Fundação para a Ciência e a Tecnologia

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1. Qualitative inquiry through ethnographic fieldwork

1.1. Observations and Interviews

The methodology involved conducting structured interviews with nine healthcare professionals. These interviews were held either in person or via video call, depending on the preference of the healthcare professional. The focus areas of the interviews were based on topics outlined in the interview guide script [Annex 1], which included glaucoma assessment and examination methods, the dynamics of the doctor-patient relationship, the challenges faced, and the use and awareness of emerging technologies in the field.

During the analysis [Annex 2], the primary objective of these interviews was to explore healthcare professionals' practices and perceptions regarding glaucoma care. Specifically, the study aimed to understand their workflows when assessing a glaucoma case and to identify the core values that guide their practices. The values identified were categorised into three main themes during the analysis: values present during the assessment and diagnostic process for glaucoma, values associated with patient care and treatment, and values related to emerging technologies, particularly those involving artificial intelligence (AI). This included both the values they currently associate with AI and the values they believe AI should incorporate in the future.

A total of 77 values were identified, some of which appeared to be common across more than one of the analysed areas — Diagnosis, Patient Care, and the use of emergent technologies/AI. To extract these values, each interview transcript was carefully reviewed, and statements or phrases that reflected guiding principles, priorities, or beliefs of the healthcare professionals were highlighted. These statements were then coded and categorised on one of the three main themes.

Regarding **Values in Diagnosis**, we aimed to identify the essential values underpinning the clinical diagnosis of glaucoma, highlighting the core guides that orient and sustain medical assessment practices. A total of 20 foundational values were collected in this area. Among these, the most prominent are Structuration, Synchronisation, Humanisation, Pragmatism, Bias, and Patience.

Table 1 - Values in Diagnosis

Value	Description	Citation
Structuration	The importance of following a structured and systematic approach to ensure a thorough patient assessment.	"So, for us to accurately assess a patient with suspected glaucoma, the process involves 3 to 4 steps." –P03
Synchronisation	Integrating multiple results to form a comprehensive understanding of the patient's condition.	"There has to be some consistency in the test results." –P04
Humanisation	Recognising patients as human beings with distinct needs and abilities.	"We have to try to understand who is in front of us." –P06

Patience	Initial examination results may be inconclusive or contradictory, sometimes requiring repeated tests over time to achieve an accurate diagnosis.	"Then, often, the glaucoma diagnosis isn't precise; the patient may need to repeat tests and be reassessed..." –P02
Bias	Acknowledging that human factors, such as emotional state, skills, and preconceptions, can influence clinical outcomes and decisions.	"When my colleagues refer patients to me, thinking they have glaucoma, what are the chances they're always correct?" –P01
Pragmatism	Taking a practical, less immediate approach based on the patient's overall health and test results.	"In situations like these, we can very well say, 'The person is young, healthy, has borderline pressure, does the OCT and visual field tests, and they're not quite right, so we leave it for now and repeat in a year to see again.'" –P04
Instinct	Automatic responses and decisions that arise from accumulated experience and familiarity with the situation.	"There are situations that are more evident, where we almost don't need to run tests because we already know the condition is present, right?" –P04
Verification	Continuously re-evaluating patients to ensure the diagnosis remains accurate over time.	"Then, often, the glaucoma diagnosis isn't precise; the person may need to repeat tests and be reassessed." –P02
Precision	Emphasis on the precision of tests in relation to diagnostic decisions.	"You're cataloguing a person with a disease who will be using eye drops for their entire life... It's important to be certain about what you're saying." –P03
Diversity	Awareness that certain tests may not be perfectly suited to all patients.	"And with these patients, it's sometimes difficult to determine if the person has glaucoma or not." –P03
Praticality	Recognising the need for direct and accessible diagnostic approaches, despite the current limitations of glaucoma diagnosis, which cannot be simplified.	"Unfortunately, with a condition like glaucoma, it's not like a blood test where you get a positive result for glaucoma—that would be a dream." –P05

Realism	Acknowledgment of glaucoma and its specific characteristics.	"They shouldn't expect to feel any improvement in anything because they won't feel it." –P06
Experience	The ability to assess an unusual situation and make a decision based on experience and instinct.	"…one aspect or another that slightly deviates from the guidelines is where experience comes into play..." –P06
Resourcefulness	Recognising the need for adaptability in clinical practice in the face of limitations and challenges.	"I often cannot adhere to the suggestions of international guidelines for timely diagnosis because I don't have available slots to schedule patients... what happens is that we book as many tests as we can based on the clinical likelihood of that patient developing a disease." –P05
Prioritisation	Determining which patients require urgent evaluation, ensuring timely diagnosis and intervention for those in more critical situations.	"There are patients who are extremely urgent, and in those cases, they even slightly bypass the usual process, and we schedule them directly, even as extras, because these are patients who will clearly go blind in weeks if we do nothing." –P05
Variability	Acknowledging that different professionals may have varying opinions or classifications based on the same data.	"And both of them had the same lectures, the same studies, and there's no agreement." –P01
Standardization	Promoting a standardised approach to patient categorisation.	"…we usually categorise them into traffic light colours: red patients, yellow patients, and green patients." –P05
Courage	Courage to act, advocate, and provide care, even when not all answers are available.	"But the technique is... what we have is what we have. That's what we have to rely on." –P04
Opportunity	A tendency to identify and diagnose conditions like glaucoma when patients present with unrelated health issues.	"Then there's the issue of patient flow; the poor patient was given a pair of glasses and suddenly faces this shock." –P01
Doubt	Doubt regarding the progression of glaucoma due to its variability and diversity over the long term.	"'Did I really need to do what I did, surgery, treatment, etc., to end up exactly the same?'

		That's a reasonable doubt the patient has and can raise with us. And we will probably respond that they would likely be worse off, but I can't prove it to you." –P05

Regarding **values in patient care**, we aimed to identify the values that healthcare professionals consider essential for providing good care and fostering a strong doctor-patient relationship. A total of 29 values were collected that serve as foundational pillars in this area. Among these, the most prominent are Care, Education, Transparency, and Assertiveness.

Table 2 - Values in Patient Care

Value	Description	Citation
Care	Patient-centred care aims to ensure that the patient is well cared for and satisfied with the services provided.	"Initially, it's about treating the patient so that they feel content, within the limits of their illness. That they are satisfied and understand what is intended, and that they are able to adhere to the treatment." –P04
Education	This involves educating them about the disease, treatment, and a longitudinal view of their condition so that they can anticipate and prepare for potential developments in their health.	"It's an important weapon to show the patient, to explain, 'Look, this was the situation in 2015, this is how it was in 2018, and in 2024 it might look like this.'" –P03
Transparency	An honest and clear perspective should be shared with the patient regarding their condition, examinations, and results.	"This [treatment] can lead to symptoms that are more disruptive than the disease itself, which is asymptomatic." –P06
Assertiveness	Communication should be direct and clear about the chronic, progressive, and potentially sight-threatening nature of glaucoma, ensuring that the patient fully understands the seriousness of the condition.	"It's a phrase we commonly say in glaucoma: it's a chronic, progressive disease that can lead to blindness." –P05
Success	The importance of achieving positive outcomes for patients serves as a source of motivation and fulfilment.	"In treatment, it's about finding the best way to lower intraocular pressure." –P06

Empathy	Putting oneself in the patients' shoes, adapting communication, and demonstrating sensitivity to their individual needs and limitations.	"Obviously, if I am communicating to a patient that their mother went blind due to glaucoma, I need to be a bit more attentive." –P03
Reassurance	Providing emotional support to patients by alleviating feelings of guilt or anxiety, and ensuring their comfort and support throughout the diagnostic and treatment process.	"This is a slow disease; you won't wake up blind tomorrow." –P01
Responsability	The importance of effectively communicating the seriousness of the disease while passing on the responsibility for care, such as the application of eye drops, to the patient, and monitoring and following up on the progression to the clinician.	"If we don't convey the message that it's a serious disease that can cause blindness over time, it may lead to blindness." –P06
Clarity	Emphasising the need for clear and simple communication tailored to the patient's understanding.	"Often, it doesn't help much to come with extensive scientific explanations; it would be easier to be more direct and less explanatory..." –P04
Trust	Building trust with patients throughout their entire treatment journey.	"The patient needs to feel confidence at every point of this journey." –P01
Empowerment	Empowering patients by offering them clear actions to manage their health condition.	"Only by doing this can you delay the loss of visual field throughout your life." –P03
Sensitivity	Awareness of the cultural, familial, and educational backgrounds of patients.	"It depends on whether the patient is in a supportive family environment or has a more challenging background." – P03
Involvement	Ensuring that all patients, regardless of their background or level of understanding, can access and comprehend information.	"Every week, I have patients who cannot read." – P01
Compliance	Involving patients in discussions about their condition, helping them become active participants in their own care.	"It's very important when communicating with the patient to involve them in their condition. Explain what the

		disease is and what needs to be done." – P03
Persistance	Recognising the ongoing challenge not only of initiating treatment but also of maintaining it over time.	"This is not a disease where patients …consistently follow the instructions from doctors every day. Therefore, it's necessary to work on this with them." – P03
Delegation	Transferring the responsibility for managing treatment from the patient to their family or external entities.	"Often, it's more about the family environment that resolves these issues than what we tell the patient." – P04
Minimisation	A gentle perception that glaucoma does not significantly interfere with daily life or activities, suggesting that once the condition is understood, its management becomes easier.	"As long as the person understands or has someone who understands, it becomes easier." – P04
Clemency	A careful assessment of whether imposing a treatment will bring more benefits than burdens for the patient.	"When we have an older patient… with multiple comorbidities, we have to consider that life will not improve with our treatments... The vision-related quality of life remains the same, but as time goes on, the patient will have more complaints, as our treatments all have side effects." –P05
Attention	When the clinician identifies that a patient may not be adhering to treatment properly, they prioritise closer monitoring and more frequent examinations.	"And we know that if we have a clinical impression that the patient is not adhering properly to the treatment, that patient is at risk. That patient needs to be monitored more closely and regularly." –P05
Prevention	The intention to treat all patients to prevent disease progression, even if not all require immediate intervention.	"There are some studies showing that mild glaucomas, even if untreated, do not progress in most cases… We are treating everyone to save, let's say, 10%. We don't know who those 10% are; if we did, we would only treat them." –P05
Luck	Recognition that factors outside the clinician's control can lead to favourable outcomes, such as	"Some patients may be able to 'afford' to miss half of their applications. If we continue to

	maintaining stability in the patient's condition, despite inconsistent adherence to treatment."	monitor and conduct exams, and the patient is not progressing, we might even question whether the patient should be undergoing treatment at all." – P05
Influence	Use of stronger and sometimes shocking communication to ensure that patients become fully aware of the risks associated with their condition.	Many times it's necessary to scare patients a bit, perhaps more than what is warranted, so they are aware of what is happening… " – P04
Time	Understanding the time limitations within healthcare contexts.	"Sometimes we don't have all the time in the world that we would like. We allocate that time to explain, but we can't always have the same amount of time for every consultation, right?" – P06
Encouragement	Motivating patients to maintain adherence to treatment and resist the temptation to stop their medication prematurely.	"It's important to explain that they might get worse if they don't adhere to their medication, and not to be tempted to stop it just because they experience burning or redness in their eyes. Just saying…" – P06
Skepticism	Assessing the trust and reliability that the patient demonstrates.	"...it also depends on the trust that the patient inspires." – P04
Collaboration	Valuing the diversity of specialisations and perspectives within the team.	"Sharing is always the way forward." – P06
Humility	Acknowledging that positive outcomes are not solely attributed to one's own talent and recognising that no clinician has all the right answers, as different conclusions may arise from equally valid reasoning.	"...whether by talent or by luck, things turn out perfectly." – P05
Ambition	A desire to achieve higher standards of care and improve outcomes for patients.	"It would be phenomenal and would lead to a greater turnover of patients. It would not only allow me to diagnose the problem more easily but also

		exclude it more quickly and discharge the patient." – P05
Magic	The complexity of explaining visual changes to patients that, while real, are not perceived by them can create an almost magical sensation, where clinical reality feels invisible and difficult to translate into accessible terms.	"It's more difficult to graphically represent a defect in the visual field that exists but the patient does not perceive. This seems like magic; it's hard to link this information." – P05

Regarding values related to emergent technologies and particularly the integration of Artificial Intelligence, the collected values indicate not only the qualities that these technologies should embody but also provide guidance on the interaction between doctors and technology. In total, 28 values have been identified as cross-cutting pillars in this domain. These values include critical thinking as an essential aspect of the human-machine interaction, while qualities such as efficiency, precision, evidence and accuracy were emphasised as key attributes of the technology itself.

Table 3 - Values in Technology and AI

Value	Attribute/ Interaction	Description	Citation
Critical Thinking	Interaction	It emphasises the need to maintain a critical stance when evaluating the tools and results used in clinical practice, ensuring informed choices.	"I don't mind if things are done here with artificial intelligence, but in the end, I trust and interpret."–P02
Precision	Attribute	There is a necessity to guarantee the quality of the data provided to artificial intelligence, ensuring that the analysis is accurate and minimising noise in the information.	"It is essential to know what information is provided for analysis in artificial intelligence. This is where your role comes in, taking studies and everything available to provide good information, so we can make the most of it using the computing systems you have." – P06
Accuracy	Attribute	It highlights the importance of using AI to improve the	"Therefore, I want the system to be as reliable as possible, to identify

		accuracy of diagnoses and treatment decisions.	patients who will have the disease, and to reliably indicate that I don't need to see the patients who will not have the disease.“ – P05
Efficiency	Attribute	Optimisation of workflows and automation of routine tasks allows professionals to dedicate more time to direct patient care.	"...if the machine catches 80% and only sends 20%, then those are the only 20 I need to worry about.“ -P01
Evidence	Attribute	Demonstration that artificial intelligence can perform precise triage, classifying patients according to the urgency and need for ophthalmological assessment with a high level of confidence.	"Through artificial intelligence, to classify that patient right away, to determine if they need an ophthalmology consultation for better assessment.“ -P03
Empathy	Interaction	Understand the limitations and error risks associated with AI.	"We are often harsher with machines than we are with people." – P01
Understanding	Interaction	Recognise that AI is not a mysterious or manipulative entity but a tool designed to support healthcare professionals.	"Artificial intelligence is not some kind of monster, it’s here to help us." – P03
Fairness	Interaction	Extend the same understanding of AI errors that applies to human errors, acknowledging their possibility and learning from them.	"Why should we be so strict with AI's mistakes when humans make more errors?" – P01
Patience	Interaction	Accept that AI is in a learning phase, requiring time for its	"I believe we will get there, I'm almost certain it won't take long for AI to be useful

		evolution and refinement.	in our clinical practice." – P03
Education	Atribbute	Emphasise the importance of continuous learning and constant adaptation to new technologies for both professionals and patients.	"This type of technology is constantly monitored and continuously improved, just like the education of our doctors." – P05
Optimisation (Money)	Attribute	Assess the financial implications, with the potential to save costs in the healthcare system by preventing advanced treatments and complications associated with vision loss.	"Another issue is its clinical applicability, which will depend on many other factors, including funding and resource organisation." – P05
Intuitive	Attribute	Facilitate user experience without adding complexity.	"And there needs to be an interface that is easy to use and doesn't create more clicks." – P05
Transparency	Attribute & Interaction	The importance of clear communication regarding the capabilities and limitations of AI, ensuring an informed perspective for both healthcare professionals and patients.	"It is important for people to understand the limitations of AI to avoid unrealistic expectations." – P01
Ethics	Attribute	Careful consideration of ethical principles when integrating AI technologies into diagnosis and treatment.	"But the patient has the right to know from an ethical standpoint that this have." – P01
Responsability	Interaction	The obligation of healthcare professionals to critically assess and	"If the patient seeks the doctor for this, and if the doctor trusts that technology, I think the

		select technologies that genuinely enhance patient care.	patient will also trust that technology." – P03
Trust	Interaction	Valuing the gradual build-up of trust, starting with verification and evolving to full trust as confidence in the technology is established.	"Obviously, in the early days, a person will have to confirm, but if they start to trust it after a while, why not?" – P04
Explicability	Attribute	The necessity for transparency in AI algorithms and decision-making processes, allowing healthcare professionals to understand how the results generated by the technology are achieved.	"And it won't just be a matter of saying 'yes' or 'no', will it? It will involve presenting a series of data that was gathered from various tests, which leads to a conclusion. So, if the journey that led to that conclusion is documented, then it makes sense." – P04
Portability	Attribute	Enabling mobility and access across different locations, ensuring that information is always available	"Therefore, it needs to be fast, accessible, and portable. It should have the capacity for remote work, right? So I can receive images from Mozambique and do the work here [Lisbon] and make my recommendations..." – P05
Contentment	Attribute	Respecting patient's choices regarding their health and treatment options, fostering an environment of support and understanding.	"Many people end up being reluctant and just living with it, and that's it; there's nothing to be done... If the person lives and feels fine that way." —P04
Perceptiveness	Attribute	AI enables the pursuit of deeper insights that go beyond superficial data,	"You can perform mass feeding to these algorithms, and their ability to extract data

		encouraging thorough investigation and a broader understanding of patient information.	and draw conclusions that wouldn't be possible for a human observer is enormous." —P05
Collaboration	Attribute & Interaction	Valuing collaboration between AI and healthcare professionals, where technology complements and supports human clinical judgment.	"Not only our human medical perspective but also exams using these technologies to assist us, like alerting us that this change here could be significant and should be addressed soon. We hope that this will help us, of course." —P06
Prioritisation	Attribute	Emphasising the importance of identifying and prioritising patients who require immediate attention and care.	"I believe these technologies will help us better filter patients, alerting us to those we need to monitor more closely versus those who are less relevant and can be seen less frequently." —P06
Feedback	Attribute	Providing indicators for the prompt recognition and response to changes in a patient's health status.	"For instance, saying, 'Look, this patient requires closer monitoring because they may progress very quickly; we need to pay attention to their intraocular pressure.'" —P03
Personalisation	Attribute	Valuing the adaptation of health solutions according to the unique circumstances of each patient, including medical history, lifestyle, and specific health concerns.	"Highlighting the importance of monitoring patients who may progress rapidly in just two or three exams, as stated, 'Look after this patient closely because they are likely to progress very quickly...' –P03.
Innovative	Attribute	The importance of adopting new	"There are numerous technologies currently

		technologies and methodologies that can bring revolutionary improvements to the healthcare sector.	in research that may prove significant in the future.” –P03
Adaptability	Attribute	The significance of developing AI systems capable of adjusting to new information and environments, ensuring that they remain relevant and effective in clinical contexts.	"The problem is that technology keeps evolving, and therefore the perimeters... used to store data in one way, but now these ones store it differently, and the next ones will do it in another way... And now, to manage all of that, you either need to have an IT company to convert everything, or it becomes very difficult, doesn’t it?" –P04
Skepticism	Interaction	Recognising the caution of healthcare professionals, who, although they see the benefits of AI, have legitimate concerns about its reliability and impact on clinical judgment.	“They can assure me that there is a very high degree of certainty, but I need to see it to believe it. Therefore, I do not agree; I am afraid." –P02
Equity	Attribute	Promoting the use of technology to reduce inequalities in access to healthcare, especially for disadvantaged populations.	“Nevertheless, access to tests is expected to become much easier for patients without needing to go through a doctor” –P03

1. Workshop 1: Values Elicitation and Prioritisation

2. Exploration of values through participatory design

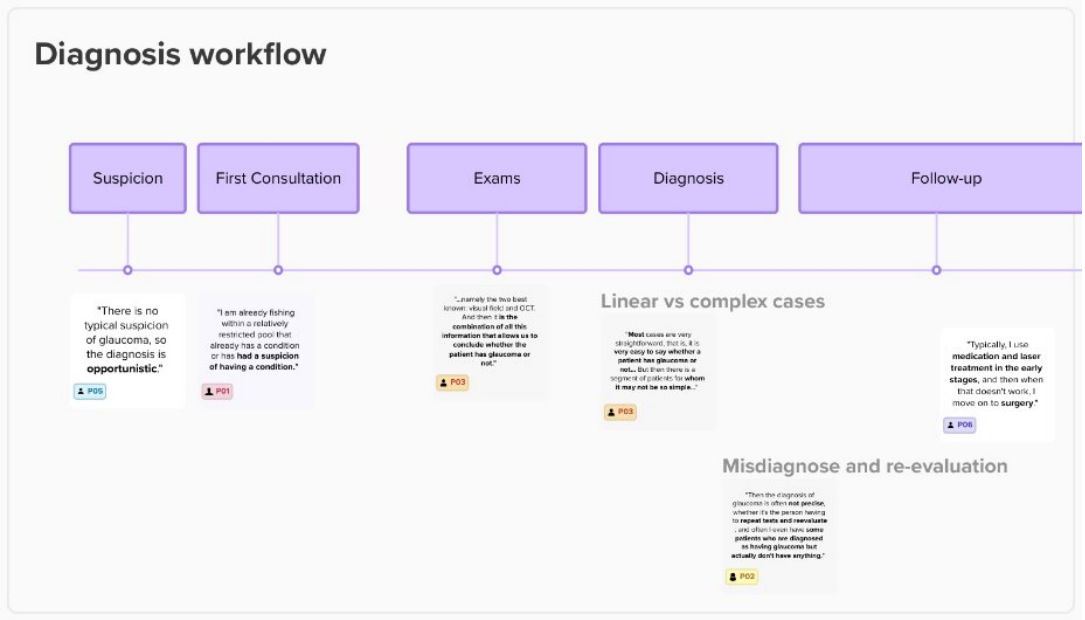
We designed a card-based methodology for identifying and reflecting on values in glaucoma diagnosis and treatment. Developed from interviews with ophthalmologists and co-designed with researchers and designers, the tool uses value and scenario cards to facilitate discussions on how values shape clinical practices and influence technology design. Tested in interdisciplinary workshops with ophthalmologists, HCI researchers, designers, data scientists, and philosophers, the method promotes dynamic value prioritisation and bottom-up value elicitation, ensuring healthcare technologies better align with diverse user needs and guiding the design of speculative prototypes.

The tool developed for this workshop consists of two decks: the Value Deck and the Scenario Deck. These decks are used in conjunction with a board featuring an X-axis representing the temporal dimension and a Y-axis representing the importance of a given value. Additionally, the board includes a dedicated section at the top for timeless values—those that are consistently relevant throughout the entire patient care journey.

The Value Deck was created based on the set of values collected during the interview phase. It was further enriched by incorporating additional values, including antonyms of the collected values and values sourced from the literature.

The Scenario Deck was designed to reflect five key moments identified in the journey of a patient with glaucoma: the suspicion phase, the first consultation, the conduct of examinations, the diagnosis, and ongoing follow-up. This deck includes two types of scenarios: common situations (represented by black cards) and personalized, extreme scenarios (represented by red cards). Additionally, we created scenario cards specifically focused on the introduction of technology, exploring the relationship between technology and the patient, as well as between technology and the healthcare professional.

To further contextualize the discussion around values, the tool also included role tokens (e.g., developer, designer, philosopher, doctor, and patient) to help participants attribute values from different perspectives, enriching the dialogue by clarifying whose viewpoint was being considered.



2.1.1. Validation

To ensure the effectiveness and usability of the tool, we conducted two validation sessions with professionals from diverse fields, including design, technology, and communication. These sessions focused on refining the tool's design, content, and dynamics. During the validation process, participants provided feedback on the clarity and relevance of the cards, the effectiveness of the communication, and the overall flow of the tool.

Based on the insights gathered from these sessions, we iterated on the design of the cards, improved the content and messaging, and refined the dynamics of the tool. Only after these two rounds of validation and subsequent iterations was the tool finalized and deemed ready for use in the workshop.

2.1.2. Participants

We conducted three workshop sessions, each comprising a diverse group of experts from various fields, including design, philosophy, technology, and ophthalmology [Annex 4]. The composition of each group was as follows:

Group 1: 2 philosophers (F1) (F4), 1 designer (D1), 1 ophthalmologist (M1), 1 technologist (T1)

Group 2: 1 technologist (T2), 2 designers (D2) (D4), 1 philosopher (F2), 1 ophthalmologist (M2)

Group 3: 1 designer (D3), 1 technologist (T3), 1 ophthalmologist (M3), 1 philosopher (F3)

All workshops were recorded to transcribe and enable qualitative analysis of the insights and decision-making processes.

2.1.3. Workshop Plan

The session began by asking participants to select three values from the Value Deck that they personally identified with (whether reflecting their individual perspective or their professional

practice). As an icebreaker, each participant introduced themselves and chose one of their three values to explain why they selected it.

Next, participants were asked to draw additional cards until they held seven values in hand, replenishing from the shared deck (which contained over 50 value options). With these cards, they engaged with the board:

- A scenario card was drawn (from the Scenario Deck), and participants played values they deemed most relevant to that situation, placing them on the board according to temporal importance (X-axis) and priority (Y-axis).
- Once the group completed the discussion for a scenario, another card was drawn, and the process repeated. The team adapted the exercise dynamically to the group's pace—some groups progressed through more scenarios than others, depending on the depth of discussion and time constraints.
- Participants were encouraged to remove values they felt no longer applied, add custom values (if missing from the deck) and designate universal values (those critical across all patient journey phases).
- By the end, the board accumulated values from all discussed scenarios. Each participant was asked to select one standout value from the entire session, a value they believed was especially important to highlight, based on the collective deliberation.

2.1.4. Results

The analysis process required a multifaceted approach to interpret the interactions and outcomes from the workshops.

We began by digitally recreating each group's boards, documenting all value placements, movements along the temporal/importance axes, and modifications made throughout the sessions. This included tracking initial selections, subsequent additions/removals, and the designation of universal values. We then conducted an audio analysis of workshop recordings, extracting participant quotations that justified value positioning and capturing debate dynamics around contested choices.

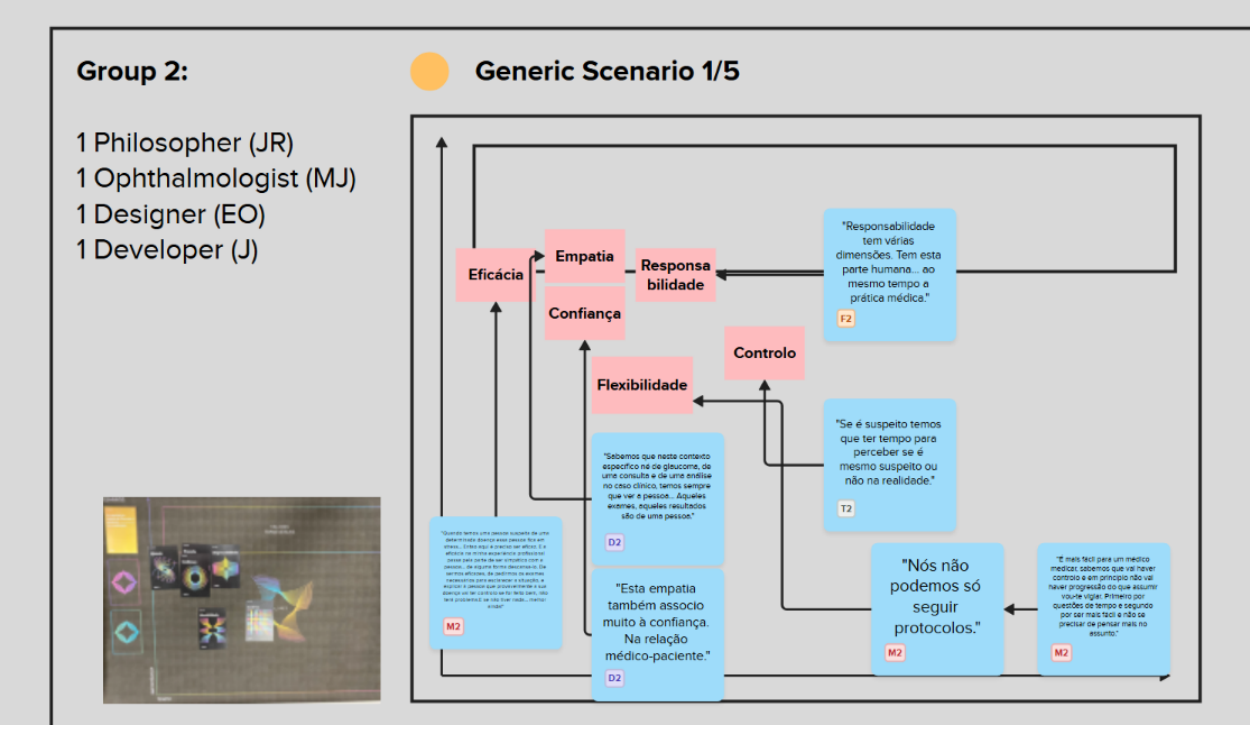


Figure 1 - Analysis of game board of Group 2.

After this, we focused on 1. Tracking of value frequency, distribution and relations across scenarios and groups. 2. Examination of participants final value choice and decision-making processes. 3. Analysis between different stakeholder's value choices and patterns. 4.Thematic categorisation of values (human-centric vs technology-related).

2.1.4.1. Tracking of value frequency, distribution and relations across scenarios and groups

This table presents the played values, their frequency across recurrent workshops, and the meanings attributed to them by workshop participants.

Table 4 - Frequency and meanings of played values.

Value	Workshops Recurrency	Participant Consensus	Illustrative Quotes
Clareza (clarity)	3/3	Clear communication adapted to patient's literacy level	"Ser claro, ser objetivo. E sabendo que a nossa população não tem um nível de informação que implique estar com grande explicações... Usar um português se calhar simples." -M1 "Muitas vezes explicar aos doentes com a linguagem adequada obviamente porque os doentes não entendem todos as mesmas coisas

			e não querem todos ter a mesma informação..." -M3
Transparência (Transparency)	3/3	No hidden information, but with contextual filtering.	“Transparência eu entendo como não esconder nada. E se calhar na clareza não se sobrepõe só isso. Ou seja, porque a transparência se calhar era vincular todo o tipo de informação, não é que se esconda, mas que num primeiro contacto se calhar não será o ideal... Tem que haver um filtro mesmo sendo claro." -M1 "A tecnologia tem que ter transparência para sabermos se aquilo está de acordo com o que foi desenhado ou não." -T2
Autonomia (Autonomy)	2/3	Patient control over care, balanced with support.	“É empoderar” -M1 "A tecnologia pareça a quem a usa uma coisa que é absolutamente confiável atendível e eu sei o que estou a fazer, quem vai ver e quem é que não vai... Não é a tecnologia que decide por mim, não estou dependente dela." -F3
Responsabilidade (Accountability)	3/3	Shared duty among patients, doctors, and technologists.	"Responsabilidade do paciente fazer as coisas e escutar o médico, responsabilidade do médico de tratar e orientar bem, responsabilidade também da pessoa que está a fazer a tecnologia. Eu acho que cada 1 tem um papel." -D1 "A responsabilidade engloba ser responsável obviamente... ser ético, ser empático " -M2
Empatia (Empathy)	3/3	Humanizing care beyond data.	"Sabemos que neste contexto específico né de glaucoma, de uma consulta e de uma análise no caso clínico, temos sempre que ver a pessoa... Aqueles exames, aqueles

			resultados são de uma pessoa." - D2
Rigor (Rigor)	2/3	Strict adherence to standards, with critical thinking.	"Qualquer tecnologia tem que ser sensível para aquilo que foi desenhado."- T2
Adaptabilidade (Adaptability)	2/3	Flexibility to individual needs.	"Perante um exame com alterações é preciso termos o nosso sentido crítico. Se o doente tem um nervo óptico com bom aspeto ou com uma escavação mas não nos parece patológica. E a seguir temos um OCT nervo óptico com bastantes alterações, eu tenho que perceber se aquilo é do glaucoma ou não. Não é por vir um exame alterado que eu vou medicar o doente." -M2
Ética (Ethics)	2/3	Privacy, fairness, and non-discrimination	"A base de dados foi feita com uma população inteiramente caucasiana com mais de 18 anos. Portanto aquilo é muito bom para doentes brancos com 30 anos mas se nós virmos um miúdo de 17 anos estamos a comparar os valores com nada...É impossível comparar..." -M3
Verificação (Verification)	2/3	Cross-checking tech outputs with human expertise	"A questão que está em causa de facto é que há uma desconfiança em relação ao médico... Isso é derrubado através da verificação... A verificação... uma evidência que vai corroborar com a posição do médico. Não é algo que o médico acha, é algo que ele tem evidência." -F1
Humanização (Humanization)	2/3	Prioritising personhood over efficiency	"Naquele primeiro impacto é preciso considerar que é uma pessoa inteira, com uma história, com toda uma bagagem emocional atrás e que é preciso cuidar" -F3
Praticidade (Practicality)	1/3	Usability in real-world clinical settings	"Tem que ser algo prático. O artefato, a aplicação, seja o que for, tem que ser algo que seja prático senão não vai ser aderente..." -F1

Atenção (Attention)	2/3	Sustained focus on patient	"Atenção constante. Ou seja um feedback constante, um acompanhamento constante para que deixe o usuário o utente, seja médico ou paciente, atento à aquele acompanhamento." -F1
Colaboração (Collaboration)	2/3	Team-based care approach (with humans and tech)	"Essa colaboração é colaboração entre médico e paciente. São do mesmo equipe." -D1 "A própria tecnologia em si tem que colaborar com múltiplos sistemas geralmente... A colaboração também entre o sistema tecnológico e a pessoa... E até da própria autonomia de uso." -D3
Presença (Physical Presence)	2/3	Importance of in-person care	"Uma consulta virtual na oftalmologia é muito difícil...A presença física é muito importante" -M2
Controlo (Control)	1/3	Clinical oversight	"Se é suspeito temos que ter tempo para perceber se é mesmo suspeito ou não na realidade." -T2
Flexibilidade (Flexibility)	2/3	Adaptive protocols	"Nós não podemos só seguir protocolos." -M2 "O processo de não seguir sempre um fluxo restrito mas poder ser adaptável" -D3
Confiança (Trust)	3/3	Foundation of therapeutic relationship	"Esta empatia também associo muito à confiança. Na relação médico-paciente." -D2
Eficácia (Efficacy)	2/3	Achievement of intended outcomes	"Quando temos uma pessoa suspeita de uma determinada doença essa pessoa fica em stress... Então aqui é preciso ser eficaz. E a eficácia na minha experiência profissional passa pela parte de ser simpático com a pessoa... de alguma forma descansa-lo. De sermos eficazes, de pedirmos os exames necessários para esclarecer a situação, e explicar à pessoa que provavelmente a sua doença vai ter

			controlo se for feito bem, não terá problema. E se não tiver nada... melhor ainda!" -M2
Assertividade (Assertiveness)	1/3	Clear directive communication	"Ás vezes as pessoas que estão em negação precisam de um abanãozinho" -M2
Personalização (Personalisation)	2/3	Tailored care approaches	"Cada paciente é diferente e temos que ir de acordo com o que o paciente sabe ou quais os valores do paciente, e tentar explicar, estruturar de acordo com o paciente." -T2
Explicabilidade (Explainability)	2/3	Sharing understanding knowledge	"Através do meu conhecimento tentar passar ou explicar a este paciente a patologia.... Passar este conhecimento de forma efetiva, para trazer esta confiança." -D2
Partilha (Sharing)	1/3	Transparent information exchange	"Partilhar, mesmo sendo novo, com o doente como é que será esta progressão da doença ou não... mas a partilha que nesses casos fase a isso tudo, é se simpático, simpatia com o doente, explica-se, mostra-se... E depois diz vai pensar vai para casa... nas opções que temos e se quiser vá ouvir outra opinião...Partilha nesse sentido, ouvir uma segunda opinião." -M2
Dignidade (Dignity)	2/3	Respect for patient rights and autonomy	"Não podemos impingir determinados formatos às pessoas e extinguir certas formas de acesso aos cuidados. Enquanto por um lado eu vejo a necessidade de capacitar, talvez haja alguns casos em que não é possível oferecer dignamente, dar dignamente o acesso... Nem que ensinassem não tem os recursos para ter uma consulta virtual. E não podemos permitir que fique sem o acesso porque só se vai dar daquela forma. " -D3
Liberdade (Freedom)	2/3	Patient choice in care options	"É importante que o paciente perceba ou tenha, ou que lhe seja

			dado, a liberdade de escolher se quer mudar de médico, se quer consultar uma segunda opinião." - F3
Capacitação (Empowerment)	1/3	Patient self-management	"Capacitação no sentido de co-responsabilização... Há coisas que pode fazer, há coisas que estão na sua mão. A sua função é fazer as gotas sempre direitinho, que eu ou outro colega mandamos fazer, e ir às consultas... Se da sua parte fizer isso nós vamos conseguir controlar a doença. " -M3
Robustez (Robustness)	2/3	System reliability across conditions	"É importante que a tecnologia seja construída e validada... que se adapte, ou que tenha em conta diferentes anatomias, diferentes características da própria retina..." -T3 "É muito importante ter robustez ao longo do tempo. Se tivermos a pensar num propósito de utilização da tecnologia num cenário temos que saber muito bem qual é esse cenário... É preciso ver muitos doentes, ter diferente situações... e depois também saber as limitações onde a tecnologia não é robusta e caracterizá-la com transparência..." -T3
Supervisão (Supervision)	2/3	Human oversight of technology	"É preciso sempre ver, verificar os resultados que dá." -D3
Precisão (Accuracy)	2/3	Diagnostic/technical accuracy	"Tendo em conta o doente o paciente, eu primeiro privilegiei a accuracy, a precisão no diagnóstico" -D2
Sensibilidade (Sensitivity)	2/3	Responsiveness to contextual needs	"Qualquer tecnologia tem que ser sensível para aquilo que foi desenhado." -T2
Compreensão (Understanding)	1/3	Mutual clinical alignment.	“Eu coloquei compreensão e atenção no sentido de um reforço da atenção.” -F2

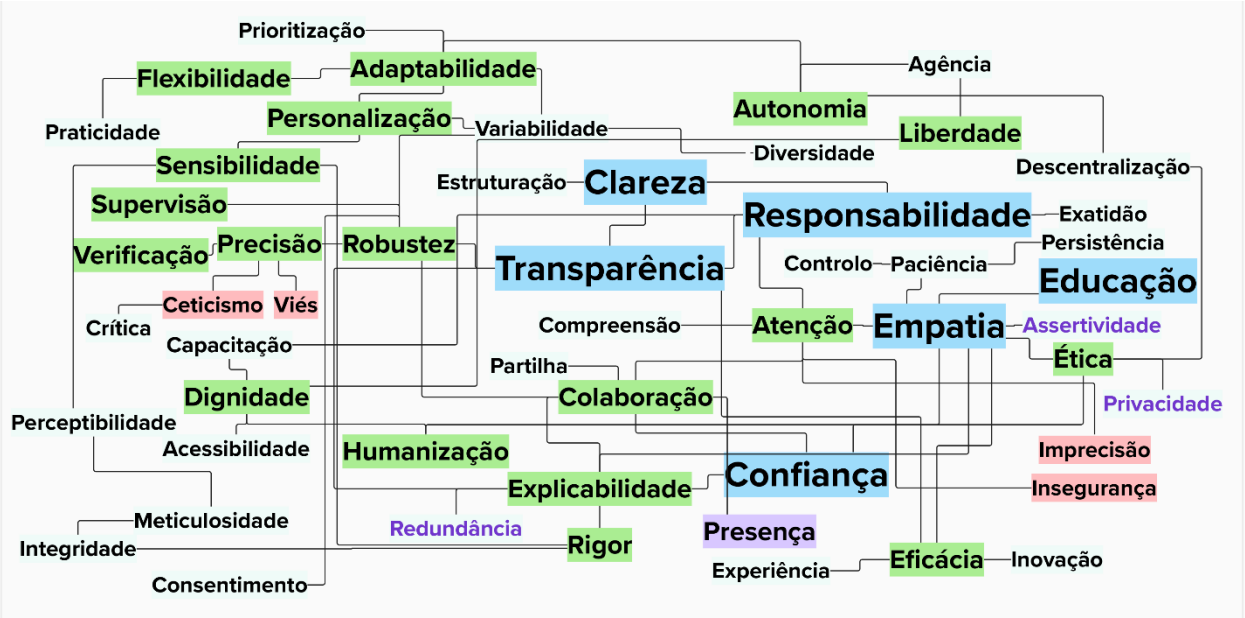
Perceptibilidade (Perceptibility)	1/3	Clear system feedback	"Temos de ter percepção do que a tecnologia nos pode dar. Não é para fazer um diagnóstico a sério, é só para ter uma percepção como é que é o paciente, como é que se comporta...É preciso essa perceptibilidade quando usamos o zoom." -T2
Educação (Education)	3/3	Knowledge transfer between health care professional and patient	"Coloquei esta carta no sentido de trazermos estas limitações destes contextos para os intervenientes, para os atores, para as pessoas, tanto para o paciente como para o médico... Tem que ser mas existem estas limitações e não podemos decidir, não podemos tomar decisões porque estamos constrangidos, limitados a este meio que nos separa." -D2
Meticulosidade (Meticulousness)	1/3	Thorough data collection	""Tem alguém com glaucoma na família?" "Não" "E tem alguém cego?" "Ah sim a minha avó era cega de um olho, o meu tio era cego dos dois olhos". Provavelmente era glaucoma." -M3
Variabilidade (Variability)	1/3	Accommodating differences	“Não podemos medicar nem fazer diagnósticos por exames. Tem que haver uma complementariedade e nós devemos ter sempre sentido crítico, mesmo nos exames que são exatos... Temos que ver outras situações e aí é que tenho algum receio das máquinas. Que não entendam que lhes apareça por exemplo um OCT nervo óptico completamente alterado e é um doente que tem um nervo óptico oblíquo... Ou seja sai do normograma do aparelho.” -M2
Diversidade (Diversity)	1/3	Inclusion of varied populations/approaches	“Diversidade tanto embarca a parte humana como os cuidados clínicos... como por outro lado diversidade nos métodos em si." -D3
Integridade (Integrity)	1/3	Ethical consistency	"Às vezes aqui tomamos por garantido e supomos que partimos

			desta base que ninguém vai ser discriminado e que vai ser aplicado aquela meticulosidade para ter o cuidado de recolher todos os dados para obter uma decisão clínica o mais rigorosa possível. Mas acho que se pensarmos de raiz e isto não estivesse assegurado, seria para mim das coisas fundamentais... " -D3
Consentimento (Consent)	1/3	Informed permission	"Parte de uma tecnologia ser robusta é assumir que não vai funcionar para todo o caso. E o consentimento funciona para os dois lados. não só para o paciente dizer "eu não quero usar a tecnologia, quero exames tradicionais" e para o próprio médico que se pode sentir mais ao menos seguro a utilizar aquela outra tecnologia." -F3
Redundância (Redundancy)	1/3	Multiple communication methods and persistent information sharing	"Na passagem de informação, se conseguir passar esta informação de formas diferentes até que o paciente entenda" -F3
Privacidade (Privacy)	1/3	Data protection and confidentiality	"Ter em atenção a privacidade dos dados..."
Experiência (Experience)	1/3	Cumulative practice wisdom,	"É uma coisa que se ganha com o tempo e que faz muita diferença no contacto com as pessoas... Para que as consultas virtuais fluam e que consigamos os objetivos que temos para cada uma das consultas é importante tanto a experiência do médico como do paciente nesse tipo de ambientes." -F3
Inovação (Innovation)	1/3	Progressive solutions	"A inovação de facto pode trazer maior eficácia" -T3
Viés (Bias)	1/3	Systemic limitations	"Alguns destes viés na aplicabilidade dos exames a cada

			doente só conseguimos identificá-los logo no início... Alguns deles só os conseguimos identificar logo no início, e vão nos poupar muito tempo, e vão nos eliminar logo vias erradas de seguimento dos doentes outros não. Outros não conseguimos perceber, só conseguimos perceber com o tempo." -M3
Ceticismo (Skepticism)	1/3	Critical evaluation	"Há um resultado ali que parece positivo mas é preciso ficar um pouco cético em relação aquilo para questionar de que forma a pessoa está a evoluir... É uma certa atenção aos resultados, ao que se está a ver e ter a capacidade de questioná-los." -D3
Agência (Agency)	1/3	Patient self-determination	"Que o próprio paciente seja agente da sua, responsável pela sua saúde. E que o perceba que o é." -D3
Descentralização (Descentralization)	1/3	Distributed data systems	"Muitas vezes é uma barreira a considerar. É essencial contar com este valor" -T3
Acessibilidade (Accessibility)	1/3	Equitable access	"Nós temos que lutar para que toda a gente tenha o mesmo nível de acesso atempadamente a cuidados de saúde de alto nível" -M3

The image below presents a visual mapping of the values identified during the workshops and their relations, highlighting how they interconnect to form a broader network where each value relates to others in multiple ways.

Table 5 - Visual representation of values and value relationships.



The visual representation of values highlights the richness and complexity of participants' perceptions throughout the workshops. The blue-colored values emerged consistently across all sessions, reinforcing their centrality and universal importance. The green values appeared in two out of the three workshops, indicating their relevance while suggesting that their significance vary depending on the context or participants' perspectives. The remaining values, mentioned only once, reflected enriched viewpoints and nuances that were part of the discussion. The purple-colored values represent contributions made directly by participants, and the red-colored values serve as critical counterpoints, highlighting the challenges and potential issues that may arise from the excessive or unbalanced application of other values.

The interconnection between all values formed a network where each concept influences and is influenced by multiple others. Many of these connections occur in different ways, depending on the perspective from which they are analysed. Additionally, some values function as synonyms or closely related concepts, such as Flexibility-Adaptability, Perceptibility-Sensitivity, Explainability-Comprehension and Autonomy-Agency, suggesting that in some cases, the distinction lies more in their application than in their meaning.

Another notable observation is how certain values encompass broader meanings or multiple interpretations. To illustrate this, we will focus specifically on the values that were present in all workshops (blue ones), as these offer strong evidence of interconnectedness. These connections between values were made based on explicit mentions by participants during the workshop, with relationships drawn based on what they said in the workshop. While additional links could exist in a broader conceptual analysis, the ones considered here are those established by participants within the given scenarios and exercises.

Clarity was associated with the structuring of dialogue, the transparency of communication, and the responsibility of the communicator. Although not explicitly connected in the visual map, it was also recognised as a synonym for comprehension and explainability. Similarly, **transparency** was directly linked to clarity, responsibility, and explainability, reinforcing its role in fostering open and structured interactions.

Trust emerged as a highly interconnected value, with direct links to explainability, empathy, and collaboration, highlighting its foundational role in effective communication and cooperation. **Empathy**, in turn, was mentioned in relation to assertiveness in dialogue, ethics, efficacy, explainability, trust, attention, patience, and education, demonstrating its broad impact on various dimensions of interaction.

2.2. Examination of participants final value choice and decision-making processes.

At the end of each workshop, participants were asked to select one fundamental value they considered indispensable throughout the entire journey. This exercise aimed to underscore the importance of a value, whether one that had already been introduced during the workshop or one that, despite not being previously mentioned, emerged as equally significant to the participant.

Within the first group, three fundamental values were selected, in the second group, four values were identified and in the third, five values emerged. In total, this process resulted in ten key values: Attention, Autonomy, Responsibility (chosen twice), Empathy, Ethics, Personalisation (chosen twice), Humanisation, Diversity, Robustness, and Persistence.

Based on an analysis of their meanings and relationships, we grouped these values into three clusters:

- **Responsibility:** This cluster includes values that emphasise the need for both technology and healthcare professionals to act with accountability, ethical considerations, and structural reliability. *Responsibility, Robustness, and Ethics* fall into this category, as they highlight the importance of clear communication, validation, and ethical decision-making in the integration of technology in healthcare and medical care.
- **Inclusion**: This group shows the importance of ensuring that all patients are actively included in their treatment journey, not only by integrating technology as a tool for engagement rather than exclusion but also by recognising the critical role of medical professionals in fostering an inclusive and attentive care experience. *Empathy*, *Attention*, and *Persistence* emphasised the need for continuous support, personalised interaction, and recognition of each patient's unique experience.
- **Humanisation**: The third cluster highlights the importance of maintaining a human-centered approach in healthcare, ensuring that technology adapts to the needs of individuals rather than the other way around. *Personalisation*, *Diversity*, *Autonomy*, and *Humanisation* are grouped here, reinforcing the idea that medical interactions should respect patient differences, promote empowerment, and maintain a personal, adaptable approach.

2.3. Analysis between different stakeholder's value choices and patterns

Our cross-stakeholder analysis revealed distinct value preference patterns among professional groups:

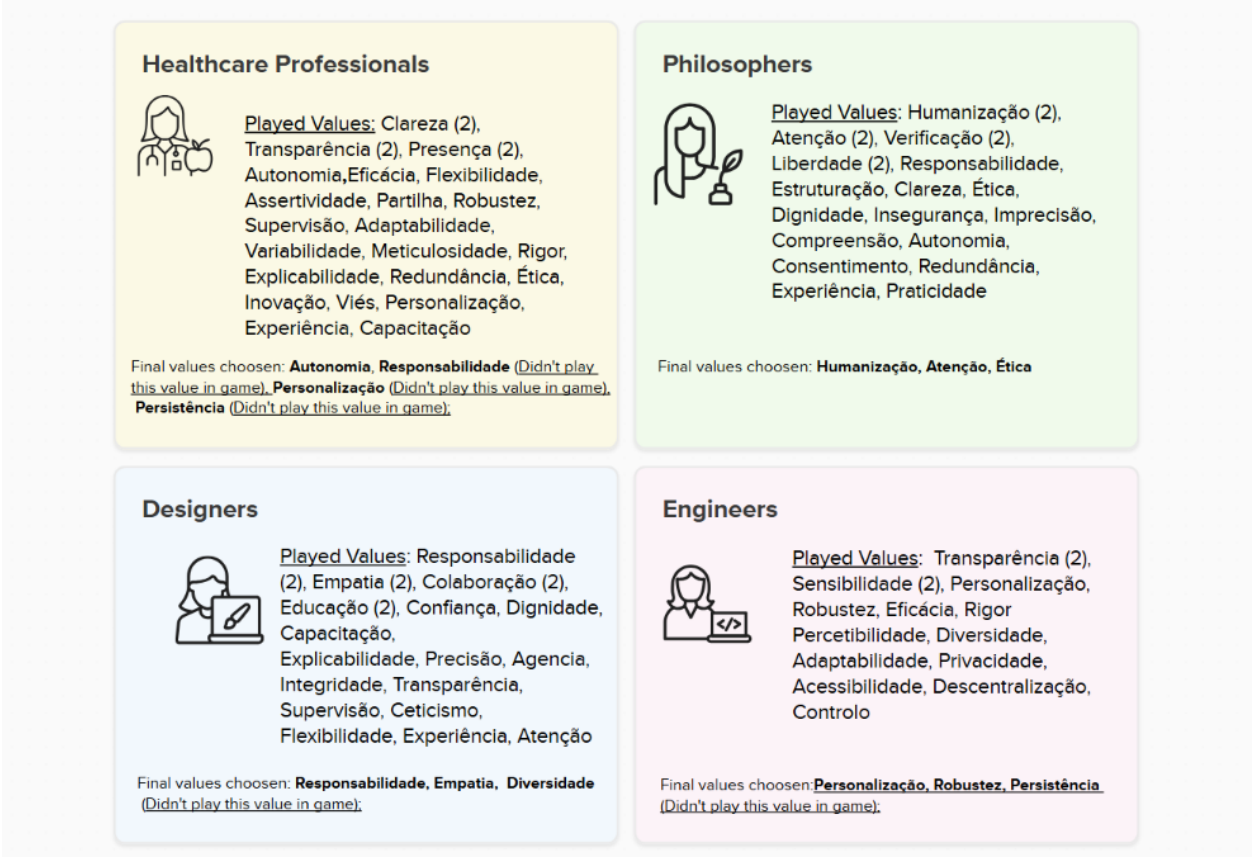


Figure 2 - Value choices according to participant profile.

Healthcare Professionals demonstrated strong alignment with operational and clinical values, prominently selecting Clarity (2), Transparency (2), and Presence (2). Their gameplay emphasised Autonomy, Effective, Flexibility and others, reflecting patient care priorities. Notably, the final selection of values choosen where Autonomy, Responsability, Personalisation and Persistency.

Philosophers consistently prioritised humanistic values with Humanisation (2), Attention (2), and Liberty (2) appearing most frequently. Their selections of Ethics and Dignity during brainstorming sessions carried through to gameplay, underscoring their focus on moral dimensions. The use of 'negative values' like Insecurity and Imprecision uniquely highlighted their comfort with ambiguity. Their final selection of values included Humanisation, Attention and Ethics.

Designers exhibited a strong orientation toward relational values, prominently playing Empathy (2), Colaboration (2) and Education (2). Some choices reflected user-centered priorities such as trust, education, dignity, transparency and more. Notably, the final selection of values choosen where Responsability, Empathy and Diversity.

Engineers prioritised values balancing technical precision with human considerations. Their most frequently played values were Transparency (2) and Sensibility (2), reflecting dual commitments to system clarity and user awareness. Technical robustness emerged as a core theme through selections of Robustness, Rigor, and Control, while Personalisation and Acessibility demonstrated user-centered thinking. Notably, they operationalized abstract

concepts like Perceptibility and Descentralization revealed their systems architecture perspective.

Findings:

- Clinicians and engineers shared emphasis on *Personalização* but interpreted it differently (clinical customisation vs. technical personalisation)
- Philosophers uniquely played antonym values (*Insegurança*, *Imprecisão*) as deliberate provocations
- Designers were the only group to prioritise *Empatia* as both self-identification and frequent play
- All groups eventually converged on some form of *Responsabilidade* (explicit or implicit) in final selections
- Final deliberations surfaced unplayed priorities (*Persistência* for engineers, *Diversidade* for designers), proving reflection uncovers deeper stakes.
- Presence of values duality like for example personalisation: Customised care (health care professionals), Customised systems (engineers), Customised experiences (Designers)

Final implication: While stakeholder lenses differ—health care professionals on precision, philosophers on ethics, designers on experience, engineers on reliability—their overlap on Responsability and adaptive values (Personalisation, Adaptability) suggests a shared foundation for interdisciplinary collaboration in healthcare flows.

2.4. Thematic categorisation of values (human-centric vs technology-related)

Figure 3 - Example of thematic categorisation fo values.

Values associated with technology

Starting with technology, the following values were played during the workshop: Practicality, Autonomy, Responsibility, Presence, Precision, Rigor, Transparency, Sensitivity, Ethics, Supervision, Robustness, Dignity, Freedom, Verification, Adaptability, Consent, Explainability,

Collaboration, Effectiveness, Comprehension, Attention, Perceptibility, Education, Insecurity, Imprecision, Empowerment, Innovation, Decentralization, Accessibility, and Experience.

From this list, we could conclude that **technology must be** precise, rigorous, transparent, sensitive, robust, verifiable, adaptable, effective, responsible, explainable, perceptible, accessible, and innovative.

In relation to people, technology must provide practicality, autonomy, presence, ethics, supervision, dignity, freedom, consent, collaboration, comprehension, attention, education, experience, and empowerment.

However, **the wrong use of technology can lead to** insecurity, imprecision, and decentralization.

Values associated with health care professionals

When analysing the values that emerged from common treatment scenarios for glaucoma, the following were identified: Empathy, Patience, Rigor, Attention, Responsibility, Effectiveness, Trust, Control, Flexibility, Adaptability, Variability, Personalisation, Verification, Integrity, Humanization, Diversity, Meticulousness, Redundancy, Bias, Skepticism, Sensitivity, Precision, and Experience.

Values that appeared in challenging moments with patients included Clarity, Transparency, Verification, Collaboration, Attention, Trust, Empathy, Effectiveness, Sharing, Explainability, Personalisation, Structuring, Assertiveness, Freedom, Education, Ethics, Privacy, Responsibility, Agency, and Empowerment.

Based on this we could conclude that **Healthcare professionals (HCPs) need to be** patient, clear, transparent, attentive, trustworthy, empathetic, assertive, ethical, respectful of privacy, responsible, and possess integrity at all times.

The required **skills for HCPs** include verification, effectiveness, experience, rigor, precision, sensitivity, and meticulousness.

Key considerations in their practice include adaptability, variability, personalisation, diversity, humanisation, redundancy, bias, and skepticism.

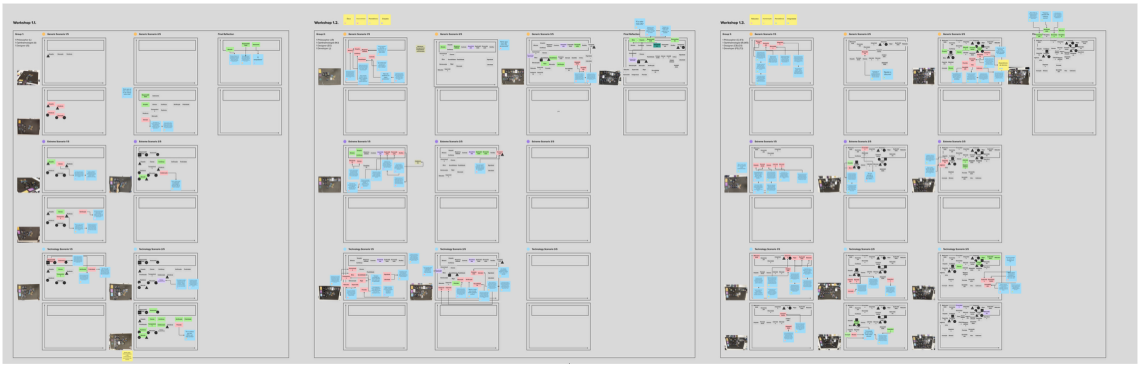
In moments of challenges, HCPs need to maintain clarity, transparency, attention, trust, empathy, assertiveness, ethics, privacy, responsibility, and explainability to their patients.

The **required skills during these moments** include verification and effectiveness, while key considerations involve personalisation and structuring.

In moments of challenge, they have to **remind patients that they have the right to** agency, freedom, sharing, responsibility, empowerment, education, and collaboration.

Common values

Neither the less, some values were used in common to both dimensions, such as Responsibility, Transparency, Verification, Effectiveness, Attention, and Ethics.



Annex 1: Interview script with Ophthalmologists

Good [morning/afternoon], Doctor. My name is Y, and I am a researcher here at Fraunhofer Portugal AICOS. This is my colleague X.

We would like to thank you for taking the time to participate in this interview.

Our project is called Signo. It is a research initiative that brings together researchers in design and philosophy, along with patients and healthcare professionals in the field of ophthalmology, to co-create and test technologies and data visualisations built around a shared set of values, and to understand how these values are communicated.

Today, we are focusing on one particular aspect of your field: the diagnosis of glaucoma. Our goal is to gain a deeper understanding of the challenges and complexities you face in this process.

Introductory Questions:

1. Could you tell us about your professional background (how long you have been working as an ophthalmologist, and with glaucoma in particular)?
2. Where do you currently practise?
3. Do you have a private clinic?

Glaucoma Assessment and Patient Education:

4. Could you briefly explain the glaucoma diagnosis process?
5. In your opinion, what are the biggest challenges in diagnosing glaucoma? And in its treatment?
6. Do you usually follow a specific protocol when diagnosing glaucoma, or do you rely more on your clinical experience?
7. Have you ever encountered cases where test results revealed unexpected findings or led to a reassessment of your initial diagnostic impressions? If so, could you give an example?
8. Which moments in your practice do you enjoy the most?

The Patient:

9. What aspects of your interaction with patients do you value the most?
10. What are the most challenging moments in dealing with patients?
11. Do you have any strategies or good practices for sharing a patient's situation or diagnosis?
12. What are the key pieces of information or strategies you use to educate glaucoma patients?
13. In your experience, what most motivates patients to adhere to the recommended treatment? How do you help foster that adherence?
14. How do you deal with patients who are resistant to following treatment?
15. How do you balance glaucoma diagnosis and treatment with other difficulties the patient may be facing?

Visualisation Preferences:

16. How do you usually monitor disease progression over time?
17. How confident are you in the accuracy of imaging tests in capturing and representing glaucoma?
18. How do you balance the information provided by imaging tests with other clinical findings and symptoms reported by the patient in your diagnostic process?

Collaboration with Others:

19. In your practice, do you feel the need to share patient results with colleagues — perhaps in doubtful cases or when referring to other professionals due to a possible alternative diagnosis?
20. What kind of data summaries do you usually share when communicating findings related to glaucoma? Do you share imaging exams?

Challenges, Innovations, and Stakeholder Considerations in Glaucoma Visualisations:

21. In your experience, what are some challenges or limitations associated with current glaucoma diagnostic techniques?
22. Are there any emerging technologies or advances in glaucoma detection that you find promising and have integrated into your practice?

AI for Glaucoma:

23. Have you come across artificial intelligence or machine learning tools to assist in glaucoma diagnosis? If so, could you describe how they were implemented in your practice?
24. Are there specific aspects of glaucoma diagnosis or management where you believe AI could be beneficial?
25. What level of interpretability or explainability would you require from AI-generated diagnoses?
26. What specific features or capabilities would AI need to have for you to trust its recommendations or interpretations in glaucoma diagnosis?
27. Would you feel comfortable integrating such tools into your decision-making process?
28. What role do you see for human oversight or validation when using AI in glaucoma diagnosis?

Trust, Ethics, Transparency, Interpretability, and Patient Acceptance in AI:

29. How do you foresee patient acceptance and trust in AI-generated diagnostic recommendations influencing your willingness to incorporate AI in your practice for glaucoma diagnosis?

Final Question:

30. Is there anything else you would like to add?

Annex 2: Interview analysis conducted on mural board