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# Low vision users in graphical user interface interaction:

Examining the effects of visual perception parameters on quality of experience through a display style proposal.

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Abstract: Interaction design is the act of designing the dialogue between people and systems, services or products. User interface (UI) facilitates sensory and emotional interactions by acting as a bridge between users and products while graphical user interface (GUI) refers to graphical or visual presentations of information The accessibility of GUIs directly impacts the quality of experience (QoE) since the sense of sight plays a pivotal role especially for low vision users throughout the interaction process. Though low vision users can use GUIs on their own, they often face challenges that hinder their QoE. Although existing research has explored accessible UI design principles, studies specifically addressing the accessibility issues of low vision users in GUI interactions remain limited. The goal of this research is to evaluate the effects of visual perception differences between people with low and normal vision on home appliances' GUI interactions and discuss how these differences affect the QoE of low vision users. To this end, we created a total of 12 washing machine GUI cases based on the GUI model of the best-selling washing machine in Turkey in 2021 and tested these cases online with two groups of 7 participants each with low vision and normal vision. The results infer that low vision participants have accessibility issues on GUIs in terms of colour contrasts, text sizes, display options and control panel distances. The study suggests that using an uppercase larger font (22pt) for just the first syllable of the text in text-based displays can improve accessibility of GUIs for low vision users compared to using the same font size (16pt) in sentence case for all text. Overall, this study contributes to a better understanding of the challenges faced by low vision users in GUI interactions and offers practical recommendations for creating more accessible GUIs through a display style proposal.[1]

## 1. Introduction

The evolution of technology has led to a significant change in traditional physical consumer products, resulting in innovative visual, auditory and kinaesthetic product interactions that improve the quality of life. These innovations, adding more functions and features to the

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[1] This study is a part of the thesis entitled "Investigation of visual perception parameters in the interface interactions of low vision users on home electronics products" submitted to Gazi University Graduate School of Natural and Applied Sciences to fulfil the degree of PhD in industrial design.

consumer products to meet the needs of a wider range of users, inevitably reveal increased complexity with a reduced accessible use (Lee, 2021).

Home appliances, having an important role for people to meet their basic needs and live independently (Lee et al., 2019), are considered as consumer products where disabled individuals have accessibility problems (Lee, 2021). World Health Organization (WHO, 2011) estimates that over one billion people fall into disability category who are alien to use these products. Meanwhile, a pilot interview with a visually impaired teacher in a secondary school for the visually impaired revealed significant challenges in accessibility of home appliances for low vision individuals, especially during the pandemic. The interview results emphasized the increased reliance on home appliances without assistance due to social distancing measures. Although visually impaired users can operate these devices independently, quality of their use experience is often inadequate, especially for products with various analogue and digital interaction elements, such as washing machines. These findings also coincide with the experiences of one of the researchers of this study, a product designer with ten percent vision. According to the researcher's own experiences, accessibility issues of low vision users when interacting with home appliances can lead to, if not psychological problems, at least loss of time or extra physical effort; that is, a loss of users' product experience quality. In fact, the problem is that, people with low vision are highly dependent to visual information even if the information is not clear to them (Lee, 2021).

Interaction design is the core area for the accessibility of any manmade artefact. It is defined as creating physical and emotional interactions between a person and a product, system, or service. (Kolko, 2010; Morshedzadeh, Ono, & Watanabe, 2016). It is the act of crafting user experience (UX) that enhances and expands the ways people interact, communicate, and work (Preece, Sharp & Rogers, 2015). UX covers all aspects of user-product interaction, including product's usability, physical feel, emotional impact, functionality, and contextual relevance (Alben, 1996). It is a subjective and often implicit synthesis of personal factors such as interest, effort, satisfaction, desire, cognition and perception, as well as design domains like purpose, method, function, form and structure. The engagement and success of all these aspects represent the users' quality of experience (QoE) (Alben, 1996) throughout the interaction process.

User interface (UI) refers to the bridges where users access to and interact with designs. A UI is evaluated within three areas: physical UI (PUI), logical UI (LUI) and graphical UI (GUI) (Jin & Ji, 2010; Lee, Jin & Ji, 2011; Mendez & Mendoza, 2013). A PUI represents the interaction tools by which a user executes a task physically. The interface concerning the information-specific contents and structures refers to LUI. Finally, a GUI is the interface which covers the presentation of information by visual or graphical items.

Vanderheiden and Vanderheiden (1992) examines UI accessibility in five main groups: Display elements, control elements, manipulations, documentation and safety. Display elements represent devices that convey information to the user while control elements are the tools that enable interaction between user and machine. A GUI can act as both a control and display element at the same time.

Although existing research has developed standards and guidelines that can increase the potential of home appliances' GUIs to be more accessible to everyone, they are limited in several ways. For instance, accessibility standards for disabled people by Americans with Disabilities Act (ADA) (US Department of Justice, 2010) are limited to mobility of wheel chaired population. In addition, most ISO standards except for ISO 22411 and ISO 9241-20 omits elderly people and

many of them such as ISO 9241-20, ISO TR 29138-1, and ISO TS 16071 address web and software-based accessibility issues (Lee et al., 2021).

Designing "for those with specific needs" (Pullin, 2009) requires empathy and it can lead to misconceptions driven by misinterpretation of those users' experiences when empathy lacks Goodman, Langdon, & Clarkson, 2007; Lee et al., 2021; Segelström, 2009). Because not all stakeholders who design and produce GUIs have the pre-built empathy ability to apply the given standards (Lee et al., 2021).

In fact, studies about the accessibility of GUIs mostly focus on web and software-based contexts because GUIs have a vital role in human-computer interaction (HCI) especially for bridging the information output and user input visually. However, there are several authors outline basic and shared principles for universal accessibility of display and control elements of products. For instance, Vanderheiden and Vanderheiden (1992) suggest that all important visual information should be conveyed via the auditory and/or tactile senses and sequential tasks should be minimized or there should be clear cues about the order. Displays with values that must be observed together should be in the same horizontal or vertical alignment (Cushman and Rosenberg, 1991; Pheasant and Haslegrave, 2005). Moreover, controls must be operable with minimum force, speed, and accuracy and must be designed with the needs of the lowest-capacity user in mind (Cushman and Rosenberg, 1991; Damon, Stoudt, and McFarland, 1966; Vanderheiden and Vanderheiden, 1992). For simplicity, the number of control elements should be as few as possible (Cushman and Rosenberg, 1991; Damon et al., 1966; Vanderheiden and Vanderheiden, 1992). No complex or unnecessary operations should be required to operate the machine (Bridger, 1995). However, these studies are too general for improved accessibility of GUIs and mostly lack of low vision user-specific guides.

The aim of this study is to uncover datasets associated with QoE of low vision users in home appliances' GUI interactions. To this end, we determined the GUI of the best-selling washing machine in Turkey in 2021 as the case to analyse the effects of various display options on QoE of low vision users. First, we modelled a 1/1 scale copy of the light backgrounded version of this GUI as a vector. Then, based on this model, we modelled two different alternatives that included the display features frequently encountered in other washing machine GUIs on the market. Finally, we modelled a new GUI proposal that we developed based on the experiences of one of the authors, the low vision designer. We determined the dial indicators as the basic variable in all these four GUI cases. In order to test colour variables of dial indicators, by taking the sample GUI colours as reference, we created a dark backgrounded copy for each case. In addition, we developed two more alternative dials to test the dial types. We created a total of four cases by producing an alternative for each of these dials, again based on the colours of the sample GUI. As a result, we subjected these 12 cases to an online simulation test with seven low vision and seven normal vision participants. We recorded the task completion times in seconds and errors made by each participant, where they completed a total of 72 tasks. We also tried to reach qualitative data by conducting semi-structured open-ended short interviews with each participant at the end of the simulation test. We analysed the factors affecting the QoE of low vision participants in washing machine GUIs by examining both the qualitative and quantitative data together. The current research is of modern importance and relevance as it contributes to a better understanding of the challenges faced by low vision users interacting with washing machine GUIs and offers practical recommendations for creating more inclusive and accessible UIs.

## 2. Visual perception and visual impairment

Visual impairment term is used to describe all kinds of sight loss which covers moderate sight loss, severe sight loss and blindness (Sardegna & Shelly, 2002). When researching with visually impaired users, it is important to recognize and understand the level of the impairment. This includes determining whether a particular user is completely blind, functionally-blind or partially-sighted (Jacko & Sears, 1998).

WHO (2004) defines visually-impaired people as those with low vision, and blindness with less than 6/18, but 3/60 or more or a corresponding loss of vision. This can correspond to more than 20 degrees of divergence with the best possible eye. Completely-blind people have no light perception or usable vision. People who are functionally-blind can perceive light, but any vision-enhancing device (optical aids such as binoculars, magnifiers, and telescopes) can give them more vision. Partially-sighted people have some useful vision features and can use visual enhancement techniques and devices to function alike fully-sighted people (Kraut & McCabe, 1994).

An assessment of the visual limitations includes a baseline data for visual acuity, contrast sensitivity, field of view and colour perception (Jacko et al., 1999). Visual acuity refers to a person's ability to resolve the fine spatial details (Kline & Schieber, 1985) from both close and far locations (Dini et al., 2007). Contrast sensitivity tests a person's ability to perceive the pattern stimuli at low to moderate contrast levels. It is the capacity to detect the differences between the adjacent elements (Dini et al., 2007, p. 16). Contrast sensitivity function represents the spatial discrimination capabilities of the visual channels in a comprehensive manner (Wood & Troutbeck, 1994). Useful field of view is the total area where an effective vision is maintained based on the fixed straight edge fixation point (Kline & Schieber, 1985). The size of the field of view is the size of the space that can be embraced at a glance (Dini et al., 2007). A person's ability to distinguish and define the colours is called colour vision (Dini et al., 2007). Additionally, light sensitivity is the eye reaction to light and light changes (Dini et al., 2007).

The ability to perceive depth, known as stereopsis and binocularity, is achieved by utilising the variations in the viewing angles of the eyes (Dini et al., 2007). By combining visual information from both eyes, tasks such as accurately judging distances, grasping objects with precision, and gaining a more comprehensive understanding of the visual world can be carried out (Dini et al., 2007). The term motility refers to the ability of the eyes to make coordinated and continuous movements (Corn, 1983). It encompasses the regulation and synchronisation of eye movements, enabling individuals to track moving objects, shift their focus between different points, and sustain stable and synchronised motions. Impaired motility can result in challenges when engaging in tasks that necessitate precise eye movements and coordination.

## 3. Methods

The research was conducted based on the analyses of both qualitative and quantitative data obtained from seven low vision participants with a visual acuity of 0,10-0,40 and were able to use their personal computers and another seven with normal vision (*see* Appendices). Four of normal vision participants were industrial designers by whom we could get professional suggestions on GUI test cases. We developed an online simulation platform to test the visual qualities of various washing machine GUIs. We created 12 distinct cases by modelling the GUI of a bestselling brand's washing machine in Turkey in 2021. The tests were carried out between 12th and 30th January 2022 via an online meeting software that allows screen sharing.

*Figure 1. Sample UI Model*
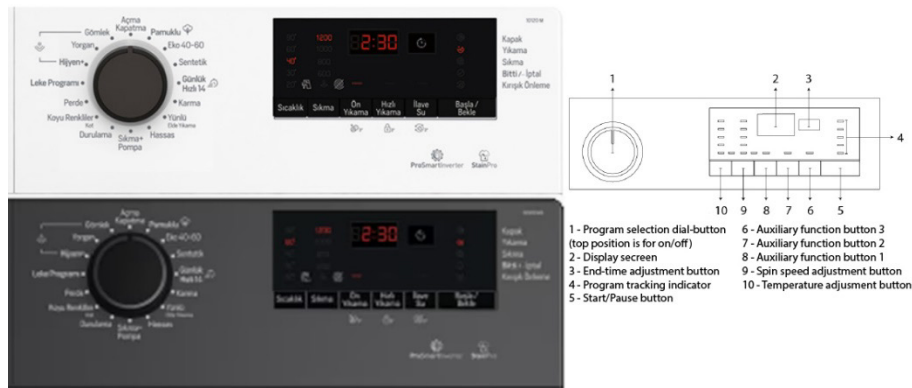


## 3.1. Design of GUI Cases

First, we defined top five brands that have the largest market shares of the Turkish white goods' sector based on the 2019 report by Euromonitor (Özden, Seheri, & Ersan, 2019). Then we obtained best-selling washing machine models of these top five companies in 2021 from two well-known price comparison websites in Turkey. Notably, all these five models share a similar type of UI, featuring a black digital display with a program selection dial on the left and other button adjustments on the right. For the purpose of this study, we defined the GUI shown Figure 1 for testing, given that this brand holds the highest market share.

The current GUI models available in the market are presented in the form of dial options, where symbols, texts, and combinations of both are displayed in various sequences and graphic formats. In the provided GUI sample, the display formats for the screen and the options controlled by the buttons primarily rely on textual information. Consequently, the dial GUI offers greater potential for creating diverse graphic display formats compared to the right panel. Hence, it was deemed suitable to experiment with different representations of the dial options in regards to the research goals.

During the design phase, we modelled the 1/1 scale of the sample GUI in vectors. Accordingly, the preferred font used in the sample GUI was determined as *Helvetica Neue LT Pro Lt* with 16-point size. In addition, the sample GUI icons exhibited varying dimensions, with a minimum size of 6x6 mm and a maximum length of 6.5 mm.

We developed four distinct GUIs those which included the sample GUI model (C1), two design adaptations tailored to specific functionalities (C3, C6), and a design proposal (C5) based on the experiences of low vision designer-researcher of this study. In addition to the original version which featured a light background, we created an identical set of the four GUIs with a dark background (C2, C4, C7, C8) (see Figure 2). Hence we should evaluate the impact of these two variables on the characteristics of the dial colours. The location of the dial indicators was varied in each GUI to prevent participants from habituating to the indicator locations.

In cases C1 and C2, we matched all GUI attributes exactly with the sample GUI. However, in C3, C4, C6 and C7, we produced variables by preserving the sample GUI's icon sizes, font and text size. Of these, we obtained cases C4 and C6 by adhering to a popular format frequently encountered in the market. We determined the icons in C3 and C7 through our research on washing machine program icons.

Figure 2. Dial indicator test cases
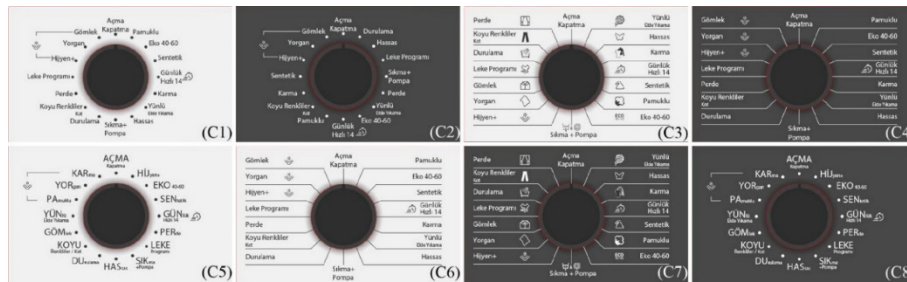


Text size is one of the most common problems faced by low vision users. Drummond et al. (2004) conducted a study where they tested unmodified *Arial* font samples of various sizes with 180 participants. They found that using a font size of 16 points is preferable for users with a visual acuity of 6/24, 18 points for those with 6/36, and 22 points for individuals with 6/60 visual acuity. The sample GUI utilized a 16-point H*elvetica Neue LT Pro Lt* font, which addressed some of these situations but may still pose accessibility challenges in other cases. To address this, we developed a different display model based on the empathy of one of the researchers, a professional visually impaired designer. In this design proposal seen in cases C5 and C8 in Figure 2, the first or first two syllables of the display text that may evoke the target task, or the entire text in cases where there is enough space to position the text, were displayed in a 22-point font and capital letters, and the syllable(s) following these situations, if any, were displayed in a 11-point font and lowercase letters.

To determine the correlation between the dial colour and the background colour, we conducted an investigation using the GUI of the sample models (C1 and C2). As part of the test, we designed a dial in a lighter shade, as shown in Figure 3 (C9 and C10).

Figure 3. Dial type test cases
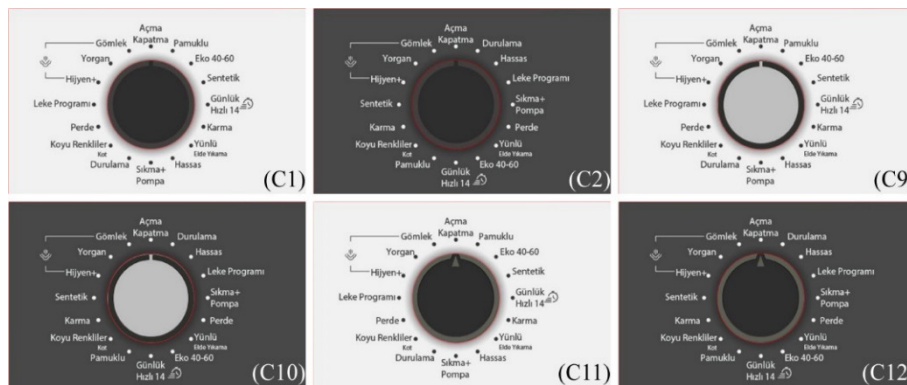


The dial of the GUI sample is a dark-coloured model where its marker should have two-dimensional clarity problems due to the colour contrast. Although the dial of sample GUI had a tactile depth, it should be difficult for low vision users to perceive it from afar. To assess this situation, we added a dial with a light-coloured arrow marker to the simulation (*see* Figure 3; C11 and C12).

## 3.2. Simulation test procedures

Prior to conducting the tests, we subjected the GUI to a preliminary test to familiarize the participants with the simulation platform (*see* Figure 4). At this stage we used a null GUI that have number indicators rather than washing programs. Additionally, each participant was asked to adjust the width of the GUI they saw on the internet browser screen to 40 cm (1/1 scale of the

sample model width) using the browser's zoom feature and a ruler. To maintain accuracy, we monitored the width adjustments of the participant GUIs displayed on our monitors simultaneously with the participants. We informed the participants when these dimensions reached the fixed width of the participant GUI width we determined before the test on our own monitor, so that each participant tested GUIs with the same width. Hence, we compensated for differences in participants' screen resolutions by preparing the GUI simulations in jpeg format that is fixed to the same width. Differences in contrast and colour settings on the participants' monitors were ignored, assuming that the participants perceived them best on their own computers. This was additionally sufficient for us to have each participant test each case using the same monitor settings. Following this phase, under the guidance of the researcher, the participants were randomly assigned tasks to perform on the null GUI.

*Figure 4. Simulation GUI: (a) null GUI, (b) active buttons and their displays*
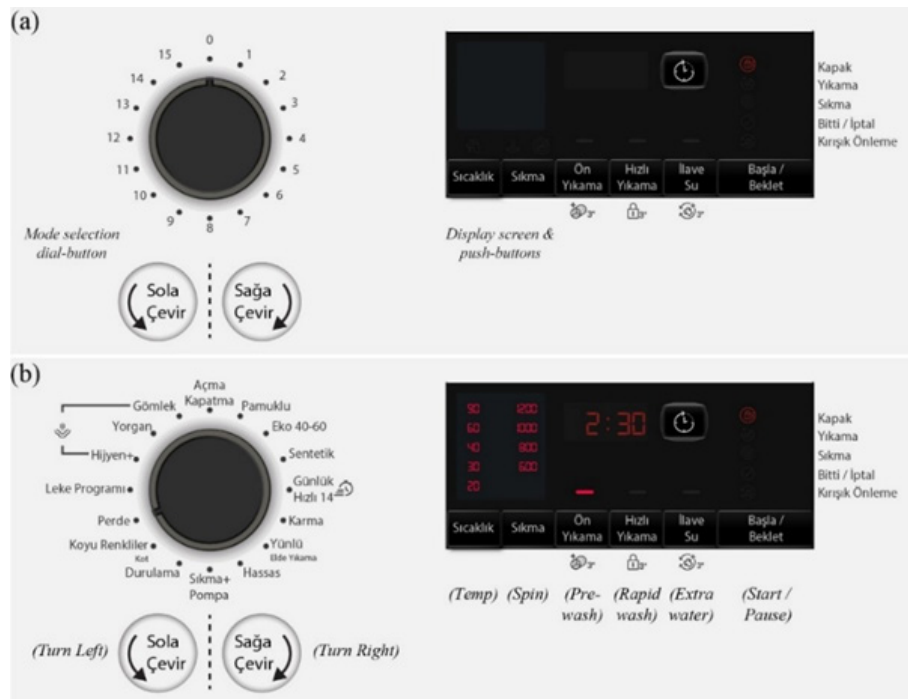


All the buttons located on the right control panel of the test simulation screen were configured to be active. The purpose of the tasks associated with temperature settings, spin preferences, and pre-wash status was to divert the participants' attention towards the right control panel, thereby preventing them from becoming acquainted with the dial indicators. We aimed to assess the participants' level of awareness regarding the dial task they were engaged in by this approach. Moreover, we recorded the number of clicks performed during button tasks to evaluate the participants' proficiency in completing the assigned task. Furthermore, in these supplementary tasks, we enabled all the values within all programs to prevent participants from detecting their errors in the program-related tasks since in reality button adjustments of the washing programs are limited in regards to selected washing programs.

Dial routing interaction was provided by discrete "turn right-turn left" buttons supported by 22 point *Helvetica Neue LT Pro L* font and arrow indicator in 34x34 mm active click area. The reason for choosing such a discrete interaction was to prevent participants' task concentration on the dial from being distracted by platform button interactions. It was foreseen that an interaction to be positioned around or on the dial could affect the performances of the participants and increase

the margin of errors. In the test simulation, no visual or audial feedback was provided by interactive buttons but the visual change on the display screen and dial itself.

The cases were tested in a random sequence to avoid the participants from learning the program display and the logic behind the task queries. In each case, all participants were asked to adjust six programs in different tasks. We aimed to render the dial indicators within a total of 24 steps; 17 on the right and 7 on the left. The tasks were asked by the researcher via vocal input and the mouse moves and clicks of each participant were monitored in a step-by-step fashion. For instance, in case C2 (*see* Figure 5), the participants were asked to find "perde (curtain)" mode *(+5 steps)* before they have seen the upcoming GUI. When they were sure that they found the program, they were asked to repeat the task "perde" or say "yes/ok". Right after the participants' vocal input, the researcher posed the next query of the task regarding temperature, spin and pre-wash (e. g. 40 degrees, 800 rpm, with pre-wash) adjustments. Right before the participants' push to the "başla/beklet (start/pause)" button, the researcher raised the next task query as "pamuklu (cotton)" *(+4 steps)*. The steps were repeated until the completion of six tasks for each case.

*Figure 5. Video conference screenshot.*



After the completion of the 12 cases with 72 tasks, we showed the images of the dial indicator (C1-C8) and the dial type (C1, C2, C9-C12) cases respectively to each participant in two separate stages. In these phases, we conducted short open-ended interviews about the participants' experiences with GUIs and dial features within the contexts:

- Comfort: Which GUI layout they feel comfortable using and why.
- Accessibility: Which dial and ground contrast they can perceive more easily.
- Easiness: Which dial type is easier to use and why.
- Suggestion: What can be done for a more accessible GUI design in these cases.

We asked the participants to evaluate the GUIs and score 1 as the lowest and 5 as the highest. We did not restrict the participants in scoring value repetitions so that they could examine their experiences within a wider perspective rather than grading the GUIs with distinct scores.

## 3.3. Data collection and analysis procedures

We recorded data in video format with the participants' permissions and analysed the execution times of the 72 tasks in seconds manually for each participant. It was deemed sufficient and appropriate to receive the data in seconds because the participants exhibited very different

behaviours while completing the tasks, and these differences required participant-specific follow-ups. For example, some participants preferred to use their mouse and take action at the same time when thinking about the tasks but others preferred to find the desired program setting first and then take action. Similarly, some participants completed the dial tasks by constantly searching from left to right, while others did the opposite. Therefore, the GUI tests were administered by the researcher following the cursor movements, button click behaviours, and voice feedbacks for each participant rather than analysing the number and duration of mouse clicks with a software that may cause data deviations.

## 4. Results

### 4.1. Dial indicator test results

Throughout the analysis, we did not observe any discrepancies in the time required to complete the dial and button tasks. However, 6 out of the 7 low vision participants were unable to successfully complete cases C3, C4, C6, and C7, resulting in a total of 64 errors, (see Table 1). This was attributed to the fact that the simulation presented the same choices for each mode of button adjustments, making it difficult for participants to identify their mistakes. Consequently, the participants spent more time on both dial and button adjustments for these particular tasks due to the confusion they experienced.

*Table 1. Low vision users' completion times and total errors in dial indicator tasks (C1-8).*

| Cases | L1 | L2 | L3 | L4 | L5 | L6 | L7 | Avg. time (sec.) | Total errors |
|-------|----|----|----|----|----|----|----|------------------|--------------|
| C1 | 25 | 101 | 78 | 46 | 45 | 39 | 63 | 57 | 1 |
| C2 | 27 | 60 | 47 | 54 | 46 | 44 | 59 | 47 | - |
| C3 | 48 | 88 | 87 | 49 | 70 | 76 | 78 | 71 | 16 |
| C4 | 36 | 118 | 53 | 40 | 55 | 63 | 82 | 64 | 18 |
| C5 | 27 | 63 | 52 | 40 | 38 | 41 | 56 | 45 | - |
| C6 | 28 | 84 | 83 | 44 | 64 | 81 | 95 | 68 | 15 |
| C7 | 29 | 103 | 57 | 38 | 62 | 96 | 83 | 67 | 14 |
| C8 | 25 | 56 | 39 | 40 | 40 | 37 | 51 | 41 | - |
| | | | | | | | | 57,5 | 64 |

*L: Low vision user*

Based on the Skewness and Kurtosis values of C1-C8 tasks for low vision participants falling within the range of +2 and -2, the test times of each case showed a normal distribution. However, the homogeneity test exhibited a Sig.(p) value of 0.037<0.05 indicating that the variances were not distributed uniformly. Anova Welch Test also showed a significant difference between the test times of low vision participants in C1-C8 cases with a Sig.(p) value of 0.02<0.05. Post Hoc Test results revealed that only the C3 and C8 cases have a significant difference with a Sig.(p) value of 0.032<0.05. The mean difference values (29,714) suggested that this difference was in favour of C8.

Normal vision users' time scores and errors made in C1-C8 tasks are shown in Table 2. Since the test of normality for Skewness and Kurtosis values of the cases were between +2 and -2 values,

test times for normal vision participants showed a normal distribution within themselves. Since the Sig.(p) value in the test of homogeneity was 0.317>0.05, the variances were distributed homogeneously. In addition, One-way Anova revealed a significant difference in the task completion times of the normal vision participants in C1-C8, since the Sig.(p) value was 0.002<0.05. Post Hoc Test results showed that there were significant differences between test times of the cases C3-C5 (Sig.(p) = 0.013), C3-C8 (Sig.(p) = 0.004), C4-C5 (Sig.(p) = 0.043), and C4-C8 (Sig.(p) = 0.013). When the mean difference values were examined, there was a difference of 8.286 in favour of C5 in C3-C5, 9.286 in favour of C8 in C3-C8, 7.286 in favour of C5 in C4-C5, and 8.286 in favour of C8 in C4-C8.

*Table 2. Normal vision users' completion times and total errors made in dial indicator tasks (C1-8).*

| Cases | N1 | N2 | N3 | N4 | N5 | N6 | N7 | Avg. time (sec.) | Total errors |
|-------|----|----|----|----|----|----|----|------------------|--------------|
| C1 | 23 | 27 | 21 | 28 | 28 | 19 | 22 | 24 | - |
| C2 | 25 | 21 | 33 | 30 | 28 | 17 | 20 | 25 | - |
| C3 | 29 | 27 | 27 | 32 | 33 | 29 | 25 | 29 | 1 |
| C4 | 34 | 28 | 26 | 30 | 35 | 17 | 25 | 28 | - |
| C5 | 21 | 22 | 25 | 21 | 22 | 15 | 18 | 21 | - |
| C6 | 24 | 25 | 31 | 24 | 27 | 18 | 20 | 24 | - |
| C7 | 25 | 25 | 23 | 26 | 30 | 19 | 21 | 24 | - |
| C8 | 20 | 22 | 22 | 20 | 22 | 15 | 16 | 20 | - |
| | | | | | | | | 24,4 | 1 |

*N: Normal vision user*

The equality of error variances of the time variable for all participants in C1-C8 was determined by the Levene homogeneity test as sig.(p)=,000<0,05, that is, it did not show homogeneous distribution. However, since the sample numbers in the case groups were the same, ANOVA was assumed to be robust to violations of the normality and group homogeneity of variance assumptions (*see* Appendices). When the effect of independent variables, case and visual status, on the test duration was interpreted:

- Since Sig.(p)<0,05, Visual Status significantly affected the test times. According to the "Partial Eta Squared" value, this effect was 0,587, or 58.7%.

- Since Sig.(p) for Case is ,006<,05, different cases affected test times significantly with a value of ,182, or 18.2%.

- The Visual Status*Case did not significantly affect the test times together with Sig.(p) value ,249>,05, that is, the effect on the test duration was ,088, or 8.8%.

When the Sig. (p) values of Post Hoc Tests for all participants were examined, since the sig.(p) value was 0.026 <0.05 and the mean difference of C3 from C8 was 19.50, the test times differed significantly between C3 and C8 cases and this difference was in favour of C8. Furthermore, when considering the data for all participants with a homogeneous distribution according to the alpha value of 0.05, it was observed that the fastest completed tasks were C8, C5, and C2, while the slowest completed tasks were C3, C6, and C4.

Table 3 displays the scores of all participants for the dial indicator test cases in the open-ended interviews. C8 received the highest score of 62 points and was perceived as the most easily readable case by all participants while C5 ranked second with a score of 60 points. Conversely, C3 and C6 were the most challenging cases to detect, receiving only 26 points. Although there were no significant differences between task completion times and users' preferences for all participants in the simulation, it is worth noting that C4 was the most comfortable example for one low vision participant and two participants with normal vision. Furthermore, a low vision participant (L2) reported that she could read the texts easily, but could not detect the dial pointer in C1-C8.

*Table 3. Evaluation scores of all participants for dial indicator test cases*

| Evaluation scores | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 |
|---|---|---|---|---|---|---|---|---|
| Low vision users' scores | 22 | 25 | 11 | 14 | 30 | 12 | 14 | 32 |
| Normal vision users' scores | 27 | 29 | 15 | 20 | 30 | 14 | 18 | 30 |
| Total scores | 49 | 54 | 26 | 34 | 60 | 26 | 32 | 62 |

It is noteworthy that the C5 and C8 cases, which are proposed within the scope of this research, are the cases that received the highest scores albeit with a close difference by normal vision participants. In the interviews, this was expressed by N4, who was also a product designer, as follows:

> "I think this example is very well designed. A very simple and plain [G]UI. I have never seen such an example before; did you design it? […] At first glance, I can see the circle form formed by the texts. For example, in the striped examples, I have a rectangular array. The circle is clear in C1 and C2 as well, but much clearer in C5 and C8. I think the best is C8; So I can give five points. The C5 is the same but I would prefer it to be on a dark background. Maybe if the dial on the C5 was different, I could have chosen it, but between these two, the C8 is more preferable for me. That's why I give 4 points for C5."

The C5 and C8 cases were deemed the most readable by one participant with low vision (L5), although she encountered difficulty distinguishing between the letters "I" and "J" in the word "HİJYEN" due to the space between these letters. Two designer participants suggested using the least but meaningful syllable in capital letters to express program preferences. As part of this proposal, it was suggested during open-ended interviews that "DURUlama" and "PAMUKlu" would be more appropriate representations than "DUrulama" and "PAmuklu", respectively[2]. Within the same framework, it was stated that different alternatives could be tried, especially for programs with two syllables (for example, YORGAN or YORGAN instead of YORgan).

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[2] In Turkish, words are derived by adding meaningful suffixes to meaningful sounds. For example, the word "durulama" (rinse) is derived by adding the suffix "-lama(k)" meaning "to make something into that state" to the word "duru" (pure). Hence it means making something pure when the suffix added. Therefore, the least meaningful form of the word "durulama" is the word "duru". Similarly, the word "pamuklu" is derived by adding the suffix "-lu" to the root "pamuk". The suffix "-lu" indicates that it contains the root to which it is added. Therefore, the word "pamuklu" means "containing cotton" and its smallest meaningful part is "pamuk".

The findings from the open-ended semi-structured interviews showed that the symbols were not seen as important by any of the participants. In fact, the majority of participants found them confusing, with the exception of two normal vision participants who found them useful.

*Table 4. Low vision users' completion times for dial type tests*

| Cases | L1 | L2 | L3 | L4 | L5 | L6 | L7 | Avg. time (sec.) |
|-------|-----|-----|-----|-----|-----|-----|-----|------------------|
| C1 | 25 | 101 | 78 | 46 | 45 | 39 | 63 | 57 |
| C2 | 27 | 60 | 47 | 54 | 46 | 44 | 59 | 47 |
| C9 | 27 | 62 | 27 | 33 | 45 | 38 | 57 | 41 |
| C10 | 28 | 51 | 32 | 43 | 43 | 36 | 53 | 41 |
| C11 | 29 | 46 | 35 | 30 | 41 | 34 | 48 | 38 |
| C12 | 25 | 43 | 30 | 30 | 39 | 34 | 46 | 35 |
| | | | | | | | | 43 |

*L: Low vision user*

## 4.2. Dial type test results

The dial types were put to the test using cases C1, C2, and C9-C12. Analysis of time scores shown in Table 4 revealed that the values of Skewness and Kurtosis were in the range of +2 to -2 and the test times showed a normal distribution among the participants with low vision. However, the homogeneity test showed a Sig.(p) value of $0.009 < 0.05$, indicating that variances were not equally distributed. As a result, Anova Welch Test Sig.(p) value was evaluated and found to be $0.177 > 0.05$, indicating that there was no significant difference in the test times among low vision participants.

*Table 5. Normal vision users' completion times for dial indicator tasks (C1-8).*

| Cases | N1 | N2 | N3 | N4 | N5 | N6 | N7 | Avg. time (sec.) |
|-------|-----|-----|-----|-----|-----|-----|-----|------------------|
| C1 | 23 | 27 | 21 | 28 | 28 | 19 | 22 | 24 |
| C2 | 25 | 21 | 33 | 30 | 28 | 17 | 20 | 25 |
| C9 | 20 | 23 | 26 | 23 | 19 | 15 | 21 | 21 |
| C10 | 23 | 21 | 27 | 24 | 21 | 16 | 20 | 22 |
| C11 | 17 | 20 | 18 | 21 | 17 | 15 | 19 | 18 |
| C12 | 20 | 19 | 19 | 21 | 18 | 16 | 17 | 19 |
| | | | | | | | | 21,5 |

*N: Normal vision user*

Time scores of normal vision participants (see Table 5) exhibited Skewness and Kurtosis values between +2 and -2, indicating a normal distribution of test times for each case in One-way ANOVA analysis of variance. However, the homogeneity test revealed that the variances were not evenly distributed, as evidenced by a Sig.(p) value of $0.02 < 0.05$. Consequently, Anova Welch Test Sig.(p) value of $0.011 < 0.05$ indicated that there was a significant difference in test times among the participants with normal vision. Further analysis with Anova Post Hoc Test revealed that cases C1 and C11 showed a significant difference with a Sig.(p) value of $0.038 < 0.05$. When the statistical

mean difference values were examined, it was revealed that this difference supported C11 with a value of 5.857.

Levene's homogeneity test was conducted to determine the equality of time variable error variances across all participants. The results indicated that the Sig.(p) value was,000<0,05, indicating a lack of homogeneous distribution. However, given that the sample sizes in the case groups were the same, the ANOVA analysis was assumed to remain robust to violations of the assumptions of normality and group homogeneity of variance (*see* Appendices). When interpreting the impact of the independent variables, case and visual status, on the duration of the test, the findings revealed the following:

- *Visual Status* variable had a significant effect on the test time, indicated by a Sig.(p) value of ,000<,05, meaning the effect was ,555, equivalent to 55.5%.

- *Case* variable had a significant effect on the test time, indicated by a Sig.(p) value of ,0007<,05, meaning the effect was 0.194, equivalent to 19.4%.

- The combined effect of *Visual Status* and *Case* on the test time was not significant, because the Sig.(p) value was ,399>,05, meaning the effect was 0,068, equivalent to 6.8%.

Furthermore, when the Sig.(p) values from Post Hoc Test were examined, it was found that the cases C1-C11 and C1-C12 showed significant differences in test times. The Sig.(p) value for C1-C11 was ,023, favouring C11, and the Sig.(p) value for C1-C12 was ,021, favouring C12.

In semi-structured interviews, both C11 (63 points) and C12 (65 points) were defined as the most accessible by both participant groups (*see* Table 6). On the other hand, one low vision participant defined C9 and C10 as the most accessible configurations.

*Table 6. Evaluation scores of all participants for dial type test cases*

| Evaluation scores | C1 | C2 | C9 | C10 | C11 | C12 |
|---|---|---|---|---|---|---|
| Low vision users' scores | 8 | 11 | 25 | 26 | 32 | 32 |
| Normal vision users' scores | 9 | 11 | 23 | 18 | 31 | 33 |
| Total scores | 17 | 22 | 48 | 44 | 63 | 65 |

All participants, especially those with low vision, stated that adding arrows or markers onto the dials should make the GUI more accessible. Moreover, in spite of the fact that background colours of the dials had not a statistically significant role for in-case results, it was found that the readability was related with colour contrasts between dials and backgrounds. Hence, dark dial on dark background (C2, C4, C7, C8) or light dial on light background (C9) was preferred by 12 of 14 participants in interviews. The reason behind this preference was attributed to the excessive contrast created by dark dials on light colour tones or vice versa, which made it challenging to maintain focus.

## 5. Discussion

It is evident that low vision participants experienced longer task completion times compared to those with normal vision. The results indicate that visual status accounted for 58.7% of the variance in test times. This significant difference can be attributed to the shorter distances (18-35 cm) between the low vision participants and the simulation screen, in contrast to the greater sight distances (55-65 cm) of normal vision participants. In fact, low vision participants had to

exert more eye and body movements to navigate dial markers and locate the corresponding indicators. Additionally, the presence of discrete dashboards in certain test cases further contributed to the challenges faced by low vision participants. Specifically, when transitioning from dial tasks to button tasks, these participants had to physically turn or swipe their heads to the panel found at the right of the GUIs. In contrast, normal vision participants could complete all tasks without the need for such efforts.

A closer examination of the cases reveals that the dial indicators in C1, C2, C5, and C8 are positioned closer to the dial mark than in C3, C4, C6, and C7. The statistical data supports the idea that the indicators marked with lines and positioned further from the dial mark are more difficult to perceive for participants with low vision. In fact, they made a total of 64 errors, whereas the total number of errors in these particular cases reached 65. This can be attributed to the narrowing of the visual field due to the low visual distance and the additional effort required to follow the lines.

For low vision users, the level of contrast in GUIs can pose visual accessibility issues, again due to looking closely to GUIs. Especially in cases where the contrasts between dials and their backgrounds were high, low vision participants can be challenged to adopt their eyes to these high-contrasted elements perceived at a short distance.

Qualitative evaluations revealed that the indicators defining a virtual rectangular area around the circular dial, as shown in Figure 6, also contributed to difficulties faced by low vision participants. In fact, completing tasks with a circular virtual geometric shape around the dial (C8, C5, C2, and C1) was faster compared to tasks with a rectangular shape (C7, C4, C6, and C3). This can be due to the fact that it is challenging for low vision users in establishing the connections between the dial marker and the indicators when these GUI elements do not trace at least similar geometries.

*Figure 6. GUI cases indicator frames*



Based on the time scores, it was statistically significant that the test times for C8 and C5, GUIs proposed by low vision product designer and one of the researchers of this study, were significantly different compared to C3 and C4, favouring these GUIs. Furthermore, these two cases received the highest scores (60/70 points for C5 and 62/70 points for C8) in the open-ended interviews, indicating that they were considered as the most accessible and/or comfortable tasks. It is worth noting that even participants with normal vision gave these cases high scores, albeit with a slight margin. This superiority can represent the importance of empathy in design of accessible UIs. Considering that both uppercase and lowercase letters are used together in the text displays of these proposals, it can be said that text indicators shown in uppercase letters are perceived more easily than those shown in lowercase letters for the same font size. Furthermore, using an uppercase larger font (22pt) for just the first syllable of the text or the first part which evokes the meaning of the entire text in text displays can improve accessibility of GUIs for low vision users compared to using the same font size (16pt) in sentence case for all text.

Based on the statistical analysis of the dial types, there was no significant difference observed in the test scores of the low vision participants. However, when examining the average completion

times, it was found that the tasks C12 (35.71 seconds) and C11 (36.43 seconds) were completed the fastest by these participants respectively. Furthermore, the open-ended interviews revealed that low vision participants found C11 and C12 with 32/35 points each to be more easily perceivable. Conversely, a statistically significant difference was found in the compilation time scores of participants with normal vision in these cases. Upon examining the mean difference values, it was evident that this difference favoured C11 to C1. Additionally, when considering all participant data, the task completion times differed significantly between C1 and C11, as well as C12 in favour of the latter cases. As all these data show that for dial types, C11 and C12 were more accessible to all participants than others. Known for accessibility, dial markers need to be designed with a contrasting hue to the hue of the dial.

## 6. Conclusion

In this study, we investigated the accessibility aspects of 12 washing machine GUI cases through a comprehensive analysis of dial and button tasks. The findings shed light on the difficulties encountered by low vision participants, who exhibited longer task completion times compared to normal vision participants, resulting in reduced QoE. This difference is attributed to the shorter viewing distance and the increased need for eye and body movements by low vision users when navigating GUIs.

In this study we found that individuals with low vision can have greater difficulty perceiving dial indicators located far from the dial marker compared to those positioned closer to the dial. Furthermore, the virtual circular arrangement around the circular dial can be easier to perceive by low vision users, as opposed to the virtual rectangular configuration outlined by the dial indicators. Additionally, when the distance between distinct control panels in a GUI increased, low vision users can experience difficulties compared to normal vision users due to having to look closely at GUI elements.

This study showed that, for a GUI containing both icon and text indicators, the perception of text indicators took precedence over the icons. Furthermore, it can be more difficult for low vision users to identify dial functions in striped dial displays where the lines do not centre the display texts or icons on the horizontal axis. The ambiguities in these display tasks can have a slowing effect on the other (button) tasks. In such cases (C3, C4, C6, and C7), we recommend that the lines on the displays should be aligned with the display texts and/or graphical representations.

This study revealed that GUIs with high contrast levels on the dial markings (C9 and C10) have a positive impact on user accessibility for both low and normal vision users. Furthermore, the addition of a graphically obvious marker to indicate the position of the dial (C11 and C12) can make the GUI easily perceivable. However, high contrast levels between the dial and the background can negatively affect the accessibility of the GUIs for low vision users due to close viewing. In fact, low vision users have to adopt their eye lenses to such GUI elements in a shorter distance which can lead to extra effort of the eye pieces. We suggest that keeping the contrast levels between GUI elements at optimum level but not the maximum can make the GUI more accessible to low vision users.

We introduced two GUI models in this study, C5 and C8, proposed by a low vision product designer's empathy and experience. Statistical significance in the test times and high scores in the open-ended interviews confirmed their superiority for both low and normal vision participants. As these cases emphasized, it is important to consider text height in text displays, noting that lowercase letters pose greater difficulties to visually perceive than uppercase letters

in the same font size. Furthermore, we suggest that a text display in search-and-find tasks can be perceived more easily by low vision users, regardless of the size of the rest of the text, if the first syllable or the first part which evocates the meaning of the entire text is written in uppercase letters and a larger font.

The study's holistic approach, integrating quantitative data, qualitative assessments, and user feedback, provides a detailed understanding of the complex interplay between design elements and QoE in GUIs, with implications for both low vision and normal vision users. Ultimately, these findings can inform future developments in GUI design, promoting inclusivity and accessibility across diverse user groups.

## 7. Acknowledgements

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# 9. Appendices

## 9.1. Participant demographics

*Table 7. Low vision participant profiles*

| Participant | Age | Gender | Education |
|---|---|---|---|
| L1 | 30 | Female | BSc |
| L2 | 65 | Female | BSc |
| L3 | 39 | Male | MSc |
| L4 | 34 | Female | BSc |
| L5 | 42 | Female | MSc |
| L6 | 30 | Male | BSc |
| L7 | 55 | Male | High Edu. |

*Table 8. Normal vision participant profiles*

| Participant | Age | Gender | Education |
|---|---|---|---|
| N1 | 33 | Female | MSc |
| N2 | 35 | Female | BSc |
| N3* | 37 | Male | MSc |
| N4* | 40 | Female | PhD |
| N5 | 33 | Female | BSc |
| N6* | 26 | Female | BSc |
| N7* | 40 | Male | MSc |

*\* Industrial designer*

## 9.2. Tests of Between-Subjects effects

*Table 9. Tests of Between-Subjects effects for dial indicator cases*

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 38260,205a | 15 | 2550,680 | 11,149 | ,000 | ,635 |
| Intercept | 187862,223 | 1 | 187862,223 | 821,159 | ,000 | ,895 |
| Visual Status | 31255,723 | 1 | 31255,723 | 136,621 | ,000 | ,587 |
| Case | 4890,134 | 7 | 698,591 | 3,054 | ,006 | ,182 |
| Visual Status * Case | 2114,348 | 7 | 302,050 | 1,320 | ,249 | ,088 |
| Error | 21962,571 | 96 | 228,777 | | | |
| Total | 248085,000 | 112 | | | | |
| Corrected Total | 60222,777 | 111 | | | | |

*Dependent Variable: Time; a. R Squared = ,635 (Adjusted R Squared = ,578)*

*Table 10. Tests of Between-Subjects effects for dial type cases*

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 12447,238a | 11 | 1131,567 | 10,207 | ,000 | ,609 |
| Intercept | 87300,762 | 1 | 87300,762 | 787,479 | ,000 | ,916 |
| Visual Status | 9945,190 | 1 | 9945,190 | 89,709 | ,000 | ,555 |
| Case | 1923,381 | 5 | 384,676 | 3,470 | ,007 | ,194 |
| Visual Status * Case | 578,667 | 5 | 115,733 | 1,044 | ,399 | ,068 |
| Error | 7982,000 | 72 | 110,861 | | | |
| Total | 107730,000 | 84 | | | | |
| Corrected Total | 20429,238 | 83 | | | | |

*Dependent Variable: Time; a. R Squared = ,609 (Adjusted R Squared = ,550)*

# Practical wisdom for accessible cities
## Creative tensions in Universal Design processes for Swedish urban development

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Abstract: This paper explores knowledge creation in Universal Design (UD) processes that aim to make cities accessible to all. It contributes insights into the practice of urban development in Sweden which, in accordance with the UN Convention on the Rights of Persons with Disabilities, shall utilize UD. Workshops and qualitative interviews were conducted in three mid-sized cities re-designing a city square, a street and the building of a new library. Drawing on Aristotle's typology of knowledge, the analysis shows that different kinds of knowledge were in play in local collaboration. UD was akin to phronesis, i.e. practical wisdom. A number of factors contributed to tensions: organizational asymmetries, divisions between professional and experiential expertise, the perception that accessibility is a limited interest for a specific target group, as well as uncertainties about user legitimacy. To overcome these tensions, the article proposes that disability organizations should be seen as contributors rather than commentators.

## 1. Introduction

By implementing the UN Convention on the Rights of Persons with Disabilities (CRPD) (UN, 2006), Universal Design (UD) has in recent years been introduced in Swedish policies on disability, design and architecture, public procurement, and standardization (Erdtman, Rassmus-Gröhn, & Hedvall, 2021). Design of 'programmes and services' has in UN (2006) been added to the original definition of UD, which included the 'design of products and environments to be usable by all people, to the greatest extent possible' (Story, Mueller, & Mace, 1998). Hedvall, Ståhl, & Iwarsson (2022) bring together the concepts of *accessibility* as measurable and based on standards, *usability* as purposefulness, efficiency and satisfaction, and *UD* as equality, non-stigmatization and intersectionality. Accessibility draws boundaries between different groups while UD is inclusive. Steinfeld and Maisel (2012, s. xi) define UD as 'a process that enables and empowers a diverse population'. From the start, UD pedagogy has included consultation with users to integrate the disability experience in design (Welch, 1995).

In the Nordic countries, UD and accessibility are used differently (Tunström, M., & Löfving, L., 2020). In Norway, UD was enshrined in legislation even before the CRPD was adopted. From Norway, Lid (2013) views UD as a strategy for societal recognition of human diversity, implying knowledge development based on disability experiences. In Sweden, UD was perceived as little

known and controversial in 2016, while accessibility was the 'key parameter' (Andersson, 2016, s. 26). According to the Swedish Planning and Building Act, it is in the public interest to promote environments that are accessible, usable and good for all people (Anderssson, 2022). However, laws and agreements are no guarantee for compliance. Egard et al. (2022) noted an ongoing resistance toward 'accessibility' measures. Individual experiences of 'promises' of policies like the CRPD collide with the reality of everyday life, leading in turn to frustration and disillusionment. Spatial exclusion, described by Kitchin (1998), generates fear, anger, stress, and anxiety (Bonehill, von Benzon, & Shaw, 2020). Accordingly, shared spaces without kerbs increase the danger for some groups, according to Lawson, Eskytė, Orchard, Houtzager, and Vos (2022). Koch (2022) found in one Swedish city, differences in the experiences of shopping malls. They were related to the impairments but also to feelings of freedom or confinement. This aptly illustrates the difference between impairments as bodily conditions and disability as a social experience of exclusion, articulated as the 'social model of disability' (Bruce, 2014).

National UD policies are followed by municipal ones, e.g., in local manuals for urban design. This paper connects such policy ideals with the everyday practice of UD. Exploring the collaboration between municipal administrations and disability federations contributes to knowledge about citizen participation and the contextualization of UD. By analysing workshops about UD in Swedish cities, this paper aims to bring new insights into how knowledge is created in urban development processes and thereby contribute to the improvement of UD practice.

Research questions:

1. What kinds of knowledge can be distinguished in the practice of UD in urban development and how do they relate to each other?
2. In terms of knowledge creation, what tensions can be identified in the collaboration process between municipalities and local disability organizations?

## 1.1. Municipal responsibilities and participation in urban development

In Sweden, the legal responsibility for land-use planning and urban development lies at the municipal level (Larsson, 2010). Municipalities shall control compliance with accessibility regulations, and at times hire certified accessibility experts for inspection. According to Müller, Ericsson, and Hedvall (2022), UD is sometimes mentioned in comprehensive plans as an overarching ambition, but is not seen as a practical tool in planning and construction. They argue for clear public procurement requirements for guaranteeing basic accessibility. Stakeholders and citizens must be consulted on larger building projects (Larsson, 2010). Besides this compulsory participation process, the Swedish Association of Local Authorities and Regions (2023) urges municipalities to arrange informal dialogues with its citizens. Hellquist and Westin (2019) found that rather than mobilizing or strengthening specific groups or equalizing power, consensus was the goal of these dialogues. As Sandin (2022) notes, dialogues are generally initiated, controlled, and supervised by municipalities, though done in reality through hired design companies.

Since the 1970s, municipalities have advisory disability councils with political leadership. Additionally, civil society associations of and for persons with specific impairments, their families and/or allies have local organisations at regional and municipal levels in federations (Hugemark & Roman, 2007), referred to in this paper as local disability federations (LDFs). According to UN (2018), authorities must actively involve advocacy organizations of disabled people in issues concerning them. Besides strictly legal reasons for involving disabled people in urban design, there are also quality-related reasons. Heylighen and Herssens (2014) found for example, that blind people notice variables that visually biased design professionals miss. Speaking from the

discipline of product design, Westerlund (2009, p. 11) found that participants with bodies outside the norm contributed 'crucial experience that we designers lacked'. In such design processes, disabled participants contribute with personal experience and do not speak for, or on behalf of an organization or group. However, such participation is often seen as 'an afterthought rather than as an integral element' in urban design and building processes (Imrie & Hall, 2001, p. 345).

## 1.2. Knowledge creation in endeavours for UD

According to one of the early pragmatists, Dewey (1997), knowledge is created in activities through experience, that is the result of adaptation to the environment. When habits are broken by problem-solving, re-orientation is necessary. Design scholars like Sanders & Stappers (2008, p. 6) talk about co-creation as acts of 'collective creativity', and define co-design as collective creativity in design processes, including 'people not trained in design'. More common than collaboration – and more so co-creation – is the model of negotiation. Campbell (2013) describes societal conflicts surrounding resources, property, and development in terms of interests between economy, environment, equity, and justice. For Larsson (2010), actors with different objectives play the game of negotiation with officials as mediators. However, the interests of the actors are not fixed but instead interwoven and evoked by changes in the process, like when construction is obvious and tangible.

Based on a relational understanding of planning, De Blust, Van den Broeck, Devos, & Moulaert (2022) analysed planning studios where teachers, students and stakeholders develop a culture of discussion, negotiation and reflection, thus co-constructing a dynamic process of collective critical inquiry. In this paper, collaborative knowledge creation will be examined through a contemporary reading of Aristotle. Bornemark (2017) characterizes Aristotle's three kinds of knowledge as: *episteme*: theoretical, rational, facts, measurable and secure descriptions, *techne:* productive know-how, embodied, professional, creative, goal-oriented, and *phronesis:* practical, political-ethical wisdom, sound judgements related to action(praxis) in local situations. Flyvbjerg (2004) includes power in his concept of phronesis. It balances analytical episteme and the instrumental rationality of techne with a reflexive discussion and practice of virtuous social and political judgement concerning consequences for different groups. According to Briassoulis (2023), phronesis is relational and situational, dealing with the 'particulars of a case'.

## 2. Method

To explore different kinds of knowledge, collaboration and tensions in the local practice of UD in Sweden, two workshops were arranged, one for two hours and one for approximately ten hours. Three, 45-minute member-check interviews were conducted during the analysis phase. All sessions were recorded and transcribed verbatim by the first author.

## 2.1. Workshops in three municipalities

Workshops were held from March to September 2022 in cities, designated mun.X, mun.Y, and mun.Z. The workshops dealt with roles, interests, policy and innovation. They were led by the authors but designed in collaboration with staff at LDFs and municipalities. The overarching goals were mutual learning and the exchange of experiences for the purpose of furthering a change towards UD-oriented urban development. The workshops in mun.X (held in a municipal conference room) and mun.Y (held in an open conference area at the LDFs' office) took two hours and focused on the collaboration between municipalities and LDFs. The two-day workshop in

mun.Z (in conference centres accessed by the municipality) was part of a collaborative project between the municipality and academia concerning equality related to UD.

All workshops started with presentations of ongoing projects by officials, subcontractors, and LDFs. The first author led the following discussion, ensuring that prepared questions about practice and dilemmas of UD, collaboration, and knowledge creation between municipalities and civil society were covered. By using the word 'workshop', an openness was indicated concerning what the participants wanted to discuss. In mun.X and mun.Y, the second author facilitated by catalysing, enabling and motivating (Storvang, Clarke, & Mortensen, 2014). The combined half-day and a full day workshop in mun.Z, and the non-existence of a municipal LDF there, made the focus more general. At the half-day meeting, the researchers introduced UD and six groups were formed to discuss internally and with a researcher, how ongoing urban design processes concerning schools, parks, sports arenas, etc. contribute to equality. At the full day meeting, the groups presented their results followed by questions, reflections, and advice for future projects.

## 2.2. The studied municipalities and projects

The approximate numbers of inhabitants, not including surrounding areas, are 200.000 for mun.X, 100.000 for mun.Y and 50.000 for mun.Z. All three cities had medieval origins and all were the administrative centres for their respective regions. The term 'municipality' refers to the local level of public administration in Sweden. Private companies hired after public procurement to carry out municipal assignments are also referred to as the municipality, e.g., in mun.X the people users met were from the architectural company hired to design a city square. In mun.X and mun.Y, there were active LDFs on both the municipal and regional levels. The three municipalities all had disability councils that mainly dealt with overarching questions and invited local officials to speak about ongoing projects. Studied projects:

- Mun.X: Redesign of a central square to make it safer and socially vibrant. According to the public procurement requirements, persons with impairments – referred to as accessibility experts – should contribute with ideas through workshops at the site of the square.

- Mun.Y: Building of new library at a suburban square under redesign. The library is located in a multi-functional building. Initially, politicians proposed no library in this suburb. The workshop presentation focused on procurement requirements for the library furniture.

- Mun.Z: Redesign of a central street aiming to vibrant city life and commerce in the historic city centre which must compete with new suburban malls. This street was one of six ongoing processes discussed at the full day workshop. This group's meetings were documented.

## 2.3. Selection of workshop participants

The selection of participants for mun.X and mun.Y was strategic, meaning invitations were discussed with the co-organizers to cover a diversity of professions and organizations. Officials and LDFs used their networks to send open or personal invitations, thus selecting those who would be interested by the invitation. All who showed interest were welcomed: eight persons in mun.X and 14 in mun.Y. Out of a total of 22 people, eight came from LDFs, four members and four employees. Two of the employees reported impairments, two did not. Most of the participants in mun.Z were municipal employees. The municipality selected 50 for the half-day meeting and 53 for the full day meeting. For all the workshops, the participating employees came from various units in the municipality. They were strategists, architects, librarians, etc. Table 1

depicts the knowledge areas according to Carayannis & Campbell's (2009) Quadruple Helix division of GOV (authorities), CIV (civil society), IND (business, i.e., architects) and UNI (academia).

*Table 1. Participants according to municipality, their knowledge area and sex*

| W.shops | Time | CIV | GOV | IND | UNI | Total F + M |
|---------|------|-----|-----|-----|-----|-------------|
| Mun.X | 2 h | 3 | 2 | 1 | 2 | 8 (5 +3) |
| Mun.Y | 2 h | 5 | 7 | 2 | - | 14 (10 + 4) |
| Mun.Z | ≈ 10 h | 1 | ≈ 40 | ≈ 10 | 6 | ≈ 60 |
| M.check | 45 min | 2 | 1 | - | - | 3 (1 + 2) |
| Total | ≈ 15 h | 11 (≈ 10%) | ≈ 60 (≈ 60%) | ≈ 15 (≈ 20%) | 8 (≈ 10%) | ≈ 85 |

Abbreviations: W.shops=workshops, mun.X, Y and Z=municipalities, M.check=member check, F=female, M=male, h=hour, min=minutes. Some numbers are approximate, signed with an ≈.

## 2.4. Analysis and member check

The entire material was analysed using qualitative content analysis (Graneheim & Lundman, 2004). Coding, categorization, and conceptualizing were done in the analysis program NVivo, resulting in a division of categories under types of knowledge and structural, categorical, and interpretational tensions. All citations were transcribed from Swedish to English by the first author. In order not to reveal the identity of the participating municipalities, the analysed public procurements documents and workshop report are not referred to explicitly. During the analysis phase, one person in each municipality was interviewed for 45 minutes in public buildings and in a private residence. This 'member check' aimed to follow up preliminary results and strengthen validity. To achive this, respondents were selected among those who had been involved in the processes but had not had a leading role. One was a municipal employee, one a member of a disability council and one a user participant from the city square process. The term 'member checking' stems from Lincoln and Guba, describing a feedback tool for confirming or dismissing interpretations of data (Motulsky, 2021). The method guarantees that validity is adequate and trustworthy. It improves the shared understanding among researchers and participants, and 'diminish[es] epistemic injustice' (Caretta & Pérez, 2019, s. 370) – a term for excluding knowledge from certain groups from the collective epistemic resources (Scully, 2018).

## 2.5. Note on workshop style

For Hanington and Martin (2019), design workshops aim at ideation and understanding other people's worlds by using personas, scenarios, or objects. However, no participants brought objects or made other kinds of presentations than PowerPoint talks, despite such initiatives being encouraged. Though being mostly verbal sessions, the workshops resembled design ethnography, where the researcher acts as a 'change agent' (Hanington & Martin, 2019). Gunn, Otto, and Smith (2013) argue that researchers should take an active role as contributors to the empowerment of marginalized groups, supporting their dreams and aspirations but also contributing to local change processes. The workshops in mun.X and mun.Y methodologically resemble focus groups, particularly through the second author's assisting role.

## 3. Results

Based on reflective workshops and official documents, this chapter presents identified kinds of knowledge, following Aristotle's divisions. Tensions of a structural, categorical, and interpretational nature were identified concerning knowledge creation in the collaboration between municipalities and disability organizations.

### 3.1. Types of knowledge in UD practice

Three kinds of knowledge – episteme, techne and phronesis – were identified, although not clearly distinguishable. Fact-based knowledge about the content in laws and local manuals resembles *episteme*. It was used as corrections regarding measurable rules for contrasting colours, heights, and widths of kerbs. Officials referred to the law as their overarching framework and a guiding force amid disparate directives, helping them to solve conflicts and ensure suitable performance. Rules – here an overarching term for regulations and requirements – were expected to clarify that which was discretional. One official, working with art, wanted accessibility guidelines 'so that the art will not be … wrong somewhere'. When a librarian mentioned using colours for distinguishing different parts of the library, others asked for such guidelines.

Internalizing guidelines in professional routines for planning and performance, resembles *techne*. LDFs and some officials regarded accessibility as an overarching label for their work, internalizing, defending, and monitoring this interest. Further, officials described their job as interpreting political decisions and balancing interests. They judged formal and informal, existing and assumed future rules in local situations related to imagined future places. This ethical endeavour resembles *phronesis*. Part of this was making exceptions and adaptations – e.g. steps on inclines, compensated with handrails and contrasts as far as possible. Deviances from rules were documented for the purpose of being able to respond to potential critique. Related to phronesis was personal knowledge such as disability experience, embodied by encountering exclusion and hindrances but also deviating positively from the societal norm. These experiences yielded valuable knowledge for understanding others and understanding the reasons for existing rules.

### 3.2. Collaboration and knowledge creation

The studied processes all aimed at urban revitalization. They were described as pilot projects for testing new work methods to learn from for future projects. Municipalities and local disability organizations collaborated in public procurement requirements and project planning, thus developing personal contacts. Municipalities consulted disability organizations who answered questions and reacted to municipal proposals. Both sought to facilitate compliance with rules. Officials and LDF employees organized activities like outdoor workshops with persons with impairments, in order to collect and integrate disability experience in development processes. Officials viewed personal narratives about disability as the source of valuable knowledge, helping them understand the reasons behind accessibility requirements– 'understand in practice', as one official said. She recommended this for practitioners as a way to avoid building errors. The subcontractor in mun.X voices a similar opinion when referring to the city square workshop:

> *'We thought it was very good that you get understanding, because you have different perspectives, and sometimes they are at odds with each other. … It's great to meet and we learned a lot in the project group. We can't have that detailed knowledge. We relate a lot to legal requirements and technical manuals, but you get another understanding when you hear someone talk.'*

The contradicting perspectives that are mentioned by officials were between participants with visual and mobility related disabilities – a dispute denied as a misunderstanding by the LDFs. Another disagreement was about movable furniture at the square. The LDFs argued that the official goals of vibrant city life (expressed in policy texts) made the environment unpredictable for, e.g., persons with autism or visual impairments, for whom a crowded square might induce anxiety rather than safety. Accessibility as a clear interest did – for some – guarantee that the needs of persons with impairments were taken into consideration. An architect in mun.Y argued for highlighting accessibility through certain features as a way for a neglected group to claim space. For her, a tactile line surrounded by lighting art was an example:

> '*I thought it was nice that it lights up this tactile line – that it actually lights up this accessibility path and that it takes up space in the room. I thought that was a good thing. Otherwise, it's something that you might think should be shovelled away or something, that it shouldn't be so visible, but that it is allowed to stand out I thought was nice.*'

Some participants with impairments argued against visible features since they often signalled subsequent add-ons or highlighted that it was done for a specific group. They preferred integrated and thus unnoticeable and invisible design as a natural part of the place.

The general mood of collaborations was cordial. One of the accessibility experts in mun.X felt 'surprisingly involved' compared to earlier processes. The municipality had listened to their desire for fixed activity areas. The project leader agreed they had changed the original plan after hearing the accessibility experts talking about furniture, sound milieu and water in the square. In mun.Y, the president of the municipal LDF praised the municipality for listening to their organization and in most cases doing as the LDF suggested. Many of the officials were familiar with the LDFs' office where the workshop was held. The LDF gave courses for municipal units and architectural companies about building regulations. The library staff lobbied for UD as a procurement requirement and then collaborated with the LDF in educating the winning design company. They proudly told how they succeeded in getting a better ramp, underground heating, entrance lighting and mirrors lower than the procured standard. However, they had entered process at a late stage and the library had to pay for these changes to the original plans. Mun.Z had no LDF, but a politician argued before the officials to involve the local disability associations (without an umbrella organization) since 'they are the ones with the knowledge and competence'.

## 3.3. Tensions in the knowledge creation

Three types of tensions were identified: structural, categorical, and interpretational.

### 3.3.1. Structural tensions

a) Organizational asymmetry: Resources and professional skills differed between the municipal authority and the non-profit associations in the LDFs. There were mundane hurdles such as meeting hours. Daytime meetings suit professionals but excludes most citizens with jobs. Officials saw involving citizens as an appealing idea, yet an overwhelming task. Receiving many proposals was confusing. Further, citizen participation was only realistic in a few cases. The officials sometimes had an unrealistic image of the capacity of the LDFs. In mun.Z the disability council was invited to present ideas about the street but then were only able to present them late in the process. Five student projects about this project were not integrated into the process in the way the disability council had assumed.

b) Consultation: Despite attempts at renewal – calling participants experts in mun.X, etc. – the municipalities invited the LDFs to answer questions and react to municipal proposals. The officials primarily wanted these supported and confirmed. These roles of consulter and consulted were not communicated to the LDFs and caused mistrust since the LDFs wanted to be involved earlier in the process and negotiate results by convincing or making officials work for their interests. They took an oppositional role and talked tactically about using their given time effectively and checking that their opinions were logged. However, the LDFs accepted being consulted in order to ensure a basic level of accessibility. Referring to the official goals of the project, one user expert commented that without being able to access the square, you cannot talk about feeling safe at a vibrant meeting point.

c) Professional/user divide: The professionals' rational planning perspective of complying with rules and measurable features, interplayed with the everyday experience of users. For instance, Mun.X wanted confirmation about the heights of kerbs in centimetres, while user experts felt that their feelings of safety at the square were related to how much bus drivers paid attention to pedestrians. Another user said that he feels what is a good kerb with his white cane but leaves the question of centimetres to the professionals. He criticized architects for propagating tactile lines without good function with current cane techniques. He follows facades or kerbs and stated that his ability to follow tactile lines depends on the situation and context – e.g., they are difficult to use if you are in a hurry, or if there is paving stone around, and impossible to use if there is snow or gravel. Such experiences were sometimes diminished, neglected, overlooked or dismissed as anecdotal, irrelevant, or 'details'.

d) Public procurement rules: Officials felt hogtied by procurement rules, hindering them from getting and requiring what they want. The library in mun.Y could not get local materials and had a hard time influencing procurement requirements to get the furniture they wanted. Finally, they educated the winning design company which made the choice. The collaboration resulted in an innovative lighting system for the shelves, but the librarian says this effort is only worth it if the knowledge is used elsewhere. Public procurement seemed to hinder knowledge from being shared freely and limited the process to existing products. 'You can think freely but if there are no products in the market, you can't create what you thought', added an official in mun.Y.

e) Resistance to rules: Some officials joined the LDFs in describing themselves as bothersome and nagging in the struggle against resistance to accessibility rules. Together, they made fun of the ignorance about regulations and some companies' lack of imagination, e.g., only communicating with pavement signs. However, when officials during the workshop in mun.Y mentioned an ongoing revision of a local prohibition on pavement signs, the LDFs were taken by surprise. Mun.Z had made similar attempts but according to one official, flowerpots and signs were back in the street the day after the police had removed them. They had dialogues for years but 'some are very stubborn'. If rules are not complied with, they are suspended.

f) Lacking learning structures: Learning within the municipality was hindered by frequent circulation of staff and reorganizations. Members of LDFs and councils were more permanent. They lacked a municipal structure for lodging and developing the knowledge between projects. They repeated the same standpoints about hearing loops, car parks, and kerbs in every project. With bitter pride, they told how they argued for a higher fence in a conference centre in mun.X, but that this was installed only after an accident. On an individual level, one could see one's proposals correctly documented but then overlooked.

### 3.3.2. Categorical tensions

Accessibility was an overarching label for the square workshop and the task of the experts in mun.X. Accessibility was understood as being limited to features for solving the needs of persons with impairments, e.g., even surfaces or tactile and visible paving, height and width of kerbs, car parks, and large toilets. There was a bias towards pedestrians, including wheelchair users. Outside this topic, comments were ignored. Proposals about roads, public art or air quality did not belong to accessibility. Proposals about furniture and sound milieu were in a grey zone.

How accessibility was interpreted in mun.X was indicated by the division of the municipal report from the square workshop, with subtitles like kerbs or tactile lines. When the project leader recalls the workshop at the square, she summarizes the themes as 'details'. When orientation was discussed, it was about finding one's way through the square, avoiding obstacles like outdoor seating furniture or flowerpots – described as 'delimitations' or 'equipment and objects on the square' in the municipal report. Categorizing accessibility as a minority interest made it a soft issue. An official in mun.Z compared accessibility with emergency vehicles:

> 'The emergency services are within the hard box that is easier to tick off, as one has always done, perhaps historically because that has to be solved, as it always has been. But now you have to work more, with accessibility for the mobility and visually impaired.'

Despite originating in the 1960s, accessibility legislation was seen as weak compared to interests like safety, art and cultural heritage. However, interests were unclear and intersected. The combined tactile-line and artwork was – with laughter – called both art and an 'accessibility thing', as in the quotation above. Another artwork consisting of a metal trim on a building floor was not intended as orientation help, but was understood as accessibility. In a street in mun.Z, different design intentions contradicted each other. Different paving was meant to mark cultural heritage but gave the impression of separated traffic, in conflict with the design goal of pedestrian streets.

### 3.3.3. Interpretational tensions

Beyond positive attitudes to collaborating to gather disability experience, there were uncertainties about how to judge personal narratives in relation to rules and future places. Officials felt disturbed by remarks on non-compliance with rules. They wanted to listen to disability experiences to gain understanding but were concerned about the composition of users and their representativity. In mun.Z, where there was no LDF, miscommunication was even more notable. By calling participants 'experts', mun.X wanted to widen the disability scope and focus on personal experience rather than organizational standpoints. In the municipal report, experts were identified as 'representatives' for their impairments. For example, blind and vision-impaired people were treated in separate chapters despite belonging to the same association. However, in the end, all experts were presidents of local associations.

Officials were uncertain about interpreting stories about personal experience. They wondered about the general relevance and applicability of the process. The subcontractor in mun.X explains:

> 'What we can perhaps see as the disadvantage of this way of working: being on site with a somewhat small group – is that it depends a lot on the people involved. After all, it is your personal opinion that you are expressing. And it can then vary, we think, from project to project depending on who is involved … There is still a risk that we interpret something wrong … You don't know if it's personal opinions … It's hard to know whose voice you're hearing.'

LDF employees without impairment did not count as experts and were first not invited to the square workshop. In the reflective workshop, they joined the municipal officials in doubting legitimacy. As recruiters, they were concerned with selecting and balancing a broad diversity. They knew the difficulties of convincing people and the risk of involving the same ones as usual. Then they might become 'torn apart' and 'bitter'. They were also concerned about their legitimacy within their associations – 'what role they have in their association'. However, they saw their task as mediators, conveying and interpreting stories, ensuring that no group dominated and that representatives followed the line of the LDFs, and didn't act as representatives only for themselves. They offered to judge what were personal anecdotes, small talk, or experiences of general relevance.

## 4. Discussion

Even if UD encompasses more than disability, it is still closely associated with it. UD was only utilised in collaboration with disability organizations in relation to 'accessibility'. The use of UD was always related to measurable facts and rational planning. Accessibility came in at the end of the process and dealt with particular features. As just one interest among other interests, accessibility became 'soft' in comparison to, for instance, security or access for emergency traffic. The fact that UD in practice seldom reaches farther than disability is confirmed by, e.g., Lid (2012), who found that only disability organizations were invited to a UD project for urban development in Oslo. The project claimed that 'UD is good for everyone' but the concern in practice was how to prioritize between different groups (Lid, 2012, s. 199).

### 4.1. Connected rules in reflecting judgements

The workshops revealed collaboration between municipalities and LDFs as a friendly tug-of-war with a mix of seriousness, humour and familiarity. This may be due to the size of towns. There was no citizen control in Arnstein's (1969) sense of the term, or communities of practice as described by Lave and Wenger (1991), but rather, what they call communities of interest – with an exchange of information, questions, and opinions. Officials felt quite sure in their professional role of balancing interests and applying rules situationally. However, they expressed uncertainty regarding the legitimacy of stakeholders as representatives, experts, or individuals, in this case judging the relevance of disability experience in relation to rules and proposals of future design. Hence, personal experiences were reduced to 'details'.

Aristotle's phronesis as judgement is valid here. Inference of facts shall, according to Dewey (1997), lead to ethical judgements prior to decisions being made. Bornemark (2017) depicts how theoretical knowledge about laws and regulations must be connected to reflecting judgements, made in complex and uncertain situations. Since phronesis is situational and context-bound, it cannot be transferred through texts and manuals. Learning how to apply rules and how to treat people in certain situations is achieved through participation. According to Bornemark (2017), city planning is dominated by episteme and technical expertise. Phronesis is the least-used type of knowledge. What cannot be measured rationally or evaluated quantitatively is seen as 'soft'. Phronesis is, according to Bornemark (2017), a reflection of presence and listening. This is a perspective that may help assess the legitimacy of participants' contributions. UD is according to Welch (1995), a pedagogical endeavour for explaining the reasons behind accessibility requirements and why minimum compliance is not sufficient.

## 4.2. Different kinds of expertise

Referring to user participants as 'experts' in mun.X challenged the power balance but did not change established routines of formal accessibility work. Ostroff (1997) opts for 'user/expert' for people with 'natural experience in dealing with the challenges of our built environment', having 'developed strategies for coping with the barriers and hazards they encounter every day'. Direct interaction with potential users during the design process is a natural resource that gives designers 'expanded insights' and helps them to frame design problems in new ways. However, planning is regarded as objective–neutral, technical–rational and impersonal–numerical. The 'scientization of society' connects expertise to a closed and self-reliant professionalization (Yanow, 2009). Such an 'expertocracy' denies the agency of others. However, genuine science is based on doubt rather than certainty and conviction. Yanow proposes cultivating a passionate humility that values different ways of thinking, being open to alternatives and seeing when one's own expertise is limited or inapplicable.

Bertolini, Laws, & Higgins (2010) affirm the relevance of Schön's 'reflection-in-action'. Schön's idea about engaging in conversation with the situations, is still valid. Processes have become even more complex, uncertain and unstable. However, there are tensions between open, continuous inquiry and routines and institutions demanding products that are accepted by stakeholders. To develop professional practice, Bornemark (2016) urges officials to not see themselves as representatives for the municipality but as thinking, feeling, and reflective citizens who, together with others, have different opinions but common concerns. Dialogues based on phronesis are creative arenas for exploring and developing goals and values. Bornemark refers to Davidoff (1965) who in the 1960s urged planners to implement 'plural planning', not regarding themselves as value-neutral technicians, but affirming values and engaging in political processes as advocates for minorities. Competition and debate among proposals would improve quality. Davidoff wanted architects to work for civil society organizations to match the municipal offices. However, still today, the dominant model is one governmental plan and one proposal that planners advocate and stakeholders reject or approve.

## 4.3. Different roles in collaboration

For De Blust, Van den Broeck, Devos, & Moulaert (2022) planning is a socio-pedagogical project and collaboration reinforces and mobilises vulnerable and marginalised groups in new roles. Their 'socio-environmental justice' is not based on representation, meeting needs or universal principles but rather on situated moral inquiries. Collective interaction between practitioners' experiences stimulated a learning environment with flexible and critical responses in specific moments and places with changing conditions. However, the studied cases indicate that bringing personal stories of exclusion and oppression into the public realm requires training. Further, focus on disability experience instead of organizational standpoints risks generalizing needs and activities that are associated with certain specific impairments. Using accessibility as a minority interest for guaranteeing usability and for highlighting signs for claiming space, may backfire. If accessibility is limited to particular features related to persons with impairments, this 'interest' risks down-prioritization.

Limiting the application of UD to specific groups and interests may hamper the intersection of discrimination perspectives and innovation for comprehensive human diversity. Instead of seeing particular features as minority problems, Boys (2014) recommends general discussion about how, for instance, the use of contrast and handrails serve all and why, for example, stairs are used as 'visual contemplation' (p. 179). Furthermore, impairment-bound design excludes the needs of

other groups or persons outside or between the examined categories. Regarding users simply as orientation objects obscures their user needs for, e.g., social life. Not focusing on impairment may give a better picture of what it is like to spend time in the city, getting there and back and combining different activities, regardless of impairment. Sometimes users' personalities, wishes, and desires might be better served by decisions other than those concerning more tactile lines or other features. Feeling welcomed, comfortable and being a part of the community with others, relaxing and meeting people as you want, is not connected to one's impairment.

## 5. Conclusions

This paper has revealed different kinds of knowledge practiced in urban development collaboration. Impersonal measurements and rational professional knowledge about accessibility as rational, resemble episteme and techne. Phronesis is akin to UD, which brings understanding and direction to accessibility requirements and potential design. However, in actual practice, UD was associated with a narrow understanding of accessibility as features for a minority, conveying a limited scope of manoeuvring. Such an interest became weak in the negotiation process and risked losing priority or being added late in the process. Enforcement is not a priority for soft interests. Hence, interests higher up the hierarchy, such as security or sustainability, could be tried, i.e., for even surfaces, contrasts, or tactile orientation.

Disability experience was the driver of knowledge and the matter of collaboration. However, much can be done to highlight the innovative strategies developed by disabled people and to connect disability experience to other experiences. Intersectional collaborations between the different legal grounds for discrimination, rather than collaborations with separate target groups, may better reflect users' experiences. Here, techne and phronesis may help interpret and assess disability experiences in relation to rules and the design of future places.

Since regulation and standards do not explain exactly how to deal with complex and unpredictable situations, design decisions should be done with phronesis, i.e., context-sensitive and ethically wise judgements based on empathy and flexibility. Applied phronesis means balancing professional and experiential expertise as well as engaging in reflection with mutual respect. That can include collaboration on local guidelines and interpretation and integration of requirements in processes that are seen as a common endeavour. This does not mean dissolving the user role but rather regarding people experiencing disability as contributors to design processes. While consultation that implies expected responses to municipal proposals, can result in a sense of feeling ignored, a co-creative collaboration can give members of disability organizations (many of them with valuable life experience) a crucial role in the design process. Participants should not merely be seen as subordinate contributors, reacting to municipal proposals with approvals or rejections, but rather as legitimate contributors to a common foundation of knowledge for the creative process.

Although they entered dialogues with different knowledge perspectives, parties strived to understand and learn from each other, thus shaping conditions for local knowledge based on trust. There were ambitions to integrate disability experience in the processes but uncertainty about how to do it. Beyond jovial descriptions of collaboration, tensions existed regarding organizational asymmetry, consultation, the professional/user divide, procurement rules, resistance, inadequate learning structures, accessibility as a minority interest of particular features and legitimacy. Co-creation remained a discussed ideal. Structural tensions like organizational asymmetry yield risks of 'effective' but symbolic participation processes, or processes that are only employed in prestigious cases, like centrally located sites.

Participants' motivation for shared and used knowledge, implies a need for a long-term user perspective with 'solutions' and projects in a weave of multiple processes. In such contextualised and situated learning processes, parties contribute to the co-creation of knowledge. Here, tensions offer a base for an epistemological strategy for collaboration concerning situated and practically wise judgments. However, the roles and opportunities to influence must be discussed and clarified in every project. Reflection is needed on 1) expectations and characteristics of roles, 2) selection and interpretation of user experiences, 3) communicative skills and internal tensions of the disability organizations, and 4) the beneficial potential of ambiguities and tensions. Further research may clarify how to diminish the risk that procurement rules restrain the creative process by only promoting existing solutions.

# 6. Ethical declaration

According to formal advice from the Swedish Ethical Review Authority, ethical approval was not required for this study. The authors declare no conflict of interest.

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# From user perception to architecture
## Improving arrival and waiting spaces in primary healthcare centres

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Abstract: This research paper examines primary healthcare facilities in Montenegro, focusing on outpatient spaces - arrival infrastructure, outside spaces, and inside spaces. In Montenegro, primary health centres provide 80-85% of all health care services and are designed to serve patients within the defined local community. In these facilities, the maintainer of primary care is a chosen doctor (GP), a person most familiar with the patient's conditions and social background. Despite the personal service healthcare centres provide, the architectural expressions of the built facilities do not reflect the intimate nature or personalisation of this service. By examining the user experience and doing field research, we identified several shortcomings in these facilities' exterior and interior quality. Data was gathered through a questionnaire involving users and field research, encompassing large, medium, and small-sized healthcare centres. Participants initially expressed neutral perceptions of existing elements, but when given the opportunity to choose, they became more inclined to suggest improvements. The field study identified rather negative architectural aspects, including inconsistencies in performance across the facilities. The design primarily serves the functional requirements determined by the current capacity, whereas considerations regarding aesthetics and the users' comfort are often neglected. The findings highlight the need to align architectural design with user preferences, emphasising the significance of user-centric healthcare facility design in Montenegro and similar environments.

## 1. Introduction

Montenegro provides healthcare services on three levels. The first level is primary healthcare, provided by a general practitioner (GP) called a 'chosen doctor' or a team of doctors in the health centre. The secondary healthcare level provides special clinics and hospital wards; the tertiary level supports it with sub-specialist clinics (Montenegro Ministry of Health, 2015). The majority of healthcare providers are public entities. The healthcare institutions can be in a standalone building or a designated space within a residential or mixed-use building with a separate entrance and exit. The official gazette of Montenegro from 2008 stated that all spaces for conducting healthcare activities must form a single unit and be completely physically separated from any other residential or office spaces (Službeni list Crne Gore, 2008).

The Master Plan for the Development of the Health System for the Years 2015–2020 highlights the importance of primary care in enhancing population health and bringing down medical expenses (Montenegro Ministry of Health, 2015). The primary point of a patient's access to the healthcare system is the chosen doctor (Mosca et al., 2022). However, primary care is not being used to its full potential (World Health Organization, 2020).

In Montenegro, there are 18 primary health care facilities, which provide both primary care services and additional services offered by support facilities. Supporting services include diagnostic and prevention centres, home visits and patient transport units, centres for lung diseases and tuberculosis, mental health centres, centres for children with special needs, daycare centres, and primary-level physical therapy units. In daily service delivery, primary care settings differ from hospital inpatient settings, where patients are cared for continuously and frequently for longer periods. In contrast, in primary service, patients receive treatment almost immediately. Many health problems can be resolved entirely in primary care, and patients who require secondary care services are first evaluated there (Morgan et al., 2021). However, even for diseases that may receive treatment in primary care, the current Montenegrin primary-care model and the chosen doctors' payment structures encourage referrals to specialist services. This model contrasts with the government's goal, which has existed since 2005, of organising primary care to address up to 80-85% of the population's healthcare needs (Government of Montenegro, 2022a).

Mechanic (2004) states that choosing a personal doctor and care settings, continuous care, and effective communication contribute to trust in healthcare quality. He points out that central to patients' trust is how doctors communicate and whether they seem caring. Primary healthcare satisfaction could result from good practice organisation or good personal relations with the GP (Gabbott & Hogg, 2010). Neighbourhoods with more primary care physicians tend to have healthier patients, as greater access to primary care is associated with better health outcomes. The primary care physician can influence unhealthy behaviours to prevent diseases thanks to this trusting relationship (Krist et al., 2016). Ideally, individuals should connect with a primary care physician when they are healthy.

Besides the quality of health services, the architectural design of healthcare facilities also impacts patient satisfaction. The atmosphere created by the physical environment can predict patients' satisfaction, their intention to return, and their willingness to recommend a healthcare provider to others(Hutton & Richardson, 1995). Evidence suggests that factors under the control of architects can significantly affect patient satisfaction and influence the quality of life, treatment times, medication levels, displayed aggression, sleep patterns, and compliance with regimes, among other factors (Lawson, 2010).

## 1.1. Objectives

The dominance of research on inpatient facility environments and the lack of studies on outpatient or primary care facilities in the healthcare design literature is noticeable (Watson et al., 2016). There are significant gaps in the literature regarding the types of outpatient or primary care buildings and visitors' viewpoints within the social spaces of healthcare environments. Research about user perspectives in these settings has been done separately for patients (Jovanović et al., 2022) and staff (Oandasan et al., 2009) or discussed from a combination of both (Huisman et al., 2012).

There is currently not much research regarding the social context of healthcare buildings and their design aspects in Montenegro. While surveys have measured the users' satisfaction with

services, none addressed the space quality for these services. This paper's analysis starts with areas of arrival where users get their first impression of the facility. The research deals with the users' impression of arrival and waiting within the facility and examines whether some design elements are perceived differently. By collecting data from patients, staff, and accompanying persons, this study can contribute to users' satisfaction databases with aspects that consider satisfaction with the physical appearance of the facilities. Hospital clinical practices mainly focus on treating the illness rather than on a patient's social, spiritual, and psychological needs (Dilani, 2008). Healthcare facilities should provide a therapeutic atmosphere where overall design contributes to the healing process rather than simply being a place to carry out the treatment (Phiri, 2014). Quality healthcare architecture must overcome profitability problems within the public sector to overcome these shortcomings and perform thorough research for the most favourable outcomes.

## 2. Literature Review

Hospital clinical practices mainly focus on treating the illness rather than on a patient's social, spiritual, and psychological needs (Dilani, 2008). Lawson (2010) emphasises the importance of the patient's experience and the need to create healing places rather than machines for treatment. Healthcare facilities should provide a therapeutic atmosphere where overall design contributes to the healing process rather than simply being a place to carry out the treatment (Phiri, 2014). To achieve these objectives, it is important to prioritise quality healthcare architectural design, regardless of profitability concerns and public sector financing challenges.

## 2.1. Public sector issues and lack of evidence-based research

Since medicine sometimes neglects the significance of the physical environment in patient well-being, architecture lacks a profound tradition of study for healthcare facilities. This oversight makes the research process in healthcare settings especially demanding (Devlin & Arneill, 2003). The starting research point of these facilities can be evidence-based design (EBD), which is done during the design process. It is followed by building performance evaluation (BPE), based on analysing post-occupancy evaluation (POE) after the facility is in use.

Problems associated with sponsors' and clients' funding scenarios persist, as the amount of funding can determine greater design options and higher-quality building execution(Verderber et al., 2014). The public sector typically has fewer design opportunities than private clients, as public procurements prioritise the cost-effective provision of products and services for public use over profit (Palaneeswaran et al., 2003). Radulović, the director of the Clinical Center of Montenegro, stated that the budget plan 2021 allowed the planning and execution of four new healthcare capacities within the existing healthcare complex. The State Audit Institution announced the construction of these facilities in 2011 through official reports. However, until 2021, there was no allocated funding for them, so the realisation could not occur (Clinical Center of Montenegro, 2022). In July of 2022, the construction work started for the mental health clinics (Government of Montenegro, 2022c), while work on two facilities for infectious diseases and dermatovenerology clinics began in October of the same year (Government of Montenegro, 2022b).

Nevertheless, no regulations ensure the building design quality of healthcare facilities in Montenegro. Research may provide answers regarding the effects of design on the users' health and mood, improve the importance of the design profession, provide a better return on

investment, and—possibly most importantly—create optimal healthcare environments for patients, families, and staff. Still, in the case of publicly funded buildings, most design guidelines tend to focus on compliance with several minimum standards. Public-sector guidance concentrates on the issue from the staff and treatment perspective, often leaving the patient-focused impressions behind (Zborowsky & Bunker-Hellmich, 2010).

Joseph et al. (2014) describe EBD as a three-step process. First, the design activity employs research to make decisions and evaluate their impacts. Second, a key component of the EBD process is emphasising research rather than relying solely on anecdotal evidence or best practices. Lastly, it centres all design decisions made throughout the design process on the needs of patients, staff, technology, and organisational outcomes. Another issue to be addressed is the exclusion of POE from conventional architectural education, possibly with the help of professional pressure (Hadjri & Crozier, 2009).

According to Alfonsi et al. (2014)., understanding EBD results should be a 'mandatory step' for any designer working on a healthcare building design. Still, it has not yet been widely applied to healthcare design globally. EBD is currently widely utilised and included in the process by many healthcare designers in the US. However, in Montenegro, it is still not required by regulations.

The crucial part of EBD is assessing how design decisions affect outcomes. Research linking healthcare facility design to patient, staff, and family outcomes is becoming more widely available (Joseph et al., 2014). Much of the research available in EBD is done through case studies since it can be challenging to generalise healthcare design case studies beyond the individual setting where they happen. Each healthcare system, independent of its scale, has its organisational structure combining social layers that sometimes operate independently, like nursing and physician culture or administrative vision. Ensuring that organizations are comparable for unbiased research or identifying similar organizations to study is a challenging task, according to Zborowsky and Bunker-Hellmich(2010).

Evaluating the building's design after it has been built and occupied, the last phase in the EBD process is crucial because it adds to the body of knowledge and completes the innovation cycle. Post-occupancy evaluations (POE) have always prioritised gathering user opinions and input regarding building performance. Research regarding POE has lately concentrated on a building's technological performance (Budaiwi et al., 2022; Eijkelenboom & Bluyssen, 2020; Garcés et al., 2022). By measuring patient clinical outcomes, along with user satisfaction with the built environment, the EBD method could strongly influence the performance of healthcare facilities.

To reflect the quality of a building's design and output, Preiser et al. (2009) put users at the centre of the design of a building by utilising the term performance, which is less ambiguous and simpler to measure. They used building performance evaluation (BPE) to measure if the facility effectively meets a performance target. Post-occupancy evaluation (POE) is considered a sub-process of BPE by them. It is described as 'the act of evaluating buildings systematically and rigorously after they have been built and occupied for some time' (Preiser et al., 2015).

While researchers frequently discuss EBD, practitioners who play a significant role in forming the built environment must also get involved to achieve a positive turn in creating buildings. Unfortunately, most new healthcare facilities in Montenegro do not implement these methodologies. According to Lawson (2010), designs must improve remarkably to achieve a better standard of care. It is important to highlight the role of architects engaging in POE of the completed building despite this approach demanding a systematic assessment and investment of resources and time (Samah et al., 2013). In conclusion, POE is a helpful tool for enhancing

structures, raising user comfort levels, and controlling expenditures. However, the cost, defending professional territory, time commitment, and skill requirements are still barriers to the broad implementation of POE (Vischer, 2002).

## 2.2. Design aspects and components

In healthcare architecture, a notable transformation occurs as architects prioritise humanist values and design principles, focusing on patients' social and psychosocial requirements while enhancing their experience within the facilities (Lyon, 2017). Architectural factors like the building's composition scale, daylighting, colour palette, wayfinding amenities, staff, patient circulation patterns, aesthetic ambience, and overall suitability for disseminating healthcare are frequently overlooked (Samah et al., 2013). Understandably, the primary concerns regarding healthcare services are measuring health outcomes, worker morale, productivity, and care quality. However, recognising how the physical environment performs in the architectural aspects can help strengthen their relationship.

Montenegro does not have a particular architectural guideline regarding the design of healthcare facilities. In August of 2023, the Ministry of Ecology, Spatial Planning and Urbanism announced the international competition for the healthcare centre in Podgorica. Even though this is the newest proposed healthcare building, the guidelines from the competition brief did not include any requirements for the design quality regarding this specific facility category (Ministry of Ecology, 2023).

However, several requirements exist in the general regulations for providing primary care in Montenegro. As stated in the Official Gazette of Montenegro, the yard and access roads around the building must be paved or asphalted, while other areas must be covered with grass; all rooms of the health care facility must be airy and lit with natural light or appropriate artificial light; and the waiting room must contain chairs for patients, a hanger, and a plastic wastebasket (Službeni list Crne Gore, 2008).

Guidelines already implemented in other countries can help broaden the design knowledge. General design guidance for healthcare buildings issued by the UK Government distinguishes policy and regulatory scope, master planning, and building design guidelines (Phiri, 2014). Guidelines mainly deal with the arrival to the facility, both outside and inside. Outside elements include a canopy, bright lighting, a well-lit entrance, directional information, design surface, plants, external seating, and an external appearance that is confident and has a well-cared-for look. Inside elements include light, spacious and airy atmosphere, seating distribution, recognisable reception, easy wayfinding, plants, and high standards to give the organisation a positive image.

The interior environment is the setting that helps create a healing environment and includes elements such as a relaxing atmosphere, general safety, suitable ergonomics, and therapeutic methods (Ghazali & Abbas, 2012). These elements must be adequately organised to avoid confusion and disorientation in the user's perception.

## 3. Methodology

As noted, few official requirements exist for the architectural design of healthcare facilities in Montenegro. Based on this information, it was hypothesised that the buildings would comply with the regulations but not display additional design qualities. The research consisted of two phases and used a mixed-method approach. The first step was a questionnaire conducted at the biggest

healthcare centre 'Nova Varoš', which used a quantitative methodology. Results from this part served as leads for the second part, which focused on the elements that received the most significant impressions. This part included qualitative analysis field research of three different Podgorica facilities: a large, a medium, and a small-sized facility. The assessment focused on survey elements, including arrival, outside and inside spaces. Data was collected by visiting the chosen healthcare centres, gathering graphical material and making notes on the space design and usage, which were later evaluated.

Ethical approval for the study was obtained from the Primary Health Care Centers of the Capital City in Montenegro and the Budapest University of Technology and Economics before any data collection happened.

### Phase I

The questionnaire consisted of 30 questions with a 7-point semantic differential scale and a Likert scale. Questions considered specific personal data, impressions about the arrival at the centre, the outside facility appearance, and the interior waiting zone. Every participant could express further personal experiences outside of the preset questions. The questionnaire was conducted in person, in the healthcare centre 'Nova Varoš', while the online version was distributed to people who could not fill it out on the spot. This principle ensured that all participants had the most recent impression of the examined site.

Age, gender, employment, education, and role in the healthcare centre were part of the collected personal data.

Questions considering elements of the built environment included:

- Arrival spaces included transport means, length of the route, waiting time, parking lot, public transport, and covered areas.

- Outside spaces focused on the overall appearance of the building, entrance, seating places outside, and vegetation around the healthcare facility.

- Inside spaces were the most detailed and considered design of the waiting area, reception, atmosphere, signage, wayfinding, seating area, natural lighting, interior plants, and artwork and decorations.

A total of 41 categories were available for participants to evaluate. Participants could use the 7-point semantic differential scale to express their perception of the elements by placing a mark along a scale that spans between opposing pairs. This mark represented a numerical value, from -3 as entirely negative to +3 as a completely positive adjective. The data from patients, staff, and accompanying people was analysed using Jamovi statistical computer software.

### Phase II

Three primary healthcare centres were selected for the detailed qualitative analysis based on the number of registered patients in the facility. Table 1 shows every primary healthcare centre in Podgorica organised by the building characteristics and the patient capacity.

The research included three institutions with a large, a medium, and a small patient count. As previously mentioned, a questionnaire was conducted in the largest facility' Nova Varoš', which has 25807 registered patients, so this institution was automatically selected for further analysis. The medium category included primary healthcare centres ranging from 11714 patients ('Konik') to 16014 ('Stara Varoš'). Even though the 'Stara Varoš' centre was numerically in the middle, it was disregarded as it is physically identical to the Nova Varoš building. For this reason, the 'Zlatica'

centre, which had 13449 patients, was selected. The 'Zabjelo' healthcare centre was chosen as the smallest facility, with 7280 registered patients.

*Table 1.  Categorisation of facilities by the number of patients (source: Authors, 2023)*

| Size | Type | Patient number |
|---|---|---|
| Large facilities | | |
| Nova Varoš | Individual facility | 25807 |
| Blok 5 | Individual facility | 22849 |
| Medium facilities | | |
| Stara Varoš | Individual facility | 16014 |
| Zlatica | Individual facility | 13449 |
| Stari Aerodrom | Individual facility | 11769 |
| Konik | Individual facility | 11714 |
| Small facilities | | |
| Gornja Gorica | In multipurpose building | 9373 |
| Studentski centar | In multipurpose building | 9202 |
| Zabjelo | In residential building | 7280 |

We visited three institutions, 'Nova Varoš', 'Zlatica' and 'Zabjelo' in February 2023, following the implementation of the initial survey. Photographs, researcher sketches, and notes on impressions were collected. The staff could also describe their impressions in an informal conversation, albeit at the workplace. The focus of the facility visits was on the elements included in the survey. Assessment of the arrival included examining parking facilities, public transportation options, alternative modes of transportation, and pedestrian access. Entrance, overall look, outside seating, covered areas and vegetation were part of the analysed outside spaces. As for interior spaces, the evaluation encompassed the reception area, waiting area, signage, seating arrangements, natural light availability, indoor plants' presence, and artwork display.

# 4. Results and Analysis

## 4.1. Phase I

A total of 52 people participated in the questionnaire. Female respondents formed the majority, 66% of the sample. However, the analysis showed no significant differences in the impression results of the two genders. The majority of the participants (54%) were using a car as the means of transportation to the centre, followed by taking a walk (28%), with the least number of them taking a means of public transport (14%) and a bike (4%). Only 8% needed 30-60 minutes to reach the facility, while 14% took less than five minutes. Most (38%) took 5-15 minutes, followed by 36% whose reach time was 15-30 minutes.

As the sample was too small to obtain generalisable results, the distribution of the responses was irregular for many parameters examined through the questions. Variables with regular distributions are presented in Figure 1.

*Figure 1. Bar plots with the regular distributions (2023)*
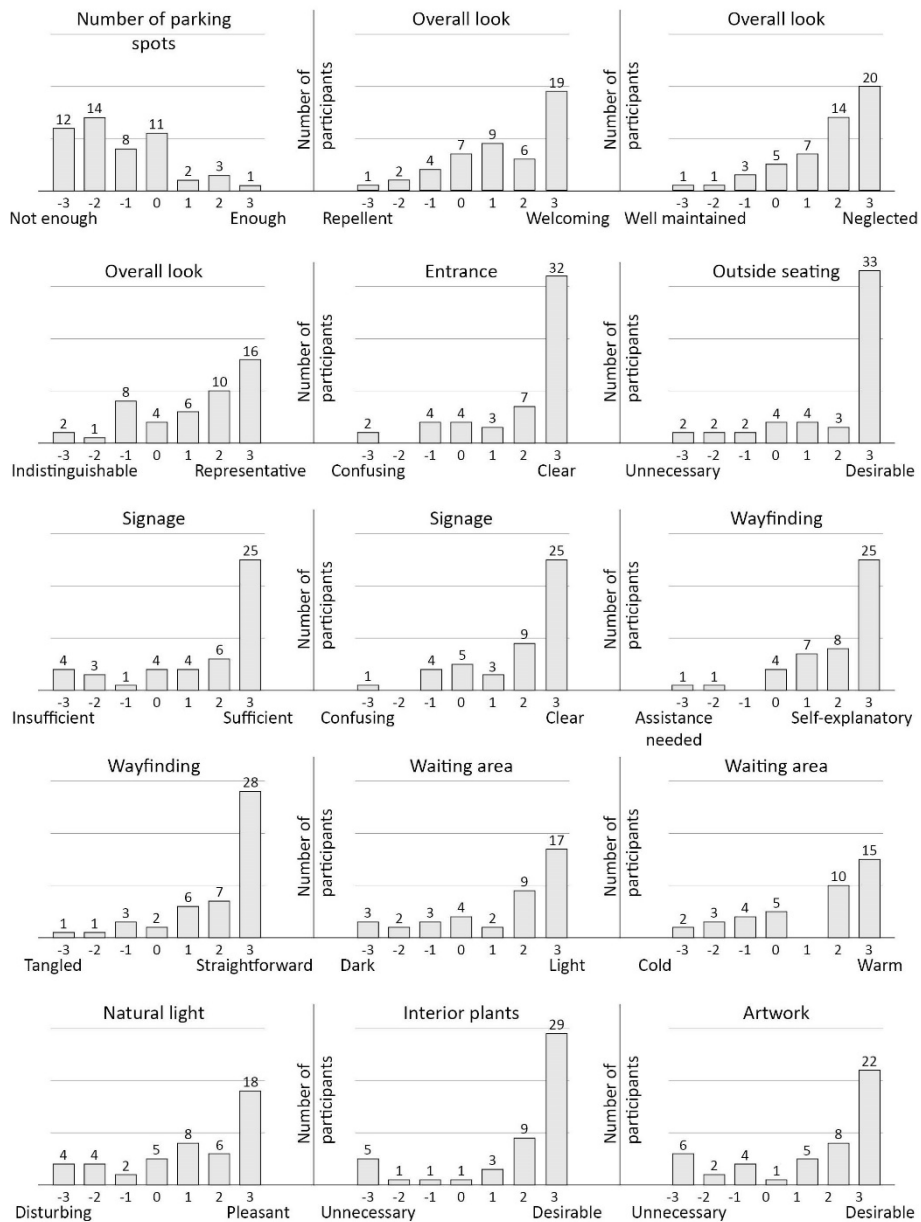


As depicted in the bar plots in Figure 1, according to the regular distribution of the answers, the greatest attention was directed towards the exterior appearance, signage, and wayfinding, which constituted the initial contact with the institution and accessing services. Participants only expressed reactions regarding the ambience in light/darkness and cold/warmth within the waiting area and their preference for pleasant natural light, interior plants, and artwork. The phase I results indicate a relatively neutral perception of the remaining categories within the healthcare centre where people spend their time. However, Figure 2 displays a stronger inclination among respondents to suggest improvements in certain elements.

Based on the result, Phase II focused on evaluating the facilities' exterior, firstly, overall look and entrance, which received positive perceptions from Phase I. From the interior spaces, special attention was paid to adequate seating, signage, artwork, and interior plants.
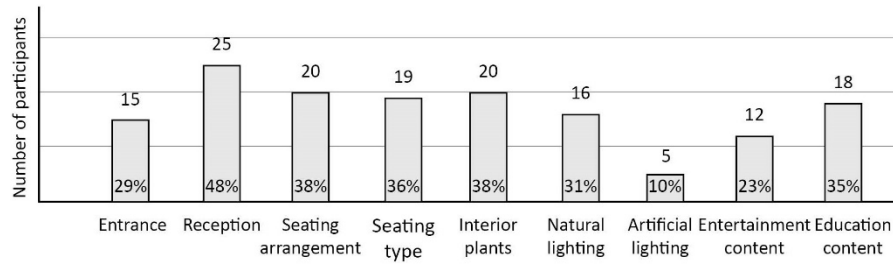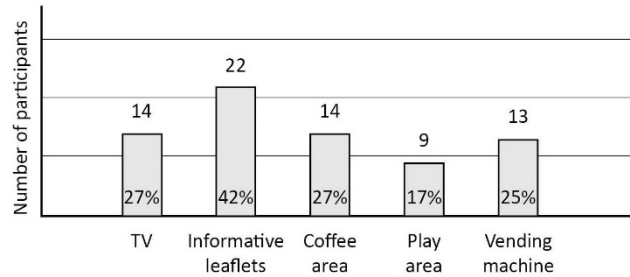
*Figure 2. Elements to be improved (2023)*



*Figure 3. Elements to be included (source: Authors, 2023)*



The reception area garnered the highest impressions; nearly half of the participants desired improvements. The seating type and arrangement, along with the presence of interior plants, ranked closely behind in terms of user preferences. Education content, natural lighting, and the entrance zone received between 29% and 35% of participants who wished for enhancements. In contrast, only 12 participants voted for improvements in the entertainment content, while a mere five indicated a desire for better artificial lighting, as per the questionnaire results.

In addition, participants were allowed to select elements they would like to have in the centre, regardless of whether they already existed. Of the respondents, 22 expressed a desire for informative leaflets, while 14 participants preferred a TV and coffee area. Furthermore, 13 respondents wished for the inclusion of a vending machine, whereas only nine participants selected a play area as their choice (Figure 3).

## 4.2. Phase II

### 4.2.1. Healthcare centre 'Nova Varoš' (A)

Healthcare 'A' is a freestanding, ground floor + one floor (GF+1) facility in the inner city core (Figure 4). In the immediate vicinity, residential buildings range from GF+0 to GF+3 floors, and public facilities include an elementary school and a theatre. The building faces a secondary road, providing access to all entrances. River Ribnica flows behind the building, although there is no established connection between them.

Arrival: Access to the building is possible for vehicular and pedestrian traffic from several directions, and there are two public transport bus stations within a radius of 250 m. The surrounding environment is not designed to accommodate cycling and other alternative modes of transportation.

*Figure 4. Exterior of the health centre 'Nova Varoš' (source: Authors, 2023)*



Although the Phase I results indicate general dissatisfaction, more vacant parking spots were observed during visits to the facility at different periods of the day. The dominance of drivers in the questionnaire (54%) shows a slight bias towards the preferences of this group. The location has many parking spaces with different parking systems; however, no part is designated exclusively for health centre users.

Outside spaces: The building's front facade is nearly symmetrical and features two identical entrances with ramps for individuals with reduced mobility. The only covered external spaces are in front of the entrance zones, a few meters from the facade. Two wooden benches are placed in front of the facility, while three additional benches, also used by the patients, are located 30 m from the entrance. A board with the institution name, function and logo is next to the entries.

Previously, the right main entry servedadult patients, and the other for minors. However, because of the adult patient overload, the paediatrician's workplace was eventually relocated to the first floor, eliminating the distinction in the entrance hierarchy. Typically, accompanying people or patients who arrived during a break occupied the outside benches. Just over half of the respondents (52%) feel that the number of places to sit outside is insufficient, while a significant majority (85%) consider it desirable.

Several perennial evergreen and deciduous species make up the vegetation in the immediate surroundings of the building, which existed before the facility's construction. Pedestrian pavements consist of monolithic concrete slabs cast on-site without design ambitions. The additional green areas are not specially designed for the health centre, so unpaved regions do not have proper landscaping.

Inside spaces: After entering the facility through either door, the visitor encompasses the wider corridor-like space, which serves as the waiting zone beside the communication (Figure 5). The reception is not in direct sight from the entrance point but is visible only after a few meters inside the building. The floorplan is symmetrical, with an even distribution of doctors' rooms on the sides and the reception and injection department in the middle (Figure 6). Signage is present in large numbers, with signs and descriptions on every door.

*Figure 5. Reception and waiting area of the health centre 'Nova Varoš' (source:Authors, 2023)*



The reception desk is attached to the side walls and has one longer approaching side. Six workplaces and seats are provided for the staff, while archive papers are directly behind them. The reception area is double-height and does not have direct natural light, while the artificial light is dim and diffused. The desk height is around 120 cm, which makes it maladjusted for wheelchair users and children.

*Figure 6. Sketch from the field research, facility A (source: Authors, 2023)*
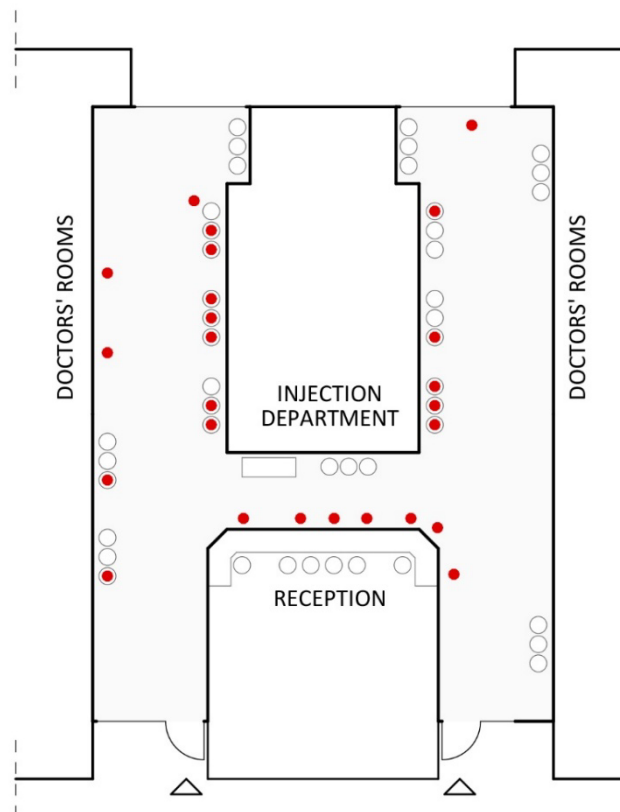
Distance from the openings and central position make the reception area dark, especially in gloomy weather conditions. The outdated design troubles patients: they cannot maintain the correct queue, and the area gets crowded during busy periods. There is no division between the counters, so several patients approach one worker simultaneously. Usually, more staff are needed, but they must stand behind due to the lack of workspace.

The waiting zone contains 36 seating places, most placed across the GPs' room doors. Natural light comes from the entrance doors and windows on the opposite side at the end of the building. Artwork is present in several framed photographs with nature motifs behind the seating, but no interior plants exist. The area also contains trash bins, vending machines, informative posters, and advertising displays.

Patients occupied each seat during busy periods, while some were broken at the time of the visit. Despite accessible seats, several patients stood in front of the doctors' rooms. The users' mistrust that the doctor calls patients in order leads to this situation. Three questionnaire participants included the display with patients' calling order as a desired element. The waiting room atmosphere was rated as bright, and the natural light was highly pleasant. Spaces at the end of the ground floor are well-lit, which is not the case for the waiting area further from the windows.

## 4.2.2. Healthcare centre 'Zlatica' (B)

Healthcare centre 'B' is also a freestanding one-floor facility in the city's suburban area. We find the forest-like park and two open football fields on the southwest side. On the northeast are individual residential houses of a maximum of two storeys and a primary school. The main five-lane road passes next to the building, connecting Podgorica and northern cities. This health centre is the newest one, constructed in 2018. (Figure 7).

Arrival: The primary road access for vehicular traffic is via the main road, while the additional secondary streets exist within the residential area. Pedestrian traffic is possible along the traffic streets through the sidewalks. There are two bus stations within a 550 m radius, while the surrounding area is not appropriate for cycling and other modes of transportation.

*Figure 7. Exterior of the health centre 'Zlatica'(source: Authors, 2023)*

The facility has pavement for pedestrians on the perimeter, but some streets within the neighbourhood have just asphalted areas dedicated to vehicles. This situation affects safety and is particularly uncomfortable when these areas become flooded in unfavourable weather conditions.

Parking with 24 spots dedicated to users is next to the building and is the only one in the vicinity. During the visit, around half of the free spaces were observed. Cars were parked on the street in front of the building, but it is unsure whether they were from the health centre. This situation is commonly frequent in many suburban residential neighbourhoods.

Outside spaces: The building has a representative door from the primary roadside with the canopy. A sign with the official name and logo is on the wall beside it. However, this is not a usable door and can be misleading for first-time users, mainly because no additional sign suggests the entrances are on the opposite side.

Two main entrances are at the backside – one for the adults and one for the minors. Both have a board with the institution name, function and logo attached. Besides the health centre, the facility accommodates a pharmacy and the post office on the same side. Two meters wide protrudes through the entire length, efficiently protecting the users who sit or stand outside. Ground floor elevation is around 30 cm, and access ramps for individuals with reduced mobility exist along three sides. Two benches exist before the entrances, mainly used for short waiting periods.

Vehicle traffic prevents any physical connection between the park and the centre. While waiting in front of the building, a significant part of the vegetation was visible, and the atmosphere was pleasantly quiet. The landscape design, except on the primary entrance, included shorter vegetation, such as rosemary shrubs, younger trees, and grass surfaces.

Inside spaces: The interior situation is similar to facility A's corridor-like entrance space (Figure 8). The reception is visible from the entrance to the left side, with the upper level's high counter and glass separation.

*Figure 8. Reception and waiting area of the health centre 'Zlatica' (source: Authors, 2023)*

*Figure 9. Sketch from the field research, facility B (source: Authors, 2023)*
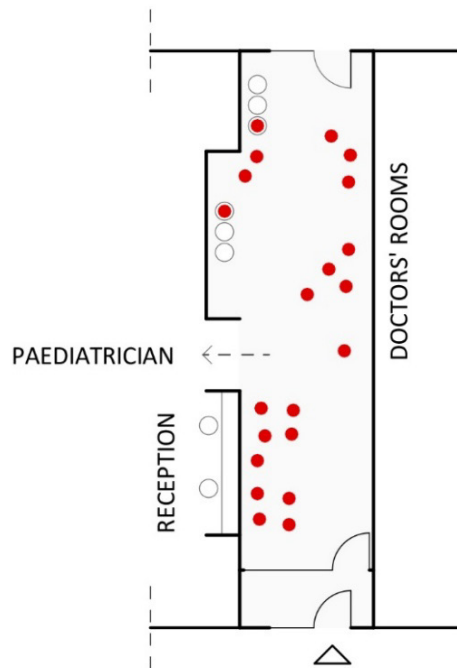


This position created crowds, as waiting for the reception or the doctor's appointment and passing through were mixing in busy times. No division between the counters also disturbs the order of receiving patients. The reception staff uses two chairs behind the desk, but this number is insufficient. They expressed the need for more workspace, as the services almost always need four members, and the lack of space makes the other two people assist from behind.

The ground floor for the waiting zone is symmetrical, so adults and children have the exact proportions and design, with the reception and additional rooms in the middle. An open corridor above reception connects paediatrician and adult GP waiting rooms, and anybody could pass—this distribution of space and no physical boundaries created noise between different areas. Staff pointed out that this uninsulated zone caused discomfort on both sides.

Like facility A, the building has numerous signage featuring signs and descriptions on every door.

The waiting zone accommodates six seating places, all of them located across the doctor's rooms. Only two people used the seat at the visit time; two were standing next to them, eight waited closer to the doctor's room door, and nine patients were waiting in front of the reception (Figure 9). The space size seemed insufficient for a comfortable atmosphere, especially in the reception area closest to the entrance.

Natural light mostly comes from the entrance door. On the opposite side is another door, previously mentioned as an unused entrance, next to the main road. Distance from one light source and coverage of the other makes the space quite dark during the daytime.

The artwork was similar to the previous facility, with natural motives behind the seating, but in a notably smaller quantity. Two potted plants were present in the area around the reception. Staff confirmed bringing the plants to make the space more comfortable and cheerful.

### 4.2.3. Healthcare centre 'Zabjelo' (C)

Healthcare centre 'C' is the only analysed facility integrated into a residential building. It is positioned on the raised ground floor, with seven more storeys above (Figure 10). The

surrounding area is mainly residential, mixed with multistorey collective housing and up to two-story private housing. Kindergarten and two elementary schools are near the facility.

Arrival: Vehicular and pedestrian traffic can access the facility from the multiple secondary streets. The busy main road is 100 m from the entrance, but the green buffer zones soothe the noise. Two public transport bus stations are within a radius of 350 m. Neither here is the surrounding adjusted to alternative modes of transportation.

The parking zone is located after the secondary street. The area seems adequate for accommodating users' needs, but since there are no divisions of zones, it can get crowded in busy periods of the day since residents use it primarily.

Outside spaces: Three almost identical door elements represent the healthcare facility within the residential building and are distinguishable by blue louvres. Their design is in order with the existing facade rhythm, with the PVC joinery of the newer date. A plate with the institution's name, function and logo is present above the entrance door, which makes it clear. The main entrance is not covered with any element, while the balconies above serve as a canopy for the facility's sides.

Monolithic concrete tiles cast in the site make the pavement in the front, while the material of the access stairs is marble. Uneven paving with cracks and unstable stair surfaces makes the approach uncomfortable and unsafe. This neglect diminishes the overall representation of the facility. Access for people with reduced mobility is difficult due to the lack of appropriate ramps or platforms.

Nearby the facility, there are three wooden benches, all in neglected condition. None of them face the facility and are not dedicated to the users expressly, so residents use it more often in good weather conditions. Patients were seen waiting outside the door or sitting on the concrete pavement during the break.

*Figure 10. Exterior of the health centre 'Zabjelo' (source: Authors, 2023)*

Extensive vegetation exists on the site, with primarily evergreen perennial species. The greenery makes a comfortable and cosy neighbourhood atmosphere. Landscape design lacks, with unkempt grass areas and untrimmed branches and plants that sometimes obstruct passage.

Inside spaces: The reception desk is right before the entrance, where patients directly enquire about their visit (Figure 11).

The desk resembles an office desk, with one side mounted to the wall. The counter's height is also around 120 cm, with no additional separation of the staff from the patients. The middle corridor divides two waiting zones for two doctors in the shift. Specifically, each has a nurse's desk, so there are two receptions in the facility for each GP. The other reception also has an office desk and no additional barriers (Figure 12).

*Figure 11. Reception and waiting area of the health centre 'Zabjelo' (source: Authors, 2023)*



*Figure 12.  Sketch from the field research, facility C (source: Authors, 2023)*
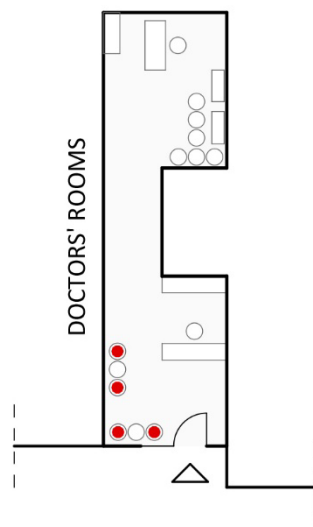
The receptions are small, but the crowd is rare, so it does not get busy. However, during the pandemic, patients were told to wait outside and were called inside individually according to the queue.

The facility has information sheets on the walls and doors, marking each function. However, in this space, many advertising materials are assigned.

The chairs are in use but are rarely busy since only a few patients have appointments at a similar time. Distribution and overlapping in the farther waiting zone make two seats unusable. The groups cause the problem of insufficient space to accommodate this specific type of seat.

There is no natural light besides the sufficient glass surface on the existing door. Staff confirmed that the louvres never function due to technical issues. This inconvenience makes the need for artificial light constant and lowers the comfort of the workplace. Artwork and plants were not present in any form in the interior.

### 4.2.4. Overall facilities performance

After the data collection, facility elements performance was categorised in three groups: + Positive; + - Neutral; - negative and displayed in Table 2.

*Table 2 Facilities performance along the analysed aspects (source: Authors, 2023)*

| Facilities | A - 'Nova Varoš' | B - 'Zlatica' | C - 'Zabjelo' |
|---|---|---|---|
| Arrival | | | |
| Parking | - | + | + - |
| Public transportation | + - | + - | + - |
| Alternative transportation | - | - | - |
| Pedestrian access | + - | + - | - |
| Outside spaces | | | |
| Entrance | + - | + - | - |
| Overall look | + - | + - | - |
| Outside Seating | + - | + - | - |
| Covered areas | + - | + | - |
| Vegetation | + - | - | + |
| Inside spaces | | | |
| Reception | - | - | - |
| Waiting area | + - | - | - |
| Signage | + | + | + |
| Seating | + - | + - | - |
| Natural light | + | - | - |
| Indoor plants | - | - | - |
| Artwork | + - | + - | - |

Elements marked as positive were sufficient in quantity and well-designed to perform their function. Neutral elements existed on site and had certain qualities but showed flaws such as insufficient quantity, malfunction, poor design, position or service issues. Negative elements were either nonexistent, in insufficient quantity, poorly designed or completely malfunctioning.

Alternative modes of transportation, reception and indoor plants performed negatively in all three facilities. On the other hand, signage was adequately present in each place. Inconsistency is noticeable, as each building performed differently considering the remaining elements. Overall, large facility 'A' showed the best, while the small facility 'C' recorded the lowest performance level.

## 5. Discussion

Kearns et al. (2020) suggested that the receptionist and waiting room play crucial roles in shaping a person's transition into becoming a patient. By analysing Phase I, we got the impressions from the patients and compared them from the architect's perspective through field research in Phase II.

The previously mentioned situation in Montenegro showed that no communication was made with the healthcare users regarding architectural preferences, followed by the problems of more profound design studies and financial sources. Phase I results suggest that patients first cared about services and comfort rather than the general look of the building and spaces.

Vehicle infrastructure in facilities A and C was incompetent due to the lack of division, especially for the centre users. On the other hand, facility B had sufficient parking lots but had problems regarding the pedestrian approach.

Entrances were ranked positive and clear by most of the participants, suggesting their proper functioning. Field research showed that none of the facilities carried the architectural value of the welcoming outlook of the entrance. However, information sheets and signage that were present in a large number possibly played a role in understanding the services in the facility. Even boards with irrelevant information can be helpful for the patients and staff to navigate the facility (Pati et al., 2015).

Patients did notice the lack of indoor plants and artwork and marked both as desirable. In a similar study, participants sometimes identified green indoor plants as providing positive distractions (Ayas et al., 2008). Additionally, artwork can be calming and further help with navigating the facility.

Even though the users in facility A complimented natural light, it was critical in B and C, with the need for artificial light during a major part of the day. Research shows that some users like it when the waiting room has features connecting it to the outside world and that waiting areas with open views or access to the outdoors are highly valued (Kearns et al., 2020). The authors explained that many patients feel obligated to remain in the waiting room to secure their spot and avoid missing appointments.

A similar situation was observed inside all three facilities. Patients usually stood before the GPs' doors and waited for their turn, even though seats were nearby. Several participants mentioned that providing queue numbers would diminish this feeling of missing an appointment or being called in proper order.

The study's findings may be limited by the relatively small sample size of respondents who participated in Phase I, which could impact the generalizability of the results to a broader population. Additionally, examined healthcare centres may undergo renovations, repositioning, or closure over time. These changes could influence the study's conclusions, as the spaces and services offered at these centres may differ from those initially assessed.

# 6. Conclusions

The research detailed in the paper highlighted numerous planning, organisational, and operating deficiencies that hinder the humane design of primary healthcare infrastructure.

The results from Phase I and Phase II showed a discrepancy between the current architectural design and the relative indifference of the users who participated in the questionnaire. The resigned way in which people in need of healing relate to the architectural quality of the facilities presents a cultural flaw arising from the history of political systems and is partly a consequence of the designers' modesty. The basis of development and progress is an extensive education, where all groups involved in implementation and use must participate.

In order to learn the potential healing effects of the environment, reference pilot projects are necessary, where all users themself can experience the benefits of a purposefully designed healing environment.

In most countries, instead of the overregulated, unmotivated state organisations, private investors create these reference facilities, which can only be afforded by a small class of those in need, slowing down the qualitative development of the infrastructure in primary care. We propose several suggestions regarding the architectural decisions and qualities that are not present in the current guidelines:

- Arrival infrastructure should be adequate and comfortable for as many types of transportation as possible.

- Adequate parking for different vehicles should be provided and separated only for healthcare centre users.

- The facility outlook should be designed according to evidence-based design principles and implement local architectural values and the already established international guidelines.

- Natural light, vegetation, and artwork create a more comfortable atmosphere in the waiting room and are desired by the patients. Natural light should be provided as much as possible in every room that serves patients and staff.

- The reception area should be improved in consultation with the users to make the workflow easier and more comfortable for patients and staff. Additionally, user privacy could be more protected with the proper reception design.

- Healthcare centres could implement digital communication systems so patients can trust the institution and feel relaxed in the waiting room.

The Post Occupancy Evaluation is necessary because even though some features malfunctioned or were missing, they needed to be adequately solved according to the existing national regulations. Implementation of POE in the future could be done by gathering regular feedback from users and employees and reviewing facilities once they're in use.

While certain recommendations may appear standard, they have not been implemented in most national healthcare facilities. Therefore, the research reveals a consistent disconnect between user needs and actual design practices. To address this inconsistency, architects, healthcare administrators, and policymakers must establish a collaborative approach.

Future research directions may involve developing evidence-based design guidelines specifically for healthcare facilities in Montenegro and similar contexts. Such guidelines would provide architects with a systematic framework for integrating user-centered principles by establishing continuous improvement in healthcare infrastructure. Thus, this research could present a starting point for evaluating and enhancing healthcare facility design quality in the future.

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# Environmental pressures and elderly people
# in the Guadalajara metropolitan area:
## The performance of the nearby territory

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**Abstract:** This paper analyses the social, cultural and urban factors influencing the mobility of older adults in Guadalajara, Mexico. Specifically, it addresses the experiences of 18 elderly within their immediate urban environment, identifying the environmental pressures they encounter during their movements. The study maps destinations that satisfy needs shaped by participant's culture and identifies the emotional resources and social capital that support older adults in accessing these destinations. The findings reveal that mobility barriers arise not only from non-universal design but also from a fragile social-institutional framework, primarily reflected in an environment perceived as unsafe.

## 1. Introduction

Population aging poses challenges in the inclusive design of cities, which are discussed in WHO's Age-friendly Cities Guide (2014), a program that Guadalajara (GDL) has recently begun to implement. Currently, the municipality registers 14% of people over 65 years of age (INEGI, 2020) and prospects indicate that within a couple of decades the state of Jalisco, of which GDL is the capital, will enter the category of "aging society" (Camacho et alt., 2019). Given such a perspective, it is worth asking whether the public space in GDL is adequate to support an aging population profile.

The central hypothesis of the study is that while urban infrastructure in Guadalajara (GDL) can support older adults' use of the environment by meeting specific needs, significant barriers also exist that could arise both from a non-universal urban design and inadequate urban policies. This study seeks to answer the following questions: What kind of barriers do older adults face during their movements? Which destinations are the most frequent? And what forms of social support do aged people the elderly rely on during their journeys?

To explore the dynamics of the relationship between habitat and the elderly, we considered two primary models: the ecological model (Lawton, 1982, 1989) and the congruence model (Kahana, 1975, 1980). We also adopted social capital theory as a valuable framework for examining the support older adults receive in navigating their immediate environment. In doing so, this research aligns with the recommendations of Wahl and Gerstorf (2018), who coined the term Context

Dynamics in Aging to expand the scope of studies on older adults. Wahl and Gerstorf (2018) argue that it is necessary to merge the perspective of environmental docility studies, rooted in M. P. Lawton's ecological model, with research grounded in the concept of Life Space, as developed by Cantor (1975), which explores the urban environment of ageing.

Lawton's "environmental docility hypothesis" (Lawton & Simon, 1968) suggests that as individuals age and their capacities decline, they are increasingly likely to abandon efforts to overcome barriers, conceptualized as "pressures", a term whose meaning is borrowed from H. A. Murray (1938). Lawton studied the interplay between motor skills, cognitive functions and the characteristics of the environment, focusing on the capacities required for successful adaptation to varying levels of environmental pressure. For our purposes, it provides a framework for understanding various elements of the urban environment as barriers or pressures that not only discourage mobility but also trigger a negative feedback loop, leading to a decline in individual capabilities. Escudero (2005, p. 52) used the ecological terminology in his work, noting that "the reduction of environmental pressure (...) is achieved by enacting accessibility guidelines (...), with architectural resources aimed at minimizing architectural and urban barriers". Such resources can also be conceived as elements that contribute to universal design, which allows a product or space to be used by all people without the need for adaptation (Soydaş and Tosun, 2022).

Latin American cities present numerous deficiencies in universal urban design research but there are interesting studies detailing them. G. Boils (2019) provides a thorough description of the design errors that sidewalks have in Mexico City, which, on occasions are even non-existent or have dangerous, high or very narrow ramps for a wheelchair to circulate. M. Yeannes (2007), in his work on falls among older adults in Mar del Plata, Argentina, reported that 67% of falls were due to environmental factors, such as slippery floors and poor lighting. The remaining falls were linked to personal factors, including walking difficulties and reduced visual perception, as well as behavioural factors, such as choices related to wearing appropriate footwear, maintaining attention while walking or using a cane.

Lawton (1989) to develop a more sophisticated of "personal resources", among which we find affective self-regulation. This idea of personal resources (broader than the previous concept of competence, without clinical connotations) makes it possible to include emotional and motivational elements, as well as the proactive capacity to dominate or take advantage of the environment, thus emphasizing the dialectical relationship between individual resources and environmental resources. Michael et alt. (2005) have shown the benefits of access to nearby stores and services, as well as walkable surface, which encourages seniors to walk and experience healthy activity. This work follows the path emerged since the 1980s, with the "congruence model" (Kahana, 1980), in which well-being does not only depends on a level of adaptation between capacities and environmental pressures but from coherence between what the environment offers and the needs of each older adult. Carp & Carp (1984), by integrating the ecological model and the congruence model, conceived different stages in which the initial variables (competencies, needs, environmental traits) do not have a direct influence on the results (satisfaction, autonomy, stress) but are modulated, in an intermediate stage, by actions, attitudes, perceptions and social support.

In the context of Latin American societies, characterized by a limited welfare state and streets that can often be unsafe, the social climate and the support accessible to older adults are vital. This support can be studied from the social capital perspective. A substantial body of literature identify social capital as a critical source of support for older adults, encompassing promotion of healthy living (Simons et al., 2020; Kawachi et al., 1997; Carrasco & Bilal, 2016) and assistance

with mobility (Gray et al., 2016), particularly at the time when the elderly leave wheeled transport (Isbel and Berry, 2016). Phillips et al. (2010, p. 227) developed a model of interactions between older adults and the city, applying it to residents of Hong Kong. Their study, among a wide range of cultural factors, highlights the influence of filial piety, a core tenet of Confucianism. The authors highlight the need to take into consideration caregivers' competencies and advocate for viewing family support as a form of collective competence. This work serves as an inspiring example for researchers addressing non-European contexts, underscoring the need for analytical models tailored to these unique realities.

Social capital can be understood as a component of a community's social cohesion (a more structural perspective) but other perspective sees it as a resource derived from networks formed by individuals through their proactive engagement in groups and families (Portes, 1998). An intermediate position argues that individuals initiate efforts to establish social ties, but the community's social environment helps them by providing the conditions necessary for fostering enduring relationships. Social capital has been categorized into three types: bonding social capital, which refers to relationships within families or close-knit communities; bridging social capital, involving connections with more distant social groups; and linking social capital, for relationships with groups of significantly different social status. Fu et al. (1980) found a correlation between high levels of bonding and bridging social capital and an increased likelihood of maintaining high levels of physical activity among older people. From an urban perspective, Bronfenbrenner (1979) drew a distinction between proximal and distal contexts, with the latter including interactions with strangers, which may involve both trust and distrust. It is interesting to examine the extent to which the elderly in Guadalajara can benefit from these forms of social capital to make effective use of nearby urban facilities.

## 2. Methodology

The methodological model chosen for the study was a mixed-methods approach, with the qualitative method serving as the main component. The qualitative approach was appropriate to delve deeply into the users' daily experiences, as constructed by their subjectivity. The quantitative method, adopted as a complementary component (Morse & Niehaus, 2009), involved determining the distances travelled and the number of services available in the environment. The mixed-methods design followed a sequential framework (Creswell & Creswell, 2017), with quantitative data collected based on the destinations mentioned during the previous semi-structured interviews. The tool used for transcription and coding was QDA Atlas.ti Cloud software.

The database was a set of 18 interviews with people between 65 and 90 years old, residents of Guadalajara and the surrounding municipalities of Zapopan, Tlajomulco and San Pedro Tlaquepaque. In a complementary manner, qualitative observation of the environment was used, with images obtained from a photographic survey of the environment and Google Earth (Street View). The urban territory exploration provided data that could be contrasted with the experience of the interviewees. Additional tools included the drawing of route diagrams illustrating the distances travelled in metres. These quantitative data were combined with location maps of services and significant segments from the interviews, all of which were integrated into a single FileMaker file for each participant studied.

The individual interviews considered a script with the following points:

- Usual destinations. Characteristics of the places that satisfy their needs. Distances travelled, mode of travel.

- Travel experience and accessibility to destinations.

- Specific difficulties in urban mobility.

- Family situation and help obtained in the immediate environment.

- Relationship with neighbours or close social group.

The qualitative data collection process adhered to ethical guidelines, ensuring confidentiality and the responsible use of private data. Written informed consent was obtained from participants, explicitly authorizing the use of their data for academic purposes.

# 3. Results

## 3.1. Distances

The destinations mentioned in the interviews provide information on the maximum distances users can travel (Fig. 1) in one trip (they don't offer data about the maximum distances people interviewed walk daily). The distances have been calculated in AutoCAD on Google map, looking for the most direct or "natural route" between home and destination.

*Table 1. Distances covered by the participants and density of urban facilities.*

| Case and Person ID | Age | Maximum walked distance (mts) | Mobility support | Presence of urban equipment in the surrounding area |
|---|---|---|---|---|
| 1 Ca1 | 82 | 650 | Wheelchair | High |
| 2 Mar | 65 | 360 | Wheelchair | High |
| 3 Jos | 61 | 900 | Wheelchair | High |
| 4 Ade | 85 | 0 * | walking frame | High |
| 5 Vid | 90 | 0 * | Walks | Intermediate |
| 6 Vic | 67 | 2300 | Wheelchair | Intermediate |
| 7 Mar | 64 | 1300 | Walks | High |
| 8 Be1 | 66 | 2100 | Walks | Low |
| 9 Ire | 74 | 0 * | Walks with a cane | Low |
| 10 Ire | 64 | 550 | Walks | Intermediate |
| 11 Enr | 68 | 700 | Walks | Intermediate |
| 12 Be2 | 62 | 1000 | Walks | Intermediate |
| 13 Ma2 | 65 | 1300 | Walks | Intermediate |
| 14 Dom | 85 | 120 | Walks | Intermediate |
| 15 Ca2 | 76 | 1100 | Walks with a cane | Low |
| 16 Mar3 | 65 | 150 | Walks | Intermediate |
| 17 Yol | 72 | 1200 | Walks | High |
| 18 Bla | 81 | 400 | Walks | Intermediate |
| Average: | 72 | 802* | | |

*\*Cases without routes discarded.*

Table 1 shows three groups of users: those who walk 1000 m. or more, those who are in the 500-1000 m. range, and those who walk less than 500 m. There is no immediate correlation between the distance walked and the density of urban facilities, as occurred in Michael et alt. (2006).

People living in an environment with an abundant supply of services do not always use them. Four people out of 18 were found to be walking more than 1000 m. where the Gps route shows little presence of facilities.

This can occur for various reasons, such as the use of mobility aids like a wheelchair or walker (as seen in the cases of Man, Ca1, Jos1, and Ade). These instances support the ecological model, which emphasizes the role of physical capacities in determining how individuals interact with their environment. By contrast, Ca2 and Be1, both in good health but residing in areas with low density of services, have a high score in walking performance. Here what triggers a displacement is not the quantity of facilities but the quality of destinations congruent with the preferences of older adults. This supports the congruence model, which emphasizes the importance of alignment between individual requirements and environmental provisions.

The results of the most relevant interviews in terms of our interests are presented below, first presenting those cases in which walking distances are longer and then those in which shorter trips are detected.

## 3.2. Destinations, barriers and social support

Yol. (72-year-old, lives with her husband, daughter, son-in-law, and 5 grandsons) She attends church and a sport club, where she goes with her husband to work out. Despite her age, she walks extensively (1,200 metres), benefiting from an environment abundant in services. Her routine includes walking to the bank and shops. Yol. warns of the danger of simply not sweeping leaves from trees, ("people can slip"). No one, neither neighbours nor authorities, has taken responsibility for sweeping, so the street creates an environmental risk factor that needs to be known. In this case, the environmental pressure arises from a lack of street maintenance by both local authorities and area residents.

*Figure 1. Environment and distances traveled by Case 17 (Yol.).*



Ma3 (65, divorced, two daughters) is in poor health ("I can't sweep or mop because the days I do it I can't get up and they have to inject me with medicine"). The cobblestone streets hurt her a

lot ("I can't walk much because the cobblestones hurt my spine when I walk"). Furthermore, cars irritate her "(...) cars do not respect you, that is, if they see a space on the corner they park and block the way; I feel that the best days to walk are Saturdays and Sundays when there are not so many cars". However, she can walk 1300 m. Going to church by metro is not a problem for her ("the metro moves me and very quietly"); the destination acts as a motivation for a journey that would otherwise be difficult for her.

Ma2, 65 (three children, teaches virtual classes, walks 1100m) lives in a colonia (neighbourhood) close to many favourite destinations. "I have Galerias (a mall) in front of me, I direct my walks there or to the park. He has an active life, with many destinations within walking distance, although he suffers from the problem of the city's pavements; "because in some parts (local authorities) only cover up the holes where cars pass, but they don't care about the pavements, I think almost nobody cares about that". Negligent management of urban maintenance here leads to a loss of hope about the ability of local politicians to care about pedestrians.

Ca2 (a 76-year-old former university teacher from Santa María Tequepexpa) visits nearby restaurants, where she socialises with her friends—a stimulating social activity that was limited during the pandemic. Her immediate social environment is not very rich, as she lives alone, has no children, and only one brother. Consequently, maintaining a broader social network of friends encourages her to lead a more outward-facing daily life, travelling up to 1000m. She goes out to buy small quantities in nearby shops ("I am alone, there is no point in going to the Abastos market to buy a lot, if I buy too much it will go to waste"). Her case validates the importance given by the ecological model to individual resources. Attention to obstacles and the use of a cane are part of the behavioral aspects in which individual agency is expressed, which are linked to personal resources such as

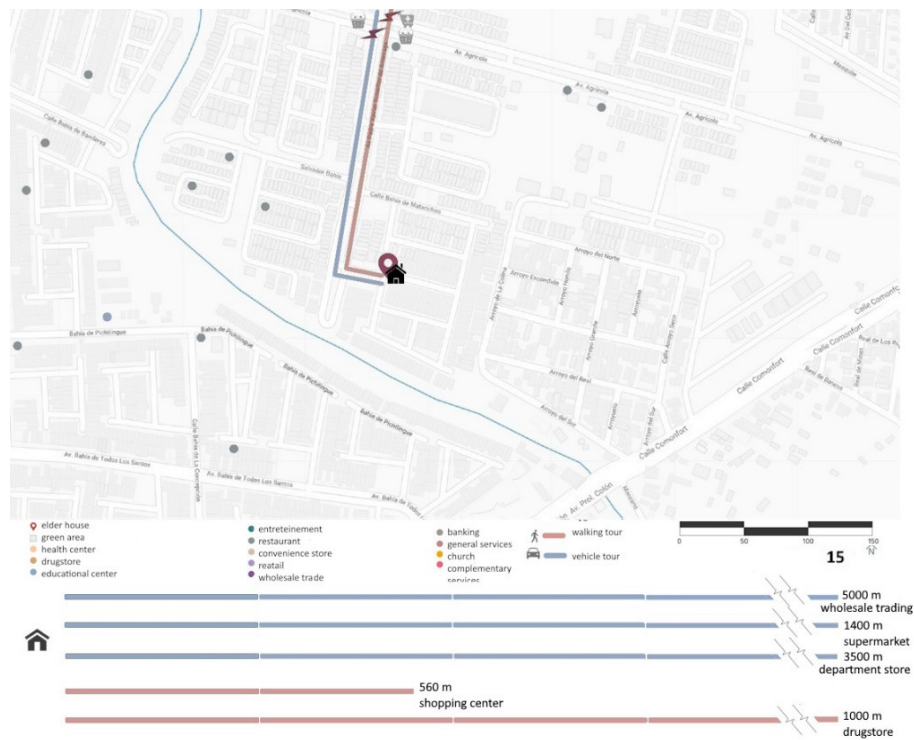*Figure 2. Environment and distances traveled by Case 15 (Ca2).*

*Figure 3. Environment and distances traveled by Case 12 (Be2).*



Thanks to her knowledge of the pavements, she can avoid obstacles and unevenness in the ground ("I already know the pavement"). Another resource is the acceptance of help from strangers who observe her walking with difficulty: "there are always kind people who help me to climb pavements, ramps". Despite her age, she still drives a car, although she walks most of the time with a cane to prevent falls. Her personal competences (optimism, openness) push her to an active life. She confesses that sometimes she would go out of the house aimlessly, perhaps to a store just to look around, with no real need to buy anything; "that's why I tell you when I'm bored, I go out. There are people moving around here. Also, children who shout but it's not like being between four walls". A brother accompanies her to the bank to withdraw money, as it is not safe to do it alone at ATMs. [Before the pandemic] I would go to my brother's house, we would play dominoes [...] there were about five of us. One can guess that, through her brother, Ca2 connects with a wider environment; close people and not so close people appear interconnected here.

Be2 (62, three children, widow) also lives alone and does 1000 m rides. Despite the pains she suffers in her spine (which prevent her from cycling as she used to) she is active in cleaning her house. She is very close to her son who helps her ("my son, I dial him and he is here in 3 minutes; I love family meetings") and she has the courage to move forward in life ("I tell my grandchildren that they should always move forwards"). Her personal psychological resources (she is cheerful even though her daughter who lived with her died last year) and family support compensate for her delicate physical health and low supply of services in her nearby territory.

The following case is noteworthy as it reveals an instance of environmental pressure related to a social environment shaped by insecurity. Ire, a 64-year-old married woman who walks 550 m. explains that neither she nor her husband drive because their car was stolen ("there are criminals on the other side of my house, they are in collusion with the police"). The couple only go to the supermarket, to the shops (Wallmart) and to the doctor.

The case also raises the issue of the presence or absence of social ties. The interviewed have the support of a son and of neighbours they have known for four decades. With neighbours they have

an apparently cold relationship ("we say really just good morning, good afternoon, how have you been and that's it", which points to an intermediate level between bonding and bridging capital. "Only for special reasons, if they want to tell me something or I want to tell them something, then we visit each other".

Ade, an 85-year-old rarely goes outside in spite of a rich urban environment:" I have never gone out alone, I can't do anything, I don't feel able to risk it again (…). If you go out you have to be home early because you can't go out very late at night, (…) maximum until 8 - 9 at night". A. is a widow, lives with an unmarried daughter, has another daughter in Durango and a son in Houston who supports her financially.

"In the afternoon I read or go out to the garage for a while, or I lie down for a while, because the walker makes me very tired. Ad. relies on a walker to get around, says that the condition of the sidewalks is the main inconvenience when leaving the house. Another stressor pointed out is the presence of badly parked cars. For more distant outings she resorts to the help of her children; "they put my chair in their van, and we go to a coffee shop or a mall. They take me in, they take me out, they get me settled, I just tell them to leave me here and you go and do your shopping, I just watch the people go by, that's enough to keep me entertained".

The narration of past events by F. (66, does not appear in the table because his routes were not specified) illustrates the benefits of bridging social capital. F. bought a large van "in order to move friends, to move colleagues, before the pandemic we went to the cinema forum, we went to different places"; it seems that these are past times, because currently, he lives alone, he supports himself with his pension and the support of the parish where there is a community canteen. He has no relationship with his neighbours ("my neighbours are criminals, in other words, they steal"), nor with his children, who, after separating, are linked to his mother. "There have been times when I have also been sick and I have gone to a hospital for help, but I have not been able to get there, I have fainted. Passengers have got out of the truck fainting and sat me down on the pavement and asked for an ambulance". The nearby support is replaced by the support of anonymous people in the street, who help him in case of need.

*Figure 4. Environment and distances traveled by Case 12 (Ade 85).*

Enr. (68) reads psychology, exercises, rides a motorbike and is about to get married ("for the last time"); his personal spirit and health compensate for a scarce social capital (one of his sons died, and he does not see two sons who left with his former wife, his sister takes care of his mother who has Alzheimer's). He walks 700 metres to the market and the SNDIF (Sistema Nacional para el Desarrollo Integral de la Familia, a social organization addressing family vulnerability) and maintains close relations with his neighbours.

Domi. (85, widower) walks a short distance (15-20 minutes, 120 m) in a park in front of his house, with no problems with the pavements. When he needs to make longer trips, his granddaughter drives him in his car, which he is no longer able to drive himself.

Vic. (67, married) sells sweets and peanuts at traffic lights in the streets, from morning until 6 p.m. His cases show how the congruence between environment and user in GDL takes on nuances not observed in similar studies in other regions. He receives food in the church and has multiple pains in his body; his courage and mental strength allow him to survive. To get to the crossroads where he works, he has to use a wheelchair and get a bus. When the bus arrives, a ramp is lowered for him (he doesn't need help from passengers because "I only get on backwards to support myself with my good foot and my good hand). On the pavements, where there are holes "I have fallen several times, I push the chair backwards and sometimes I don't see that there is a hole"). Like other transcriptions of users' accounts, his narrative reveals a sense of discomfort and risks caused by physical barriers (pavements in poor condition) that do not comply with numerous principles of universal design: fairness and flexibility of use, perceptible information, tolerance of error, low physical effort (criteria listed by The Center for Universal Design, 1997).

## 4. Conclusions

The use of a qualitative methodology enabled a deep observation of the motivational factors shaping participants' access to the nearby territory. This approach proved suitable in understanding the urban decision-making processes of the participants, particularly the alignment between the availability of services and the fulfilment of their needs. These needs, clearly shaped by social and cultural factors, in our case highlight the significance of specific services such as churches—reflecting Jalisco's status as one of the most religious states in Mexico—and the presence of state social inclusion programs, such as those provided by the SNDIF. In Guadalajara, a substantial portion of the older population views the city as a source of economic opportunities, religious services, and safe spaces for social interaction. As a result, the congruence between the environment and the user takes on unique characteristics not observed in similar studies conducted in other regions of the world. The analysis presents a opportunity to refine the dimensions of environmental congruence at the urban level in cities outside Europe and Asia. To the dimensions proposed by Kahana et al. (1980), we propose adding two additional dimensions: one related to the desire for spiritual protection (fulfilled by sacred spaces) and another associated with physical protection.

In this respect, numerous references to insecurity underline the relevance of this dimension. Mexico is currently experiencing an era marked by the negative presence of drug trafficking. This situation justifies the use of the lawtonian concept of environmental docility, driven in this case by a perception of the environment as hostile. The study conceptualizes crime and crime perception as an environmental pressure, drawing connections between the docility hypothesis and perceptions of insecurity, as also suggested by Köber et al. (2022). However, while Köber and his colleagues identified a weak correlation between crime perception and urban activity in Europe and Australia, the reality in Mexico reveals a significantly stronger relationship. This

disparity highlights the suitability to account for regional socio-cultural and environmental factors when examining environmental congruence and urban dynamics.

Older adults report deficiencies that can be categorized as both institutional and social, arising from factors such as non-compliance with urban regulations (e.g., illegally parked cars), uncivil behaviours, and inefficient management of urban spaces (e.g., poorly maintained or upswept surfaces).Thereupon, it is pertinent to recall Murray's definition of "pressure" as any external influence that affects the satisfaction of an individual's essential needs. As with issues of crime and safety, our findings reaffirm the necessity of rethinking and redefining categories of environmental barriers and pressures within a sociocultural and institutional framework.

The study included questions addressing the resources and support available to older adults in Guadalajara (GDL) to manage the challenges outlined above. Alongside emotional resources such as resilience and optimism, several participants demonstrated a proactive approach to deal with risks, anticipating difficulties (for instance, being aware of pavement conditions or seeking assistance when needed). These findings underscore the relevance of Carp & Carp model (1984) with reference to intermediate factors, which extend beyond behavioural and cognitive dimensions to encompass the disposal of social support.

The responses identified two distinct forms of social support. The first, derived from bonding social capital, refers to assistance provided by individuals closely connected to the participants. The second involves more casual support from those with weaker personal ties, such as infrequently visited neighbours or strangers who occasionally offer help in public spaces. Building on the findings of Fu et al. (2018), we observe that this second group plays a crucial role in responding to falls or unexpected situations. Strong relationships between neighbours are uncommon; however, there is a widespread belief in the importance of neighbourhood support during times of need.  This kind of support aligns with the concept of bridging social capital, as studied by sociologists in other contexts and for different population segments, where weak ties have been shown to be pivotal, for example, in facilitating career advancement.

In summary, the study highlights the need to adapt classic models of environmental gerontology to diverse socio-spatial contexts, differing significantly from those that informed the original frameworks, which were predominantly based on residential areas or neighbourhoods in Anglo-Saxon countries. Integrating approaches from environmental gerontology, urban studies, sociology and inclusive design can contribute to future research projects in this field in Latin America, where environmental characteristics differ markedly from those in countries with a greater theoretical tradition on age-friendly cities research.

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# Experiences of cognitively impaired elderly patients with a Brazilian oncology service

## An analysis through the lenses of inclusive design.

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Abstract: Cancer and ageing are factors that increase the risk of developing cognitive impairments. Given this context, there is a complexity of access to healthcare by cognitively impaired elderly patients in oncological contexts. The aim of this study is to analyse the experiences of cognitively impaired elderly cancer patients with a Brazilian oncology outpatient service from the perspective of inclusive design to outline takeaway messages for the design of inclusive health services for these patients. Non-participant observations of the service and interviews with patients and their caregivers were carried out to understand to what extent the service provides proper care to cognitively impaired elderly patients. Thematic analysis of the data was carried out and categories were generated through an inductive approach. Results show that the service is adequate in terms of inclusion overall, but there are opportunities for improvement. Critical points related to the built environment, informational and communication design, trust in the healthcare team, and empathy were identified as opportunities for service improvement to better include and assist such user groups. Takeaway messages for the design of inclusive health services for cognitively impaired elderly patients were highlighted in this study.

## 1. Introduction

Cancer is pointed out as a risk factor for disabilities due to the disease itself and the treatment (Hewitt, Rowland & Yancik, 2003). Cognitive acuity is one of the factors that may be largely affected in cancer patients, leading to cognitive impairment (ACS, 2020). Cancer-related cognitive impairment might be caused by the disease's effects, previous conditions unrelated to cancer, or the effects of cancer treatments (Pendergrass, Targum & Harrison, 2017). In that regard, cognitive decline can be more aggravating for groups of people who may already have cognitive limitations prior to cancer, such as the elderly (Crimmins et al., 2011).

Regarding access to health, this can be a complex process for people with disabilities, especially cognitively impaired ones, who need inclusive support to understand health information (WHO, 2020). When interacting with health services, a user needs to comprehend, think, act, access, and receive care (Clarkson et al., 2007). So, users with cognitive impairment and high anxiety and

stress levels caused by age and cancer may find it difficult to access and receive care. This becomes even more complicated    when three characteristics already complex to services come together: cancer, ageing, and cognitive impairments. In this context, multiple vulnerabilities are noted since the elderly are more susceptible to cognitive impairments and cancer. In addition, pre-existing cognitive impairment increases the risks associated with chemotherapy, making the elderly even more vulnerable in oncological circumstances (Magnuson, Mohile & Janelsins, 2016).

In addition, studies have shown a lack of adequate health services to meet the needs of elderly patients (Smith & Carragher, 2019; Rudnicka et al., 2020; Moghadasi et al., 2022). Regarding the limitations experienced by the elderly, there are several barriers that make    difficult for them to access to healthcare, such as the lack of affordable physical spaces, long waiting lines, excessive information, communication failure for those who have visual and hearing losses, etc. (Araujo de Carvalho et al., 2017). The study by Webber, Bowers, and Bigby (2010) adds foundations to this discussion, emphasising cognitive impairment as another point of complexity in caring for the elderly. Their study identified that health services have difficulty assisting these patients due to professionals' lack of perception and knowledge about the particularities of elderly people with cognitive impairment, and failures in communication with these patients.

 This panorama is critical from the perspective of inclusive design (ID), which seeks to include all people    when designing    services (Goodman-Deane, 2014), especially concerning the needs and capabilities of older and disabled people (Persad, Langdon & Clarkson, 2010    So, the design of health services must develop an inclusive mindset, meeting all existing needs and following the principles of inclusive design (König, Bohn & Libânio, 2022). These principles are highlighted by the London Commission on Architecture and the Built Environment (CABE): putting people at the centre of the design process, recognizing diversity and difference, offering options when a single solution is not able to encompass them all, providing flexibility of use, and designing products, services, processes, technologies, built environments and other solutions that are convenient and enjoyable for everyone, all of which make them easier to use (CABE, 2006).

    Therefore, this study aims to analyse the experiences of cognitively impaired elderly cancer patients with a Brazilian oncology outpatient service from the perspective of ID and to outline takeaway messages for the design of inclusive health services for these patients.

## 2. Background

## 2.1. Brazilian health context

In Brazil, health is provided by both the public and private sectors. Currently, 78% of the Brazilian population does not have private health insurance and is entirely dependent on the public system, which was designed to be universal to guarantee the right to health for the entire population (OECD, 2021). The public system - Unified Health System (SUS) - seeks to ensure universal, equitable, and integral access for all people in Brazilian territory (Brazil, 1988; Brazil, 1990). The private initiative is a complement to the public system in health provision (OECD, 2020). Regardless of the Brazilian federal constitution ensuring that health is everyone's right and duty of the State and that SUS should provide health for all, the population faces inequalities in healthcare (Garnelo et al., 2020). For this reason, people with more favoured socioeconomic conditions have higher access to health services than those from lower socio-economic backgrounds (OECD, 2021).

Concerning the elderly, the change in the profile and the global demographic dynamics has shown an ageing population trend (Almeida et al., 2020), which has also been reflected in the Brazilian context (Veras & Parahyba, 2007; OECD, 2021). The country has more than 30 million older people aged 60 years and older, representing 13% of the country's population (PAHO, 2022). By 2050, it is expected an increase of approximately 21.5% for the population aged 65 years and over and 6.5% for those aged 80 years and over (OECD, 2019). This perspective requires attention from the Brazilian health system as a whole. Given this, the country has Ordinance No. 2,528, which approves and regulates the National Health Policy for the Elderly. This policy aims to recover, maintain, and promote the autonomy and independence of elderly individuals, directing collective and individual health measures for this purpose. Moreover, it establishes regulations for accessibility, humanised care, inclusion, and equity for the elderly in all contexts, including health services (Brazil, 2006).

However, there are many challenges      involved in the healthcare of the elderly since ageing leads to the loss of several capabilities, which compromise their execution of activities of daily living (Belasco & Okuno, 2019). Furthermore, population ageing generates a more significant burden of diseases in the population, more disabilities, and increased use of health services (Brito et al., 2013). That way, considering the coexistence of the Brazilian public and private systems, it is crucial to articulate the levels of care from the perspective of comprehensive care for the elderly in both of them (Almeida et al., 2020).

## 2.2. Cancer, ageing, and cognitive impairment

Cancer causes a series of damages, with cognitive impairments standing out among them. Due to cancer and related treatments, many patients have impaired brain functioning concerning communicating, thinking, learning, solving problems, and remembering (ACS, 2020). Many possible factors contribute to the symptoms of memory problems in cancer survivors, such as (i) the stress of receiving the diagnosis, causing anxiety, and depression, contributing to thinking and memory problems, (ii) chemicals that affect memory are produced by certain types of cancer, and (iii) cancers that begin or spread to the brain can cause changes in cognition (MFMER, 2023). Many patients with or without central nervous system tumours develop cognitive problems during their illness that can result in decreased functional independence (Schagen & Wefel, 2013).

Decreased mental sharpness is common during and after treatment for cancers. This condition is known as chemo brain (ACS, 2020; MFMER, 2023). Chemo brain or chemo fog consists of cancer-related cognitive impairment or cognitive dysfunction, presenting symptoms as unusual disorganisation, confusion, difficulty concentrating, finding the right word, learning new skills, and multitasking, a feeling of mental fogginess, short attention span, short-term memory problems, taking longer than usual to complete routine tasks, trouble with verbal memory, such as remembering a conversation, and trouble with visual memory, such as recalling an image or list of words (MFMER, 2023).

Another factor that increases the chances of developing cognitive impairments is ageing, since cognitive functions develop in childhood, peak at some point in adult life, and decline in old age (Tucker-Drob, 2019). More than that, ageing also represents an increase in chronic diseases in the population (Barreto, Carreira & Marcon, 2015). In Brazil, according to data from the National Cancer Institute (INCA), overall cancer mortality in 2020 was significantly higher in groups aged 60 years or older, regardless of gender (INCA, 2020). In this context, elderly people with cancer

are at particular risk of presenting cognitive impairments during treatment (Magnuson, Mohile & Janelsins, 2016).

## 3. Method

This research is of an applied nature (Zanella, 2013) and has an exploratory objective (Markoni & Lakatos, 2010), utilizing a qualitative approach (Hutton, 1990) and employing the case study method as a technical procedure (Zanella, 2013). The case study was carried out in a private outpatient oncological service of a Brazilian hospital that nowadays assists 86 cancer patients. We conducted non-participant observations of the service for eight days, and in depth-interviews with six patients. Two male and four female patients (mean age 69 years old) and three caregivers were interviewed to understand to what extent the service provides proper care to cognitively impaired elderly patients. For this, the ID principles (CABE, 2006) were considered in the interview script. Two researchers conducted the observations and interviews and refrained from intervening in the normal functioning of the service to map the journey of the cognitively impaired elderly patients in the most reliable way possible.

For the selection of participants, those who were 60 years of age or older and had cognitive impairments were included. The cognitive decline was confirmed by the patients and/or caregivers in the interviews.

Concerning research ethics, the study was approved by the UFCSPA's Institutional Review Board (CAAE 55467222.5.0000.5345). The hospital also provided a term of acceptance to carry out the research. The study has complied with the Data Protection Act, which requires anonymized personal, professional, and institutional data.

For data analysis, we conducted a thematic analysis using an inductive approach (Braun & Clarke, 2014). The process began with the transcription of the interviews and field diaries. Next, initial codes were generated, followed by the identification of themes and the establishment of relationships among the interviews. Finally, categories were generated and named: built environment; informational and communication design; trust in the healthcare team; and empathy. The inclusive design principles guided the analysis. To ensure the anonymity of respondents, patients will be identified as P1, P2, P3, P4, P5, and P6; and caregivers as C1, C2, and C3. Table 1 presents detailed information about study participants.

*Table 1. Information about study participants*

| Patients | | | |
|---|---|---|---|
| Participants | Age | Type of cancer | Cognitive aspects |
| P1 | 67 | Skin cancer | Forgetfulness intensified after the start of chemotherapy |
| P2 | 63 | Ovarian, fallopian tube, and peritoneal cancer | Forgetfulness and memory loss intensified after the start of chemotherapy |
| P3 | 67 | Bowel cancer | Forgetfulness, memory loss, emotional fragility, and anxiety intensified after the start of chemotherapy |
| P4 | 83 | Pancreatic cancer | Forgetfulness and memory loss intensified after the start of chemotherapy |
| P5 | 60 | Lung cancer and central nervous system metastasis | Cancer has touched on motor coordination, causing tingling and confusion |
| P6 | 75 | Pelvic cancer | Forgetfulness intensified after the start of chemotherapy |

| Caregivers | |
|---|---|
| Participants | Relationship with patients |
| C1 | Family member of P3 |
| C2 | Family member of P5 |
| C3 | Friend of P4 |

## 4. Results

The results of this study are presented through four categories of analyses identified as critical points for inclusion in healthcare services: built environment; informational and communication design; trust in the healthcare team; and empathy. Each category highlights (i) how these themes emerge in the service, (ii) areas of adequacy, and (iii) opportunities for improvement based on the experiences of cognitively impaired elderly cancer patients.

### 4.1. Built Environment

Two interviewees highlighted the importance of the built environment in the context of cognitive impairments. P2 reported that she always gets lost on her way to the service. She indicated that signage could be improved, as she experiences disorientation every time, regardless of whether she enters from the parking lot or the main entrance.

C1 reported difficulties in finding parking and expressed concern about leaving P3 at the entrance to navigate the service alone. Besides cognitive impairments, P3 also has physical and sensory impairments. Additionally, during the interview with P3 and C1, we observed that the patient is extremely emotionally vulnerable due to the challenging phase of her treatment and her inability to maintain the active lifestyle she had before the disease. The combined mental and physical confusion experienced by P3 raises concerns for the caregiver about whether the structure is sufficiently prepared to accommodate her needs.

The other interviewees did not report issues related to the built environment, aligning with our observations that the parking lot includes indicative signs and even a location map. However, we also noted a high volume of information available, as the facility houses multiple clinics and laboratories for various specialties. This abundance of options, including numerous elevators, stairs, and parking floors, can exacerbate navigation difficulties for users who are fragile, anxious, or cognitively impaired.

This category underscores the critical role of thoughtful design in reducing disorientation and emotional stress for cognitively impaired users. They require clear and accessible navigation through healthcare facilities to be able to navigate them.

### 4.2. Informational and Communication Design

This category is related to the built environment, as it forms part of the physical environment. Although we observed that the institution provides signs and maps indicating where each service is located, P3 identified problems with the signage. Referring back to the previous discussion, the way this information is presented—using large amounts of text, varied colours, and arrows among other competing details—may confuse patients with cognitive impairments.

Beyond signage, informational and communication design encompasses all forms of communication between the service and the patient. During the interview with P6, she expressed confusion about her treatment, as she believed that she was supposed to receive an additional chemotherapy drug that day based on her recollections of previous sessions. Although the nurses

reviewed the protocols and explained that her recollection was not accurate, she remained dissatisfied and contacted a relative to express her concerns. This situation highlights that the communication approach failed to ensure clarity and left the patient feeling suspicious and confused.

C1 also reported uncertainties regarding the treatment of P3. Neither the patient nor her caregiver had a deep understanding of the disease itself. Although they followed the care protocols, such as cleaning the colostomy bag, they lacked a comprehensive understanding of the type of cancer being treated.

These examples illustrate the importance of clear, patient-centred communication. There is a need for strategies to foster trust, reduce confusion, and enable cognitively impaired patients and their caregivers to engage meaningfully with their treatment plans.

## 4.3. Trust in the Healthcare Team

Trust in the healthcare team was another critical point for the inclusion of patients. The example of P6, mentioned earlier, also illustrates a lack of confidence. While the patient reported and demonstrated a good relationship with the team, she became suspicious when the team corrected her misunderstanding (correctly, as she was confused).

P5 also expressed distrust regarding his treatment protocol. He reported that, even after agreeing to the treatment, he did not feel entirely secure due to the differing opinions he had encountered about his case. This patient, who has developed severe cognitive impairment (corroborated by C2), does not acknowledge his condition and often uses humour and sarcasm as coping mechanisms to shield himself from the painful reality of his situation. His distrust seems to stem from a state of denial, which was not reflected in his caregiver's perspective.

Lack of trust was observed and reported in only these two cases. The other interviewees, by contrast, indicated high levels of confidence in the healthcare team and expressed full trust in the competence of the doctors and nurses. These patients were also well-informed about their own cases. Establishing a trusting relationship is therefore essential for professionals, as it enables patients to better understand their diagnoses and treatment processes, fostering greater engagement and contributing to their overall well-being

Building trust with cognitively impaired patients is a vital component of inclusive healthcare. Trust not only ensures adherence to treatment but also promotes emotional security and a sense of partnership between patients and healthcare providers.

## 4.4. Empathy

Empathy was a category identified in all interviews and supported by non-participant observations. This was a critical point for the inclusion of patients, as it placed the person at the centre of the process, while recognizing their individual particularities, demonstrating an appreciation for diversity, and attending to the limitations each patient may present. Empathy proved to be a positive feature of the service and could serve as a model for other contexts. We observed that the service strives to follow the principles of humanized care outlined by Brazilian regulations for elderly healthcare (Brazil, 2006).

P4 shared that, since she is unfamiliar with medical terms and the healthcare environment, a doctor drew a diagram to explain her condition and treatment protocol. She found this approach extremely helpful, as it allowed her to understand her situation. By prioritizing the patient's

unique needs and considering her cognitive impairment, the professional moved beyond treating her as a passive observer, placing her at the centre of the care process.

During P4's interview, we also observed another instance that highlighted the empathy of the service team. The patient uses a cold cap during chemotherapy to prevent hair loss, and the cap requires a wet scalp for better adhesion. At the end of the session, one of the nurses removed P4's cap and brought a hairbrush to comb her hair, ensuring she could leave with her hair neat. This small but thoughtful act clearly pleased the patient, demonstrating the importance of putting oneself in the patient's shoes and addressing their specific needs with care.

P1 also emphasized that the professionals at the service prioritize patient well-being. He noted that having a private television in each chemotherapy room—a feature of the service—added a personal and human touch, allowing him to stay entertained during his sessions.

Empathy not only enhances patient satisfaction but also strengthens the inclusive nature of healthcare services, making them more responsive to individual needs and reinforcing a sense of dignity and humanity in care. These findings, categorized into four critical themes, reveal the current state of inclusion within the healthcare service while also providing a foundation for a deeper exploration of their implications, which will be addressed in the following discussion.

## 5. Discussion

The findings emphasize critical areas for improving inclusivity in oncology services for cognitively impaired elderly patients. By applying ID principles, the study offers actionable insights for designing healthcare services that better accommodate this population.

One critical insight from the study is the importance of designing **physical spaces** that minimize confusion for cognitively impaired patients. Features such as clear, visually accessible signage and navigation aids play a crucial role in reducing stress and enhancing patients' ability to navigate the service independently. This aligns with research on environmental design for cognitive decline, which shows that factors such as colour adequacy, the presence of mirrors, noise levels, and the placement of furniture can significantly influence patients' ability to move through a space without experiencing mental confusion (Bakker, 2019). Quirke et al. affirm that well-designed environments can offer features to help patients to be independent and to minimise their physical, sensory, or cognitive impairments. Incorporating ID principles, such as flexibility and user-centred approaches, can address these challenges effectively (CABE, 2006).

 In addition to the built environment, **effective communication strategies** are integral to creating inclusive healthcare experiences. The study highlights the need for healthcare professionals to tailor their communication styles to the cognitive and emotional capacities of patients. Using simple language, repeating information, and employing visual aids can help bridge communication gaps. For example, while the institution provides signs and maps, the arrangement of this information—dense text, multiple colours, and arrows amidst other details—can overwhelm cognitively impaired patients. Differentiated communication strategies, such as speaking slowly, maintaining eye contact, solving patients' and caregivers' doubts, and repeating information when needed, are essential for fostering trust and engagement (Jootun & McGhee, 2011). Borson et al. (2023) add that clear and effective information, taking into account evidence, could be a good strategy to enhance trust between patients and healthcare professionals.

Building **trust** emerges as another pivotal factor in ensuring the inclusion of cognitively impaired patients in oncological care. In the oncological context, where patients often experience

heightened emotional and cognitive vulnerability, trust becomes even more critical. Consistent, clear communication and a personalized approach to care can foster trust, ensuring patients feel supported and engaged. This finding aligns with previous research showing that cognitively impaired elderly patients are more likely to experience confusion and suspicion about their treatments, leading to potential disengagement and fear (Portacolone et al., 2020). The authors emphasise that "trust in their providers may help them accept needed treatment and social supports; the sense that their provider has them in mind may help reduce their anxiety by making them feel cared for" (Portacolone, 2020). A lack of trust may prevent these patients from fully benefiting from the care provided, underscoring the importance of creating supportive healthcare environments that prioritize emotional security.

**Empathy**, identified as a strength of the service, further highlights the value of humanized care in enhancing patient satisfaction and outcomes. Acts of empathy, such as simplifying explanations or addressing patients' unique needs, demonstrate the importance of recognizing and valuing individual differences. For instance, small gestures like brushing a patient's hair after a procedure or drawing diagrams to explain treatment plans exemplify the power of empathy to create positive healthcare experiences. Previous studies have linked empathy to better outcomes in cancer treatments, as it improves patient satisfaction and overall well-being (Lelorain et al., 2012). Robieux et al. (2018) add that physicians highlight the beneficial effects of clinical empathy on patients outcomes and well-being as well as on their own professional practices. In the context of elderly patients with cancer and cognitive impairments, empathy becomes even more vital.

We would like to discuss **takeaway messages** from the analysed case study, which can serve as examples for similar service projects. Health services must be prepared to accommodate the diversity of patients. ID emphasizes the importance of developing effective solutions that serve as many people as possible. However, we also acknowledge the complexity of addressing the vast range of existing needs. Consequently, adopting different strategies for different groups of people is a crucial and effective approach to fostering inclusion (Clarkson et al., 2007).

In considering such a specific group of users as cognitively impaired elderly patients in an oncology service, several priorities emerge to ensure that health service design projects are inclusive and responsive to the complexities of care for these patients. Table 2 illustrates the connections between inclusive design principles (CABE, 2006), the themes identified in this study, and takeaway messages for the design of inclusive health services.

One key priority is putting people at the centre of the process, which involves developing a deep understanding of patients' needs, even when these are unconventional, unclear, or frequently changing. Cognitive decline presents unique challenges, such as memory and attention issues, difficulties in executive functions, and spatial disorientation. These factors require designers to exert extra effort to create healthcare services that are tailored to the specific needs of patients experiencing cognitive decline.

Recognizing diversity and difference is another essential priority. This entails understanding that individuals have different choices, feelings, perceptions, and sensations, even if they belong to the same demographic group. Healthcare services must take into account the unique preferences, emotions, and experiences of each individual.

Inclusion also depends on offering options when a single solution does not fit all. Providing a range of strategies to accommodate varying patient needs is critical. For example, requiring a caretaker's presence during consultations, using a slow and deliberate communication style, providing printed materials with information, repeating key details across multiple consultations,

and incorporating engaging tools like videos to explain diseases and treatments can be highly effective. Additionally, limiting medical jargon and ensuring that patients clearly understand their treatment journeys are important steps in fostering inclusivity.

Flexibility of use is another key consideration. Making healthcare services easier to understand and use involves presenting information clearly and accessibly. Special attention should be paid to factors such as font style, colour schemes, and the volume of information presented to avoid cognitive overload. This applies to both the design of physical environments and communication materials.

*Table 2. Lessons learned for the design of inclusive health services for cognitively impaired elderly patients*

| ID principles (CABE, 2006) | Connections with the themes identified in the study | Takeaway messages |
| --- | --- | --- |
| Putting people at the centre of the design process | Empathy | The healthcare team should strive to gain a comprehensive understanding of their patients to empathise with them, comprehend their difficulties, and provide compassionate care. It is essential to show positivity and attentiveness through gestures of affection and small actions that can significantly impact care delivery. |
| Recognizing diversity and difference | Empathy<br><br>Informational and communication design | Among a group of elderly patients with cognitive impairments, there can be significant differences in their conditions, such as variations in memory issues (causing difficulty in retaining information about the treatment) and executive functions (preventing them to function independently). As a result, providing tailored care that meets each patient's specific needs is essential. |
| Offering options when a single solution is not able to encompass them all | Informational and communication design | Not all patients can easily comprehend diagnostic and treatment information; some commonly require additional support and to understand the information accurately. Consequently, healthcare professionals must tailor their communication strategies based on the cognitive abilities of each patient. |
| Providing flexibility of use | Built environment<br><br>Informational and communication design | The built environments of healthcare facilities, including signage, space, and furniture layout, must be designed with clear understanding as the main goal to ensure that cognitively impaired individuals are not confused. Several other critical factors to consider include inadequate natural lighting, excessive space fragmentation, and poor ambience characterised by unsuitable visuals and sound/noise levels. |
| Designing convenient and enjoyable solutions for everyone | Built environment<br><br>Trust in the healthcare team | All the factors mentioned above should contribute to a better patient experience. Thus, this takeaway message represents a conclusion to the study and a summary of our results. The study shows the importance of an easy-to-understand built environment, organised service structures, prepared staff, and a patient journey that goes beyond meeting the patients' formal requirements. It is crucial for patients to feel comfortable and included in the healthcare environment to trust the healthcare team and be motivated to follow through with their treatment. |

Finally, designing solutions that are convenient and enjoyable for everyone extends beyond creating accessible physical spaces to include an organized service structure, well-prepared staff, thoughtful processes, and a coherent patient journey. By delivering not only functional requirements but also addressing emotional and experiential needs, services can provide a more meaningful and satisfying experience for all users.

Table 2 provides a detailed synthesis of the connections between inclusive design principles, the themes identified in the study, and specific takeaway messages for designing inclusive health services for cognitively impaired elderly patients. These priorities serve as a foundation for fostering inclusion and enhancing well-being through thoughtful and responsive design.

By integrating these insights, healthcare services can better support cognitively impaired elderly patients, fostering inclusion and well-being through thoughtful design that prioritizes diversity, flexibility, and empathy.

## 6. Conclusions

This study aimed to analyse the experiences of cognitively impaired elderly cancer patients with a Brazilian oncology outpatient service from the perspective of Inclusive Design (ID) and to outline takeaway messages for designing inclusive health services for this population. A case study was conducted in a private outpatient oncological service of a Brazilian hospital, employing non-participant observations and interviews with patients and caregivers.

The analysis revealed four key themes critical for fostering inclusion in the service: built environment, informational and communication design, trust in the healthcare team, and empathy. These themes provided the basis for identifying lessons learned and actionable insights for designing inclusive health services for cognitively impaired elderly patients. Each principle of Inclusive Design was linked to these themes, emphasizing the need for services to place patients at the centre, deeply understand their needs, recognize their differences, create tailored strategies to address these dissimilarities, facilitate accessibility and service provision, and ensure the service is designed in an organized, easy-to-use manner.

While the study provides valuable insights, its main limitation was the lack of access to the specific types and degrees of cognitive impairment among the patients. Future research could address this limitation by exploring how different types of cognitive impairment influence patients' interactions with healthcare services. Furthermore, comparative studies between countries with different levels of development could provide a broader understanding of how varying healthcare infrastructures, cultural contexts, and socioeconomic factors impact the inclusion of vulnerable patient populations in oncological care.

Expanding this work to include other patient demographics or contexts could also strengthen its applicability in inclusive healthcare. For instance, exploring the application of ID principles in public healthcare settings or with other vulnerable populations may provide additional insights into how to make healthcare services more equitable and accessible across different systems. Ultimately, this study reinforces the importance of designing healthcare services that not only meet functional requirements but also prioritize empathy, trust, and a deep understanding of patients' diverse and evolving needs.

# 7. Acknowledgments

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# Journey of Journal of Accessibility and Design for All: A Review

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Abstract: This study aims to examine the publication journey of the Journal of Accessibility and Design for All (JACCES). This review article utilised bibliometric analysis to conduct performance evaluation and science mapping. The study employed the Bibliometrix R package (version 4.2.3) through the Biblioshiny interface, along with VOSviewer, to address the research questions. The performance analysis focused on the publication trends, citations, and contributions from authors, institutions, and countries of the JACCES. In addition, keyword co-occurrence and bibliographic coupling analyses were performed to measure the conceptual structure of the literature and the central themes on which the journal has published. The study identifies four themes: inclusive design and tourism for all, accessible tourism: sensory and digital approaches, measuring and evaluating disability-inclusive environments, and digital accessibility in public domains. A future research agenda is also proposed for researchers to work on and provide comprehensive information to fill the research gaps and strengthen the publication journey of the JACCES.

## 1. Introduction

People in built environment often face different types of exclusion, which goes against building codes and societal goals of inclusivity. This exclusion is shaped by both personal circumstances and the design of the physical environment (Muller et al., 2024). Industrialization, urbanization, and rapid technological changes have created a gap between people's skills and the skills needed. Many people, especially seniors and those with disabilities, are unable to use city environments and are the most affected. Attempts to close this gap often fail because of infrastructure limitations (Kose, 2016). Infrastructure is limiting because it was often built without considering inclusivity, making it hard to adapt for seniors and people with disabilities. While compromises have been made, they are often temporary fixes. The challenge is whether to accept these or push for better, more inclusive designs. Living in wealthier neighbourhoods with a mix of services (shops, healthcare, schools, and parks that support daily needs and social activities) and more places (accessible destinations like cultural, social, and commercial spaces) to go helps promote social inclusion. However, crowded areas and barriers such as negative attitudes (discrimination

or stigma toward certain groups, creating social and psychological barriers to inclusion), physical obstacles, and poor transportation options make it harder for people to feel included (Abdeldayem et al., 2022).

Design for all (DFA), also known as Universal or Inclusive Design, complements Assistive Technology by creating products and services that are accessible to as many people as possible, either on their own or with the help of assistive tools (Bühler & Stephanidis, 2004). DFA promotes inclusion by enabling everyone to participate in economic development, reducing social exclusion, and boosting economic benefits. DFA creates job opportunities in tourism and is a key source of income for many countries. DFA supports human rights by respecting diversity and promoting social inclusion and equality. It complements assistive technology and barrier-free accessibility and has been applied in areas like bathing, shopping, and gardening to encourage innovation and social awareness(Bühler, 2008; Di Bucchianico, 2018)

Accessibility is a multifaceted issue that involves the design of systems and addressing the specific needs of various groups of people with disabilities. It also considers the impact of embedded content, such as images or videos, and the use of assistive technologies to make information more easily accessible and usable (Alahmadi & Drew, 2018). Accessibility and physical disability (APD) refer to the design and adaptation of environments, products, and services to ensure that individuals with physical disabilities can access and use them as easily and independently as possible. APD eliminate barriers that prevent people with physical impairments from participating fully in society. Accessibility and universal design in various fields such as architecture, technology, education, and product design can play a major role in uplifting the morale of physically disabled people.

Journal of Accessibility and Design for All (JACCES) provides a platform for researchers to find solutions for current scenarios in the above domain and present them to society. JACCES is indexed in the Scopus database, which is considered one of the most reputable and genuine databases. It has an h-index of 7 (according to Scimago Journal Rank) with a cite score of 1.4 (2023) and 1.4 (1st February 2025 as per the Scopus database), publishes double-blind review manuscripts in the English language, and has been ranked in the quartile 2 (69%) of the architectural subject category. It covers a multifaceted research area, such as architecture, engineering, education, medical and healthcare, and society and economy. The ONCE Foundation, a leading disability organisation in Spain, sponsors the open-access publication of literature in JACCES. The foundation's primary goal is to provide training programs that help people with disabilities find jobs and integrate into the workforce. In addition, it creates accessible environments, products, and services for everyone.

A bibliometric study describes the evolution and present state of research within the journal (Antia-Obong et al., 2019). It provides insights into the journal's impact, published research work characteristics, article productivity, research trends, authors, degree of author collaboration, and emerging topics with specific journals using statistical methods. Presenting a retrospective review of a journal is not a new culture; it has been done with various quality journals such as Tourism Cities (Gurung & Gowreesunkar, 2024), Consumer Behaviour (Lim et al., 2023), F1000Research (D. Kumar et al., 2023), and Contemporary Hospitality Management (Sharma et al., 2023). Following the approach of previous journal retrospectives, the authors reviewed the JACCES using bibliometric analysis (BA). Against this backdrop, the present study seeks to offer valuable insights guided by the following research questions (RQs):

- RQ1: What are the publication and citation trends in the JACCES?
- RQ2: What are the most collaborative authors and countries in JACCES?

- RQ3: Which articles published in the JACCES are the most cited?
- RQ4: How did the major themes appear over time in JACCES?
- RQ5: What emerging topics have authors explored in JACCES?

# 2. Methodology

Paul and Criado (2020) posit that a review article's main goal is to closely examine the existing research in a specific area, theme, or discipline. The literature review was classified into three categories: domain-based, theory-based, and method-based. Domain-based review is further classified into - 1) Structured review, 2) Framework-based review, 3) Hybrid review, 4) Review aiming for theory development, and 5) Bibliometric review. In this study, a domain-based bibliometric review method was used.

Bibliometric methods come from library and information sciences research and deal with analysing large amounts of bibliographic data (Broadus, 1987; Pritchard, 1969). Bibliometric studies compile and summarise the available literature to generate meaningful information on authors, countries, affiliations, citations, publication growth, research trends, and funding agencies. Additionally, it aims to pinpoint any gaps in the research, helping the journal to call for studies that can address these gaps. The bibliometric approach of systematic review was chosen in the present study because of its compatibility with the analysis of large metadata, evaluation of performance through various metrics, systematic mapping of knowledge maps, and minimisation of biases by the authors (Mukherjee et al., 2022; Pandey et al., 2023). There are various tools for conducting bibliometric reviews, such as VOSviewer, the Bibliometrix R package using biblioshiny, CitNetExplorer, Sci2, etc.

A bibliometric approach applying the Bibliometrix R package 4.2.3, using a biblioshiny interface developed by Aria and Cuccurullo (2017), and VOSviewer 1.6.20 (van Eck & Waltman, 2010) has been used in various studies to understand journal publication patterns and overall trends (Donthu et al., 2020; Donthu, Kumar, Pandey, et al., 2021; A. Kumar et al., 2024; D. Kumar et al., 2023). By following the guidelines to conduct a bibliometric analysis (BA), suggested by (Donthu, Kumar, Mukherjee, et al., 2021), the present study has been developed. Ellegaard and Wallin (2015) posit that BA is gradually being embraced as a practical tool by professionals, not just as an academic method for experts in the field.

## 2.1. Data Curation

The metadata for the study was extracted from one of the most reliable databases, i.e. Scopus. By using the keywords "Journal of Accessibility and Design for all" and limited to "published", "Article", "Review", and "English" from 2015 to 2024 (31st September 2024), data is extracted. A total of 84 articles were downloaded in the CSV file format, and manual screening was performed to check for missing information, such as authors, DOI, and duplicates. No information was missing from the metadata, and it was used for the analysis.

## 2.2. Structure

BA was performed by applying the Bibliometrix R package using the biblioshiny interface and VOSviewer software. BA have been classified into two sections: performance analysis and science mapping. Performance analysis is used to measure publication growth, highly cited articles, most productive authors and countries and so on. Science mapping was performed to identify themes, clusters, and emerging themes and propose future research directions.

*Figure 1. Publication and citation trends (Source: Author's creation)*
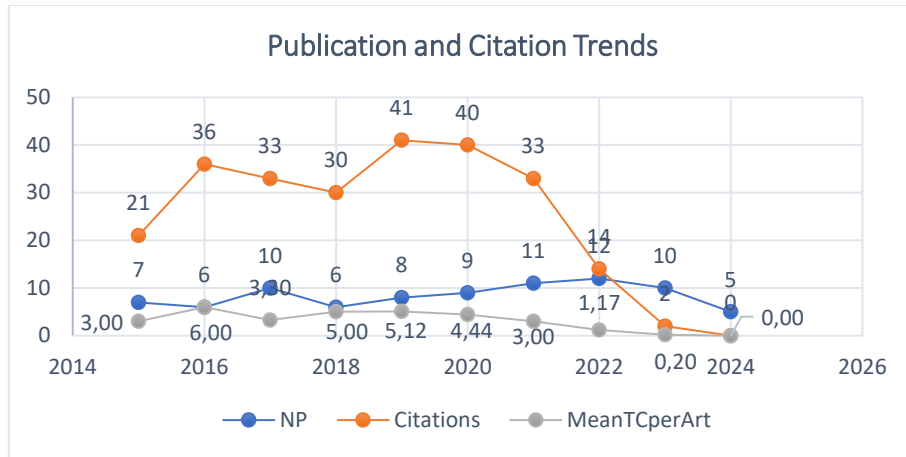


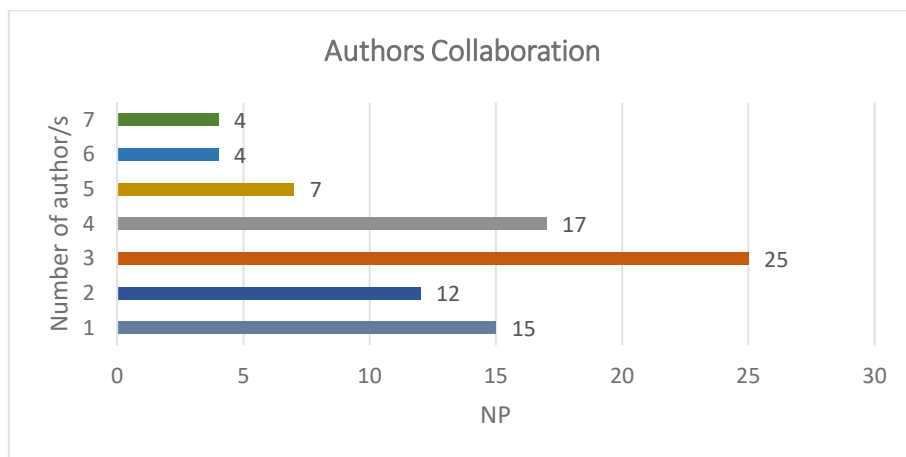*Note: NP= Number of Publications, Mean TCperArt = Mean Total citations per Article*

# 3. Results

## 3.1. Performance Analysis

### 3.1.1. Publication and Citation Trends in JACCES

RQ 1 aimed to visualise and identify the publication and citation trends of the JACCES over time. JACCES published only 84 articles in a decade (since 2015), with an average publication of 8.4 per year. The maximum number of publications (NP) (12) is published in 2022, whereas the minimum NP is published in 2018. Publication growth is almost consistent, which shows a rigorous quality check and the novelty of the literature. Over this period, these 84 publications received 250 citations, with an average of 2.98. It received an average mean Total Citations per Article (TCperArt) score of 3.12. In 2019, it received a maximum of 41 citations, followed by 40 citations in 2020, which is not very promising. Figure 1 also shows a downward trend, which is not a good indication of a quality journal like JACCES. This may be due to the journal's low visibility and awareness amongst the research fraternity.

*Figure 2. Authors collaborations (Source: Author's creation)*



*Note: NP= Number of Publications*

*Figure 3. Countries collaboration (Source: Author's creation)*



### 3.1.2. Authors, countries and institutions collaboration

Baker et al. (2023) highlighted that more collaboration represents a better research output. In the present study, Figure 2 shows that two to seven authors contributed to 69 publications (82%), whereas single authors contributed to the remaining 15 publications (18%). Multi-author contributions have the maximum contribution in the JACCES publication journey, highlighting the publication's high quality.

International collaboration significantly improves the quality of research articles, especially in countries with high research expenditure (Thelwall et al., 2024). Greater cross-country collaborations help journals enhance research quality, increase citations and visibility, and increase impact. Countries like Belgium and Italy collaborated twice with different countries, whereas Australia, Germany, India, Indonesia, Slovenia, Spain and the USA collaborated only once, as shown in Figure 3. European countries primarily collaborated with European countries, whereas Asian countries collaborated with Asian countries. A few cross-continent collaborations also exist, such as in Australia-Saudi Arabia and Japan-New Zealand.

### 3.1.3. Top 10 cited publications

The top 10 cited publications in the JACCES (RQ 2) are shown in Table 1. "Inspiring Architects in the Application of Design for All: Knowledge Transfer Methods and Tools", authored by Mosca et al., (2019), highlighted the important information such as effective communication, understanding users' needs, descriptive information, and built environment in designing inclusive environments. It received a maximum of citations (24) with a Total Citations per Year (TCpY) of 4. "A preliminary study for developing accessible MOOC services", authored by Iniesto & Rodrigo (2016), received the second-highest citations (16) and TCpY (1.78). It highlights the importance of a holistic approach that considers learners' abilities and learning objectives while developing Massive Online Open Courses (MOOC), which can be accessible to all. The third highly cited article, "Website Accessibility of Travel Agents: An Evaluation Using Web Diagnostic Tools", authored by Eusébio et al. (2020), received 12 citations and 2.40 of TCpY. It provides valuable

insights to the designers and developers of travel agency websites to ensure that their content is easily accessible to everyone, regardless of their individual needs, skills, or conditions.

*Table 1. Top 10 cited publications (Source: Author's creation)*

| Author/s, year | Title | TC | TCpY |
|---|---|---|---|
| (Mosca et al., 2019) | Inspiring architects in the application of Design for all: Knowledge Transfer Methods and Tools | 24 | 4.00 |
| (Iniesto & Rodrigo, 2016) | A preliminary study for developing accessible MOOC services | 16 | 1.78 |
| (Eusébio et al., 2020) | Website accessibility of travel agents: an evaluation using web diagnostic tools | 12 | 2.40 |
| (Hitch et al., 2016) | Does universal design education impact on the attitudes of architecture students towards people with disability? | 10 | 1.11 |
| (Palmer Peterson, 2021) | Built environment accessibility in the eastern province of the Kingdom of Saudi Arabia as seen by persons with disabilities | 10 | 2.50 |
| (Gaire et al., 2017) | Walking behaviour of individuals with and without disabilities at right-angle turning facility | 9 | 1.13 |
| (Zimmermann-Janschitz, 2018) | Geographic information systems in the context of disabilities | 9 | 1.29 |
| (Henríquez et al., 2022) | The past, present, and future of accessible tourism research: a bibliometric analysis using the Scopus database | 8 | 2.67 |
| (Piramanayagam et al., 2019) | Inclusive hotel design in India: a user perspective | 8 | 1.33 |
| (Rahmatizadeh & Valizadeh-Haghi, 2018) | Monitoring for accessibility in medical university websites: meeting the needs of people with disabilities | 7 | 1.00 |

*Note: TC= Total citations, TCpY = Total citations per year*

*Table 2. Top 10 influential authors (Source: Author's creation)*

| Author | h_index | g_index | m_index | TC | NP | PY_start |
|---|---|---|---|---|---|---|
| Freddi P | 2 | 2 | 0.25 | 8 | 2 | 2017 |
| Gamache S | 2 | 3 | 0.25 | 15 | 4 | 2017 |
| Leblond J | 2 | 2 | 0.25 | 8 | 2 | 2017 |
| Morales E | 2 | 3 | 0.25 | 16 | 8 | 2017 |
| Noreau L | 2 | 2 | 0.25 | 8 | 2 | 2017 |
| Rosa MP | 2 | 2 | 0.5 | 8 | 4 | 2021 |
| Routhier F | 2 | 2 | 0.25 | 7 | 3 | 2017 |
| Abate TP | 1 | 1 | 0.111 | 1 | 1 | 2016 |
| Abbas NY | 1 | 1 | 0.333 | 2 | 1 | 2022 |
| Acheampong E | 1 | 1 | 0.125 | 2 | 1 | 2017 |

*Note: TC = Total Citations, NP= No. of publications, PY_Start = Start of publication year*

### 3.1.4. Top 10 influential authors

A total of 241 authors have contributed their work to JACCES. Lotka's law of productivity is often used to understand an author's productivity and research output in a specific domain (Lotka, 1926). A small proportion of authors contributed to a large proportion of publications, whereas the majority contributed only a few papers. The same can be seen in the present study; 224 authors contributed only to one article, whereas 12 authors contributed to two articles, followed by two authors who contributed three and four articles. Table 2 highlights the top 10 most impactful authors based on their h-index. The h-index is a widely used scientific indicator of an author's output, as it balances publications and citations (impact in the scientific community) (Hirsch, 2005). Freddi P, Gamache S, Leblond J, Morales E, Noreau L, Rosa MP, and Routhier F have an h-index of 2, which suggests that at least 2 publications were cited 2 times. The g-index measures the overall citation impact of a collection of articles (Egghe, 2006). In the present study, Gamache S. and Morale E. have the highest g-index of 3. Moreover, the m-index is the h-index normalized by the number of years since the researcher's first publication. In the present study all top five authors have the same g-index i.e. 0.25.

### 3.1.5. Top 10 impactful countries

Articles published in JACCES have contributions from 37 countries. The top 10 impactful countries based on the citations received are shown in Table 3. Although Canada (15), the United States (10) and Spain (9) are the biggest contributors, Portugal appeared as the most impactful country, receiving the maximum number of citations (14) with only 6 contributions, followed by Indonesia (12 citations). Australia published only 3 articles but received the third-highest citations (10) with a maximum average article citation (AAC) of 10. African continent contribution is scarce in the JACCES publication journey, except for Ghana, which has a single publication.

*Table 3. Top 10 impactful countries (Source: Author's creation)*

| Country | (TC) | (NP) | (AAC) |
|---|---|---|---|
| Portugal | 14 | 6 | 7.00 |
| Indonesia | 12 | 4 | 3.00 |
| Australia | 10 | 3 | 10.00 |
| Saudi Arabia | 10 | 2 | 10.00 |
| Austria | 9 | 2 | 9.00 |
| Bulgaria | 7 | 1 | 7.00 |
| Canada | 7 | 15 | 1.80 |
| Iran | 7 | 1 | 7.00 |
| Denmark | 6 | 2 | 3.00 |
| Malta | 5 | 1 | 5.00 |

*Note: TC= Total citations, NP = Number of Publications, AAT = Average Article Citations*

*Table 4. Top 10 impactful institutions (Source: Author's creation)*

| Affiliation | Country | Articles |
|---|---|---|
| Universitas Indonesia | Indonesia | 7 |
| Thomas Jefferson University | US | 6 |
| Université Laval | Canada | 6 |
| Bandung Institute of Technology | Indonesia | 5 |
| Kyushu Institute of Technology | Japan | 5 |
| Instituto Federal De Educação | Brazil | 4 |
| University of Algarve | Portugal | 3 |
| University of Aveiro | Portugal | 3 |
| University of British Columbia | Canada | 3 |
| University of Geneva | Switzerland | 3 |

*Figure 4. Keywords co-occurrence network visualisation (Source: Author's creation)*
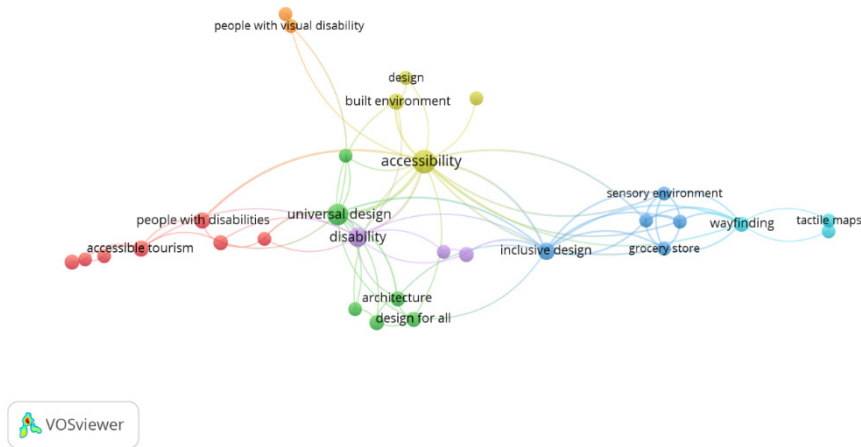


### 3.1.6. Top 10 impactful institutions

A total of 34 institutions and affiliations contributed their work to the JACCES research journey of one decade. The top ten influential institutions contributed 53.57% (45 articles) of the total published articles, as shown in Table 4. Universitas Indonesia contributed a maximum of seven articles, followed by Thomas Jefferson University and Université Laval, with six articles each. These institutions are mainly located in Indonesia, Canada, and Portugal. None of the top 10 institutions was from either the Australian or the African continent.

## 3.2. Science Mapping

### 3.2.1. Keywords co-occurrence

Keyword co-occurrence analysis was performed to measure the conceptual or knowledgeable structure of the literature (Callon et al. 1983; Cheng et al. 2018). In the present study, keyword co-occurrence analysis was performed on the keywords of 321 authors using a minimum of two occurrence criteria. 31 keywords with a total of 124 appearances and a total link strength (TLS) of 224 appeared in 84 articles. Accessibility (25 occurrences and 35 TLS), universal design (17 occurrences and 22 TLS), and disability (11 occurrences and 15 TLS) appeared as the top three occurring keywords shown in Figure 4.

These 31 keywords developed 8 clusters and created a theme of "Urban Inclusive Accessibility", "Inclusive Universal design for Vision-impaired shoppers", "Accessible Design for Intellectual Disabilities", "Inclusive Design for Disabilities", "Tactile Wayfinding", and "Accessible visual design."

Keywords' appearance over time is visualised in Figure 5 using overlay visualisation features of VOSviewer software developed by (van Eck & Waltman, 2010). Keywords visualised in yellow colour highlight the appearance of the latest keywords in JACCES-published articles. Keywords such as "Universal accessibility", "social participation", "web accessibility", "built environment", and "occupational therapy" are the latest mentioned keywords, which have the potential to be studied more by future researchers.

*Figure 5. Keywords co-occurrence overlay visualisation (Source: Author's creation)*
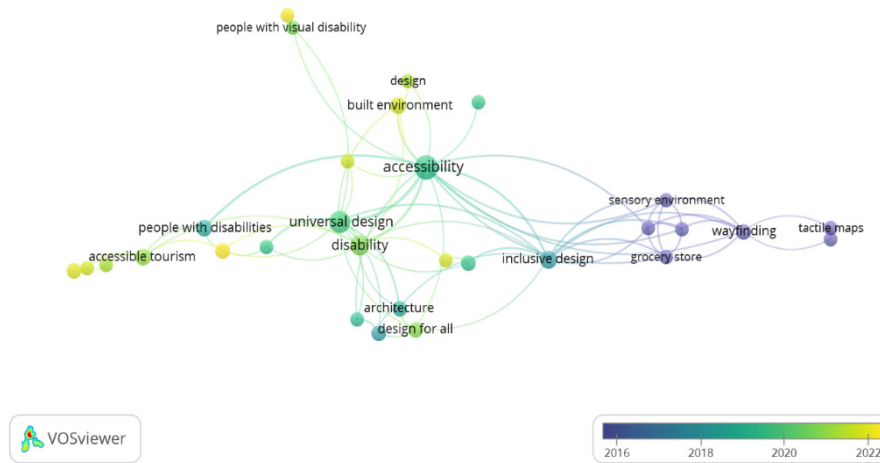


## 3.2.2. Bibliographic Coupling Analysis (Documents)

Bibliographic coupling (BC) is employed to understand the major research themes explored by JACCES authors over time. BC is used to estimate the similarity between scholarly works based on shared references or topics of interest. BC provides a fundamental understanding of the current state of a particular research area, thereby supporting the identification of potential future research directions (Gheno, 2021). Through scientific mapping utilising BC, researchers can develop themes or groupings based on the assumption that articles referencing similar literature are likely to share similar content (Lim et al., 2023). Similar to the content analysis, the articles within each cluster were carefully read to understand the underlying common theme. In the current BC of the JACCES, only four clusters emerged. The themes of the four clusters, as well as the number of articles and studies, are listed in Table 5.

### Cluster 1. Inclusive design and tourism for all

This cluster of research articles focused on accessibility in various contexts, specifically hospitality, tourism, and the built environment. The seven articles included in this research theme examined accessibility from different perspectives, including user experiences, website usability, physical infrastructure, and the economic implications of accessibility. Research articles in the cluster generally focus on building and tourism environments, highlighting the importance of inclusive spaces for people with disabilities. This is a notable emphasis on the needs of persons with disabilities, specifically with motor and dexterity impairments. Moreover, inclusive hotel design, geographical information system application, and the built environment's economic benefits were also examined. This cluster also includes both a BA and a systematic literature review. While the past, present, and future of accessibility in tourism research have been analysed using BA, a systematic literature review was conducted to examine the geographic information systems within the context of disability. A study that examined the website accessibility of travel agents found that they received the highest number of citations within the cluster.

*Table 5. Clusters identified through bibliographic coupling (Source: Author's creation)*

| Cluster | Central focus | Theme Keywords | N | Studies in the cluster |
|---|---|---|---|---|
| 1 | Inclusive design and tourism for all | Accessibility; Build environment; Inclusive design; Economic benefits | 7 | (Eusébio et al., 2020; Palmer Peterson, 2021; Pascual et al., 2015; Piramanayagam et al., 2019; Suárez Henríquez et al., 2022; Terashima & Clark, 2021; Zimmermann-Janschitz, 2018) |
| 2 | Accessible tourism: sensory and digital approaches | Sensory Experiences; Elderly/ Disabled; Digital literacy; Tourism | 6 | (Bender et al., 2021; Offei et al., 2017; Rolim et al., 2021; Rosa et al., 2021; Trotta, 2023; Vieira et al., 2022) |
| 3 | Measuring and evaluating disability-inclusive environments | Taxonomy: disability; Measurement Tools; Evidence-based approach; Urban planning and design | 5 | (Arfaoui et al., 2019; Gamache et al., 2018, 2020; Gamache, Grenier, et al., 2017; Gamache, Routhier, et al., 2017a; Rahmatizadeh & Valizadeh-Haghi, 2018) |
| 4 | Digital accessibility in public domains | Digital accessibility; Website accessibility; Online spaces; Visually impaired | 5 | (Alahmadi & Drew, 2018; Debevc et al., 2023; Rahmatizadeh & Valizadeh-Haghi, 2018; Sabev et al., 2020; Stitz & Blundell, 2018) |

*Note: N = Number of articles in the cluster*

## Cluster 2. Accessible Tourism: Sensory and Digital Approaches

The six articles included in Cluster 2 emphasised accessible tourism experiences, particularly for persons with disabilities and the elderly. Articles in this cluster cover a range of topics, including sensory experiences ((e.g. the Hand of Fatima in Lagos), accessible tourism in historical locations (Cape Coast and Elmina Castles in Ghana), proposals for inclusive and accessible tourism specifically focusing on bird watching and birding by ear (City of Logos), accessibility experiences of blind and partially sighted visitors to the Vatican museum, digital literacy for elderly tourists (Algarve, Portugal), and tactile-enabled surfaces at bus stops to facilitate accessible tourism. In general, articles in this cluster emphasised the importance of infrastructure that supports accessibility and accessible tourism. Unlike the previous cluster, which focused on the built environment and technological accessibility, studies in this cluster have expanded into sensory tourism experiences, digital literacy, and digital empowerment of elderly tourists.

## Cluster 3. Measuring and Evaluating Disability-Inclusive Environments

Five articles published between 2017 and 2020 were included in Cluster 3. Articles in the cluster focused on the assessment and evaluation of the accessibility of urban and built environments for persons with physical and sensory impairments. Studies in this cluster have examined different dimensions of accessibility, including risk factors in daily life, taxonomies for disability studies, measurement tools for environmental accessibility, municipal practices, and objective

evaluations of environmental obstacles. Studies in this cluster have strongly emphasised methodological approaches and quantification and categorisation of accessibility challenges, highlighting evidence-based approaches to urban planning and design to fulfil the needs of diverse individuals with disabilities. Compared to other clusters, articles in this cluster focused on the technical and infrastructural aspects of accessibility, emphasising the assessment of obstacles in the building environment and developing a framework to improve accessibility at the municipal level.

### Cluster 4. Digital Accessibility in Public Domains

The five articles included in this cluster focused on the evaluation and monitoring of digital accessibility across digital platforms and public domains. Studies in this cluster examined issues associated with image accessibility for visually impaired users, general website monitoring, website accessibility of a medical university, online library guides, and public websites in Bulgaria. The articles included in this study strongly emphasise the accessibility of online digital resources and websites of educational and public service organisations, considering the essential nature of websites that are essential for education, healthcare, and public services, specifically for persons with disabilities. Unlike previous clusters, the research articles in this cluster concerned the digital accessibility and needs of disabled users in online spaces, reflecting the growing importance of the digital domain that aimed to provide equitable access to information and services to all users.

In conclusion, the four clusters of research articles identified through bibliometric coupling indicate the multidimensional approach adopted by researchers to study accessibility and inclusiveness in recent years. The identified clusters also demonstrate the progression of research from physical to digital accessibility concerns. The bibliometric coupling highlights the evolving nature of accessibility research, reflecting sustainable development goals, including accessibility and inclusion.

### 3.2.3. Thematic development in JACCES for future directions

Bibliographic Coupling Analysis (BCA) generated four themes that emerged from 23 documents published over time (2015-2024). Developing a clear theme is crucial for crafting well-organised and persuasive research papers. It helps to clearly communicate the researcher's findings and arguments. Figure 6 shows the year-wise publication patterns of the various clusters that appeared over time. Cluster 1 has the highest no. of publications (NP=7), followed by Cluster 2 (NP=6) and Clusters 3 and 4 (NP=5). Owing to fewer articles published that cover a wider domain, only four clusters appeared, with a minimum of five articles in every cluster.

Cluster 1, which generated a theme of "Inclusive design and tourism for All" has a maximum of 7 articles showing a consistent growth pattern. A maximum of two articles were published in 2021, but none were published in 2017 or 2023. The social model of disability challenges professionals to recognise how the design of the built environment can create barriers for people with disabilities. By addressing these issues, practitioners can significantly improve the accessibility of buildings and public spaces (Jackson, 2018). Chan et al. (2024) posits that evidence-based approaches can be helpful for governments and businesses in developing effective strategies that promote disability inclusion and improve the representation of people with disabilities in the workforce.
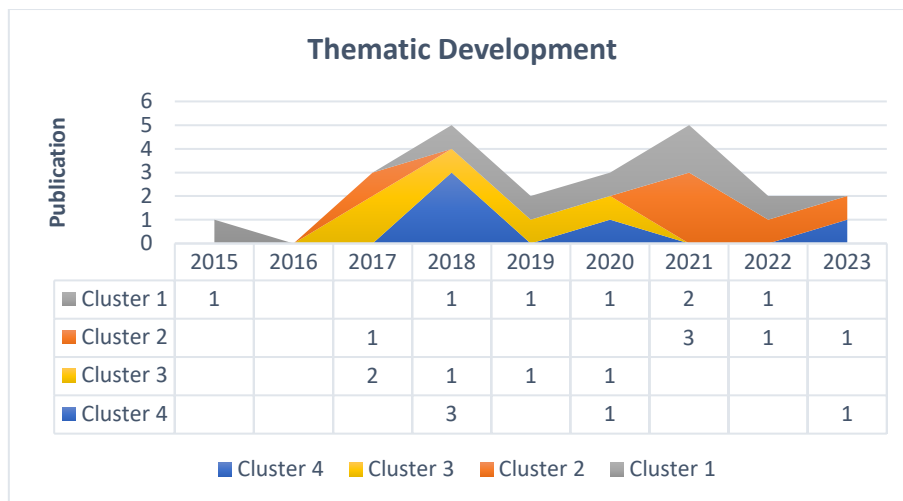
Cluster 2 highlights the "Accessible Tourism: Sensory and Digital Approaches" theme and published the second highest number of articles, i.e. 6. This cluster showed publication inconsistencies and a zigzag trend over the study period. A maximum of 3 articles were published in this cluster in 2021. Disabled tourists are often loyal, tend to spend more time, and usually stay

longer at their destinations. However, travel habits vary across countries (Domínguez Vila et al., 2019). Tourism services should be welcomed to ensure the safety of elderly individuals and people with disabilities, respecting their personal values by promoting the use of technological tools and providing a list of other accessible tourist services in the area, such as restaurants, museums, and more, ensuring accessibility for all visitors (Vieira et al., 2022). Bender et al. (2021) suggested to find a new approaches to appreciate, observe, and interpret through the senses are intended not only for tourists and visitors but also for the local community. Although published consistently since 2021, this cluster has shown consistent downward growth.

Clusters 3 and 4 highlight the "Measuring and evaluating disability-inclusive environments", and "Digital Accessibility in Public Domains" themes. These clusters published only five articles over the period but did not show any promising trends. In cluster 3, while the first publication appeared in 2017, it ceased in 2020, after which no further publication was found, indicating a diminishing interest of authors in this area. Cluster 4 has exhibited an intermittent publication trend. In 2018, there were a maximum of three publications, and only one each in 2020 and 2023. The main emphasis of this cluster is that both service providers and consumers need to increase their self-representation, rethink tourism spaces and their roles, change power dynamics and break the social barriers to increase the tourism participation of people with disabilities (Gillovic & McIntosh, 2020). Khasawneh (2024) identified that social media platforms have the potential to play a big role in addressing inequalities and can help to create a more inclusive and accessible online environment for everyone.

The specific features of outdoor and indoor spaces that limit access for people with mobility challenges can be identified using mobility assistive technologies (non-compliant items) which can be helpful in identifying areas that need improvement, especially access ramps and washrooms (Gamache et al., 2020). Gamache et al. (2017) suggested that there is a need to develop and implement guidelines to make pedestrian infrastructure accessible. Potential improvements have been identified to enhance the practices that support the social participation of individuals with physical disabilities. Using the measure of environmental accessibility (MEA) can help people improve public infrastructure for those with physical, cognitive, and intellectual disabilities. It also creates a shared language and understanding of working on urban projects (Gamache et al. 2018). Debevc et al. (2023); Rahmatizadeh & Valizadeh-Haghi, 2018) posited that combining basic and detailed monitoring would help improve website accessibility and provide a better understanding of the needs of disabled users.

*Figure 6. Thematic development (Source: Author's creation)*



| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|
| Cluster 1 | 1 | | | 1 | 1 | 1 | 2 | 1 | |
| Cluster 2 | | | 1 | | | | 3 | 1 | 1 |
| Cluster 3 | | | 2 | 1 | 1 | 1 | | | |
| Cluster 4 | | | | 3 | | 1 | | | 1 |

## 4. Discussion and Conclusion

JACCES has been quite young in the publication race as compared to other Quartile 2 journals. It started the publication journey in 2011 but on the Scopus database it appears in 2015 and, until 2024 (August), published only 84 articles due to its rigorous quality check and critical review process, which includes promptness, confidentiality, the standard of objectivity, and acknowledgement of sources. Daniel Guasch and Jesus Hernandez are the chief editors of the journal. JACCES publishes the work in five main domains, namely Engineering (Julio Abascal, Chern Sheng Lin, and Konstantinos – Editorial board), Architecture and Construction (Satoshi Kose, Nick Tyler, Nieves Navarro Cano – Editorial board), Health and Medical Care (Hennie Boeije, Alarcos Cieza – Editorial board), Education (Joan Mcguire and Roger Slee – Editorial board), and Society and Economy (Colin Barnes, Simon Andrew Darcy, Patrick Devlieger – Editorial board). The bifurcation of editorial boards can help to maintain the highest quality in a particular domain. Universitat Politecnica de Catalunya, Spain, published the journal. It has an h-index of seven according to Scimago Journal Rank, highlighting the journal's limited visibility on a global platform. The present review highlights publication and citation trends, authors, countries' collaboration, highly cited articles, impactful countries, institutions, and authors (performance analysis). It also identified the major and emerging themes in the JACCES publication journey through science mapping analysis.

The journal has published 9 articles/year since its evolution (2011). A maximum of seven authors collaborated to publish their work in JACCES, but contributed only four articles. A total of 25 articles were published in collaboration with three authors globally, followed by 17 articles by four authors. Only Belgium (Ireland and Germany) and Italy (Jordan and Belgium) collaborated with two countries, whereas the remaining 20 countries collaborated with a single country. Mosca et al. (2019), Iniesto & Rodrigo (2016), and Eusébio et al. (2020) received the maximum citations of 24, 16, and 12, respectively. However, the three most influential authors are Morales E, Gamache S, and Freddi P, with citations of 16, 15 and 8. Portugal, Indonesia, and Australia were the top three most influential countries, with 14, 12, and 10 citations, respectively. In contrast, Universitas Indonesia (Indonesia), Thomas Jefferson University (US), and Université Laval (Canada) are the top three institutions that contributed to their quality work in JACCES.

Science mapping was performed to explore keyword co-occurrences and the emergence of major themes based on the BCA of documents. A total of eight clusters emerged when analysed using VoSviewer software, and themes were developed, focussing mainly on "Urban Inclusive accessibility", "Inclusive Universal design for Vision-impaired shoppers", "Accessible Design for Intellectual Disabilities", "Inclusive Design for Disabilities", "Tactile Wayfinding", and "Accessible visual design." BCA of the documents resulted in four clusters comprising 23 documents. Each cluster developed separate themes such as inclusive design and tourism for all accessible tourism: sensory and digital approaches, measuring and evaluating disability-inclusive environments, and digital accessibility in public domains.

These emerging themes provide ideas for future research. Other major domains, such as health and medical care, education, society, and economy, are the least explored domains in which future researchers can contribute their work and support society and enhance the economy. Expanding changing place facilities not only helps meet legal requirements but also promotes greater social inclusion and participation for people with severe physical disabilities(Martin et al., 2018). These future directions can be used by the researchers and come up with some concrete ground which can be beneficial for elderly and specially-abled people.

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