK, Pollock K, Knapp P. The role and value of written information for patients about individual medicines: a systematic review. Health Expect. 2007;10(3):286–98. https://doi.org/10.1111/j.1369-7625.2007.00454.x.
79. Rijksinstituut voor Volksgezondheid en Milieu: Diabetes mellitus: Leeftijd en geslacht. https://www.vzinfo.nl/diabetes-mellitus/leeftijd-en-geslacht (2021). Accessed 19 Jan 2021.
80. OECD. Education at a Glance: OECD Indicators Poland. 2019.

Authors and Affiliations

Ian P. Smith[1] · Chiara L. Whichello[2,3,4] · Esther W. de Bekker-Grob[3,4] · Maureen P. M. H. Rutten-van Mölken[4] · Jorien Veldwijk[1,3,4] · G. Ardine de Wit[1]

✉ Ian P. Smith
i.p.smith@umcutrecht.nl

[1] Julius Centre for Health Sciences and Primary Care, University Medical Centre Utrecht, Utrecht University, Utrecht, The Netherlands

[2] Evidera, London, UK

[3] Erasmus Choice Modelling Centre, Erasmus University Rotterdam, Rotterdam, The Netherlands

[4] Erasmus School of Health Policy & Management, Erasmus University Rotterdam, Rotterdam, The Netherlands