

# Perspectives of Patients and Professionals on Implementing a Computer Adaptive Vision-Related Quality of Life Outcome (CAT-EyeQ) in Clinical Practice

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**Purpose:** The CAT-EyeQ is a computer adaptive test (CAT) which measures vision-related quality of life in patients having exudative retinal diseases. The aim of this study is to investigate the usability of the CAT-EyeQ in clinical practice and identify potential barriers and facilitators for implementation (problem analysis).

**Methods:** Patients and health care professionals participated in the study regarding the usability of the CAT-EyeQ, and clinic managers and health care professionals were included in the problem analysis for implementation. In total, we conducted 18 semi-structured interviews. The Consolidated Framework for Implementation Research (CFIR) was used to develop the interview guides and to structure results.

**Results:** Six themes were derived from the usability study and problem analysis: (1) quality of the CAT-EyeQ and the applicability to patients' needs and preferences, (2) embedding the CAT-EyeQ in current practice, (3) implementation climate of the eye hospitals, (4) attitude of professionals, (5) engaging and encouraging professionals, and (6) integration of the CAT-EyeQ in health care – needs after piloting.

**Conclusions:** Patients and professionals mentioned that the CAT-EyeQ improved insight into the impact of eye diseases on a patient's daily life, it allowed for more attention on the patient perspective and the structured measurement of vision-related quality of life. The main perceived barriers mentioned by professionals for using the CAT-EyeQ were lack of time and the integration of the patient-reported outcome measure (PROM) results within the electronic patient record (EPR).

**Translational Relevance:** The CAT-EyeQ, accompanied by an overview of stakeholder perspectives resulting from this implementation study, can now be used in clinical practice.

## Introduction

In cases of macular edema, caused by neovascular age-related macular degeneration (AMD), exudative diabetic retinopathy, and retinal vein occlusion (i.e. cystoid macular edema [CME]), about 15% of patients experience less effective treatment (injections with anti-vascular endothelial growth factor [VEGF]), leading to a reduction in vision.<sup>1</sup> Eventually, the loss of vision

will cause limitations in patient's daily activities, physical functioning, and might impact their emotional well-being and quality of life.<sup>2-5</sup>

Patient-reported outcome measures (PROMs) can be used for the assessment of patients' needs, they are proven to be suitable for measuring and evaluating patient's disabilities in daily activities, and are supportive for patient-doctor communication and shared decision making.<sup>6-10</sup> Although PROMs were previously mostly used in a research context,

PROMs are increasingly adopted in routine health care.<sup>11–13</sup> The international Consortium of Health Outcome Measurement listed families of outcome sets that cover 14 health care disciplines (e.g. oncology and ophthalmology), including 47 disease-specific standard sets of PROMs (e.g. cataracts and macular degeneration) for use in routine clinical care.<sup>14–18</sup>

In previous research, we developed and calibrated the EyeQ itembank, a PROM that can be used for measuring vision-related quality of life (Vr-QoL) and can also be administered using a computer adaptive testing (CAT) approach in patients having exudative retinal diseases and being treated with anti-VEGF in ophthalmic clinical practice.<sup>19,20</sup> Patients with widely varying vision have participated in the calibration study, as we tried to obtain the most representative study population. The itembank was calibrated with the Item Response Theory (IRT), using a constrained graded response model (GRM), which is most commonly used in IRT. The unidimensionality of the instrument (i.e. Vr-QoL is the measured latent construct) was confirmed by comparing a 1-factor model and a 2-factor model, in which the 1-factor model explained 49% of the variance, and the 2-factor model added 4% of explained variance. The overall fit of the 47 items to the GRM was adequate, which was assessed with the root mean square error of approximation (0.035), the standardized root mean residual (0.071), the comparative fit index (0.995), and the Tucker-Lewis index (0.994).<sup>20</sup>

CATs use an algorithm to select items from the itembank, which is based on the response the patient gave on previous items. This allows a test to limit the number of items that needs to be administered, which results in a unique sequence of items that are tailored to a patient's individual level of ability. After the calibration of the EyeQ itembank, post hoc CAT simulations were performed to define the optimal administration rules for the CAT of the EyeQ. This research showed that the mean test length could be reduced to six items while still obtaining reliable test scores.<sup>21</sup>

To allow for an optimal integration of the CAT-EyeQ, first, a “problem analysis” should be performed. This analysis helps in understanding the challenges and opportunities that may arise during the implementation process, allowing to develop strategies to address potential barriers and enhance the adoption and effective utilization of a new instrument in clinical practice.<sup>22,23</sup>

Therefore, the aim of the current study is to investigate the needs for implementation of the CAT-EyeQ in ophthalmic clinical practice. We focused on the usability

of the CAT-EyeQ from patients' and professionals' perspectives and investigated potential barriers and facilitators for implementing the CAT-EyeQ in clinical practice, as addressed by professionals and clinic managers.

## Methods

### Ethics Statement

The study protocol was approved by the Medical Ethics Committee (MEC) and conducted according to the Declaration of Helsinki. The MEC declared that the protocol did not fall under the scope of the Medical Research Involving Human Subjects Act.

### Study Design

All data, regarding the usability of the CAT-EyeQ and problem analysis, were collected through semi-structured interviews. The study was conducted between January 2022 and May 2022.

### Setting and Participants

Patients, professionals, and clinic managers were recruited from two eye hospitals (EH1 and EH2). Both eye hospitals provide general eye care. Patients were informed about the study by their own ophthalmologist and, if they were interested to participate, they received the detailed written study information. Subsequently, the researcher contacted the patients by telephone after which patients were included in the study. Patients who were willing to participate provided written informed consent. Patients meeting the following inclusion criteria were invited for participation: 18 years and older, having an exudative retinal disease (AMD, diabetic macular edema [DME], or CME) and currently receiving intra-ocular anti-VEGF treatment. In prior research, which involved the calibration of the CAT-EyeQ itembank,<sup>20</sup> this target population was also included. Ensuring the inclusion of the same target population in this implementation study is deemed crucial for consistency and comparability with previous research. In order to explore a broad range of perspectives, selective sampling was used for the degree of visual complaints indicated by the patient, their age, gender, and diagnosis for which anti-VEGF treatment was initiated. Our previous research also indicated that a substantial proportion of the target population maintains good visual acuity while under treatment.<sup>20</sup> Therefore, we did not impose restrictions for inclusion for this implementation study based

on visual complaints. However, we did use selective sampling to ensure a comprehensive understanding of patient insights. We anticipated data saturation to occur after approximately 10 interviews with patients. This approach ensured that we gathered comprehensive and diverse insights from participants, reaching a point where new information and themes were no longer emerging from the interviews. Professionals working as ophthalmologist, physician assistant, optometrist, or technical ophthalmic assistant who were involved in the care of patients having exudative retinal diseases, as well as clinic managers, were invited for participation in the usability study and/or in the problem analysis for implementation.

## Approach

The Consolidated Framework for Implementation Research (CFIR) was used to develop the interview guides regarding the usability of the CAT-EyeQ and the problem analysis. The CFIR is a meta-theoretical framework that provides standardized implementation-related constructs that can be applied across the spectrum of implementation research.<sup>24,25</sup> Recently, an update of the CFIR was published.<sup>26</sup> In this study, we used the new format and terms of the CFIR. The CFIR constructs are organized around five major domains, which interact and may influence implementation, these are: “innovation” (e.g. innovation relative advantage), “outer setting” (e.g. policies and law), “inner setting” (e.g. structural characteristics), “individuals” (e.g. motivation), and “implementation process” (e.g. engaging).

The included topics in the interview guide regarding usability (patients and professionals), were: perceptions about the CAT-EyeQ, the value of the CAT-EyeQ for patients with exudative retinal diseases and professionals in the care for this target group, administration of the CAT-EyeQ (mode), the professionals that should be involved, the extra amount of time needed in the care process, and the frequency of administration. Prior to the interview patients received a hard copy of the total EyeQ itembank to get an idea of the questionnaire and the topics included.

The included topics in the structured interview guide regarding the problem analysis (professionals and clinic managers), were: the actual decision making to use the PROM, the implementation climate, needs for implementation of the CAT-EyeQ, needs to ensure the continued use of the CAT-EyeQ in health care (integration), and external and internal factors that play a role in using the CAT-EyeQ. See Supplementary Files for interview guides for patients (S1), health care professionals (S2), and clinic managers (S3).

## Analyses

The interviews were audio-recorded and transcribed verbatim. Subsequently, a codebook was developed with the use of CFIR, which ensured a systematic analysis and organization of the barriers and facilitators that were addressed. The topics regarding the usability were added to the codebook. Two researchers coded the two interviews independently (authors P.R.K. and H.vA.) and discrepancies in codes were evaluated. One researcher applied the codes to all the interviews (author P.R.K.). During the coding process some new codes emerged, however, additions were minimal, which indicated possible data saturation.<sup>27</sup> The data were analyzed with MAXQDA 2020 software. SPSS Statistics 28 was used for descriptive statistics.

## Results

### Usability of the CAT-EyeQ

In total, 10 patients and 5 health care professionals were included in the usability study. Sociodemographic and clinical characteristics of patients are presented in Table 1. We included two ophthalmologists, an optometrist, a physician assistant, and a technical ophthalmic assistant, having a mean age of  $38.2 \pm 6.1$  years (range = 28–43 years) and a mean working experience in ophthalmic clinical practice of  $8.8 \pm 4.9$  years (range = 2–14 years). They were all involved in the care for patients receiving anti-VEGF treatment for AMD, DME, and CME.

### The Value of the CAT-EyeQ

Most patients were positive about using the CAT-EyeQ. It was indicated that, currently, there is little or no attention paid to the impact of the eye disease on their daily lives. Patients mentioned that completing the CAT-EyeQ will provide insight in their perspective to the health care professional, which could be a valuable addition. The impact of the disease and the consequences for their daily life, is what mattered most to patients.

*“And ... well, with those percentages [measuring visual acuity in clinical practice] and all that, I don't think it's really going about what the problem is. So that questionnaire seems like a really good addition to that. He [ophthalmologist] is more concerned with having 90% vision... yes... right now, but if that spot expands slightly, then I won't have any vision suddenly. Some of those items in that questionnaire, that's what really matters to me.”* (female patient, age 73 years, with AMD, mild VI worst eye,

**Table 1.** Sociodemographic and Clinical Characteristics of Participants ( $N = 10$ ) in the Usability Study

Age, Mean $\pm$ SD (Range)	75.2 $\pm$ 8.5 (61–88)
Male gender, $n$	5
Nationality, %	
Dutch	9
Other	1
Degree of vision impairment (VI) <sup>a</sup> of the worst eye <sup>b</sup> , $n$	
Normal vision	4
Mild VI	1
Moderate VI	2
Severe VI	1
Blindness	2
Degree of vision impairment of the better eye, $n$	
Normal vision	8
Mild VI	1
Moderate VI	1
Diagnosis for which anti-VEGF treatment, $n$	
Age-related macular degeneration	7
Diabetic macular edema	1
Cystoid macular edema (due to retinal vein inclusion)	2
Duration treatment anti-VEGF in years, mean $\pm$ SD (range)	6.65 $\pm$ 5.7 (0.5–15)
Civil status, $n$	
Single	4
Not single	6
Employment status, $n$	
Employed	1
Unemployed/retired	9

<sup>a</sup>Self-reported visual acuity transformed to degree of vision impairment.

<sup>b</sup>In accordance with the International Classification of Diseases 11th Edition (ICD-11), where no vision impairment (normal vision) is defined as visual acuity equal to or better than 6/12, mild vision impairment is defined as visual acuity worse than 6/12 to 6/18, moderate vision impairment is defined as visual acuity worse than 6/18 to 6/60, severe vision impairment is defined as visual acuity worse than 6/60 to 3/60, and blindness is defined as visual acuity worse than 3/60.

normal vision better eye, and 12 years anti-VEGF treatment).

In addition, one patient indicated that although the CAT-EyeQ provided insight into the impact of the eye disease, it was considered a disadvantage that the instrument did not measure the patient's experience with anti-VEGF injection treatment.

*"Something else: how do I experience the treatment? ... I also have something to say about that."* (male patient, age 76 years, with AMD, no VI worst eye, normal vision better eye, and 2 years anti-VEGF treatment).

It was also mentioned that the CAT-EyeQ can help patients to discuss problems they experience and that it can be helpful in identifying patients who may need additional support.

*"Well ... it is important to start using such a questionnaire because other people who are also my age, so people between 70 and 90 years old, cannot always clearly explain or express what exactly the problem is, but they do benefit with support. The questionnaire can help identify these people."* (female patient, age 87 years, with AMD, severe VI worst eye, normal vision better eye, and 5 years anti-VEGF treatment).

One patient indicated that the impact of eye disease on daily life, measured with the CAT-EyeQ, could also be taken into account in the decision whether or not to continue or adjust the treatment. The patient confirmed that this decision is currently based only on clinical measurements and the patient's perspective is lacking.

*"Then they [professionals] can judge based on my answers: ... 'how far should we continue with the treatment? ...'"* (male patient, with CME, normal vision worst eye, normal vision better eye, and 1 year anti-VEGF treatment).

Professionals indicated that they expected the CAT-EyeQ to be of value for evaluating Vr-QoL. A main advantage of the questionnaire was considered to be the fact that the CAT-EyeQ contains an extensive collection of questions, which extends far beyond their usual history taken process. In addition, it was mentioned that Vr-QoL could from now on be measured in a structured way. In addition, it was indicated that for patients who find it difficult to discuss their problems or do not feel the room to discuss, the integration of the patients' perspectives could make health care a bit more patient-friendly.

*"There is short time for that [history taken process] ... so if someone is not comfortable, they're not going to say anything about it, I guess"* (optometrist, with 14 years working experience).

*"We can make it [care process] a bit more human by putting more emphasis on it [patient perspective]"* (physician assistant, with 13 years working experience).

However, all professionals mentioned that the output of the CAT-EyeQ would not change the



decision whether or not to continue treatment. The CAT-EyeQ was, however, seen as a valuable addition to current treatment, as it could be useful in identifying patients who may benefit from referral to low vision or rehabilitation services. The professionals did realize that the use of the PROM could be a factor in improving care.

*“The CAT-EyeQ is not going to change the policy of injections. Now we evaluate the retina scans and the patient experiences his or her problems in daily life. Evaluating this in clinical practice allows for a patient to feel better understood. As a result, they might also be a bit more motivated to get the injections. I think that, in turn, this influences patient satisfaction with care”* (physician assistant, with 13 years working experience).

### **The Extra Amount of Time Needed in the Care Process and the Frequency of Administration, the Administration of the CAT-EyeQ (mode), and Involved Professional**

In the interviews with the patients, it mainly emerged that the length of the questionnaire (average 6-8 questions) was adequate. Almost all patients indicated that they could complete the questionnaire digitally in their own homes using their own computer tablet or PC. For most patients, this appeared to be the easiest way, as they were familiar with these devices and also knew how to enlarge the text on the screens if needed. A few patients indicated they would need help to fill out the questionnaire, this was because of some digital aspects that were considered to be difficult for them. Support in completing the CAT-EyeQ by a health care professional in the clinic or by a family member were suggested by the patients as a solution. The frequency of completion varied from “once every 6 months” to “once a year.” Some patients indicated that it should not be done more often than once a year as long as they had no complaints.

However, one patient indicated not to experience any problems in daily life due to his eyesight at all, but would still like to fill out the CAT-EyeQ, in order to be able to discuss this with the ophthalmologist. The feeling arose that the decision whether or not to continue with anti-VEGF injections depended too much on the objective measurements and too little on his own experience with the eye disease in daily life. Two patients indicated it was important to administer the CAT-EyeQ periodically, despite the fact that they were already referred to a low vision rehabilitation service and received good support there. The main reasons for this were to know for themselves the status of their eyesight and to let professionals know what it is like to have the eye disease. They claimed that there was very

little attention paid to that. One patient thought that completing the CAT-EyeQ would have no added value in her situation. She was severely visually impaired and had been referred to low vision rehabilitation services some time ago.

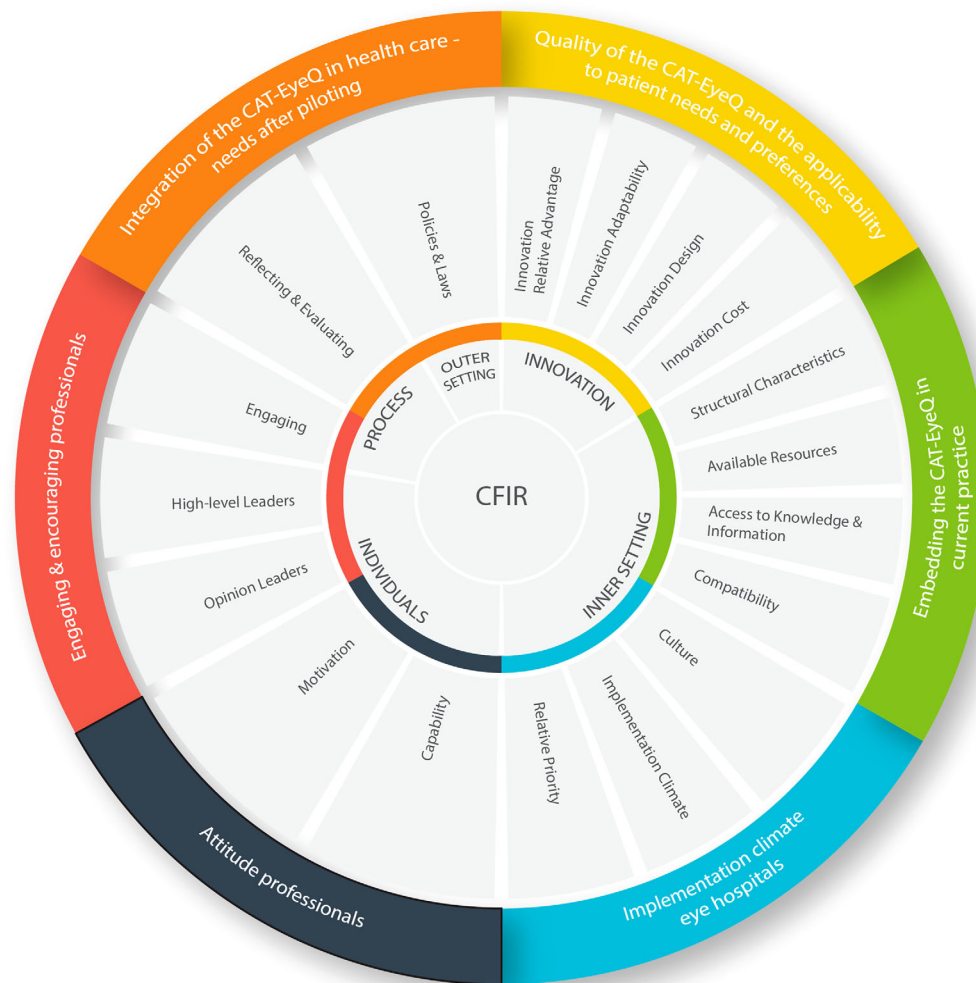
Given the short length, filling out the CAT-EyeQ was not considered to be a problem for most patients, however, they indicated that they would like to be informed of the results of the CAT-EyeQ, for example, by email, or they would like the results to be discussed with the ophthalmologist. Some patients indicated that getting the diagnosis had a major impact on them. That moment was intense, caused a lot of uncertainty, and raised many questions.

In the interviews with the professionals, it emerged in particular that the frequency of administering the PROM had to logically coincide with a so-called “evaluation moment of anti-VEGF injections.” They mentioned that patients visit the clinic often, for routine anti-VEGF injections, however, there is not always time to discuss issues with their ophthalmologist. In both eye hospitals, professionals indicated that the anti-VEGF evaluation moment would be the best moment to integrate the CAT-EyeQ to be able to discuss it with the patient. The period between the anti-VEGF evaluation moments differed between the two eye hospitals. Finally, one professional indicated that it may be confrontational for severely visually impaired patients to complete the CAT-EyeQ.

### **Problem Analysis - Potential Barriers and Facilitators of Implementing the CAT-EyeQ**

Six experienced professionals (3 men, and 5 who also participated in the usability study) and two clinic managers working at EH1 and EH2 participated (1 man). Professionals worked as an ophthalmologist ( $n = 2$ ), physician assistant ( $n = 1$ ), optometrist ( $n = 2$ ), or technical ophthalmic assistant ( $n = 1$ ). The mean working experience for professionals was  $8.7 \pm 4.4$  years (range = 2–14 years) and clinic managers worked for 8 and 12.5 years in their current function. The mean age was  $39.9 \pm 8.3$  years (range = 28–55 years).

Professionals and clinic managers mentioned barriers and facilitators regarding the implementation of the CAT-EyeQ. Six themes were derived during the analysis and were subsequently linked to CFIR constructs and covered the five CFIR domains. An overview of the themes per the CFIR domains and linked CFIR constructs is presented in the [Figure](#). An overview of barriers and facilitators per theme is presented in [Table 2](#). Barriers and facilitators mentioned by professionals in the usability study are included in this table as



**Figure.** Overview of the derived themes per CFIR domain and linked CFIR constructs. The *inner ring* shows the five CFIR domains (innovation; inner setting; individuals; implementation process; and outer setting), the *second ring* shows the CFIR constructs, that fall under the CFIR domains, to which the themes were linked. The *outer ring* shows the six themes.

well and marked with an asterisk (\*). Facilitators and barriers are often two sides of the same coin. If this was the case, we listed the factor as ( $\pm$ ) in the table. Theme one is described in the section “usability of the CAT-EyeQ.” Themes two to six are described in the section “problem analysis – potential barriers and facilitators of implementing the CAT-EyeQ.”

### Theme 2 – Embedding the CAT-EyeQ in Current Practice

With regard to structural organizational characteristics, a number of factors were identified that influence implementation: small size of the organization facilitates implementation, different workflows on sites hinder implementation, and social architecture may contribute positively when the medical director is convinced of the added value of the PROM. Using the

CAT-EyeQ was seen as a relatively small change in the existing workflow, and most health care professionals indicated that the CAT-EyeQ can best be embedded within an evaluation consultation for anti-VEGF treatment.

A barrier mentioned several times was the already high workload and the lack of time available per patient. A quick and easy access to CAT-EyeQ results, as well as a clear policy for appropriate follow-up care to offer to the patient would facilitate its implementation and use.

### Theme 3 – Implementation Climate Eye Hospitals

The absorptive capacity for change was expected to be low, largely caused by the high workload of professionals. However, it was indicated that the easiness of access to the CAT-EyeQ results, and thus also

**Table 2.** Overview of Barriers and Facilitators for Implementation of the CAT-EyeQ, Presented Per Theme

CFIR Construct	Barriers and Facilitators
<b>Theme 1 - Quality of the CAT-EyeQ and the applicability to patients needs and preferences</b>	
Innovation relative advantage <sup>a</sup>	Tool to measure Vr-QoL in a structured way (+) In-depth questionnaire compared to usual history taken process: extensive content of the EyeQ-46 itembank (+) Insights on impact of the eye diseases on daily life (+) Increasing attention for the impact of the eye diseases on daily life (+) Tool to discuss problems due to vision loss (+) Personal approach (+) Tool to identify patients who need additional support and would benefit from referral to rehabilitation (+) Digital measurement (±) Tool to measure the maximum achievable treatment effect from the patient's perspective (+) Measuring Vr-QoL confrontational for severe visually impaired patients (−)
Innovation adaptability <sup>a</sup>	Computer adaptive design – length of test (+)
Innovation design	Possible integration of PROM software with EPR (+)
Innovation cost	Computer adaptive design tailored to individual patient (+) Relative low costs software (+) Costs hiring staff (−)
<b>Theme 2 - Embedding the CAT-EyeQ in current practice</b>	
Structural characteristics	Different workflow other locations (−) Size organization (±) Social architecture (±)
Available resources	Workload/time/costs (−) Availability of staff to assist patients fill out the PROM (±)
Access to knowledge and information	Integration of CAT-EyeQ results in EPR (+) Availability of health care policy to provide proper follow-up care (+)
Compatibility	Relative small change in exiting workflow (+) Embedding intervention within evaluation consult anti-VEGF (+) Quick and easy finding of measurements - clear overview of results (+)
<b>Theme 3 - Implementation climate eye hospitals</b>	
Culture	The use of the CAT-EyeQ is in line with norms and values of the organization (+)
Implementation climate <sup>b</sup>	Absorptive capacity for change (−) Receptivity to the use of the CAT-EyeQ (+)
Relative priority	The level of support by the organization for use of the CAT-EyeQ (±) Shared perception of the importance of the use of the CAT-EyeQ (+) Including patient perspective is the norm in current health care (+)
<b>Theme 4 - Attitude professionals</b>	
Motivation	Implementation of the CAT-EyeQ is important and necessary (+) Added value of the CAT-EyeQ (+)
Capability	General knowledge about PROMs among professionals (+) Relative straightforward use of the CAT-EyeQ – extension to usual history taken process (+) Lack of knowledge about follow-up care (−)

**Table 2.** Continued

CFIR Construct	Barriers and Facilitators
<b>Theme 5 - Engaging and encouraging professionals</b>	
Engaging	Attracting appropriate individuals/departments (+) Education and training in various forms (+)
High-level leaders	Medical lead (+) Operational lead (+)
High-level leaders and opinion leaders	Professionals having expertise in retinal diseases (+)
<b>Theme 6 - Integration of the CAT-EyeQ in health care – needs after piloting</b>	
Reflecting and evaluating	Clear protocols and procedures and time (+) Structure (+) Adopt use of PROMs in mission and vision of the company (+) Evaluation of the effect of the use of the CAT-EyeQ in health care (+) Receiving periodic feedback from patients and rehabilitation centers (+)
Policies and laws	External policy for the use of the CAT-EyeQ (+)

CAT-EyeQ, Computer Adaptive Test-EyeQ; CFIR, Consolidated Framework for Implementation Research; EPR, electronic patient record; PROMs, patient reported outcome measures; Vr-QoL, vision-related quality of life.

<sup>a</sup>Theme one is described in the section “usability of the CAT-EyeQ.” (+) Facilitator; (–) Barrier; (±) Facilitator and barrier.

<sup>b</sup>Construct of the initial CFIR.

the degree of organizational support to prioritize the integration of CAT-EyeQ results in the electronic patient record (EPR) would make a major difference in increasing the capacity for change.

On the other hand, it was indicated that the receptivity to the use of the CAT-EyeQ would be high among fellow professionals, because the usefulness and importance of the PROM was acknowledged and the use of PROMs in general was currently embedded in other health care trajectories as well. In addition, the mission of the eye hospitals was to provide the best care every day, tailored to the individual patient needs; the use of the CAT-EyeQ was indicated to be in line with this.

#### Theme 4 – Attitude Professionals

Professionals and clinic managers indicated that it is important in health care to pay more attention to the impact on patients' daily life owing to vision loss. The implementation of the CAT-EyeQ was therefore considered to be important for patients with exudative retinal diseases. Although professionals were a bit hesitant to use the PROM to support shared decision making, they did see an added value in using the tool: the possibility to measure Vr-QoL in a structured way, and that it could also provide support in identifying patients who would benefit from referral to low vision rehabilitation services. They mentioned that it would potentially make health care more patient-centered.

A few indicated that the PROM might help managing the expectations that patients may have of anti-VEGF treatment: when the PROM is filled out at the moment the macular oedema is under control, for example, after the first months of treatment with anti-VEGF, it could give the patient insight in what the maximum achievable effect of the treatment would be from his or her perspective (i.e. Would I be able to read small print? Would I be able to recognize faces?).

#### Theme 5 – Engaging and Encouraging Professionals

Retina specialists were identified as one of the key individuals in making the decision to use the CAT-EyeQ. They formally (because they formally determine the care policy within the clinics) and informally (because they can ensure the success or failure of the implementation by giving their opinion) influence the attitude and beliefs that fellow professionals may have in the use of the CAT-EyeQ and this will have a positive influence on the success of the implementation. Clinic managers indicated that they had a role in the decision to implement the PROM, however, they stated that the opinion of the health care professional makes a more important contribution.

The integration of CAT-EyeQ results with the EPR has been repeatedly identified as a key facilitator for implementation, and was also mentioned as a prerequisite for using the PROM in clinical practice. Invol-



ing the information and communication technology (ICT) department at an early stage of the implementation project was recommended. In order to engage the whole team, it was suggested to provide information and education on PROMs and the CAT-EyeQ in various forms, such as an on-site training using a presentation, or a written information folder via email, etc.

### Theme 6 – Integration of the CAT-EyeQ in Health Care – Needs After Piloting

Facilitating factors that were identified which support the integration and continued use of the CAT-EyeQ after piloting were the provision of clear protocols and procedures and an extension of the time available per patient. In addition, it was considered important that it should be clear to professionals which patients have completed the PROM at what moment, a clear structure should be developed. Furthermore, receiving feedback periodically from patients and low vision rehabilitation services to whom patients would be referred, would allow for support for the continued use of the CAT-EyeQ.

Although the CAT-EyeQ seemed to fit the mission and vision of the eye hospitals; there seemed to be an intrinsic motivation to integrate the PROM, it was indicated that it would be supportive for continued use of the CAT-EyeQ if it would be included in external policies and national guidelines.

## Discussion

This study provided insight into the perspectives of patients and professionals regarding the usability of the CAT-EyeQ. In addition, potential barriers and facilitators that influence its implementation were identified. Patients and professionals were generally positive about the use of the CAT-EyeQ, the added value compared to current practice was recognized; in particular, the CAT-EyeQ increases insight into the impact of vision loss on daily life and thus contributes to patient-oriented care. Although the majority of patients saw an advantage in using the CAT-EyeQ, it was also indicated that it was a disadvantage that the CAT-EyeQ did not include questions about the treatment with anti-VEGF injections and the experience with the treatment. Previous research also described the relatively high treatment burden of anti-VEGF injections, due to the often long treatment duration, as well as the high frequency and invasive nature of the injections.<sup>28</sup> However, the experience of patients with health care and treatment concerns a different

construct and it is, therefore, not possible to include these aspects in the measurement scale of the CAT-EyeQ. To gain insight into these aspects, Patient-reported Experience Measures (PREMs) can be used to measure patients' perception of their experience with the health care received. In this way, more attention could be paid to the treatment burden as a result of the periodic injections.<sup>29</sup> When PROMs and PREMs are used together, a more patient-centered picture can be obtained.<sup>29,30</sup>

The main perceived barriers mentioned by professionals for the use of the CAT-EyeQ were lack of time and the integration of the PROM results within the EPR. These findings are in line with previous studies examining professionals' perspectives on the use of PROMs.<sup>31–33</sup> However, previous research also shows that the use of PROMs in clinical practice does not influence the length of the consultation.<sup>34</sup> In our study, it was indicated that if the professional has insight into the PROM results at the start of the consultation, this might contribute to a more targeted history taken process. This is also in line with other studies where an improved communication with the patient was mentioned (e.g. more in depth communication, providing structured consultation, and providing a starting point for conversation).<sup>33</sup> The aforementioned barriers (time and integration with EPR) are inter-related to a certain extent: it is possible that when an optimal integration of the PROM results within the EPR is achieved, the barrier "time" will take up a less important position.

We included a heterogeneous group of patients, including some with severe visual impairment. The interviews with the patients showed that the added value of completing the PROM can vary per individual: filling out the PROM can be confrontational for patients with severe vision impairment. However, severe visual impairment was not always a limiting factor to the willingness to complete the PROM. The relatively small sample size of this study may not have captured all patient insights regarding this. Nevertheless, to include the CAT-EyeQ in standard care, we recommend careful selection of patients who routinely need to complete the PROM and, where possible, also consider individual patient preferences. A clear structure that determines in which situations the CAT-EyeQ will or will not be measured in patients, as well as a clear and visible signal in the EPR that a PROM has been completed, is of great importance in order to support the professional in using the PROM during consultation.

The computer adaptive aspect of the PROM is seen as a major advantage as it minimizes patient burden. However, it is important to acknowledge the specific

needs of older patients within the target population. Although the majority of patients included in our study did not find the digital aspect of the CAT-EyeQ problematic, it is crucial to recognize that a small proportion of patients may encounter difficulties in independently completing the PROM at home due to digital illiteracy or severe visual impairment. As a result, some of the patients will eventually be dependent of support from a close relative or professional for completing the PROM. In such cases, offering the option of completing the questionnaire in the clinic with the assistance of a clinic staff member can be a good alternative to ensure their participation, in order to support the professional in using the PROM during consultation.

However, completing the CAT-EyeQ can also be challenging for other reasons; for example, for patients who cannot read or write or who may not have a good understanding of the Dutch language.<sup>35–38</sup> Despite our efforts, we included only one patient with a non-Dutch nationality. It is possible that the results we obtained regarding the opinions about the complexity of completing the digital CAT-EyeQ are not representative for the whole target group, which can be seen as a limitation of our study. Future research is needed to investigate and to improve the accessibility of the CAT-EyeQ for patients with low literacy and/or a non-Dutch nationality in order to reduce the risk of inducing health care disparities by using the CAT-EyeQ.

While describing the results of this study, the updated version of the CFIR was published.<sup>26</sup> The updated constructs within the domains of the CFIR to which our themes were linked differed little compared to the initial version of the CFIR; some constructs were rewritten, separated, or moved to another domain. However, the construct “implementation climate” (domain “inner setting”) was removed from the updated CFIR. In our study, however, there were a number of barriers and facilitators that we found best to fall under “implementation climate,” which is why we chose to maintain this construct to describe our results.

## Conclusions

In this study, we investigated the usability of the CAT-EyeQ and we investigated barriers and facilitators that influence its implementation in ophthalmic clinical practice. The results show that the CAT-EyeQ is seen as a valuable tool to use for the measurement of Vr-QoL in patients with exudative retinal diseases. Several advantages of using the CAT-EyeQ

were mentioned: improved insight into the impact of the eye diseases on a patient’s daily life, more attention and emphasis on the patient perspective, and the structured measurement of Vr-QoL. The main perceived barriers for the use of the CAT-EyeQ were lack of time and the integration of the PROM results within the EPR. The overview of barriers and facilitators for implementation that is provided in this study can be helpful for the development of an implementation plan and for the use of appropriate implementation strategies to address the barriers.

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## References

1. Verbraak FD, Ponsioen DL, Tigchelaar-Besling OAM, et al. Real-world treatment outcomes of neovascular age-related macular degeneration in the Netherlands. *Acta Ophthalmologica*. 2021;99(6):e884–e892, doi:[10.1111/aos.14712](https://doi.org/10.1111/aos.14712).
2. Brody BL, Gamst AC, Williams RA, et al. Depression, visual acuity, comorbidity, and disability associated with age-related macular degeneration. *Ophthalmology*. 2001;108(10):1893–1900; discussion 1900–1, doi:[10.1016/s0161-6420\(01\)00754-0](https://doi.org/10.1016/s0161-6420(01)00754-0).
3. Bookwala J, Lawson B. Poor vision, functioning, and depressive symptoms: a test of the activity restriction model. *The Gerontologist*. 2011;51:798–808, doi:[10.1093/geront/gnr051](https://doi.org/10.1093/geront/gnr051).
4. Hayman KJ, Kerse NM, La Grow SJ, Woules T, Robertson MC, Campbell AJ. Depression in older people: visual impairment and subjective ratings of health. *Optom Vis Sci*. 2007;84(11):1024–1030, doi:[10.1097/OPX.0b013e318157a6b1](https://doi.org/10.1097/OPX.0b013e318157a6b1).
5. van Nispen RMA, de Boer MR, Hoeijmakers JGJ, Ringens PJ, van Rens GHMB. Co-morbidity and visual acuity are risk factors for health-related quality of life decline: five-month follow-up EQ-5D data of visually impaired older patients. *Health*

- Qual Life Outcomes*. 2009;7(1):18, doi:[10.1186/1477-7525-7-18](https://doi.org/10.1186/1477-7525-7-18).
6. Greenhalgh J, Gooding K, Gibbons E, et al. How do patient reported outcome measures (PROMs) support clinician-patient communication and patient care? A realist synthesis. journal article. *J Patient Rep Outcomes*. 2018;2(1):42, doi:[10.1186/s41687-018-0061-6](https://doi.org/10.1186/s41687-018-0061-6).
  7. Detmar SB. Use of HRQOL questionnaires to facilitate patient-physician communication. *Expert Rev Pharmacoecon Outcomes Res*. 2003;3(3):215–217, doi:[10.1586/14737167.3.3.215](https://doi.org/10.1586/14737167.3.3.215).
  8. Greenhalgh J, Pawson R, Wright J, et al. Functionality and feedback: a protocol for a realist synthesis of the collation, interpretation and utilisation of PROMs data to improve patient care. *BMJ Open*. 2014;4(7):e005601, doi:[10.1136/bmjopen-2014-005601](https://doi.org/10.1136/bmjopen-2014-005601).
  9. Kotronoulas G, Kearney N, Maguire R, et al. What is the value of the routine use of patient-reported outcome measures toward improvement of patient outcomes, processes of care, and health service outcomes in cancer care? A systematic review of controlled trials. *J Clin Oncol*. 2014;32(14):1480–1501, doi:[10.1200/jco.2013.53.5948](https://doi.org/10.1200/jco.2013.53.5948).
  10. Valderas JM, Kotzeva A, Espallargues M, et al. The impact of measuring patient-reported outcomes in clinical practice: a systematic review of the literature. *Qual Life Res*. Mar 2008;17(2):179–193, doi:[10.1007/s11136-007-9295-0](https://doi.org/10.1007/s11136-007-9295-0).
  11. Smith S, Cano S, Lamping D, et al. Patient-reported outcome measures (PROMs) for routine use in treatment centres: recommendations based on a review of the scientific evidence. *J Patient Rep Outcomes* 2005;12:18–26. Available at: [https://www.researchgate.net/publication/228606703\\_Patient-Reported\\_Outcome\\_Measures\\_PROMs\\_for\\_Routine\\_use\\_in\\_Treatment\\_Centres\\_Recommendations\\_Based\\_on\\_A\\_Review\\_of\\_the\\_Scientific\\_Evidence](https://www.researchgate.net/publication/228606703_Patient-Reported_Outcome_Measures_PROMs_for_Routine_use_in_Treatment_Centres_Recommendations_Based_on_A_Review_of_the_Scientific_Evidence).
  12. Queirós L, Redondo P, França M, et al. Implementing ICHOM standard set for cataract surgery at IPO-Porto (Portugal): clinical outcomes, quality of life and costs. *BMC Ophthalmol*. 2021;21(1):119, doi:[10.1186/s12886-021-01887-6](https://doi.org/10.1186/s12886-021-01887-6).
  13. Apon I, Rogers-Vizena CR, Koudstaal MJ, et al. Barriers and facilitators to the international implementation of standardized outcome measures in clinical cleft practice. *Cleft Palate Craniofac J*. 2022;59(1):5–13, doi:[10.1177/10556665621997668](https://doi.org/10.1177/10556665621997668).
  14. International Consortium of Health Outcome Measures. Accessed October 11, 2022, Available at: <https://www.ichom.org/patient-centered-outcome-measures/>.
  15. de Rooij BH, van den Hurk C, Smaardijk V, et al. Development of an updated, standardized, patient-centered outcome set for lung cancer. *Lung Cancer*. 2022;173:5–13, doi:[10.1016/j.lungcan.2022.08.021](https://doi.org/10.1016/j.lungcan.2022.08.021).
  16. Wong D, Matini L, Kormilitzin A, et al. Patient reported outcomes: the ICHOM Standard Set for inflammatory bowel disease in real life practice helps quantify deficits in current care. *J Crohns Colitis*. 2022;16(12):1874–1881, doi:[10.1093/ecco-jcc/jjac099](https://doi.org/10.1093/ecco-jcc/jjac099).
  17. Schouten E, Haupt J, Ramirez J, et al. Standardized outcome measures for preterm and hospitalized neonates: an ICHOM standard set. *Neonatology*. 2022;119(4):443–454, doi:[10.1159/000522318](https://doi.org/10.1159/000522318).
  18. Hartmann C, Rose M, Weichert A, Weißhaupt K. The ICHOM standard set for pregnancy and childbirth - translation and linguistic adaptation for Germany. *Geburtshilfe Frauenheilkd*. 2022;82(7):747–754, doi:[10.1055/a-1666-0429](https://doi.org/10.1055/a-1666-0429).
  19. Rausch – Koster TP, van der Ham AJ, Terwee CB, Verbraak FD, van Rens GHMB, van Nispen RMA. Translation and content validity of the Dutch Impact of Vision Impairment questionnaire assessed by Three-Step Test-Interviewing. *J Patient Rep Outcomes*. 2021;5(1):1, doi:[10.1186/s41687-020-00272-z](https://doi.org/10.1186/s41687-020-00272-z).
  20. Rausch-Koster TP, Luijten MAJ, Verbraak FD, van Rens G, van Nispen RMA. Calibration of the Dutch EyeQ to measure vision related quality of life in patients with exudative retinal diseases. *Transl Vis Sci Technol*. 2022;11(4):5, doi:[10.1167/tvst.11.4.5](https://doi.org/10.1167/tvst.11.4.5).
  21. Rausch-Koster TP, Luijten MAJ, Verbraak FD, van Rens G, van Nispen RMA. Optimizing computer adaptive test performance: a hybrid simulation study to customize the administration rules of the CAT-EyeQ in macular edema patients. *Transl Vis Sci Technol*. 2022;11(11):14, doi:[10.1167/tvst.11.11.14](https://doi.org/10.1167/tvst.11.11.14).
  22. Velikova G, Awad N, Coles-Gale R, Wright EP, Brown JM, Selby PJ. The clinical value of quality of life assessment in oncology practice—a qualitative study of patient and physician views. *Psychooncology*. 2008;17(7):690–698, doi:[10.1002/pon.1295](https://doi.org/10.1002/pon.1295).
  23. Greenhalgh J, Long AF, Flynn R. The use of patient reported outcome measures in routine clinical practice: lack of impact or lack of theory? *Soc Sci Med*. 2005;60(4):833–843, doi:[10.1016/j.socscimed.2004.06.022](https://doi.org/10.1016/j.socscimed.2004.06.022).

24. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci.* 2009;4:50, doi:10.1186/1748-5908-4-50.
25. Consolidated Framework for Implementation Research. Accessed October 11, 2022, Available at: <https://cfirguide.org/>.
26. Damschroder LJ, Reardon CM, Widerquist MAO, Lowery J. The updated Consolidated Framework for Implementation Research based on user feedback. *Implement Sci.* 2022;17(1):75, doi:10.1186/s13012-022-01245-0.
27. Brod M, Tesler LE, Christensen TL. Qualitative research and content validity: developing best practices based on science and experience. *Qual Life Res.* 2009;18(9):1263–1278, doi:10.1007/s11136-009-9540-9.
28. Ahnood D, Souriti A, Williams GS. Assessing patient acceptance of laser pretreatment to reduce injection burden in diabetic macular edema: a large scale postal survey. *Can J Ophthalmol.* 2018;53(6):637–638, doi:10.1016/j.jcjo.2018.01.034.
29. Bull C, Byrnes J, Hettiarachchi R, Downes M. A systematic review of the validity and reliability of patient-reported experience measures. *Health Serv Res.* 2019;54(5):1023–1035, doi:10.1111/1475-6773.13187.
30. de Bienassis K, Kristensen S, Hewlett E, Roe D, Mainz J, Klazinga N. Measuring patient voice matters: setting the scene for patient-reported indicators. *Int J Qual Health Care.* 2021;34 (Supplement\_1):ii3–ii6, doi:10.1093/intqhc/mzab002.
31. Boyce MB, Browne JP, Greenhalgh J. The experiences of professionals with using information from patient-reported outcome measures to improve the quality of healthcare: a systematic review of qualitative research. *BMJ Qual Saf.* 2014;23(6):508–518, doi:10.1136/bmjqs-2013-002524.
32. Rouette J, Blazeby J, King M, et al. Integrating health-related quality of life findings from randomized clinical trials into practice: an international study of oncologists' perspectives. *Qual Life Res.* 2015;24(6):1317–1325, doi:10.1007/s11136-014-0871-9.
33. Teela L, van Muilekom MM, Kooij LH, et al. Clinicians' perspective on the implemented KLIK PROM portal in clinical practice. *Qual Life Res.* 2021;30(11):3267–3277, doi:10.1007/s11136-020-02522-5.
34. Engelen V, Detmar S, Koopman H, et al. Reporting health-related quality of life scores to physicians during routine follow-up visits of pediatric oncology patients: is it effective? *Pediatr Blood Cancer.* 2012;58(5):766–774, doi:10.1002/pbc.23158.
35. Jahagirdar D, Kroll T, Ritchie K, Wyke S. Patient-reported outcome measures for chronic obstructive pulmonary disease : the exclusion of people with low literacy skills and learning disabilities. *Patient.* 2013;6(1):11–21, doi:10.1007/s40271-013-0004-5.
36. Jahagirdar D, Kroll T, Ritchie K, Wyke S. Using patient reported outcome measures in health services: a qualitative study on including people with low literacy skills and learning disabilities. *BMC Health Serv Res.* 2012;12:431, doi:10.1186/1472-6963-12-431.
37. Long C, Beres LK, Wu AW, Giladi AM. Developing a protocol for adapting multimedia patient-reported outcomes measures for low literacy patients. *PLoS One.* 2021;16(6):e0252684, doi:10.1371/journal.pone.0252684.
38. Litchfield I, Greenfield S, Turner GM, Finnikin S, Calvert MJ. Implementing PROMs in routine clinical care: a qualitative exploration of GP perspectives. *BJGP Open.* 2021;5(1):10.3399/bjgpopen20x101135.