Improving the patient waiting experience in the ophthalmology clinic

Master thesis

Design for Interaction

By Hannah Kisjes

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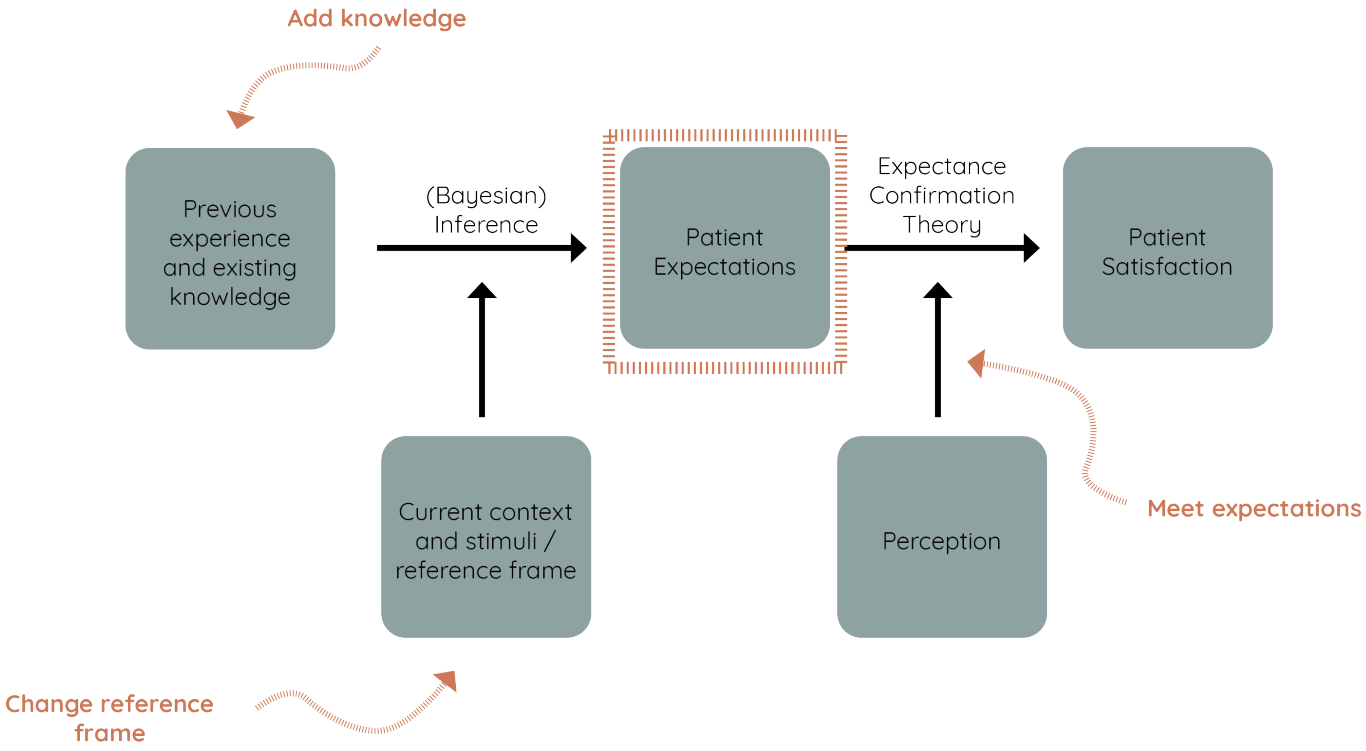
Executive summary

This graduation project arose from Erasmus MC's mission to continuously improve the patient experience. The results of the patient monitoring by Erasmus MC showed that an intervention at their ophthalmology outpatient clinic (OOC) could contribute to this objective. The patient satisfaction scores on wait time experience were very low at this outpatient clinic. Previous research has already shown that wait time experience is an important impact factor on the overall patient experience.

The project started with a literature study. The literature study looked at the topics of patient satisfaction, communication of patient information and the waiting experience. For each of these topics, patient expectations and uncertainty appeared to be among the most important drivers. The result of the literature study was a set of possible interventions, each based on adjusting and managing patient expectations and reducing uncertainty for the patient.

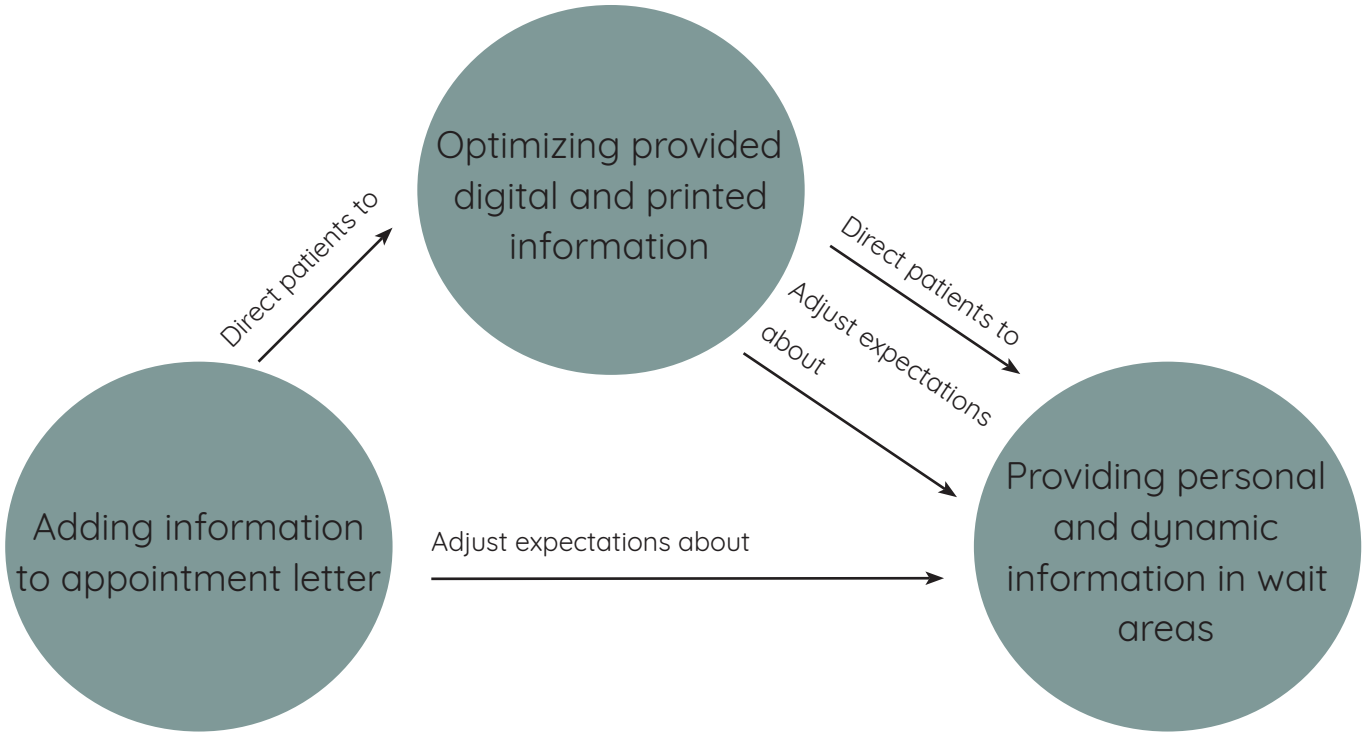


How expectations connect to patient satisfaction and possible interventions

Next in the project was mapping the context where these possible interventions happen. This user and context research concerns the environment and work flow of the clinic and patient needs and characteristics. For each sub-topic, the research method was chosen that provided the most valuable and reliable information with the least possible burden on the patients of the outpatient clinic. Methods used include walk-alongs, expert interviews, system analysis, user experience account analysis and empathy mapping.

Three main causes of dissatisfaction of patients were identified in the research. Firstly, the unrealistic expectations that patients have about the length of a visit. Secondly expectations about the provision of waiting time information, partly caused by the hospital itself, that are not being met. Lastly the lack of a clear overview of the different steps a patient goes through during a visit for both patient and employee. The complexity of the patient cases at the ophthalmic outpatient clinic in combination with the work flow at the outpatient clinic makes it difficult to predict the steps and waiting times during a patient visit based on the information present in the system. However, three data sources were found in the study that can serve as a reliable source of information to provide personal appointment information to patients. Another important finding of the user and context study is the way in which patients' visual impairments affects their waiting experience.

The design phase consisted of designing ways to apply the proposed interventions within the described context while considering the limitations of the patient group. This resulted in the following three recommendations: adding information to the appointment letter, optimizing the provided digital and printed information for OOC patients, and providing OOC patients with personal, dynamic appointment information during their wait using a physical information booth in the waiting area of the clinic. These recommendations work in unison with each other to ensure the desired effects for all patients during the full patient journey. A prototype of the designed physical information booth was developed and used in user testing to evaluate certain aspects of the design concept.



Expected effects of recommendations

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Project introduction

Origin of project

This graduation project takes place at the ophthalmology outpatient clinic (OOC) at Erasmus MC (EMC) in Rotterdam. Erasmus MC is an academic hospital located in central Rotterdam. Academic hospitals provide the highest level of healthcare possible in the Netherlands for the most complex patient cases. Academic hospitals in the Netherlands are places of innovation, education and scientific research. EMC aims to provide their patients with the best quality of care possible. At EMC the quality of care is continuously audited and benchmarked, internally and externally. At EMC quality of care is not only determined by clinical outcomes but also by how patients experience the quality of their care. In their vision of “patient as a partner” a patient should feel informed and in control throughout their health journey (Erasmus MC, 2019).

To monitor how patients experience their quality of care EMC has been using the Patient Ervarings Monitor (PEM) since 2019. This system was created in coorporation with the other academic hospitals in the Netherlands (NFU,2022). The results are not only organized by hospital but also by department and outpatient clinic. The unified monitoring makes it possible to compare between hospitals, departments and outpatient clinics. It provides insight on which aspects of patient care can be improved. Since starting with this monitoring system, the ophthalmology outpatient clinic of Erasmus MC has consistently scored extremely low on one specific aspect: information about waiting times (Erasmus MC, 2021)

Patient dissatisfaction caused by insufficient information about waiting times used to be an issue in most outpatient clinics of academic hospitals, including the EMC. To address this issue, EMC implemented electronic screens that display how much each consultation hour is delayed when the EMC moved to a new building in 2018. Unfortunately, the way that delay times are calculated and displayed in this system turned out to be incompatible with the workflow at the ophthalmology outpatient clinic. Patient visits of the ophthalmology outpatient consist of multiple consecutive steps that are not seperately registered or displayed in the system. The electronic screens were also reported as difficult to read by many of the patients. As the display of delay times in the way provided by the system increased confusion and uncertainty for patients, the functionality was turned off.

Project goal

The aim of Erasmus MC is to have informed patients that feel in control at all stages of their patient journey. The time spent in wait areas should contribute to this goal. This project therefore aims to increase patient satisfaction with the communication of information while waiting at the Ophthalmology Outpatient Clinic.

Project approach

In this project the double diamond approach is used. The double diamond approach exists of four stages: discover, define, develop and deliver, see Figure 1.

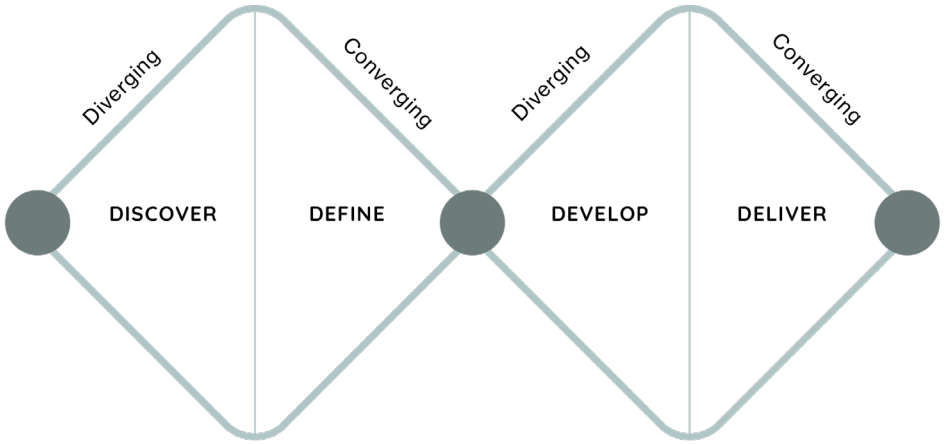


Figure 1. The double diamond model

Discover

In the discover stage research is done into all relevant factors. The aim of this stage is to fully understand how all stakeholders experience the problem, what makes the problem difficult to solve and what are the actual root causes of the problem.

Literature study

The literature study is an overview of the existing knowledge regarding relevant concepts for the project. The three concepts that are part of the conceptual framework can be directly extracted from the goal of the project

Context and user research

The goal of the research done during context exploration was to discover how contextual factors of the opthalmology outpatient clinic influence the communication of patient information. During this context exploration research it became clear that decreased vision was an important barrier to the communication of information at the Opthalmology Outpatient clinic. This meant that further research on how visual impairment influences information and communication needs was needed.

Define

In the define stage various methods of analysis and mapping are used to classify, categorize and clusters all factors found during the previous stage. The result of that stage is a blueprint for the solution space, a document that contains all requirements of the solution. This blueprint is used as the foundation for the develop and deliver stages of the project.

Design parameters
In this chapter the results of the context and user research are translated to design requirements.

Develop
In the develop stage potential solutions to the problem defined in the previous stage are explored and developed. The goal of this stage is to generate a wide range of ideas and concepts and to begin narrowing down the options to the most promising solutions.

Design process
Ideation and materialization. Feasibility important factor in design choices.

Deliver
The goal of the deliver stage is to finalize the design and prepare it for implementation.

Final concept
This chapter describes the final concept in more detail.

Evaluation
The concept design was evaluated using an experimental prototype.

Recommendations

Ethical research responsibility considerations
It is likely that patients of the ophthalmology clinic are in a vulnerable state during their visit. Furthermore, there is a limited amount of time available for each patient at the clinic. It is therefore key to interfere as little as possible with the patient visit as possible. This was a very important aspect in selecting research methods. For a full overview see Appendix A.

Literature study

Introduction to literature study

The literature study is an overview of the existing knowledge regarding relevant concepts for the project. The three concepts that are part of the literature study can be directly extracted from the goal of the project:

Increase **patient satisfaction**

with the **communication of patient information**

while **waiting.**

Patient satisfaction

Patient satisfaction ratings can be used as indication of the quality of the patient experience. There exist many different definitions of patient experience and many ways to define its quality. Most existing methods use patient satisfaction ratings on a study-specific set of impact factors or dimensions to gain an overview of the overall quality of the patient experience. Previous research indicates that there is a strong cause-effect relationship between previously held expectations and reported patient satisfaction scores. Influencing and managing patient expectations can increase patient satisfaction ratings.

Communication of patient information

This project is centered around the communication of patient information. The quality of this communication depends both on quality of the information itself as well as the quality of the manner of communication. In this project the quality of both these aspects is referred to as usefulness of the aspect. Both parts can be combined in the motto: “useful information communicated in a useful manner”.
In the context of this project information is considered useful if it complies with three criteria: the information must be available, desired and appropriate. Communication in a useful manner means that the way of communication must take into account the user characteristics of the target group. User characteristics are relevant if they impact communication skills or preferences. Context research determines when these criteria are met.

The waiting experience

The experience of waiting often triggers many negative emotions and increases anxiety levels. This can be partially explained by the lack of control that is inherently part of the waiting experience. This effect can be mitigated using the communication of information to adjust expectations.

Patient satisfaction

Many hospitals have over the last decades moved away from the traditional method of defining quality of health care using only clinical outcomes (Jenkinson et al., 2002). Instead many hospitals, including all Dutch academic hospitals, now take more patient-centered approaches that use the patient experience as an important indicator of the quality of health care (NFU, 2016; Kleefstra et al., 2015). A core idea in these approaches is that an involved, satisfied and well-informed patient ultimately leads to better health outcomes (Constand et al., 2014; Coulter, A., 2012; Hibbard & Greene, 2013; Mead & Bower, 2000). To monitor the patient experience over time questionnaires are often used. In patient experience questionnaires a patient is asked to rate how satisfied they are with several different aspects of their health care. Each method uses their own aspects or dimensions of healthcare to be rated. The academic hospitals in the Netherlands use patient experience monitoring (PEM) based on research by the Picker institute (Erasmus MC, 2022; Coulter, A., 2006). In this research eight aspects of healthcare that patients found most important are identified. How satisfied patients are with each of these aspects gives an overview of the quality of health care for the participating academic hospitals.

Increasing patient satisfaction using expectations

A leading theory on what determines how satisfied people are with their experience of a service or product is called the disconfirmation paradigm. The theory originates from research in the domain of marketing and consumer behaviour from 1982 and has been widely adopted across domains since (Evans et al., 2009). The theory states that consumer satisfaction depends on two variables: pre-purchase expectations and disconfirmation. Disconfirmation refers to the difference between what the consumer expects and what the consumer perceives in reality, as can be seen in Figure 2.

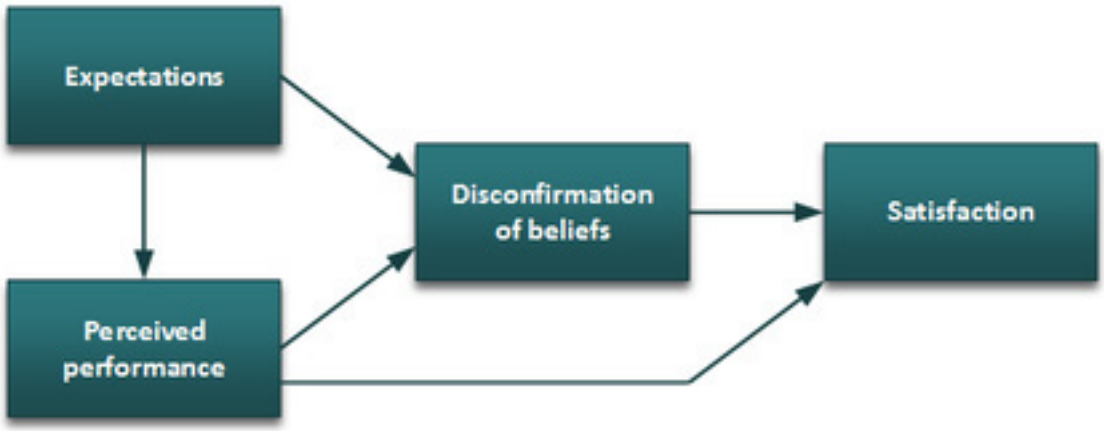


Figure 2. Schematic representation of disconfirmation paradigm, from Evans et al., 2009

Disconfirmation can either be positive or negative. Consumers with a positive disconfirmation perceive the situation as “better than expected” and are more satisfied with the product or service afterwards. Consumers with negative disconfirmation have unmet expectations and become dissatisfied. If it is known what the most important unmet expectations of a consumer are in a particular situation, these expectations can be adjusted and managed.

Adjusting and managing expectations

Adjusting and managing expectations relies on understanding the expectations that exist and how these expectations are created. The expertise in that area lays in the field of neuropsychology. The precise mechanics behind the formation of expectation are not yet clear. Hohwy (2017) uses the theory of Bayesian inference the explain how expectations are formed when someone interprets new information about a situation using prior beliefs.

This existing information is a combination of implicit information and explicit information. Implicit information is based on the own previous experiences in similar situations. For hospital visits similar situations do not only pertain to earlier hospital visits or other health care visits. Situations that involve dealing with large (public) organizations, dealing with new technology or exploring new environments with a disability can all contribute to which expectations are formed. Explicit information is what somebody has read and heard from other, external, sources, such as folders, friends or websites. How this combined information is interpreted depends on personal characteristics and circumstances. It also matters how trustworthy and relevant the user perceives each source of information to be.

Interventions

There are three kinds of intervention that can be taken to adjust or manage expectations of a patient: adding information, changing the reference frame and meeting expectations, see Figure 3 on the next page. Of these options meeting expectations is the most obvious choice. However, this is often simply not realistic. For unrealistic expectations the context and provided material must first make clear how and why there is a difference between the situation(s) in their reference frame and the situation at the OOC. If the user accepts this they will be much more likely to adjust their expectations when provided with sufficient information addressing all relevant expectations.

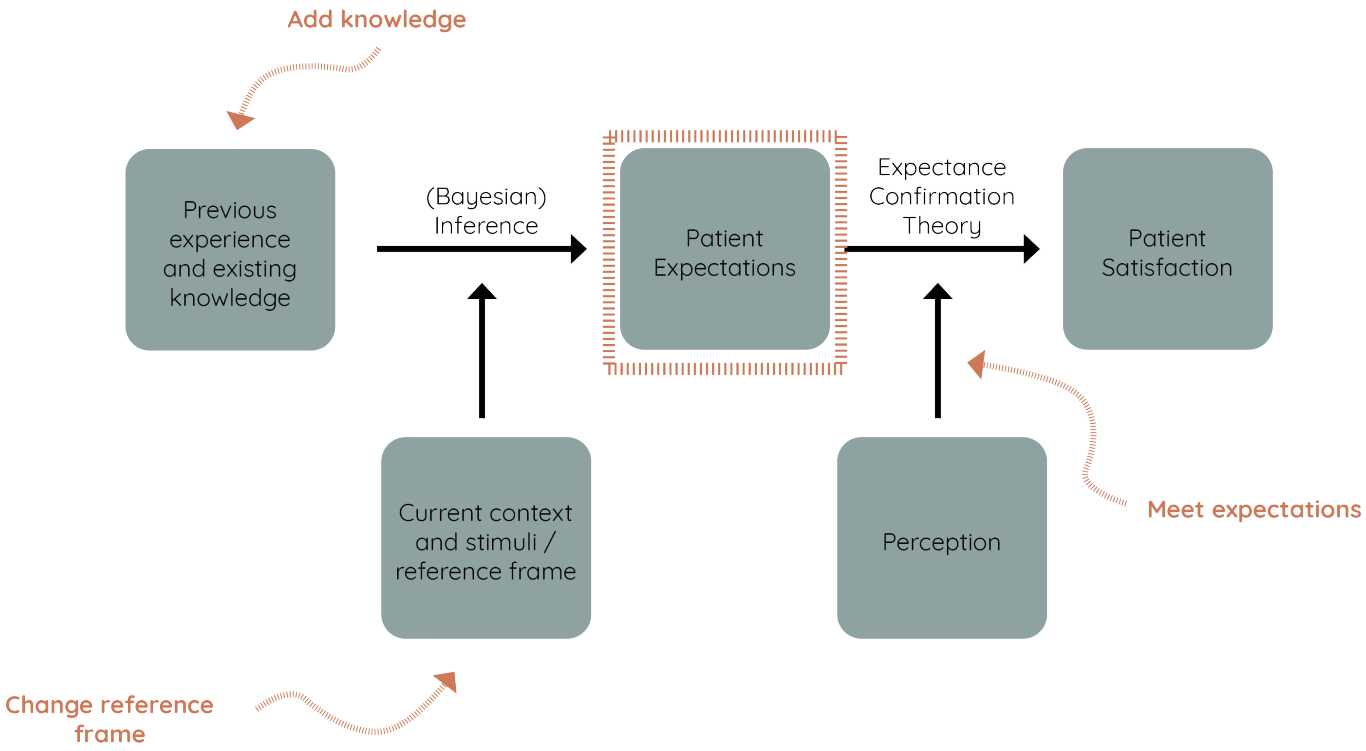


Figure 3. How expectations connect to patient satisfaction and possible interventions

Key take-aways

Patient satisfaction ratings are used to measure different aspects of patient experience

Managing patient expectations can increase patient satisfaction

Three types of intervention that can be taken to adjust and manage patient expectations adding information, changing the reference frame and meeting identified unmet expectations

Communication of patient information

The role of patient information in health care

Effective communication of information between doctor and patient is crucial for the functioning of the health care system. In traditional health care approaches this communication is mostly one-sided. The doctor gathers all relevant patient information, such as patient symptoms and patient background, interprets examination results and makes a decision about the next steps to take. The patient is in this approach only informed of the pieces of information that are deemed necessary by the health care professionals for the proper execution of these steps, such as: where to be, at what time and what they should or should not do. In more patient-centered approaches, as in the case for Erasmus MC, communication goes both ways. Effective communication of information to the patient and shared decision-making are an important tools for patient engagement in these patient-centered strategies (Coulter, A., 2012).

During the health journey of a patient there are three categories of information that can be communicated with the patient. The first is background information about symptoms and illness(es). This category includes the prognosis of the patient and the usual progression of their disease. The information in this category helps patients understand what to expect in the future and how their life will be impacted by their illness. This type of information can help patients feel more in control and reduce uncertainty and anxiety. The second category consists of treatment options and the consequences of those options as well as information about medications and lifestyle changes. The goal of providing the patient with information in this category is patient engagement.The patient becomes an active partner in their health journey. It is a necessary step in shared decision making. The last category is logistical and practical information. How and when to take medications, which health care providers they will interact with during a visit, which examinations will take place.

Quality or usefulness of information

n the context of this project project information is considered useful if it complies with the three criteria: available, desired, appropriate.

Available information

Available in this context means that the information can be extracted from existing data in the current system. It also means that processing does not require additional action from hospital staff. The data sources the information is based on must be reliable, part of the existing workflow and consistently up-to-date.

Desired information

Desired means that the information contributes to meeting or adjusting the expectations of the patient, directly or indirectly. These expectations depend on several user characteristics. There is a normal distribution among the population in technological skills and information needs. Two distinct user profiles are differentiated among the general population.

Appropriate information

There are rules, regulations and guidelines from the government as well as the hospital itself related to how certain sensitive information is communicated. Information is also considered inappropriate if the communication of it impacts the security or privacy of the staff.

Interventions

Increase accessibility of information by providing clear direction to the right information sources every step of the way.

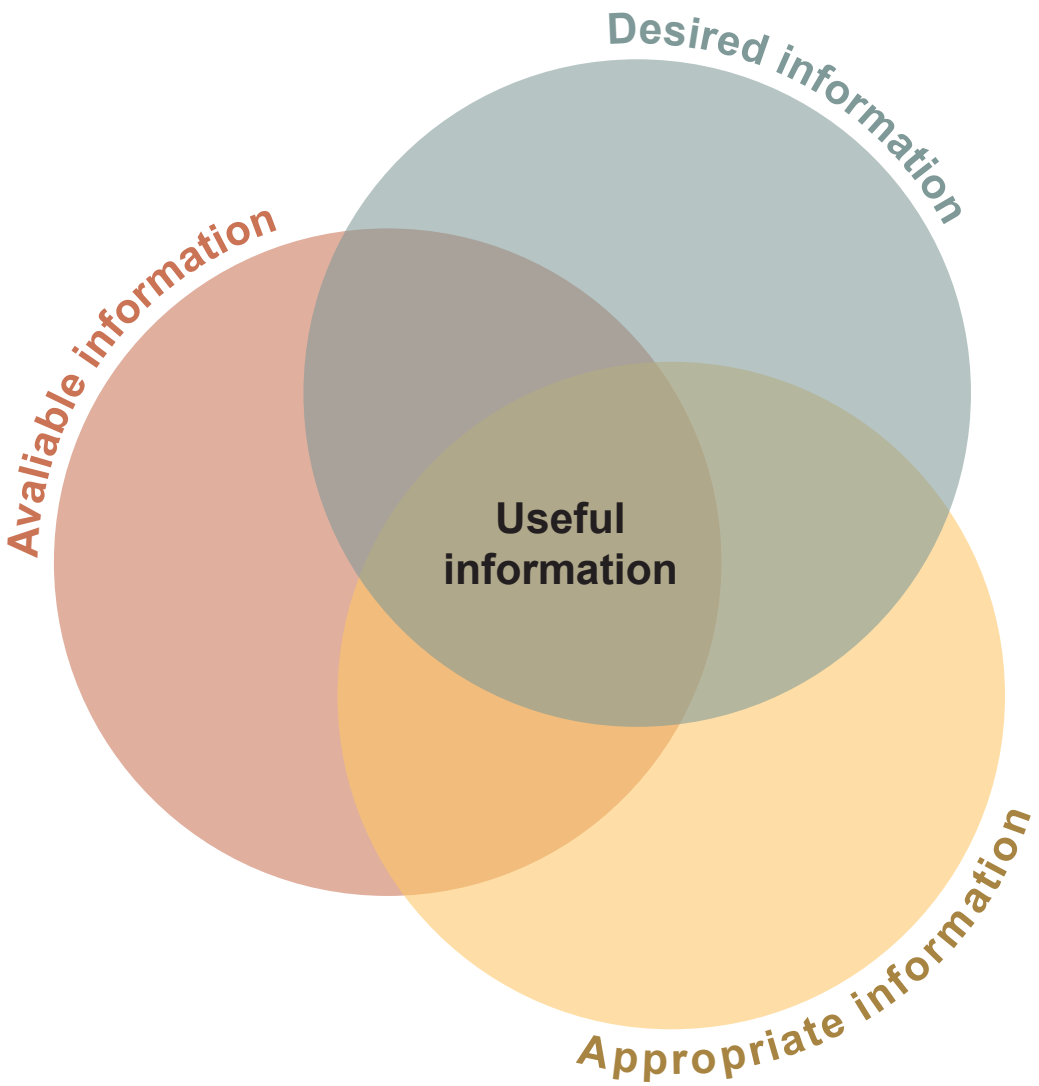


Figure 4. The three criteria for useful information

Key take-aways

Key factor is information quality
Reliable, up-to-date

Communication method must fit both user skills and preferences

The waiting experience

Types of waiting

For a patient there are two types of wait time associated with hospital appointments. The first type is out-of-hospital waiting. This is the time spent waiting before a first appointment or between appointments on different days. This type of waiting happens out of the hospital and the time is usually measured in days, weeks or months. The second type of waiting happens after a patient arrives at the hospital. It refers to the time spent before a first appointment of the day, between different steps of an appointment or between appointments with different specialists on the same day. This time is spent in designated waiting areas in the hospital. In this project and this report, when waiting or wait time is mentioned it will always concern this last type of “in-hospital” waiting, unless explicitly mentioned.

Emotional effects of waiting

An intrinsic part of waiting is passing time until an expected event is going to happen without being able to exert any control on when the expected event is going to happen. Waiting is therefore often associated with feeling a loss of control and increased anxiety levels (Chu et al., 2019).

Expectations and wait time experience

It has been shown that patient perception of waiting times greatly depends on the patients’ expectations about waiting times. (Thompson & Yarnold, 1995, Cassidy-Smith et al., 2007). Dissatisfaction with the wait time experience primarily happens when the actual waiting time diverts too much from the expected wait time. This effect is effect is even stronger when the expectation is based on information provided by the hospital. What both the study of Thompson and Yarnold in 1995 and the research of Cassidy-Smith et al. in 2007 hypothesized was that a shorter than expected waiting time is always a positive disconfirmation. While this may be true for the Emergency Department, in which context both of the mentioned studies took place, this is not necessarily true for other contexts, such as the OOC. This is due to the difference in type of patient and the activities that these types of patient may want to perform during their wait. People do things in their waiting time besides waiting. They may want or need to eat, drink or go to the bathroom. Furthermore, the many recurring patients at the OOC expect at least some waiting time and prepare for this by taking something to entertain themselves during their wait, such as knitting supplies or an audio book. If the waiting time is much shorter than expected by the patient and a patient is busy with one of these activities this can be perceived as a negative disconfirmation and therefore result in patient dissatisfaction.

Interventions

There are two types of intervention that can be taken to reduce the negative emotions associated with waiting. The first type of intervention is filling the idle time of waiting. Aside the from the small effect these types of interventions seem to have (Biddess et al., 2014), they also do not contribute to the overarching goal of having informed and involved patients that are an active partner in their own health journey. The second type of intervention is providing patients with timely and reliable information that helps patients adjust their expectations . This type of intervention does seem to provide patients with a increased sense of control (Chu et al., 2019).

Key take-aways

Chosen intervention: timely and reliable information to adjust expectations

Context and user research

The ophthalmology outpatient clinic (OOC)

Expertise

Complex eye care

The ophthalmology outpatient clinic at the Erasmus MC caters to those with complex problems involving the eye. There are several reasons why a patient is referred to ophthalmology outpatient clinic of the Erasmus MC. The treatment or diagnosis of their condition may need specialized equipment, they may suffer from a rare condition of which knowledge is not widely available, there may be comorbidity with several other conditions, their condition may be in an advanced stage or the surgery necessary to treat their condition may be particularly risky or difficult. Patients who have exhausted all other options also come here to take part in experimental treatments. Due to how the Dutch healthcare system is structured, referral to an academic hospital usually only happens after a patients has been seen by several other medical institutions. See also “Appendix B. Referral through the Dutch healthcare system”.

Figure 5. Waiting areas of the ophthalmology outpatient clinic.

Clinical Expertise

Table 1 lists the conditions that the EMC OOC considers their primary areas of clinical expertise. As the OOC is part of is an academic hospital, this also means that these are their primary areas of research. However, the OOC does not solely treat patients suffering from these conditions. For example, complex cases of cataract, diseases of the cornea or even conditions of the eyelids or eye socket are also regularly seen in patients. Patients admitted through the Accident & Emergency Department of EMC are also seen at the OOC when there is ocular involvement. These emergency cases tend to differ from the typical patient treated by the OOC.

Clinical Expertise of the OOC	
Uvea melanoma / eye oncology Cancer of the eye	**Strabismus/amblyopia** Conditions related to alignment of eyes and cooperation between eyes
Uveitis Internal inflammation of the eye	**(High) myopia** Extreme and progressive cases of elongated eyes causing near-sightedness and eventually blindness.
Retinal dystrophies Hereditary diseases impacting the retina	**Glaucoma** Optic nerve damage, often related to high pressure in the eye

Table 1. Clinical expertise of the OOC.

Floor plan

The OOC has 24 different rooms for consultation, examination and treatment.Some proceedings require specialized equipment. As this specialized equipment is very expensive the OOC often has only one or two devices of a certain type. This type of specialized equipment is housed in a number of dedicated rooms in which only tests that require the equipment take place. This allows all physicians to make use of the equipment in their diagnostic process when needed.

Waiting area 1D

Primary waiting area, used by majority of patients. Patients that are waiting for initial examination and assessment, consultations, additional tests or scans are seated here. Patients also wait in this area for pupil dilation after being administered mydriatic eye drops.

Waiting area 1E

Used for patients waiting for pre-operative screening and certain types of outpatient treatment. Examples of outpatient treatment are intravitreal injections, FAG (Fluorescein Angiography) and YAG or STL laser treatment.

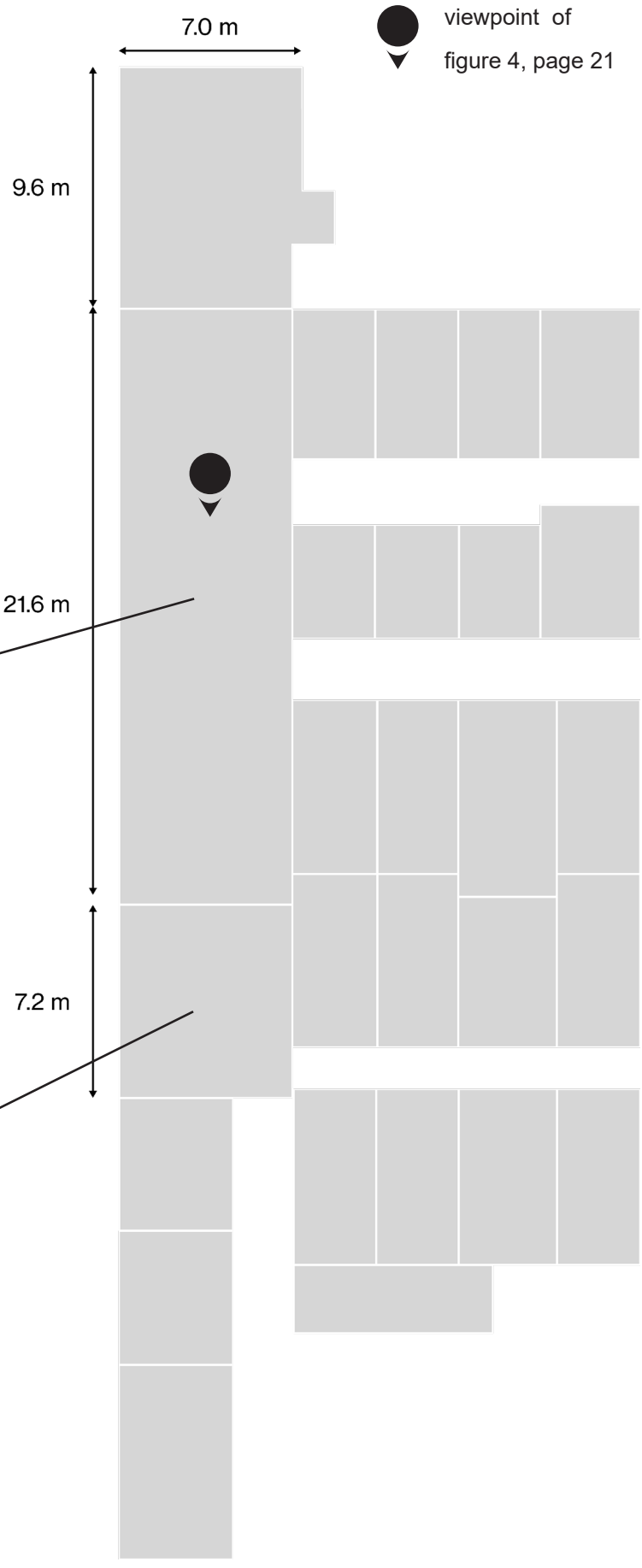


Figure 6. Overview of OOC areas

Patient routes

In the early stages of research it quickly became apparent that predicting patient journey steps at the OOC is complex and complicated due to a multitude of factors. However, within the scope of this project, patient routing is relatively simple. If normal procedure is followed, a patient never has to move autonomously between any areas than one of two connected waiting areas and the room they see a healthcare professional in. An example of the routing of a fictional but possible patient case is shown in Figure 7. A more detailed version of this patient routing with descriptions for all steps can be found in Appendix C.

As can been seen is this example, between each of the steps that happen in different locations the patient returns to one of the two (connected) waiting areas.

Key takeaway

Patient never has to move autonomously between anything other than waiting area and room.

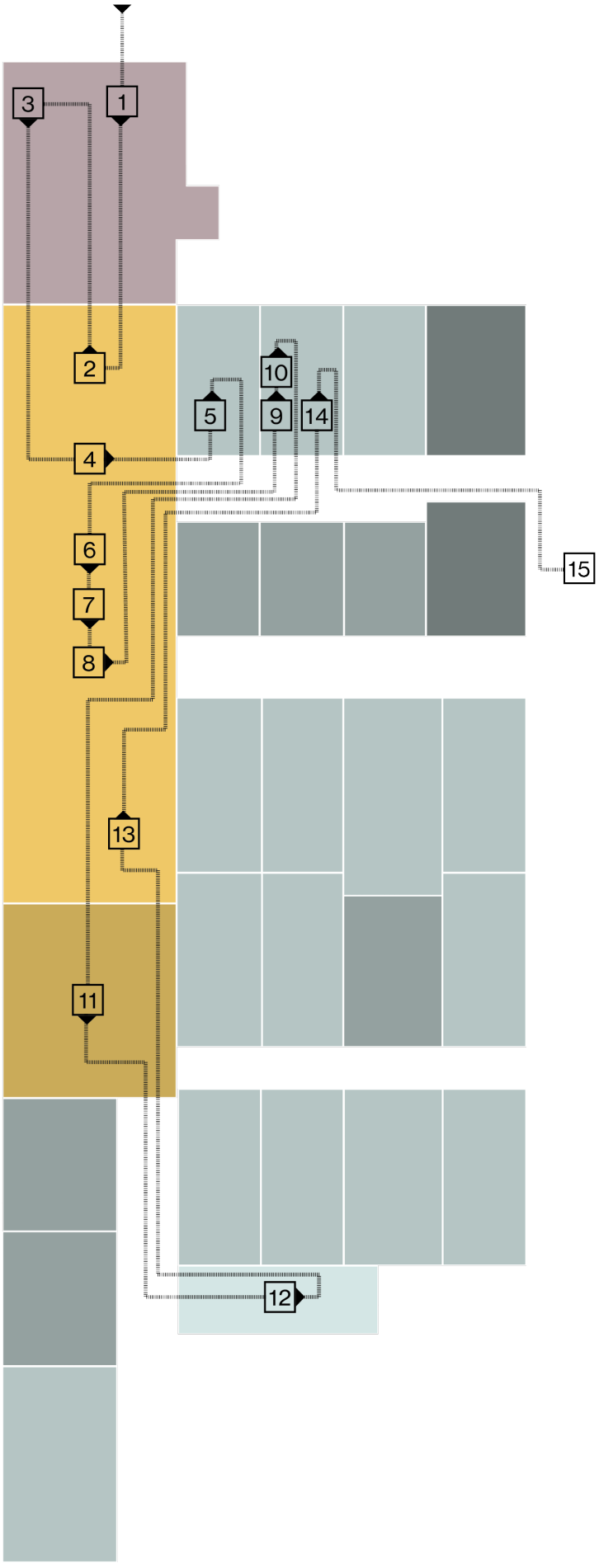


Figure 7. Example of possible patient route

Patient characteristics

Research approach

To be able to address the specific needs of OOC patients it is necessary to identify the characteristics that OOC patients have in common. The implicit knowledge gained from long-term experience with patients means that the health care professionals of the OOC know the commonalities between their patients. To tap into this implicit knowledge interviews with six OOC staff members were executed to gain more insight in the defining characteristics of the patient population of the OOC. Using semi-structured interviews does mean that the characteristics identified are filtered through a health care professional perspective. It might therefore be possible that patients have other characteristics in common but that these are considered irrelevant from a health care perspective and were not mentioned in the interviews. Identified characteristics were checked against statistical data from internal resources when possible.

Age, gender, income & education level

The characteristics that IDE designers generally use to describe a target group, such as age, gender, income level or education level are not that relevant in this project. The OOC patient population spans the entire range for all of these characteristics. While the focus lays on the adult population, there is close cooperation with the Sophia Children's Hospital and it is not uncommon for children to have a consultation at the OOC. As advanced age is a risk factor for some of the conditions (Limburg et al., 2009) a significant part of the patient population is over the age of 55.

Geographical service area

The high level of specialized care at the OOC of EMC means that patients from all over the Netherlands are treated here. However, most medical institutions do seem to take travel distance into account when referring patients. In the experience of the healthcare staff of the OOC most patients do seem to live relatively close (<1.5 hour of travel). While this is close from the perspective of the hospital, a travel time of just 45 minutes can already be a large undertaking for some patients. Patients that suffer from extraordinarily rare or complex conditions can live much further away and may need to travel up to three hours for their visit.

Comorbidity

While there are several reasons why a patient case is considered complex and is referred to top-clinical care, the existence of several conditions at the same time in a single patient, which is called comorbidity, is one of the major factors for most patients of the OOC. Comorbidity can exist in the form of multiple eye conditions,

such as a combination of cataracts and glaucoma in the same eye. It can also can involve systemic diseases, such as diabetes or immuno-deficiencies. Many systemic conditions eventually have ocular involvement. For example, diabetes can lead to diabetic retinopathy. This comorbidity means that OOC patients are often under the care of multiple specialists in different departments of Erasmus MC. It also means that patients are more likely to have cognitive or physical limitations.

Multiple staff members mentioned in their interviews that patients that live further away tend to plan appointments with different specialists in the hospital on the same day. As a large part of patients suffer from multiple conditions at the OOC this is a regular occurrence. Unrealistic expectations - by either the patient or the hospital planner - about the OOC visit duration result in the required time interval between two appointments not being estimated correctly.

Chronic and progressing conditions

Many of the conditions treated at the OOC are progressive, meaning that symptoms worsen over time. For these conditions treatment is often aimed at halting the progression of the disease. Other conditions show no symptoms for long stretches of time and then unexpectedly flare up. These flare-ups usually require immediate treatment. Both of these types of condition require monitoring over an extended period of time. Monitoring is vital for providing patients with the right intervention at the right time. The frequency of check-ups depends on the state of a condition. The time interval between check-ups can be over a year when a condition is stable. Monitoring does not always have to happen at the OOC. When possible and appropriate, a patient is referred back to the specialist that referred the patient to the EMC.

Vision loss

The diseases that are treated at the OOC typically cause some type of vision loss. The majority of the patients of the ophthalmology outpatient clinic are not (yet) legally blind. Legally blind means that a person has either less than 0.05% of their vision left or a visual field angle of less than 10 degrees (World Health Organization, 2019). When a person has reached that degree of visual impairment, it is highly unlikely that there is still any treatment (including surgery) possible that will improve visual performance significantly. These types of patient are therefore not commonly patients of the EMC OOC. Patients of the EMC OOC are instead either in an earlier stage of a progressive disease or suffer from a condition that can significantly improved by surgery. It is not uncommon for patients of the OOC to have residual vision left in at least one of their eyes. The degree of visual impairment can be different for each eye. Eye conditions can either affect one of the eyes (monocular) or both (binocular), however, a lot of progressive eye diseases that start out in one

of the eyes also affect the other eye after some time. There are many different types of vision loss. An overview of these types can be found in Appendix D.

The transitional visual impairment visitor

The user research shows that a large part of the visitors of the OOC has had a recent decrease in visual acuity in one or both eyes. Research into coping with vision loss it was found that vision loss has a large negative effect on overall wellbeing. The loss of vision causes insecurity and anxiety because of uncertainty about the further progress of the vision. These feelings are most intense any time a recent change in visual acuity has happened. The feelings usually decrease over time as new skills are acquired and the new way of experiencing the world is accepted. Coping skills and personal attitude influence how quickly this process goes. This acceptance and coping process is restarted each time a significant decrease in vision is experienced by the patient. This can be a dramatic an large change that would be hard not to notice, such as a blind spot suddenly appearing. In more slowly progressing diseases a change is often noted by a patient when they notice that they are struggling to perform a task that they used to perform with ease, such a reading a book or watching television. The perceived loss of independence was found to be the most important factor causing a negative emotional effect.

Key takeaways

Taking into account other appointments at different specialists

Impact of visual impairment and other impairments on communication

As mentioned before, age and gender can influence how people want their information communicated. From the interviews it became clear that the visual impairment of patients . Further investigation to how visual impairment influences communication of information is required.

Differences in attitude and emotional state

The reason for the patient-visit determines to a large extent how anxious the patient is during their wait. For recurring visitors the possible reasons are: regular check-up, treatment, worsened condition during monitoring. For first-time visitors there are two: specialist treatment needed, symptoms not yet explained satisfactory.

Patient information expectations

Research questions
How does the OOC context influence patient expectations about wait time information?
To which degree are patient expectations about wait time information met at the OOC?
To what extent can the different parts the patient visit be predicted?
Location, duration, order of steps

Method
Analysis informational systems at OOC, analysis of PEM answers, forum post analysis, staff interviews,Wait area observation. Sitting in on consultations. System analysis

Patient information journey

This section shows which information is received by the patient at various touchpoints during their contact with the EMC OOC.

Receiving appointment letter or email

The patient information journey starts at home, with the receival of the *appointment letter or email*, that contains little information besides the appointment time.

Gathering information

The *website* of Erasmus MC provides patients with general information about check-in procedures. *Patient folders* for a select amount of examinations and treatments can also be downloaded from the *website*. Personal patient information can be found by logging in to the *patient portal* of Erasmus MC, called My Erasmus MC. A *mobile application* that combines all patient information in a single place in under development and will be used in the near future.

Check-in at central hal

Upon arrival at the hospital, the patient checks in on a self check-in kiosk located in the central hall of the hospital. After confirming their identity the patient receives a *day ticket* listing all of their appointments that day. This *day ticket* contains a QR-code for further check-in procedures.

Arrival at OOC

After scanning the barcode on the *day ticket* at the *kiosk* located near the entrance of the OOC, patients are directed to a waiting area by text on the *kiosk* screen. A *volunteer host* is often present at the clinic to help patients with the use of the *kiosk*.

Waiting

In the waiting area there are *electronic screens* mounted on the wall displaying dynamic information. There is also always a staff member present at the *reception desk* near the entrance.

During the appointment

During the appointment the patient receives a lot of information at once. Sometimes *OOC staff members* give the patient an indication of how long the next step will take. This is an approximation purely based on their own experience.

Unmet expectations: analysis of PEM answers

From the patient answers three expectations can be discerned.The first expectation is the expectation of being given information about delays after a certain amount of time. A large part of the answers of the PEM directly states this link to a certain amount of time. This expectation can be formulated as:

E1: I expect to be informed when there is a delay of [certain number of minutes]

What amount of time differs from person to person. The minimum seems to lay around 5 minutes, most mention 15 or 20 minutes, and a few mention half an hour, 45 minutes or even a full hour before they would expect to be informed.

The second expectation is related to the electronic information screens. These screens are specifically named in many of the patient answers. The expectation related to these answers is:

E2: I expect being able to rely on the electronic screens to give me an accurate overview of delays

The third expectation that can be discerned is:

E3: I expect to be done with my full appointment within [certain number of minutes]

As is the case with expectation 1 the number of minutes mentioned is different for each person.

Key take-aways

Electronic screens cause expectation of display of delays

The information given by the EMC themselves contributes to the formation of unrealistic expectations

The website and day tickets both literally state that patients can expect display of delays on the electronic screens.

Long interval and additional hospital visits influence expectations recurring patients

Time before first contact different than other values

Large amount of combinations of patient visit steps

The large number of possible combinations of possible diagnostic steps in relation to possible diagnoses during consultations.

Each step has a limited amount of possibilities regarding location, duration and involved staff member(s)

Limit scope to consultation type appointments

Uncertainty is mainly connected to appointments of the consultation type. The steps of an examination or treatment type appointment differ very little between patients. The steps of these types of appointments are also described in printed folders that are physically or digitally distributed to the patient. The primary focus therefore becomes consultation type appointments.

Three steps as base consultation

The steps: Preliminary examination – wait for eye drops to take effect – further examination and consultation happens in some form for each of the types of consultation.

Spend time calculated from reference point

The only reference point that patients have to calculate their visit duration and waiting time from is the start time of their visit, their “appointment time”. Acceptable and actual times are calculated by the patient from this reference point.

Registration of information at OOC

Research question:
Which system information is reliable, always up-to date and part of the workflow?

Method:
sitting in on consultations interviewing different staff members to determine which types of relevant information are always part of the workflow. System analysis, anonymized data, checked what was logged for different types of appointment,

Relevant data types

Each piece of data in HiX to patient location or a visit substep that has a linked time stamp or refers to the actual status of visit substeps - including “planned” status - is a potential data source.

Much of this kind of data exists in the system primarily to benefit the internal communication within the clinic and is not required by law, insurance company contracts or hospital regulations to be logged into the patient record. This means that in cases where it is quicker or otherwise more convenient for the staff to do certain internal communication by phone or in person, the staff will choose to do so. If this happens, this data does not get logged in any computer system and can therefore not be relied upon as a consistently up-to-date data source.

For some visits the patient does have several substeps during their visit, but all of these steps are performed by the same staff member. Doing system actions that solely benefit internal communication is in those cases unnecessarily time-consuming. However, each a time a patient has to stay in the waiting room for a certain period of time during their visit, the staff member does log the time.

Key take-aways

Selected data sources

The data sources that were determined to meet the requirements for information quality are the eye drop time log field, preparation text field and time stamp of appointment mutations (triggered by Maps dragging or barcode scan).

Communication with visual impairment

Research approach

During context exploration it became clear that more research was needed on how the vision loss experienced by a large part of the OOC patient population influences the communication of information. To determine in what way assistive technology should be included in the concept design it was also important to understand how people with various visual impairments use and learn to use assistive technology. A choice was made to analyze online vlogs, blogs and documentaries to gather information on this subject rather than interviewing patients at the OOC. Only experiences of people that had the same type of visual impairment as OOC patients were included in analysis. There were several benefits to this decision. Interviewing OOC patients would only provide information for a single moment in time, while online accounts document the experience of the same person at various stages. Using video material such as vlogs and documentaries also has benefit of showing how assistive technology is actually used in many different contexts. Obviously there were also practical benefits, because time did not have to be budgetted for participant recruitment and interview setup. Therefore the amount of user experiences that could be analyzed was much larger. However, it is important to realize that these kinds of user experience account consist of filtered and edited information. These accounts are therefore strongly influenced by the perspective of the creator and might provide a biased view.

The vision loss transition period

The research on user characteristics shows that a large part of the visitors of the OOC has had a recent decrease in visual acuity in one or both eyes. Each time a decrease in vision is noticed by a patient a transition period follows in which the patient adjusts to life with decreased vision. Nyman et al. (2012) applies the response shift model to explain this transition period. The response shift model is commonly used to explain the acceptance of a disability. The Nyman et al study (2012) found vision loss to have large negative effect on experienced quality of life. The loss of vision causes insecurity and anxiety because of uncertainty about the further progress of the vision. These feelings are most intense any time a recent change in visual acuity has happened. The feelings usually decrease over time as new skills are acquired and the new way of experiencing the world is accepted. Coping skills and personal attitude influence how quickly this process goes. However, this acceptance and coping process is restarted each time a significant decrease in vision is experienced by the patient. It can be started by a dramatic, large change that would be hard not to notice, such as a blind spot suddenly appearing. It can also be much more subtle change that is suddenly noticed by a patient suffering from more slowly progressing diseases. This often happens when

a patient notices that they are struggling to perform a task that they used to perform with ease, such a reading a book or watching television.

Independence and autonomy

The perceived loss of independence as a consequence of the vision loss was found to be the most challenging factor for elderly people with vision loss later in life(Nyman et al, 2012). This dependency is largely the result of living in a world that relies on the visual communication of information for its participants to function in society [Russell-Minda, E., Jutai, J. W., Strong, J. G., Campbell, K. A., Gold, D., Pretty, L., & Wilmot, L. (2007). The legibility of typefaces for readers with low vision: A research review. Journal of Visual Impairment & Blindness, 101(7), 402-415.]. The dependency on other people regarding mobility with a visual impairment is very clear at the OOC. Patients are advised not to travel by car by themselves to the hospital as the application of mydriatic eye drops means that their vision will be impaired for some time after their appointment at the OOC. The results of this is that many patients are driven to and from the clinic by a friend or family member. Often this person - which will we will call “the patient companion” - also accompanies the patient during their visit. When information communication systems are not designed for use by the visually impaired patient, the patient has to rely on their companion for their access to information, increasing their dependency on the companion. This impairs the autonomy of the patient and

Use of assistive technology

How far along a patient is in their transition process also influences their skill in and experience with using assitive technology. The stigma associated with using assistive technology is a significant barrier for people to start learning how to use it (Nyman et al,2012).

Key take-aways

Expected permanence, severity, progress and time since onset of visual impairment key factors in assistive technology experience and skill

Independent/autonomous use very important

Vision loss has an enormous effect on daily life and large emotional consequences. The loss of indepence.

Main ways of communicating patient information at OOC are not suitable for visual impairment

Both the electronic screens and printed information are visual means of information involving small print,

Audio best alternative for visual communication

Information density

Inclusion of haptic clues for touchscreen operation

Preference for communication medium not dependent on visual impairment

The preference of someone for the use of a mobile application does not depend on their visual impairment. There are those that have use their mobile phone as one of the most

Design parameters

User preferences

Using both a mobile application and a medium for communicating the same information is the optimal way to adequately address the preferences of each identified user group.The argumentation behind this can be found in Figure 8.

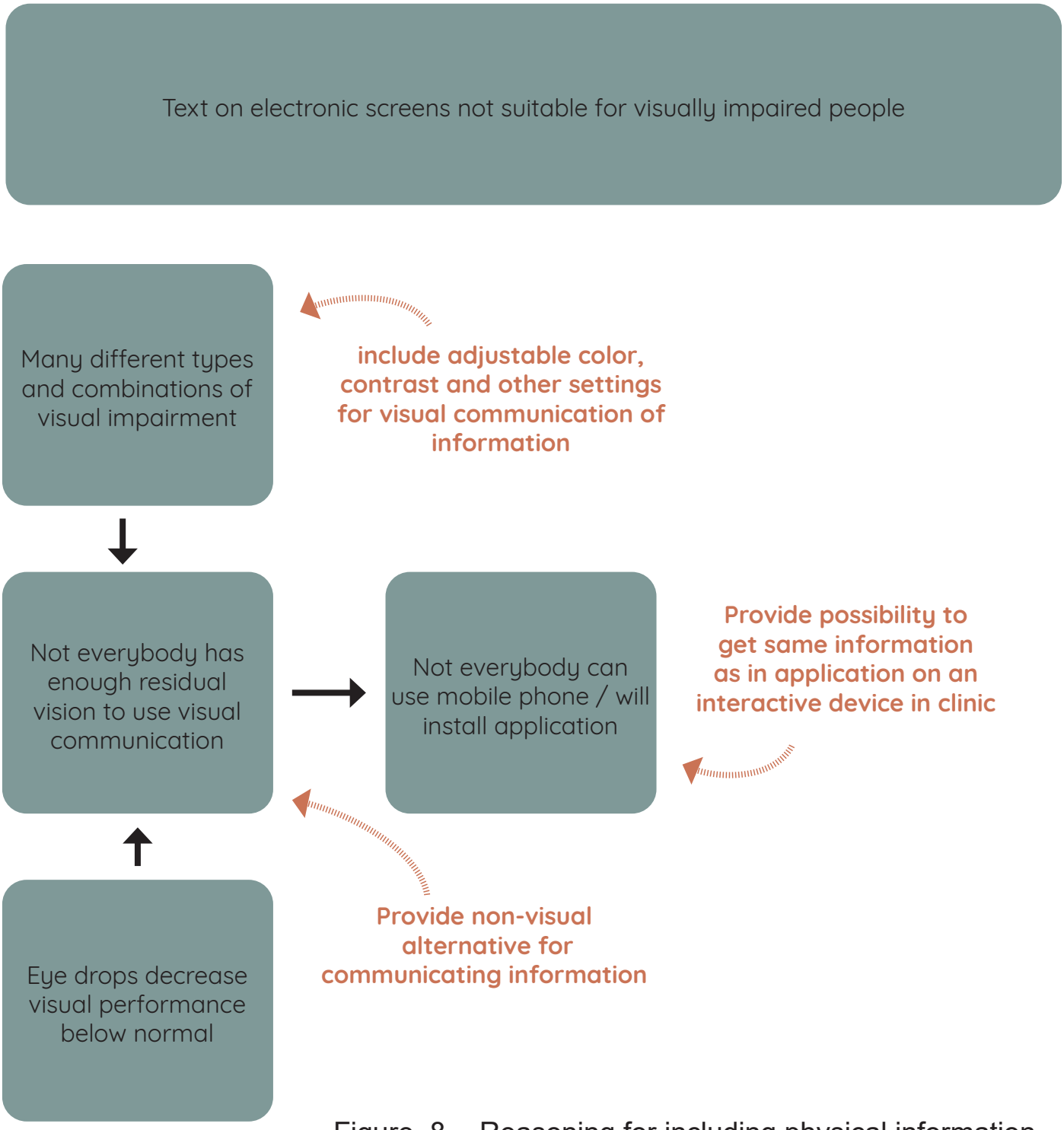


Figure 8. Reasoning for including physical information device in wait area

Identified interventions

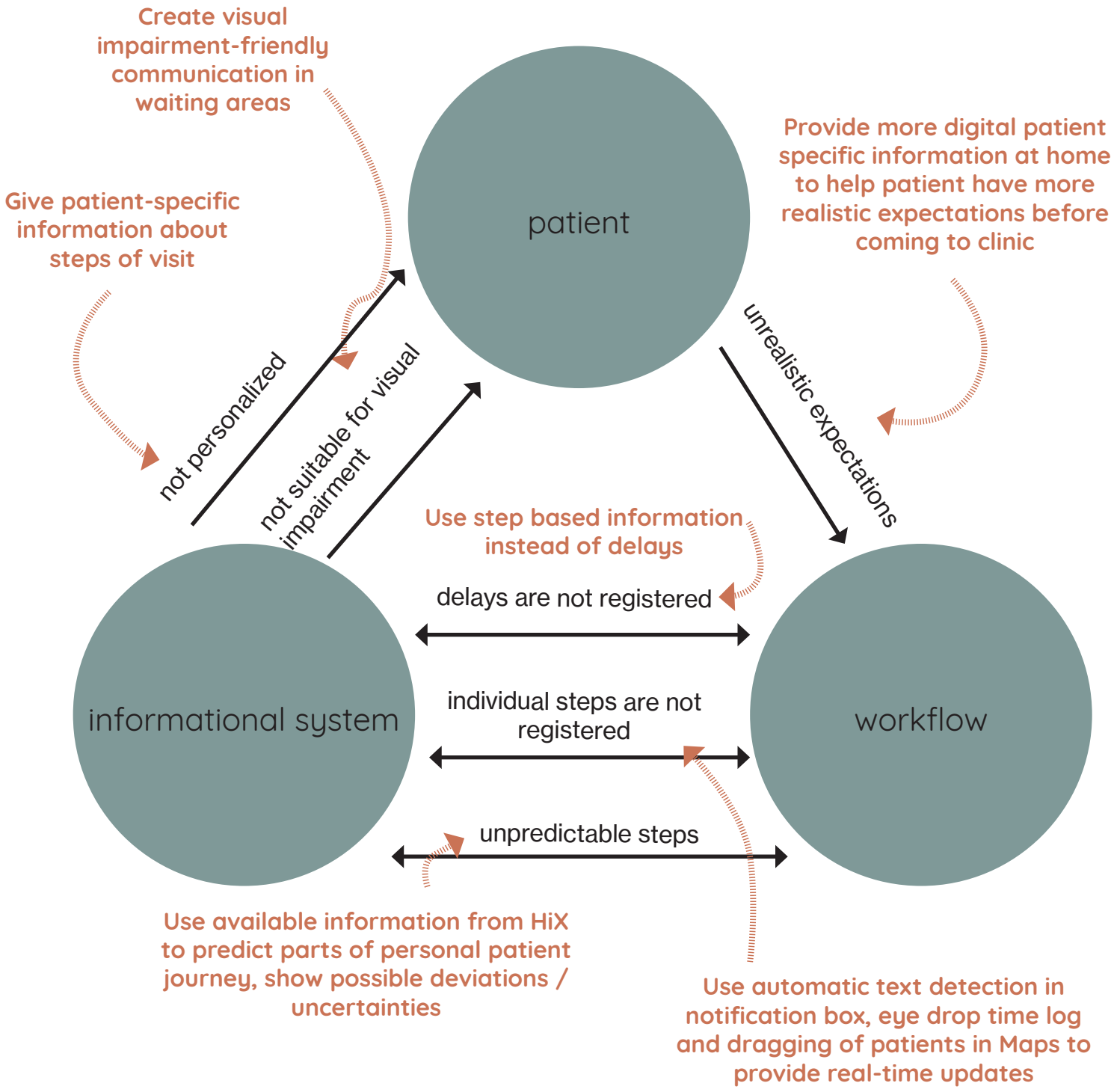


Figure 9. Identified problems and interventions

Requirements

Information and communication

	Structure and form of the information	Medium for communication
	“The information”	**“The devices”**
Creating realistic expectations	Not updated, information fixed in time General information, applicable for all patients Show differences with expected situation, explain why it is different Make sure it is clear that steps depend on examination during visit Must direct person to other information source for private information	Must be able to be autonomously used by visually impaired people Must not impair workflow of staff (including calling in patients)
Meeting expectations	Updated during visit, dynamic information Private information, applicable to specific patient, can only be seen after login Warn when expected end time means other (hospital) appointments won’t be made Steps of specific visit Time ranges of expected start and end times	Must be able to be autonomously used by visually impaired people Must not impair workflow of staff (including calling in patients) Must use also another way of communicating information than visual

Design process

Design scope

The choice was made for a design concept combination that involves communicating information to the patient at multiple moments in four different ways: in the appointment letter or email, on the website and existing web-based patient-platform, in the mobile application currently under development and with a new physical device or devices in the waiting area(s). As there is limited time a selection has to be made on where to put the focus during the design process. This selection is made based on what is most valuable for EMC as well on what is of most (scientific) value for the discipline of Industrial Design Engineering.

Appointment letter or email

The research has not indicated that a fully redesigned or extended appointment letter or email is something desired or needed by patients. Nevertheless it is an important touchpoint that can help adjust patient expectations and contribute to increased use of other patient information sources. For the appointment letter/ email a simple example of which text to add to the letter or email will be given. No recommendations on style or formatting will be given as there is no indication that there are any problems with the current style or formatting of the letter or email.

Mobile application

There is currently a full EMC design team working on the development and design of the Digitaal Verbonden mobile application. This graduation project provides them with input for further app development. The most valuable input for them is which content and information should be included for OOC patients. The structure and design of this mobile application will evolve drastically over the following months. It does therefore not make sense to focus on creating detailed screens and select a single option in how content should be communicated. For the EMC it is much more valuable to know which content should be included in order to address the needs of the OOC patient and to be given multiple example options on how the content could be communicated.

Website and web-based patient platform

An important current information touchpoint, but out of the design scope. The same recommendations and input given for the mobile application can and should be applied to the website.

Physical device or devices

The primary design focus is the design of a physical device or devices located in the waiting area(s) of the OOC that can autonomously be used by patients with different levels of visual impairment to access patient-specific information about their visit. The research indicates that the touchpoint in the waiting area is the moment when

most patient expectations go unmet. This is also the touchpoint where patients experience the most anxiety and loss of control during their visit. The context of the OOC creates a unique set of circumstances that impact patient communication needs during the patient visit. The existing communication methods at the OOC can not sufficiently address these needs.

Overview design process

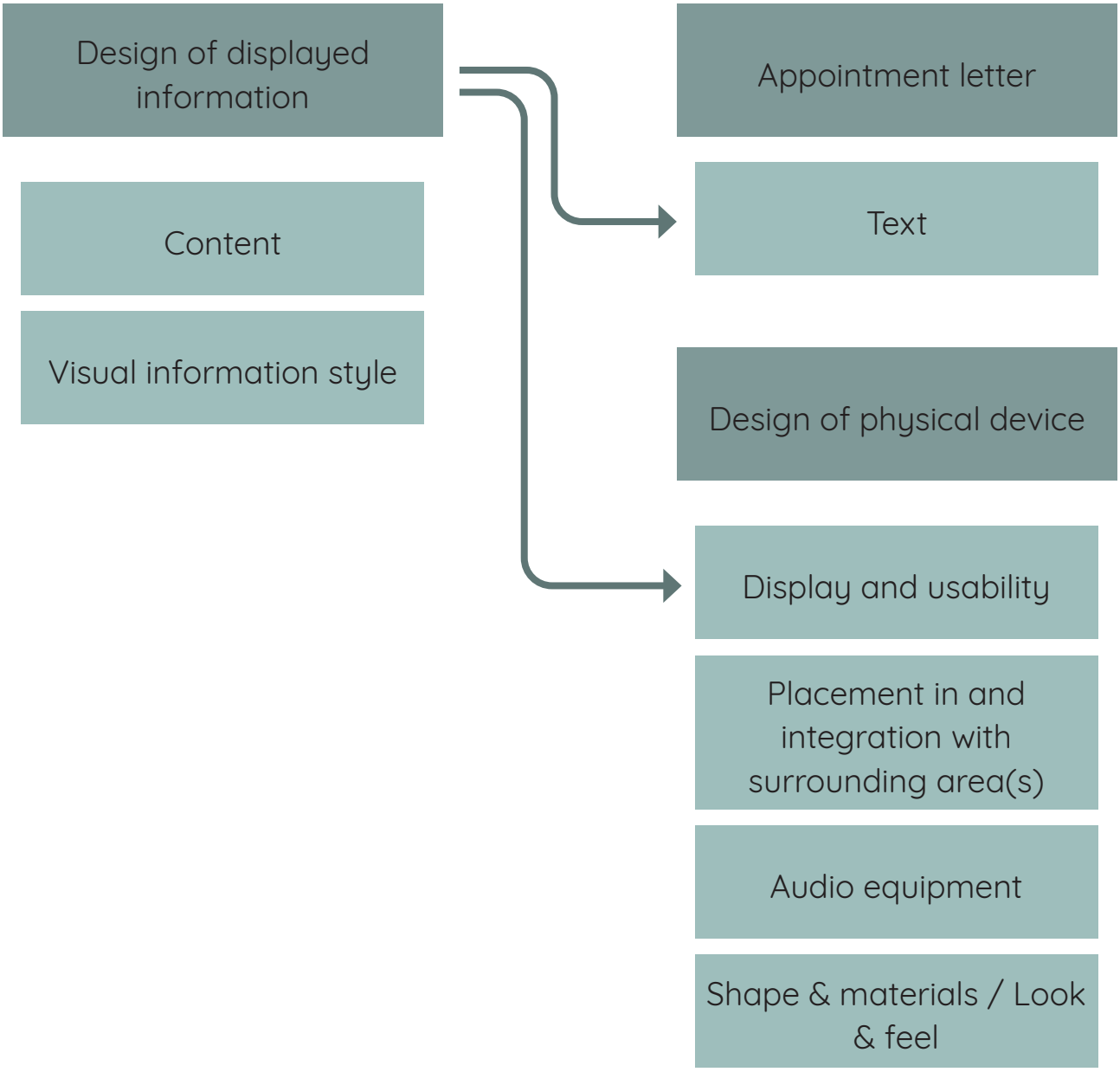


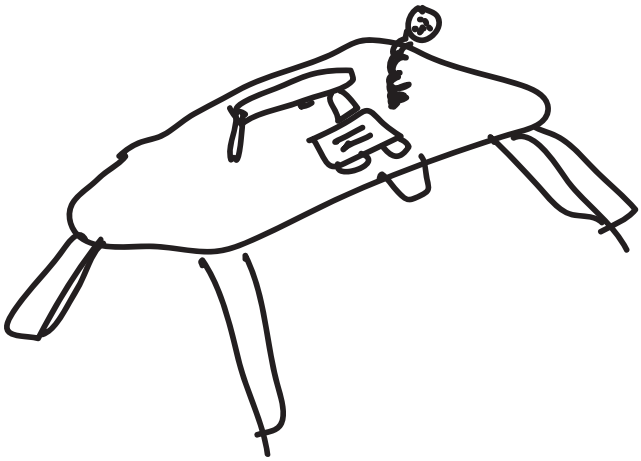
Figure 10. Schematic overview of design process

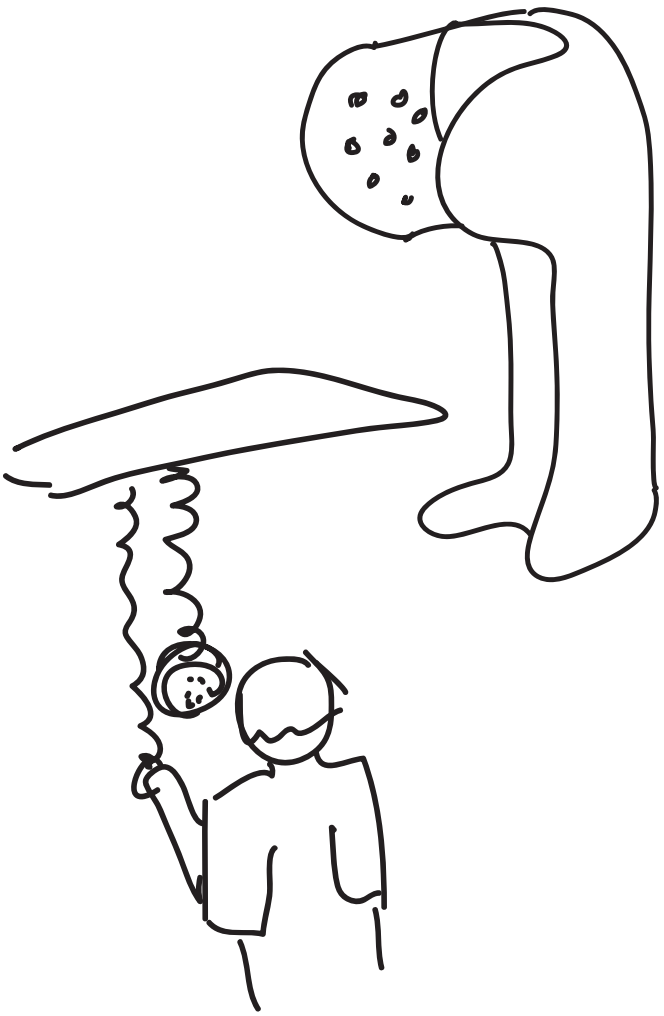
Iterating design evaluations

During the design process ideas were constantly evaluated on the following criteria

- **Implementability/ feasibility**
- **Perceived privacy**
- **Perceived accessibility**
- **Perceived optionality**
- **Perceived ease of use**

These evaluation were performed by doing small simulated tests going through scenarios with paper and imaginary prototypes.





Design of displayed information

Content

The selection of which information to display is made by the selecting the information that meets three criteria: available, desired and appropriate.

Appropriate information

Several types of information were excluded from selection as they were determined to pose risks to the security or privacy of staff members.

Available information

Available data sources for information were selected during context research.
The data sources that were determined to meet the requirements for information quality are the “eye drop time log” field, “preparation text” field and time stamp of appointment mutations (triggered by Maps dragging or barcode scan).

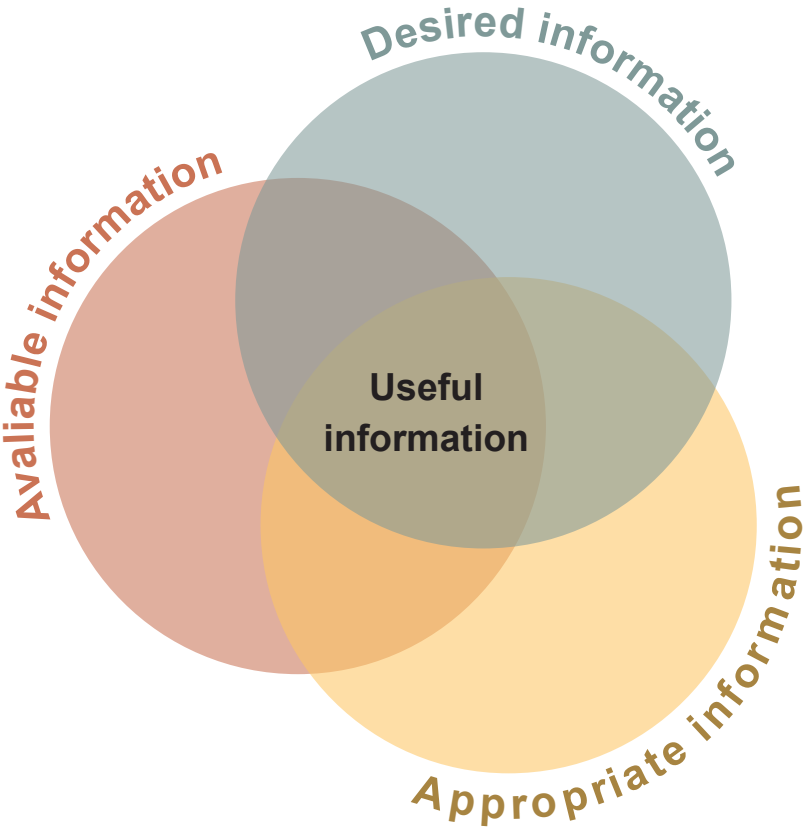


Figure 11. Criteria fo useful information

Desired information

Which information is desired is in this project extracted from the patient expectations described earlier. It includes information that patients themselves have explicitly said they want or expect. It also includes information that contributes to meeting to patients needs or wants in more indirect ways. Desired information creates finite, realistic expectations in multiple areas. The three types of Information selected are:

- General static information about the full visit duration
- General, static information about the base steps of a visit and how these steps differ from patient expectations
- Patient-specific, dynamic information about visit steps and waiting times

Style of visual information

The visual acuity of the user directly impacts requirements for design of the communication of visual information. In many cases it leads to contradictory preferences for communication and usability between the target group with average visual acuity and the low-vision target group.

Use of style elements: icons, colours and images

Most style elements that are commonly used to capture the interest of the user, portray brand identity, save screen estate and visually structure large amounts of content are cumbersome and confusing for a low-vision user. Examples of such elements are icons, detailed and small images, coloured text, coloured backgrounds behind text and specialty fonts. These elements can make a text illegible and apps unusable for low-vision users.

Font size and screen estate

Even among those with average visual acuity there are strong preferences for particular font sizes. Font size is often a major design choice by a visual information designer as the amount of space on a screen or display to display all important information is limited (a concept known as “screen estate”). This is especially important when designing for small mobile screens. Integrated mobile accessibility tools that override style sheets can disrupt the structure of applications making it impossible to navigate through the application. It is therefore important to design the application in such a way that even if the font size is scaled to 120pt the structure of the application is still intact.

Target groups: Compromising vs. separate solutions

The approach designers usually take when dealing with multiple target groups for a design is compromising between the needs of each selected target group. Usually this results in a single design that incorporates the most important aspects for each selected target group.

Mobile application

If this compromising approach is taken during the design of a mobile application where one of the target groups is visually impaired, this compromise often means that the design will actually be unusable for (a section of) the target group. The included legibility options often do not go far enough for the actual requirements of a large number of visually impaired people(Miura, T., Ohashi, T., Sakajiri, M., Onishi, J., & Ono, T. (2016). Accessible Button Arrangements of Touchscreen Interfaces for Visually Impaired Users. The Journal on Technology and Persons with Disabilities, 55.). Losing this part of the target group might be an acceptable and conscious choice for an organisation when designing an application. However, the Dutch

legislation regarding the digital accessibility of personal health information means that this is not an acceptable choice for mobile applications developed by hospitals. Futhermore, the people that would be excluded by such a compromise make up a large section of the ophthalmology patients. On the other hand, a mobile application that is fully designed to be legible and usable by the full spectrum of visually impaired people will not live up to the minimal expectations regarding style and usability of the other, non-visually impaired target groups. Fortunately, the dynamic nature of the smartphone means that this compromise does not have to be made. The same content can be displayed in multiple ways by allowing optional modes. The recommendation to the EMC is to include an optional “legibility mode” in the mobile application. An example design and proposed guidelines for the design of this legibility mode can be found in the chapter “final concept”.

Other media
All statically displayed information should be designed for usability by the criteria of the low-vision target group. This means full contrast, no icons or images that supply crucial information and in case a static medium is used a font size that requires 0.1 visual acuity on 1 metre distance . All printed information should also be available digitally through the web platform and mobile application.

Appointment letter

Text

In addition to the physical device and mobile application the appointment letter is, as crucial touchpoint inbetween appointments, an great opportunity to guide the patient to information sources and adjust initial expectations. However, information overload is an large risk here. The information added to the text in the appointment letter is therefore limited to only two sentences. The first added sentence challenges the expected visit duration by the patients and consequently triggers the patients to search for more information about why this expectation is incorrect. The second sentence supplies the patient with where to find this information.

Design of physical device

Display

This visual display included in the device should be designed for the usability criteria of the low-vision target group. This means that it must display the dynamic, consistently up-to-date, patient-specific information visually using only text, layout and generic graphic elements.

Placement in and integration with surrounding area(s)

A 3D-model to scale of the wait areas was used to determine in what way a device or multiple devices could be integrated into the environment. It became clear that staff members needed to be able to see the full waiting area in a single look from at least the four different positions. These positions are marked with A-D in Figure 12. It also allowed quick testing on how ideas would realistically work in the space of the wait areas.

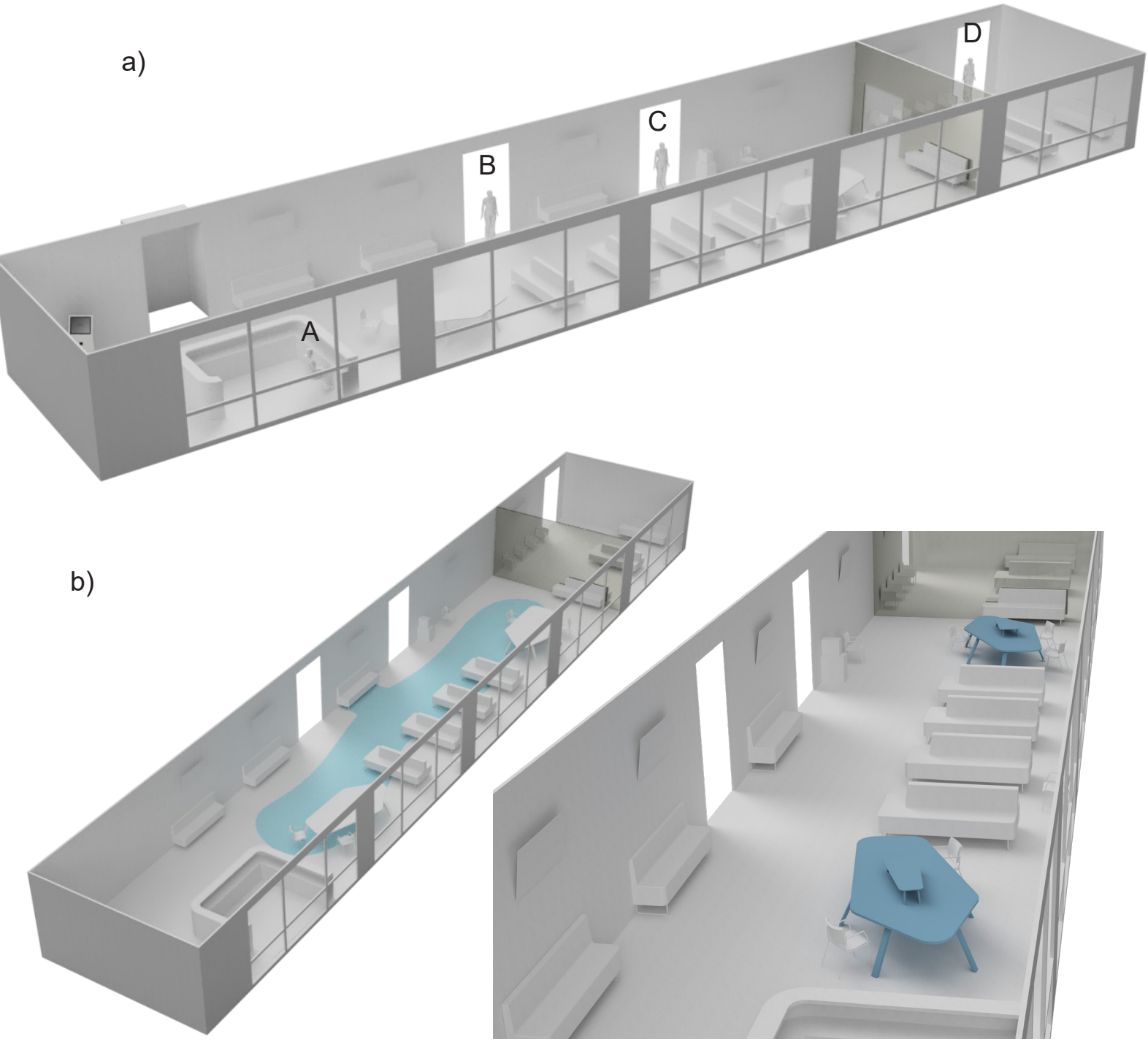
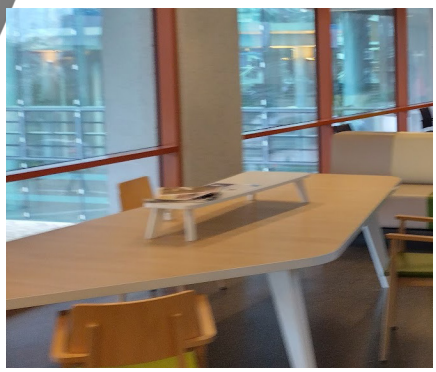


Figure 12. a) Positions that require clear sight lines b) examples of quick tests to see how ideas function in the space of the wait area

Options for using current interior pieces in design

If current pieces of the existing interior can be used in the design concept this is a surefire way to quickly safe costs and integrate the solution in the environment. The three types of interior pieces offer that offer the most promise in this respect are shown in Figure 13 .

Benches and seats

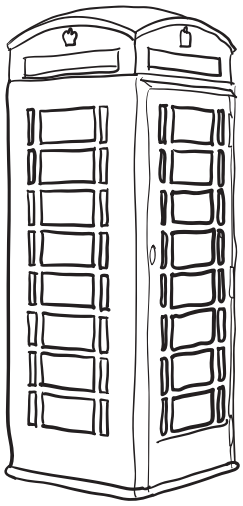


Tables

Electronic screens

Figure 13. Interior pieces for with possibilities for design

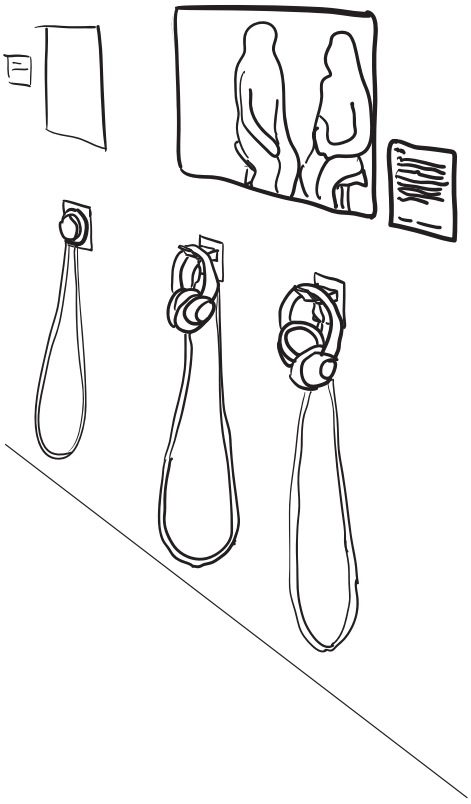
Audio equipment



Privacy concerns

The information that has to be communicated with audio includes patient-specific information. This means that there are strict privacy regulations for the communication of this information. The hospital is required to ensure that the information is communicated to only the intended recipient(s). Within this legislation it is not entirely clear what it specifically means for the use of certain types of audio equipment. Existing audio equipment options for auditory communication of private information in public spaces are headphones, ear buds, sound proof booths and parametric speakers.

Including environmental audio

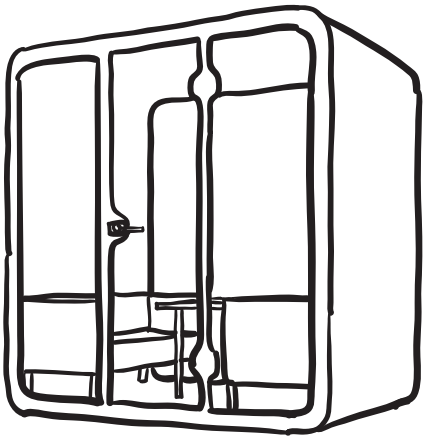


Besides the audio output of the device there are environmental sounds that the patient should be able to hear or be informed about. People with visual impairments tend to rely on environmental sound for (spatial) orientation. In the hospital waiting area it is also of vital importance that a patient is able to hear staff calling their name.

Choice of audio equipment

Parametric speakers where chosen as the best solution for communicating private information using audio. This equipment allows the user to fully hear environmental sounds even during use. They are however much more expensive than a solution like headphones and it is unlikely that it is feasible to install multiple devices containing these speakers.

The inclusion of acoustic damping panels that fully attentuate the acoustic signal means that these panels must be made from opaque material.



Mounting and orientation of speakers

The parametric speakers can be installed in different orientations . The most common way these speakers are used is mounted on the ceiling. This creates a fully vertical sound beam, something that one manufacturer has called a “Sound Shower”. An example of this can be seen in Figure 14. The benefit of mounting the speakers in this way is that users of different heights can all clearly hear the sound without the need for readjustment. However, for wheelchair users the risk of unwanted sound reflection is much larger as any wheelchair contains all kinds of sound-reflecting metal bits. Use by two people at the same time would also proof difficult. Another option is mounting the speaker on a wall or supporting structure at an angle, as can be seen in Figure 14. In this way the sound beam can be positioned above most of the sound reflecting metal parts of wheelchair users. The sound field can be intercepted on the side by acoustic panels to prevent unwanted floor sound reflections.

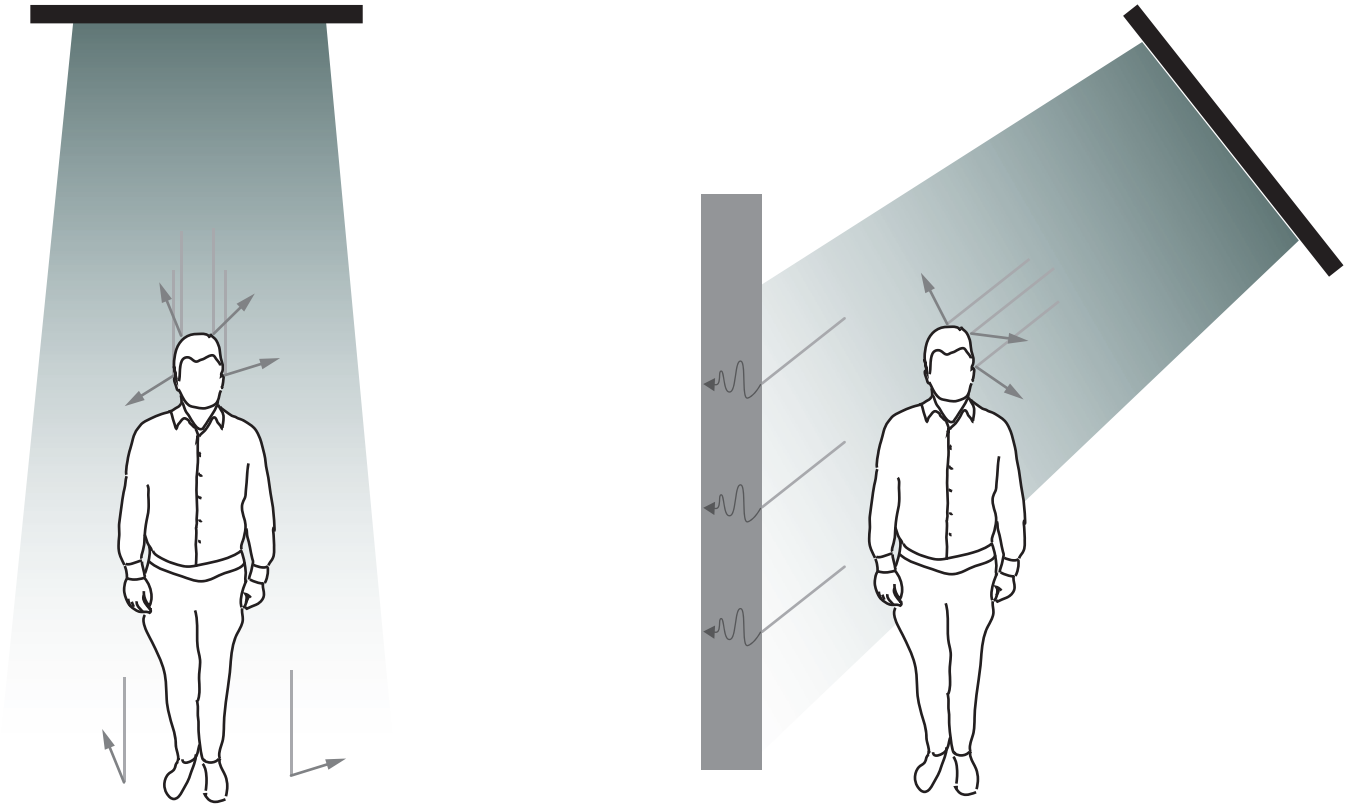


Figure 14. Mounting of parametric speakers and sound fields.

Final concept

Introduction final concept

The final result of this project consists of three recommendations. The three recommendations are: adding information to the appointment letter, optimizing the provided digital and printed information for OOC patients, and providing OOC patients with personal, dynamic appointment information during their wait using a physical information booth in the waiting area of the clinic. These recommendations work in unison with each other to ensure the desired effects for all patients during the full patient journey. Figure 15 shows how the different recommendations affect each other.

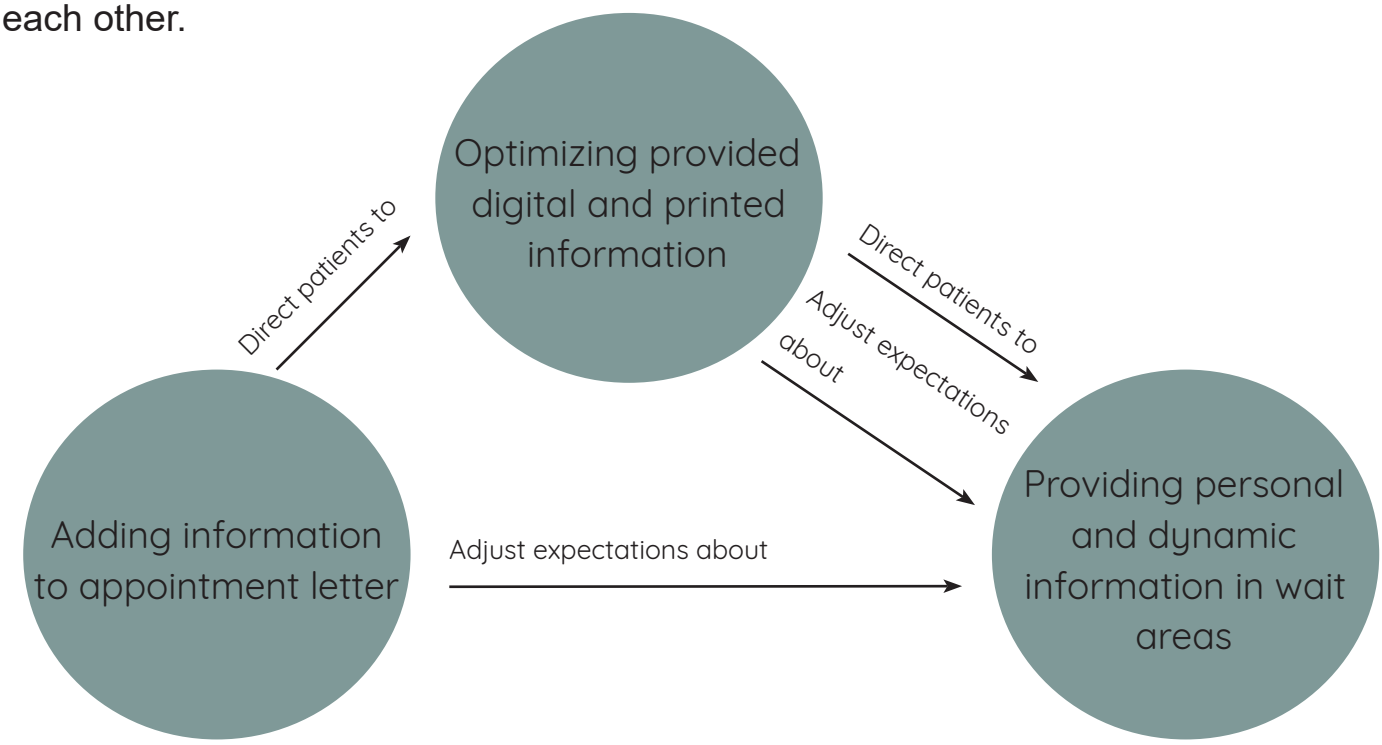


Figure 15. Expected effects of recommendations

Adding information to appointment letter

Two sentences are added to the (Dutch) appointment letter. The first sentence can be translated as: . The aim of this sentence is to adjust the visit duration expectation. The translation of the second sentence is: . The aim of this sentence is to direct the user to the appropriate information sources. An example of the adjusted appointment letter in Dutch can be found in Appendix F.

Optimizing provided digital and printed information

Proposed optimization steps

The optimization steps needed to improve digital and printed information can be divided in optimization steps for all patients and specifically for OOC patients.

General optimization steps

- Make sure all printed information is also digitally available

- Adjust content on type of visit

OOC specific optimization steps:

- Highlight how the procedure at the OOC differs from other EMC departments or outpatient clinics
- Describe the three base steps of each OOC consultation type visit
- Inform OOC patients about the existence of the appointment information booth in the wait area of OOC
- Provide a OOC patient optimized readability mode for all digital information sources

Example design: readability mode (Mobile application)

Entering readability mode

The first time a user tries to zoom in on text - using the “pinch” finger motion - while using the mobile application a modal is prompted. In this modal the user is asked whether they would like to enter readability mode. If the user chooses to enter readibility mode, this choice is saved. When the user opens the application any time after that, the application will automatically start up in readability mode. The modal is triggered only once. If the user declines, this choice is also saved to the user profile. An option to enter readability mode from a general or an “options” menu should be included in the application.

Enhance readibility:
No fully lowercase or uppercase text
No use of color or greyscale in full app, fully black and white text*
No use of images or icons**

Ensure easy navigation:
Zoomable, scrollable bounded boxes for over >6 words.
Full screen scrollable menu after menu is opened, no icons!

Exceptions
*Menu button has background color
**Arrows and close icon can be used

Figure 16. Examples design of readability mode

Providing personal and dynamic information in wait areas

The research indicates that there is a need for providing personal and dynamic information using a physical device in the wait area. This section describes the proposed design of this device. The information provided by this physical device should also be availble through the mobile application, example designs of this can be found on page 59 to 61.

Figure 17. Concept design

Device components

Figure 18 gives an overview of the components of the information booth. The information booth consists of a center module and two side panels. The side panels and module are connected with a cable cover that also provides stability for the entire booth. A hanging sign directly above the information booth directs the patients to the booth.

Hanging sign

Although it follows the style and color of other signage, the font size and overall dimensions are much larger.

Center module

The embodiment of the center module is a standard kiosk as currently used by Erasmus MC. There are three reasons for using this embodiment. The first reason is that this fits the visual identity of Erasmus MC and therefore improves recognizability. The second reason is that using an existing embodiment makes the implementation process much easier. The final reason is that it makes cost estimations more reliable.

Side panels

The side panels are curved acoustic panels. parametric speakers are mounted on these panels. inside the panels is a space cutout for the speaker cables.

Cable cover

The cable cover provides the entire booth with stability by connecting the separate parts as one unit.

Demarcation strip

Figure 18. Components of the information booth

Location and dimensions

The booth should be placed at the location shown in Figure 19. This location provides staff members with clear lines of sights from behind the reception desk and all hallways.

Figure 19. Line of sight from behind reception desk.

Sound fields

The speakers are mounted on a height of 200 cm with the angles shown in Figure 20. This placement and orientation creates optimal conditions for standing users in the full range of adult body height (P0.01 - P99.99) as well as users in wheelchairs. This means that can hear the audio while standing or while sitting in wheelchair in the full use area of the kiosk.

Figure 20. Examples of sound field overlap in different usage situations.

Example design: mobile application

Confirmation of identity

For mobile application users, confirmation of their identity and appointment time already happens on the home screen which is displayed every time they start the application.

Steps of appointment

The “steps” screen of the mobile application aims to reassure the user that the doctors have not forgotten them and to give the user more information about the steps of their visit. The Digitaal Verbonden application is still in development at the time of publication of this report. This means that it has not yet fully been determined what the application structure will be like. The patient steps as displayed in Figure 21 should be displayed below the most important information about the current appointment. It should only be displayed once the patient has checked in at the clinic. Additional information about the appointment should be displayed below the patient journey.

Figure 21. Example design patient steps

Explanation about steps

When a person taps on a step in the overview a more indepth explanation is given of what they can expect during that step.

Figure 22. Example explanation screen

Example design: app readability mode

Steps of appointment

The displayed information per screen is reduced to the bare essentials. For the display of steps this means that only the current step is displayed. The eye drop timer is still included. During the other waiting periods the next step for the user is displayed. In this case the screen reassures the user that the staff knows their current status.

Figure 23. Examples design of readability mode : steps of appointment

Explanation about steps

In readability mode, additional information on the steps can be accessed by using the menu button on the bottom of the screen.

Figure 24. Examples design of readability mode: explanation about steps

Evaluation

The purpose of evaluation is to determine whether the solution fulfills its intended purpose.

Evaluation setup

Overview

- Simulation of the hospital waiting room environment
- Engage participants by letting them play a role, aliases to ensure privacy
- A pilot test was performed to finetune the setup.
- Four participants, opportunity sampling, majority over age of 50, not fully blind.
- Surveys at three different moments

Hypotheses and research questions

The overall research question for the evaluation is:
Does the design fullfill its intended purpose?

The evaluation is used to validate the following four hypotheses:

H1: The design creates more realistic expectations about waiting

R1: Do people have an realistic expectations about how long a visit will take?
R2: Do people have realistic expectations about what is going to happen in the visit?
R3: Does the additional information in letter B create more realistic expectations?
R4: Does the panel information create more realistic expectations?

H2: The kiosk can be used autonomously by people with different levels of visual impairment and technological skill level

R5: Do users with different levels of visual impairment find the product sufficiently easy to use autonomously?
R6: Are both the application and the kiosk needed to accommodate the different user types?

H3: The method of communicating information is experienced as secure and private

R7: Does the design of the kiosk contribute to a sense of privacy and security?
R8: Are there privacy concerns related to the use of a parametric speaker?

H4: The information given by the design is experienced as useful

R9: Do users feel like they have access to all the information they require?

Out of scope of evaluation

Evaluation of usability mobile screens

Audio-based use with haptic clues

Steps of user test

1: Welcome

2: Scenario introduction Letter A + part of survey A

3: rest Survey A in wait area

4: Reading back and checking answers, Other letter eval with interview + Letter B

5: Survey B in wait area. Instruction to use

6: Survey C & parametric speaker demonstration + interview

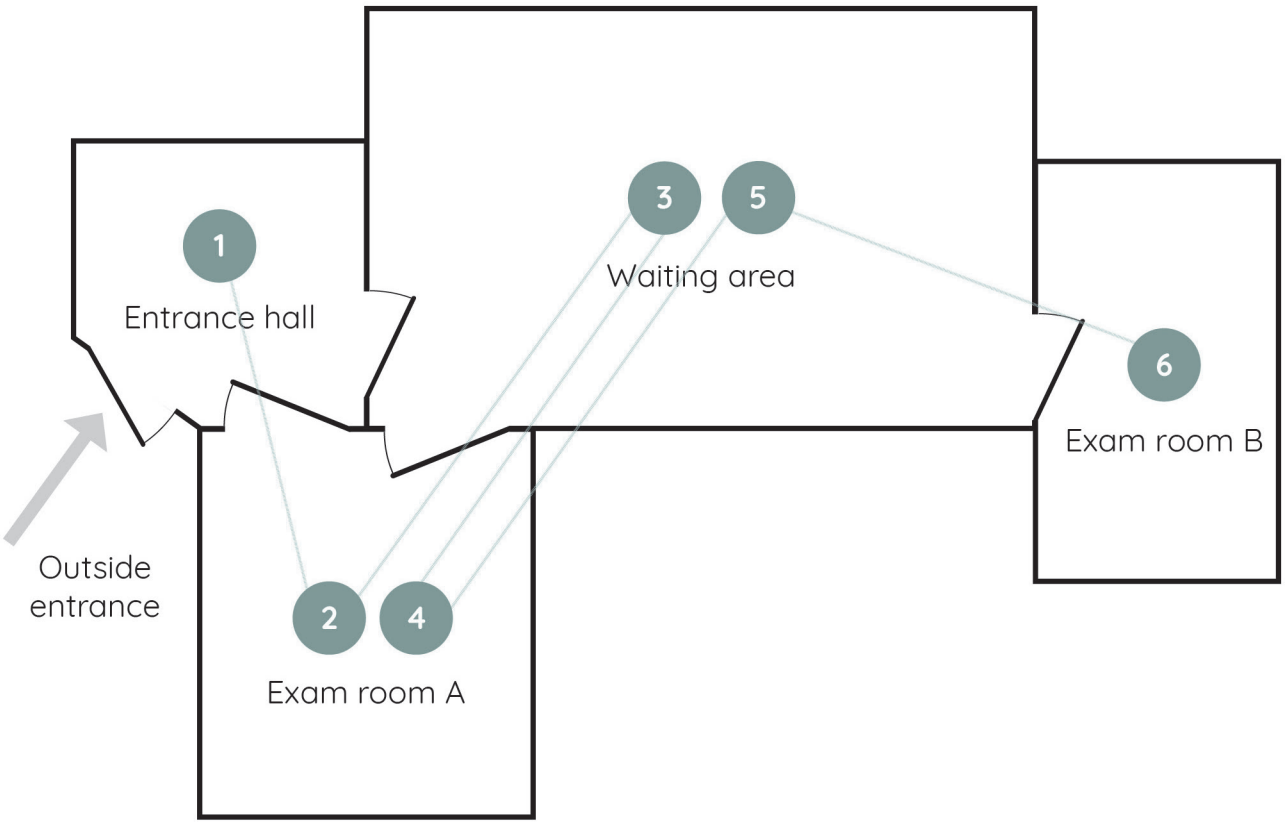


Figure 25. Overview steps user test

Prototypes for evaluation

Appointment letters

Each participant receives two appointment letters at different moments during evaluation testing. These letters are addressed to the alias used for the participant during testing and include their person-specific appointment start time.

The first appointment letter the participants receive, designated as “letter A”, only contains the information currently included in appointment letters send by the EMC. Letter B also contains the additional information. Examples of both letters for one of the participants are shown in Figure 26.

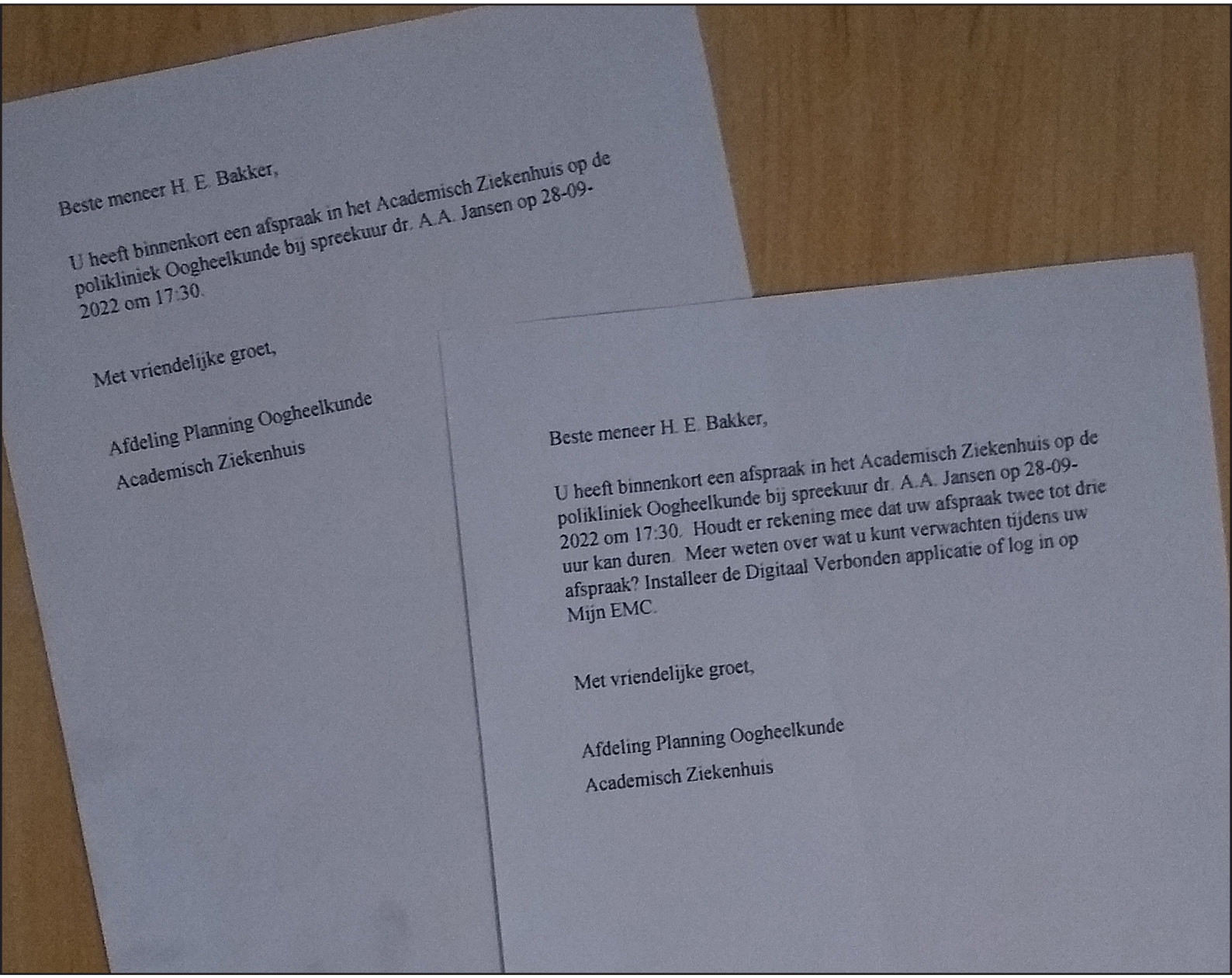


Figure 26. Examples of prototype appointment letter A (left) and B (right)

Kiosk prototype

The prototype of the kiosk includes an interactive digital Adobe XD prototype and two side panels. A touch screen computer was used to run the digital prototype. The side panels were created to the actual height of the design to simulate the effect the prototype would have in the space.

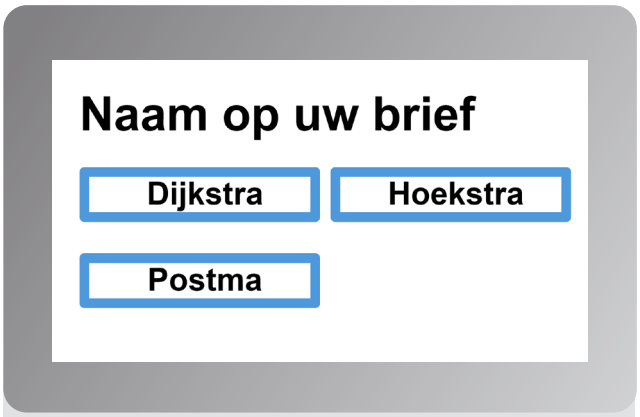
Figure 27. The prototype as it was placed during the user tests

Digital prototype user test

A digital application prototype (kiosk version) was build in Adobe XD.

The barcode scanner was not included in the prototype as the barcode scanning system is used throughout the hospital for secure patient login. Evaluating this login method is not part of the scope of this project. In the digital prototype the “home” screen that directs the user to the barcode scanner was replaced with a screen of aliases that participants had to select to get access to their “personal” information.

To display the digital prototype a laptop with touchscreen was used. The screen dimensions of this laptop are different from the screen dimensions of the kiosk. Therefore the digital prototype was adjusted to the dimensions of the laptop screen. Priority was given to realistic font size and object size as validating ease of use was one of the goals of the user test.The “next step” section of the step overview screen was cut.



Results

The results addressed per hypothesis

H1: The design creates more realistic expectations about waiting

In line with the earlier research expectations were considered realistic if:

1. Expected visit duration was between 1 and 3 hours long
2. The three base steps of a visit were expected by the patient

Expected visit duration

Expectation duration was measured in two different ways. After the scenario explanation the user was asked at what time they would plan an appointment at the same hospital at a different specialist if they had the choice. The participants were also asked directly how long they estimated the visit would take in Survey A , before they were exposed to any of the interventions. After receiving and reading letter B participants were asked if they wanted to edit their answers. The results are shown in Figure 28.

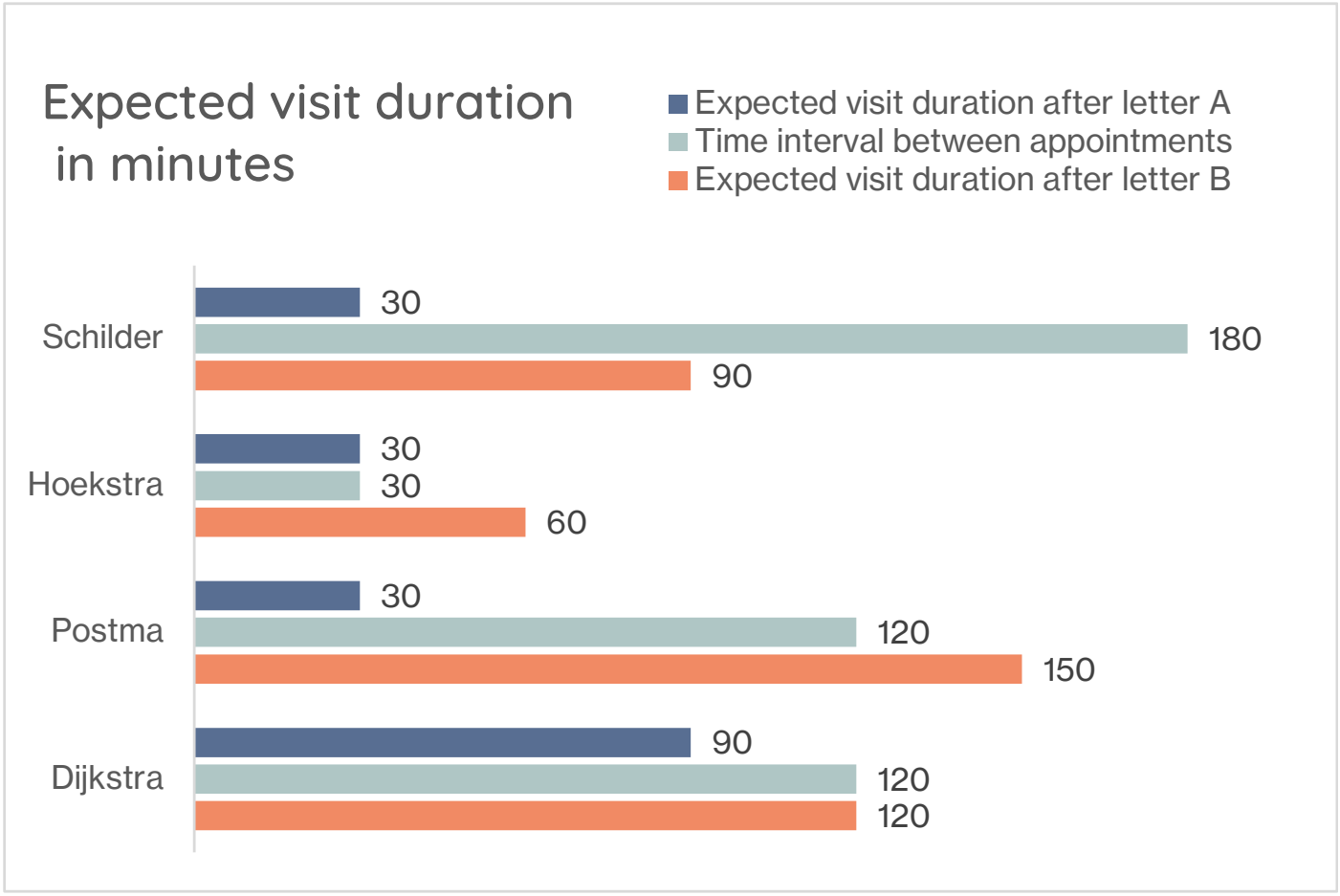


Figure 28. Results of user test – Expected Visit Duration

Three participants initially had an unrealistic expectation of the visit duration of 30 minutes when asked in the survey. Three participants took a longer interval than their estimated visit duration when asked to plan the other appointment. When asked for an explanation, all three participants mentioned taking into account that visits can sometimes take longer than expected.

Effect of different interventions

The effect of the additional information in letter B was very clear. Each of the participants edited their answer on expected visit duration in survey A after reading letter B. This can be seen in the difference between blue and orange bars in Figure 28. The information of the side panels of the kiosk did not seem to have an additional effect on the expected time duration. Nobody edited their answer about expected visit duration in survey A again after staying in the waiting area and being exposed to this information.

Expected visit steps

The information in Letter B did have an unintended side effect. Each of the participants reacted visibly surprised after reading the possible visit duration of two to three hours and immediately asked the researcher why it would take that long. No answer was given to that question was given and they were prompted to explain this visit duration themselves. All participants said they could not explain this duration. Two participants mentioned missing information about whether they were going to receive eye drops during the appointment in the letter.

Connection visit step information and expected time duration

The three participants that initially had unrealistic expectations about visit duration only expected a single step to happen. Two participants did make remarks that indicate that the information helps explain why the visit is going to take a certain amount of time. “Well, now I have seen all the things that have the happen.. That is minimally going to take an hour .”

Conclusion

The design creates more realistic expectations about waiting. The information in Letter B contributes to a more realistic expectation of visit duration. There is a need for explanation of the visit duration. The information on the side panels is satisfactory as explanation but is only accessed in waiting area. Explanation must also be able to be found digitally at home.

Discussion

As the user tests took place in the evening because of availability of participants it did take some imagination about a hospital with opening hours from 2 PM until midnight. Not sure how long effect of letter will last.

H2: The design can be used autonomously by people with different types of visual impairment and technological skill level

Abilities of participants

The participants were not selected based on their fit to one of the identified user types. It was therefore not known if all participants would fit one of the identified user types. To identify whether participants fit one of the identified user types questions about their technological skill level, visual or hearing impairments and preferences for gathering information were included in the survey.

Alias	Visual impairment	Hearing impairment	Tech. skill self-rating	Notes
Schilder	Yes	Yes	2	
Dijkstra	No	No	5	
Postma	Yes[1]	Yes	1	
Hoekstra	Yes	No	4	With companion

[1]Participant did not indicate visual impairment in survey, but was wearing glasses, and had noticable difficulty reading the text of the appointment letters and survey

Table 2. Participant ability survey and observation results.

From analysis of the survey answers it was concluded that each of the four participants did fit one of the identified user types.

Need for kiosk

Both participants that rated themselves low on technological skill said they would not install the application even though they both own a smartphone. One of these participants was concerned about the security of installing apps that deal with sensitive information. This participant would not install any such apps for fear of theft of their phone. However, this participant would use their computer at home to login to a personal health environment access information. The other participant that would not install the mobile application found it difficult to work with most technology. This participant was clear that they preferred personal contact over any other method of gathering information.

Need for mobile application

One of the participants that would install the app was over 60 years old and visually impaired. Still, this participant had a strong preference for using their mobile phone to access information. The participant argued: “It just seems efficient, as I probably will have to come back to the clinica couple of times”. The 25-year old participant also had a strong preference for a mobile application.

H3: The method of communicating information is experienced as secure and private

Data collection: Interviews

Shape of kiosk must be adjusted to block view on screen from behind the user

Two participants thought it was too easy to look on the screen from outside the kiosk.

Parametric speaker accepted as secure method of communication

All participants had full confidence in the concept of the parametric speaker. One participant did recommend include some information about why a parametric speaker is secure inside the kiosk.

Displayed information not considered as sensitive as expected

By users, but still has to comply to privacy regulations

Each of the participants indicated that they did not consider the information on the screen sensitive enough to be worried about someone overhearing or overlooking it. Although it is of course considered patient-sensitive information, the displayed information could in theory already be gathered currently by any observant occupant of the waiting area.

H4: The information given by the design is experienced as useful

Data collection: Surveys and interviews

In the surveys participants were asked to rate the usefulness and clarity of both the information on the side panels and the information on the screen. The results of these ratings are shown in Table X.X.

	Usefulness rating panel information	Clarity rating panel information	Usefulness rating screen information	Clarity rating screen information
Schilder	6	6	6	6
Hoekstra	7	7	6	7
Postma	5	5	7	5
Dijkstra	6	7	6	6

Table 2. Usefulness and clarity ratings of both tested information sources

In the survey as well as interviews the participants were asked to explain their ratings.

Information on side panels is experienced as useful and clear

Information on screen of kiosk is experienced as useful and clear

Placement of kiosk in wait area is considered useful by all participants

Even the participants that preferred the use of a mobile application.

Recommendations

Use the electronic display screen to direct the patient to other sources of information

From an implementability and recognizability perspective it makes sense to use (the shell of) a standard check-in kiosk for the center display unit. However, this is not the optimal solution for wheelchair users, as there is no room for their legs under the display.

Roadmap for implementation

The recommended steps for continuing with the results of this project were processed in a roadmap for implementation which can be found in Appendix G.

References

Biddiss, E., Knibbe, T. J., & McPherson, A. (2014). *The effectiveness of interventions aimed at reducing anxiety in health care waiting spaces: a systematic review of randomized and nonrandomized trials.* Anesthesia & Analgesia, 119(2), 433-448.

Cassidy-Smith, T. N., Baumann, B. M., & Boudreaux, E. D. (2007). *The disconfirmation paradigm: throughput times and emergency department patient satisfaction.* The Journal of emergency medicine, 32(1), 7–13. https://doi-org.eur.idm.oclc.org/10.1016/j.jemermed.2006.05.028

Chu, H., Westbrook, R. A., Njue-Marendes, S., Giordano, T. P., & Dang, B. N. (2019). *The psychology of the wait time experience–what clinics can do to manage the waiting experience for patients: a longitudinal, qualitative study.* BMC health services research, 19(1), 1-10.

Constand, M. K., MacDermid, J. C., Bello-Haas, D., & Law, M. (2014). *Scoping review of patient-centered care approaches in healthcare.* BMC health services research, 14(1), 1-9.

Coulter, A. (2006). *Trends in patients' experience of the NHS*. Oxford: Picker Institute Europe.

Coulter, A. (2012). *Patient engagement—what works?.* The Journal of ambulatory care management, 35(2), 80-89.

Erasmus MC (2019). *Koers 23. Technologie & Toewijding.*https://www.erasmusmc.nl/-/media/erasmusmc/pdf/2-themaoverstijgend/koers-23-technologie-en-toewijding-nl.pdf

Erasmus MC (2021). *PEM rapportage 2021* (Internal)

Erasmus MC (2022). *Patientervaringen in het Erasmus MC.* https://www.erasmusmc.nl/nl-nl/patientenzorg/patientervaringen-in-het-erasmus-mc

Evans, M., Jamal, A., & Foxall, G. R. (2009). Consumer behaviour. Hoboken, N.J: Wiley.

Jenkinson, C., Coulter, A., & Bruster, S. (2002). *The Picker Patient Experience*

Questionnaire: development and validation using data from in-patient surveys in five countries. International Journal for Quality in Health Care, 14(5), 353-358.

Hersh, M. A. (2008). Assistive technology for visually impaired and blind people (Vol. 1). M. A. Johnson (Ed.). London: Springer.

Hibbard, J. H., & Greene, J. (2013). *What the evidence shows about patient activation: better health outcomes and care experiences; fewer data on costs.* Health affairs, 32(2), 207-214.

Hohwy, J. (2017). *Priors in perception: Top-down modulation, Bayesian perceptual learning rate, and prediction error minimization.* Consciousness and Cognition, 47, 75-85.

Kleefstra, S. M., Zandbelt, L. C., de Haes, H. J., & Kool, R. B. (2015). *Trends in patient satisfaction in Dutch university medical centers: room for improvement for all.* BMC health services research, 15, 112. https://doi.org/10.1186/s12913-015-0766-7

Limburg, J. J., Keunen, J. E. E., & Van Rens, G. H. M. B. (2009). *Visuele beperkingen bij ouderen in Nederland–risicogroepen en mogelijkheden tot interventie.* Tijdschrift voor gerontologie en geriatrie, 40, 149-155.

Mead, N., & Bower, P. (2000). *Patient-centredness: a conceptual framework and review of the empirical literature.* Social science & medicine, 51(7), 1087-1110.

Miller, K. L. (2016). *Patient centered care: a path to better health outcomes through engagement and activation.* NeuroRehabilitation, 39(4), 465-470.

Nyman, S. R., Dibb, B., Victor, C. R., & Gosney, M. A. (2012). *Emotional well-being and adjustment to vision loss in later life: a meta-synthesis of qualitative studies.* Disability and rehabilitation, 34(12), 971-981

Nederlandse Federatie van Universitair Medische Centra. (2016). *Meer waarde voor de patiënt. NFU-visie kwaliteit 2017-2022.* https://nfukwaliteit.nl/pdf/16.9476_NFU-visie_kwaliteit_2017-2020_Meer_waarde_voor_de_patient.pdf

Nederlandse Federatie van Universitair Medische Centra. (2022). *Patiëntervaringen meten.* https://www.nfu.nl/themas/kwaliteit-van-zorg/patientervaringen-meten

Ong, L. M., De Haes, J. C., Hoos, A. M., & Lammes, F. B. (1995). *Doctor-patient communication: a review of the literature.* Social science & medicine, 40(7), 903-

918.

Thompson, D. A., & Yarnold, P. R. (1995). *Relating patient satisfaction to waiting time perceptions and expectations: the disconfirmation paradigm.* Academic emergency medicine : official journal of the Society for Academic Emergency Medicine, 2(12), 1057–1062. https://doi-org.eur.idm.oclc.org/10.1111/j.1553-2712.1995.tb03150.x

World Health Organization. (2019). *International statistical classification of diseases and related health problems (11th ed.).* https://icd.who.int/

Figure and table references

Table 1. Based on https://www.erasmusmc.nl/nl-nl/patientenzorg/specialismen/oogheelkunde-volw

“Figure 14. Mounting of parametric speakers and sound fields.” op pagina 51. Adapted from Holosonics User Manual. Retrieved from https://www.holosonics.com/user-manual-pdf