A Case Study on Improving Accessibility of Healthcare Care Facility in Low-resource Settings

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ABSTRACT

Accessibility in a hospital is challenging for people in low-income countries due to a lack of accessible mediums to communicate wayfinding, accessibility, and healthcare information. This results in delays and stress but can also result in sub-optimal treatment or sometimes a complete lack of treatment for the visitors. Sensible physical and digital interventions can greatly ease the experience of visitors and reduce the work-related stress of healthcare providers. We present a case study on wayfinding and service design for a mega ophthalmic care facility that has a daily footfall of 2500 patients. From our mixed-methods study we identified: (i) there are very few accessible mediums available to communicate wayfinding, accessibility, and healthcare information; (ii) there is a lack of inclusively designed interventions to accommodate the diversity of visitors; (iii) spatial ambiguity and situational impairment due to crowd density exasperate the situation and (iv) there exist missing as well as misleading information. We developed a spectrum of solutions on the environmental and digital infrastructures available within this context to deliver wayfinding and procedural information. We completed a progressive intervention across digital and physical mediums over a duration of 18 months. This has shown the impact of each medium on visitors' experience. We found the choice of interface to access information depends on the ease of access, and ease of access depends on visitors' abilities. Therefore, both the environment and digital mediums are found to be useful for visitors. Based on these empirical findings, we draw recommendations for an inclusive service design that incorporates using elements of the environment, human and digital infrastructure to support a more positive healthcare visitors experience.

KEYWORDS

healthcare information, accessibility, wayfinding, indoor accessibility

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1 INTRODUCTION AND BACKGROUND

Wayfinding is an essential component of life when accessing services such as healthcare. The accessibility of spaces is essential to enable people to move easily to their appointments and access the care they need. Accessing an appointment normally requires multiple types if accessibility to be in place. The building should be accessible, the signage accessible and the person will need the information about their appointment, which may be physical or digital. The effective wayfinding in healthcare facilities depends on the formulation of key components like patient flow analysis[9], non-visual accessibility, actual and ideal path differences, decision points identification[4], strategic inclusion of quality signage[8] with essential information[2], and cognitive map modeling of the hospital facility [5]. There are some interesting insights about ophthalmic patient interaction and care management [3] specific to people with disabilities.

In a low-resource setting, very often basic navigation support like clear signage that can provide wayfinding is either missing altogether or illegible[1] as referred to in figure 1. To improve the wayfinding [Greenroyd, F.L., Hayward,2018][5], presented a tool which aims to aid signage placement strategies by analyzing facility design and routes within it, based on some natural wayfinding metrics. [Bonfanti, A., Vigolo, 2017] [2], tried to profile a hospital visitor into subgroups based on their wayfinding competence, strategy, and anxiety. They find that accessibility and wayfinding satisfaction is contributed by individuals orientation skill, confidence at the venue and anxiety control. [Leonard, A.L., Verster, A., Coetzee,2014][8] proposed a method for intentional and active participation of nurses in the redesign of signage. They report that due to their sense of ownership of the signage coupled with the support and involvement of hospital management ensured that the resulting signage received wide acceptance. [Rousek, J.B., Hallbeck, M.S., 2011][9] have used five different vision simulator goggles to simulate specific visual impairment to study the wayfinding limitations among visually impaired users navigating in a healthcare

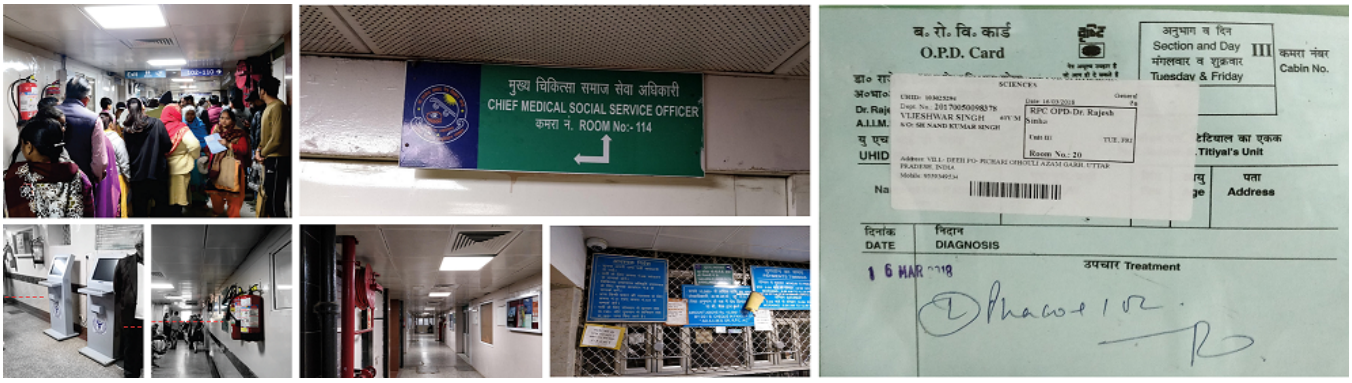

Figure 1: Hospital facility shows lack of clear signages, accessibility cues and healthcare information on registration card

facility. They found the key elements i.e. poor signage, confusing routes, and poor lighting were major issues in wayfinding.

Mobile technology is also being used to assist in wayfinding as demonstrated in many case studies. MyWay[7], a mobile application developed to access hospital maps and locate the user within the facility through GPS and wifi infrastructure using smartphones supports turn-by-turn steps. [Wright et al,2010][14] used a touch screen monitor in a large hospital to enable users to find 16 preselected destinations based on the frequency of use. Despite these works, very few hospitals have online maps for their patients to view before visiting [3, 7]. Most of the hospitals in low-income countries rely on standing maps, signages, or help desks to assist their patients. Overall, very few interventions have gone into actual field implementation[12]. Stress-free wayfinding and access to healthcare information are important but challenging for hospital visitors in low-income countries[12]. This is mainly due to overburdened building infrastructure, underdeveloped service arrangements, and the vast diversity among visitors, which is not common in high-income countries. Except for the critical medical care and treatment, to the best of our knowledge, there is no case study exists which talks about the well-being of patient healthcare journey in a low-resource setting.

In this paper, we present a case study based on our 18-month involvement to improve wayfinding and services at the outpatient department (OPD) at a mega ophthalmic hospital in New Delhi, India. The technical details of our designs are published elsewhere [12, 13]. *Here, instead we focus on the design experience. We present the following contributions:*

- Qualitative need assessment with visitors and the hospital staff
- Design and implementation of a spectrum of physical and digital interventions including:
  - Wayfinding, informative and directory signages in two different languages (Hindi and English) keeping educated, low-vision and less-educated visitors in mind.
  - A mapping tool to create and update key information on a digital map of the space.
  - An accessible kiosk and smartphone app to communicate the key information to visitors using Bluetooth beacons and no-cost April TAGs/QR codes.
- Iterations of design interventions which eliminates the need for any major adaptation and retraining requirements for hospital staff.
- A set of recommendations for robust service design which includes both digital and physical implementations, in addition to human assistance to improve the overall access.

2 CASE STUDY SETTING

In this paper, we present a case study based on our 18-month involvement to improve wayfinding and services at the outpatient department (OPD) at a mega ophthalmic hospital in New Delhi, India. Being a national referee center, this mega ophthalmic care has a daily average footfall of over 2500 visitors. It has an area of around twenty thousand square meters, which is divided into four outpatient department (OPD) zones. In addition to this, the architectural design of the space is not suited to cater to such a high crowd has been incrementally adjusted to manage the high patient load and now contributes to wayfinding difficulties and access to healthcare information. Thus, an effective wayfinding system is crucial to keep the hospital staff focused, productive, and free from interruptions while simultaneously keeping the visitors free from stress[4]. Additional redundancies in the consultation process flow that resulted in a significant unattended waiting time contributed to an increase in the stress level of patients. In addition to this, patients with online appointments, follow-up patients, and new patients did not have separate management protocols and triage. We investigated further and found that in OPD rooms, the process for admitting a patient into the room varies with the attending senior clinician, which increases the patients' confusion. Here, a digital medium like a smartphone benefited a group of visitors to this facility but was unable to cater to the vast majority. Our initial hypothesis was, to cater to the diversity of visitors, a single solution will not be sufficient. The implemented solution interfaces may be relevant to a different set of visitors as that very often depends on the users' background as well as a medical condition and/or disability. While navigating inside this facility, visitors commonly use visual signage and in confusion, patients and their attendants ask hospital staff or other visitors for help. We also found, a high crowd density (2500 patients per day), spatial complexity, a poor design of OPD card, and incremental changes of the area over a period of

time in addition to very weak signage as greatly contributing to the wayfinding difficulties as referred in the figure 1. Data from the ophthalmic center record division indicates that as of January 2020, 60% of visitors to this facility had a smartphone. Given the rapid growth in the adoption of technology by users in India, it is highly likely that hospitals will be more inclined toward smartphone apps to support wayfinding and accessibility or to communicate healthcare information to improve the patient journey experience. Our previous study has confirmed that of those with a smartphone, 50% use their device for accessing map-based applications i.e. Google map, Ola, Uber etc[12]. However, there is limited research that exists globally on an integrated approach for improving access to healthcare facilities in low-resource settings. Mapping of key information, along with localization and multi-medium interfaces can improve the journey experience, reduce healthcare costs, and increase user satisfaction while increasing the healthcare workforce productivity. In this case study, we have shown, how several interaction mediums both digital and physical, for a diverse set of users can facilitate wayfinding and access to healthcare information. We also draw recommendations based on the learning which can be easily adapted to other similar facilities. To the best of our knowledge, no case study had discussed the challenges and opportunities in a low-resource setting using a distributed and balanced intervention of interfaces over various mediums.

3 NEED FINDING AND ASSESSMENT

These need assessment studies took around six months to consolidate the challenges and assess possible interventions. These studies helped us, (i) to identify the pain points where the patients need assistance, (ii) to understand what kind of assistance they required - physical (wayfinding and accessibility) or functional (healthcare information), (iii) understand the impact of environment like which pieces of information are being perceived through cognitive landmarks, building elements, and existing signage in decision making and how they can be made more effective and (iv) Challenges faced in the consultation procedure due to a lack of awareness.

The data were collected through three methods which gave us a rich insight about the experience of patients in this particular healthcare facility. The first method was a role play experience[1] in which we lab visited the hospital as a patient to tacitly understand and immerse themselves in the overall patient journey. Complimenting this, we conducted an observational study with 15 patients visiting the healthcare facilities followed by a semi-structured interview in which we also recorded the type of queries asked by the patients and preference of choice to medium for accessing the information. Finally, we conducted a focus group discussion session with 4 hospital staff members and 2 patient care managers to understand the existing service design and possibilities to customize and upgrade their services.

Immersive Role Play Experience

In our role play experience we found that for a healthy adult, the average consultation time was around 135 minutes. During this journey, the major challenges encountered were in understanding the registration and consultation process i.e. finding the consultant room and understanding protocols, overcrowded waiting area especially in front of OPD rooms and uncertainty about the time for consultation. Furthermore, the fear of losing the registration card due to crowding as well as the fear that one would not be able to meet the doctor in time added to the stress levels. We can argue that the severity of such problems varies depending on the mental status and the patient's ability to cope-up with stress in a real-life scenario. From our role play experience we anticipated, on average the registration took around 35 minutes and OPD consultation waiting time was around 45 minutes. This was resulting in the accumulation of patients near the registration counters and outside the OPD room mainly due to smaller waiting areas outside OPD rooms. Unavailability and inaccessibility of wayfinding information, OPD consultation protocol and expected waiting time before the consultation was adding to the stress level of patients.

Observational Study

A total of 15 volunteers selected through convenience sampling from the hospital visitors participated in the observational study and semi-structured interview. Informed consent was taken before the study. During the study, we recorded their approaches to wayfinding and access to healthcare information. This included wayfinding signages, seeking assistance from other visitors or hospital staff at various decision points. We timestamped the participants' journey as referred in Figure 2, to understand the current navigation approach, pain points, query points and nature of the query. We found that on average, one complete consultation journey for a patient took around 135 minutes. We also observed the type of queries asked by the visitors and factors affecting the well-being of the consultation journey. The observations contributed to the strategic inclusion of wayfinding signage and other environmental cues to improve wayfinding. In addition to the in-person observations, we also analyzed the CCTV video data of this facility through a typical week.

Interviews

After finishing their consultation, we carried out one-on-one interviews. Our objective was to gain valuable insight to enable us to create an effective digital service design to improve the journey experience. The interview topics were related to their experience, challenges faced, current approaches to mitigate, etc. We also investigated their preferred choice of mediums to access various information. Additionally, we investigated the scope of accessible and interactive digital maps to support wayfinding and access to healthcare information with the help of geospatial information annotated by the hospital staff with the least additional infrastructure investment. A hospital journey to the OPD included an appointment, registration, consultation, test and follow-up visits etc. (refer to figure 2). Patients and their attendants encountered numerous contextual difficulties over this journey and effective communication of wayfinding and healthcare information was realized to be important for improving this journey. The increasing use of smartphones also provided an opportunity to overcome the challenges during the hospital visit one of which is wayfinding as some of the captured experiences show that how the lack of wayfinding,

[1] https://www.youtube.com/watch?v=D6O5OylDAO0

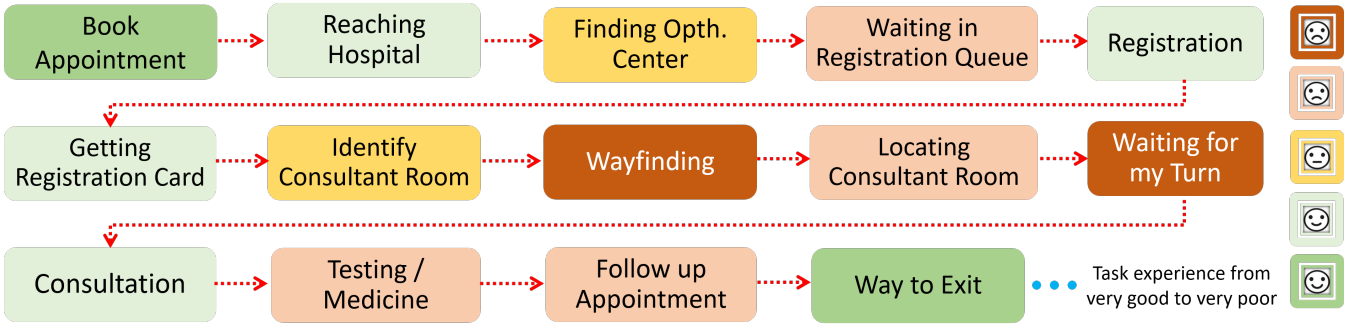

Figure 2: Patients hospital journey experiences at various touch-point (brown: Very poor, green: Very good)

accessibility and healthcare information can lead to some serious consequences for the visitors. The following stories are indicative of these assessments.

Example 1: Information delivery of appointments and registration: A 50-year-old man, registered as a low vision, reported how lack of awareness about the queue protocol at the registration counters has made things difficult for him. "I took help from someone to book an online appointment, I came on time and stood in the queue for new patients since this was my first visit. After waiting for around 40 minutes in a queue when I reached the registration counter, the staff refused to register me and asked to join a different queue for the patients with an online appointment. It was hard to identify the queue for new patients coming with online appointments, and thus I had to wait in another queue for additional 40 minutes to complete my registration. It was painful to stand for around 80 minutes in the queue in total, this delay contributed to an additional waiting of around 80 minutes at the OPD room before the actual consultation."

Example 2: Helping visitors to navigate in unfamiliar environments: A 62-year-old woman shared her experience of finding the OPD room and how the challenge of getting back to the same room was very painful. "After registration, I got the OPD card with consultant's room number marked. As it was not clear so I asked hospital staff to help and he showed me the direction towards OPD. It was so confusing because of the crowd, I barely managed to reach my assigned consultation room after asking many times with others. The consultant asks me to go for dilation and come back to the same room. After dilation, I lost my vision temporarily. Reaching back to the same room was also very difficult. Due to this confusion, I reached the wrong OPD room as they looked very similar. It took me around 25 minutes to find back my original OPD room after asking 5 - 6 people for help. It was so painful to ask so many unknown people that sometimes it made me feel very insecure apart from being confused but I had no choice."

Example 3: Communicate the consultation procedure and waiting times: A 38-year old lady, registered as a temporary low vision shared her own experience on why waiting at OPD was a stressful experience. "After registration, I used the signage and took others' help to reach my OPD room. It was so crowded(ref. figure 1) and I was not clear about what to do next, I stood near the OPD room and waited for nearly 15 minutes. Following what others were doing I also submitted my OPD card but still had no idea about my queue number at the OPD room. This uncertainty while waiting was increasing my stress. I asked the staff regarding the expected time for a consultation so that I can go to the waiting room to sit and relax my legs, he advised me not to go anywhere because waiting times were uncertain. After 85 minutes of waiting, I finished my consultation. I may have waited in a less crowded area if I knew it was going to take so long."

Example 4: Helping visitors to know follow-up appointment protocol: A 44-year old man shared his follow-up visit experience on how the lack of information leads to some serious painful experiences for him. "Today (Thursday) morning I came to the hospital and stood in the queue for the old patients (one fellow patient told me to join the old patient queue when I was going to join the counter queue for a new patient). Even after reaching so early in the morning, there were around 45-50 people before me in the queue. It took me around 30 minutes to reach the registration counter. When I reached the counter, the counter staff asked me to come on Monday afternoon. I was unaware that follow-up clinics run only in the second half and on specific OPD days. I was neither aware nor was told about this in my last visit. I ended up wasting half of my day and additional 3 days delay in my follow-up consultation. I don't know how bad it will affect my treatment"

4 IMPLEMENTATION

A number of initial ideas are presented in Appendix: Table 1 with actual implementation ideas in bold. The main reason to not implement a few interfaces was due to space, crowd, ambiance noise, and acceptability. The system-level design for wayfinding and access to healthcare information is shown in Figure 3. Patients can use one or more interaction mediums to amplify the access to the relevant information. For more detailed technical implementation One can refer to our earlier work[12]. We have shown the interaction mediums to communicate information along with possible intervention, their underlying principle, dependencies and associated target visitor group(s).

Physical Intervention

Our observations study reinforces the existing wayfinding literature in low-income countries[1]. Clearly, most of the visitors relied on hospital staff and fellow visitors to get access to wayfinding,

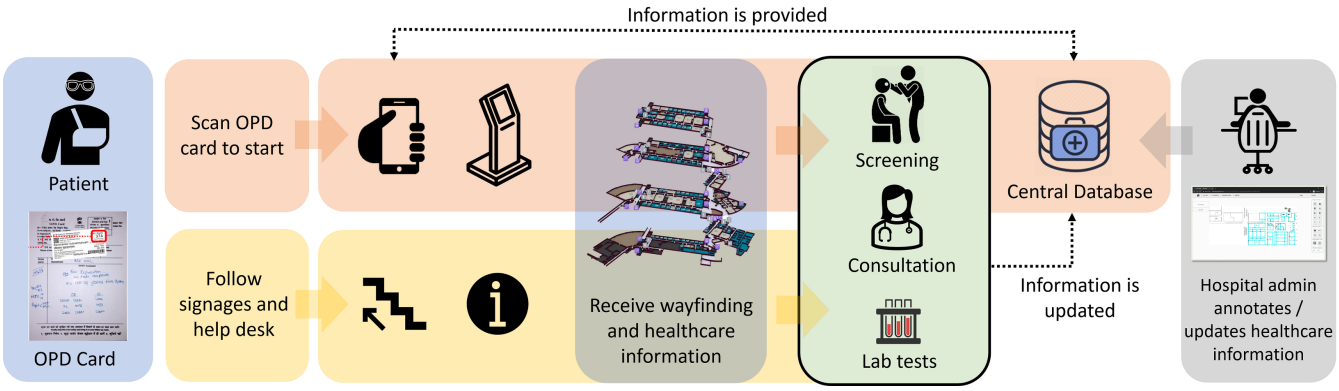

Figure 3: Overall implementation flow to accommodate needs of diverse visitors to the facility

healthcare services and information. This is a very common challenge in low-income countries especially due to lack of wayfinding signage[6]. This was affecting the efficiency of healthcare staff while additional stress on the visitors. We first implemented wayfinding and healthcare information signage. We followed the basic wayfinding design principles including the strategic placement of wayfinding signage, progressive disclosure and reassurance[8], we reinforced the visitors with spatial information so that a particular visitor is able to orient themselves and locate nearly every room cluster and exit from any location of the OPD. We also worked on the design and accessibility measures such as font size/type selection, legibility, color contrast, and information visibility from the perspective of sighted visitors at the hospital. We provided printed information in two languages and the selected font type was "Ek Mukta" for Hindi and "Interstate" for English with a dark blue background with (R=44, G=45, B=111) and white (R=255, G=253, B=237) for high contrast. These additional measures also proved to be valuable for visitors with low vision. Implementation plan of strategic information disclosure points earmarked as shown in Figure4.

Digital Intervention

The digital intervention includes two complementary software modules. The first module uses a custom web-based mapping tool to create the required wayfinding, healthcare and accessibility information for their visitors. The key idea is to create real-time geospatial information over a digital map with an active engagement of hospital staff and patient care managers in a healthcare setting. The hospital staff was able to annotate the OPD block and a seven-story ward-block in this ophthalmic care center[2]. The second application module included a package of applications for kiosks, web, and Android devices along with application program interfaces to develop customized digital service management applications for healthcare i.e. asset tracking, contact tracing, etc. Healthcare accessibility depends on the visitors' ability to book an appointment, reach the point of interest in time and access the essential healthcare information (ref. figure 5). For the healthcare setting, we used Bluetooth beacons and no-cost April tags. Visitors can scan the beacons or tags to find their current position and access the required direction in real-time over smartphones.

5 EVALUATION

In general, the ophthalmic consultation procedure is more complex than other clinics because it requires multiple short tests and examinations. A review published by the RNIB noted that "Receiving inaccessible or poor health information has serious consequences for healthcare visitors"—such as the loss of privacy and independence (someone else must read the information for them), potential risks to personal safety (regarding medication), and a loss of ability to make informed choices about healthcare[10]. For the visitors, it may not be easy to ask for help to make appointments, arrange transport to the hospital, and navigate the process of attendance. Many times visitors may miss the follow-up information that is presented in the OPD cards. Perhaps the primary focus of information provided should be to ensure that access to critical healthcare information about consultation procedures and wayfinding directions must be offered in accessible formats over multiple mediums i.e. mobile-based applications, situated kiosks or print. We conducted a post-implementation study with an additional 12 hospital visitors who volunteered to analyze the effectiveness of wayfinding and access to healthcare information. Informed consent was taken from the visitors to participate. To evaluate the efficacy of signage and registration card to support wayfinding, each researcher from our team observed a participant individually and noted down the timestamp at various touch-point/decision points which a user encountered during his/her journey in the hospital. From this study, we found the preference of medium to access wayfinding, accessibility and healthcare information used by the visitors. Clearly, ease of access, type of information and ability of the individual user-defined the preference of medium/channel i.e. for wayfinding, most of the visitors preferred to use signage, and cues from the environment when it was clearly available, in place of any other digital platform or manual assistance. For healthcare information, visitors preferred digital platforms like kiosks and smartphones whereas for accessibility information visitors predominantly preferred to take human assistance i.e. help desk. Interestingly, even after getting the information from other alternate mediums, a number of visitors preferred reassurance on the information gathered through human

[2]https://inclunav.apps.iitd.ac.in/aiims/rpc/select

Figure 4: Signage placement strategy, locations and nodal signage (Left), Registration sticker design (Right)

assistance. This clearly indicates that multiple mediums must exist simultaneously (hopefully consistent with each other) to effectively communicate various information to the diverse group.

Choice and ease of access to a medium also depend on the users' ability. Like a visual medium like signage is inaccessible to persons with blindness, hence an auditory medium over smartphones or kiosks to support wayfinding, accessibility, and healthcare information is a suitable choice. The detailed analysis of these interventions helped us in creating a possible selection of user profiles, healthcare information, and a medium to communicate this information. In the upcoming section, we briefly report our recommendation to improve access to healthcare services, especially in a low-resource setting. Although the proposed system tries to improve the visitors' journey experience in this healthcare facility, still we noticed many limitations due to the nature of the facility as well as the way participants preferred to use the smartphone. For example, the phone holding position of the participants was an issue for getting the right orientation during navigation. This is because participants want to keep their phones in their pocket once they start searching their destination with the navigation mode on and look intermittently. Unfortunately, the reduced electronic compass reliability leads to significant errors in giving directional information at turns. The diverse nature of visitors to this facility was an additional challenge in creating interfaces for a smartphone application.

6 RECOMMENDATIONS

Based on our studies, implementations, trials, and informal engagement with hospital staff over a period of 18 months[11–13], we were able to draw a consolidated set of recommendations. This can be followed to improve the accessibility of healthcare services in other similar settings. We found that there is three feasible channel/medium (environmental, human and digital) to support wayfinding and accessing healthcare information. In most of the hospitals in low-income countries, a major reliance is on human assistance with limited wayfinding support from the environment i.e. signage. We added two more channels/mediums to access wayfinding, accessibility and healthcare information which were previously inaccessible and mismanaged based on which we found a significant reduction in the time for consultations and the subjective stress levels of the visitors. Based on this understanding, here, we discuss a set of design recommendations for each medium/channel to make it more effective.

Digital Interface

- Indicate what the application does, and use accurate and specific language when communicating information. does - like "it can assist in booking appointment, wayfinding, etc, Consultant room is on your left, timings are 9 AM to 1:00 PM during the journey.
- Avoid a situation where competing background noise may be a problem (audio message needs to be loud if the ambient noise is high). The color and fonts of the digital interface must be suitable for low-vision accessibility.
- Use multiple mediums to communicate information and ask the visitors to choose their medium of preferences.
- The digital wayfinding solution should also provide information about the general consultation process and store the necessary healthcare information.
- Make the visitors aware of drastic changes in the light levels while navigating as it can affect vision. The app can provide notifications about changes in surface level, light intensity, etc. which can be considered as landmarks for people with visual impairment.
- For persons with a visual disability, the app should explain where things are placed; for example "a lift is on your right, control panel in the list is on your right at 3 feet height". These are extremely useful micro orientations.

Physical interfaces

- Ambient lighting for indoor spaces must be sufficient enough (100 lux or above) to access the visual information
- Follow the standard color and fonts for a specific type of signage.
- Content of signage should not be to increase the cognitive load and hence strategic placement of signage and progressive disclosure of the information is critical.
- All the decision points in physical space must have adequate wayfinding signage.

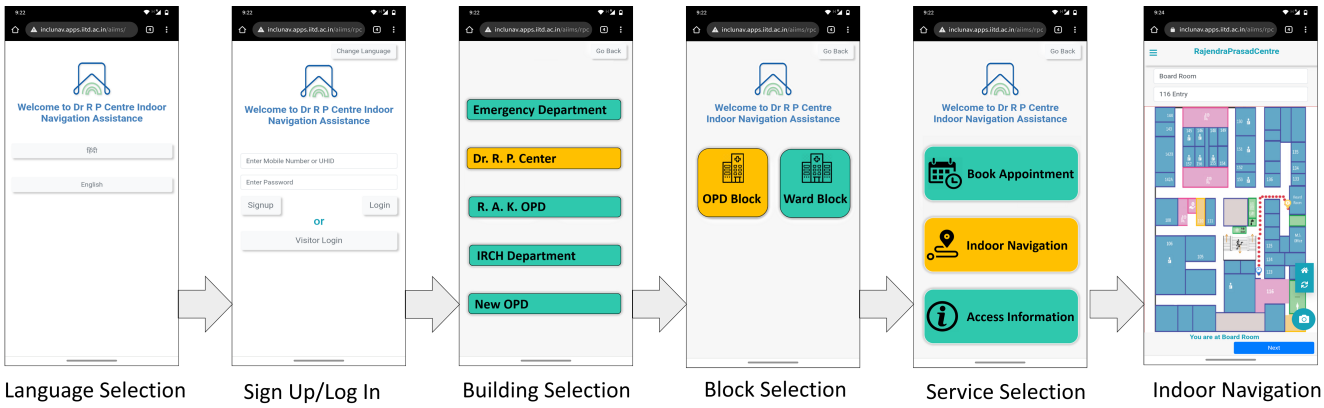

Figure 5: Digital application interface included an access to way finding and healthcare information

- Reassurance is critical in progressive disclosure, hence wayfinding signage must include "reassurance" signage at all intersections from all directions, even if they look redundant at the first go.
- All the key information on the registration card and OPD sticker must be clearly and distinctly readable to visitors.
- For the signage in large hospitals, appropriate selection of type, font, color, content and placement, is important.

Human Assistance

- Identify yourself — use your full name and indicate your role in the healthcare facility.
- Recognising users' ability and anticipating their challenges is critical. Hospital staff must be aware that visitors may have problems with language, awareness, education and communication ability apart from disability.
- Staff should take time to communicate effectively about access, facilities, diagnosis, etc. Any communications, in visual or audio format, should be accessible and tailored to visitors' needs.
- Guiding someone with sight problems, walk slightly in front of the person ensuring the pace is neither too fast nor slow. Explain changes in the ground surface, such as moving from a tiled floor to carpet.
- Ensure the patient knows the procedure, aware of the expected time required for various steps in the consultation process. During a consultation, if an examination is needed, explain that physical contact may be required.
- While providing information for later reference (i.e. follow-up, etc.) in the OPD card, ensure the key information is accessible and comprehensible. Clarify plans for follow-up– days, timings, telephone numbers, etc.

7 CONCLUSION

The case studies reported in this article encapsulates the journey of improving the patient experience at a large overcrowded hospital using wayfinding and by providing healthcare information to the visitors in a variety of accessible mediums. Analysis of its implementation suggests a design architecture that can have three distinct layers of information which over-arches multiple mediums (digital, environmental and human) to make information easily available and sensible to visitors in an overcrowded hospital facility.

- An wayfinding layer, that is annotated with key services and landmarks which are used for wayfinding.
- A healthcare information layer that contains essential information on service points that are associated with functions of the hospital and the relationship between these functions.
- A customized information layer that is based on visitor's preferences as well as the functionality of the hospital i.e. access protocols, timings, etc.

We have developed an open mechanism for creating and updating any or all of the information associated with these three layers. At this moment we are in the process of generalizing these recommendations for crowded public buildings in low resource settings to improve accessibility based on the same principles. To support this, we have also developed open-source tools and APIs to test and implement these systems anywhere. We believe this case study motivates us to set up similar solutions with a level of customization in crowded spaces that pose a similar challenge with an economical but effective implementation.

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APPENDIX

Various Mediums and Possible Interventions

We briefly presented the list of possible implementation and our implementation summary in bold as shown in the table 1.

Application Program Interfaces

- Navigation application API document: https://documenter.getpostman.com/view/2956893/TzJpiKeP

Table 1: Various mediums, possible intervention, principle and dependencies to communicate healthcare information

Medium	Possible Interfaces	Underline Principle	Dependency	Target Visitors
Physical	**Signage**, Tactile paths, Audio beacons, Wayfinding color Tape, **OPD card**	Legibility, Color, Font, Strategic placement, progressive disclosure, Reassurance,	Environment, Services, Scale of visitors	Mainstream, Wheelchair, Hearing impaired
Digital	**Kiosk**, Digital dashboard, **Interactive maps, Wayfinding application**	Indoor mapping, annotation, localization, orientation, accessible interface	Smartphones, others: beacon, UWB and Tag's	Mainstream, Wheelchair, Hearing and Visually impaired
Human	**Help-desk**, **Patient care manager**	Sequential disclosure, challenge anticipation	Hospital staff, number of visitors	All visitors, persons with disability

- Annotation tool API document: https://documenter.getpostman.com/view/2956893/TzJpiKsY

Application Demos

- Kiosk application: https://inclunav.apps.iitd.ac.in/aiims/kiosk
- Web application: https://inclunav.apps.iitd.ac.in/aiims/
- Android application: https://play.google.com/store/apps/details?id=com.disha.deployedapp

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