

Dakter Bari: Introducing Intermediary to Ensure Healthcare Services to Extremely Impoverished People

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Bangladesh (a low-income country) has a significant number of people dependent on alms for daily survival. These people, who we address as extremely impoverished people (EIP) are deprived of even basic healthcare. Their extreme levels of poverty, coupled with low literacy skills, and complete lack of access to technology means that they are unaware of existing low-cost/free healthcare services (as arranged by local hospitals) available for EIPs. In this paper, we address this gap by means of a carefully-crafted solution, *Dakter Bari* (a term in Bengali that translates to “Doctor’s Home” in English), that is contextually tailored to enable healthcare access to impoverished people. Extracting critical insights from our field study with ($N = 70$) EIPs, we create a pathway for availing lower-cost healthcare solutions using intermediaries for information dissemination. These intermediaries are small businesses that impoverished people visit often. We also conduct field studies with ($N = 71$) intermediary partners and ($N = 10$) hospitals to identify challenges and realities of such intermediary-based solutions. Based on our findings, we design, iteratively develop, deploy, and user-test our system in real cases and collect feedback from related stakeholders. Preliminary analysis on usage of our system (deployed at intermediaries) revealed 255 healthcare requests made by EIPs via our system in six months. We connect our finding to the broader interests of CSCW around contextualized intermediation, inclusive healthcare, and sustainability of deployed systems.

44

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; **Collaborative interaction**.

Additional Key Words and Phrases: Healthcare; Bangladesh; Intermediary; Low-resource; Infomediary; Technology; HCI4D; ICTD;

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1 INTRODUCTION

People that depend on alms for living are extremely impoverished. In different societies, they are referred to differently. In South Asian countries such as Bangladesh, India and Pakistan [1], the official term for extremely impoverished people that are dependent on alms is “Beggars”. The formal definition in Bangladesh for “*Begging*” (as per the Children Act, 1974) is: “*soliciting or receiving alms in a public place, exposing or exhibiting, with the object of obtaining or extorting alms, any sore, wound, injury, deformity or disease whether or not under any pretence, such as singing, dancing, fortune-telling, reciting holy verses or performing tricks*”. Communities engaging in such practises are called “*Beggars*” [2]. In other cultures, such people are referred to as “homeless people”. Either term could be confusing, and possibly even uncomfortable to some. In our study here, we focus on people that sustain their lives based on soliciting or receiving alms in public places through oral requests. Instead of using terms like “beggars” or “homeless people”, we use a generic term called “Extremely Impoverished People” (or EIP) to represent our target community.

In many Asian countries, these people are sizeable in numbers [39, 109]. In Bangladesh (a developing country), there are more than 700,000 EIPs, and around 100,000 in Dhaka alone, the capital [47]. EIPs are generally deprived of many fundamental needs including food, clean water, shelter, access to sanitation, healthcare services and more [76, 103]. All measures and investments taken by governments regarding this community are mainly towards longer-term rehabilitation and alternative employment [5, 7, 103]. However, experts are certain that complete rehabilitation is decades away [103]. While there are many critical and urgent needs for EIPs today, we focus on providing them with access to healthcare facilities.

Whenever an extremely impoverished person gets sick, he/she does not end up visiting a doctor for the most part. For example, Siddiqui et al., [103] found that 28% EIPs thought that there was no special need to visit a doctor during sickness, since they believe that their illnesses would naturally disappear. Another 20% reported that they beg for medicine. In our field study with ($N = 70$) EIPs in Dhaka, it appeared that they very rarely go to doctor’s clinic or a hospital. If in possession of some money, they go to the nearest pharmacy and buy some generic medicines from the pharmacy-owner or person working there (via simple description of symptoms), without any prescription from a doctor. When there is no money, they simply do nothing, or they pray. Only a handful of EIPs, and that too in extreme situations, consider hospitals or doctors as options, when they get very sick.

However, despite the reluctance of EIPs to visit clinics, our field study revealed that there are some hospitals and organizations that provide cheap and sometimes free healthcare services to low-income people [6, 60, 119]. For example, Zainul Haque Sikder Women’s Medical College Hospital in Dhaka provides free healthcare and treatment on every Friday to low-income people. Dhaka Medical College offers diagnosis every day for a fee of only 10 Bangladesh Taka (BDT), which is equal to around 12 US cents. They also provide some medicines free of cost. Although, such services are primarily intended for low-income people, including EIPs, these people do not know such services for them even exist. Our field studies, web scraping efforts, hospital interviews and more reveal that there exists a clear information gap between cheap/free healthcare services, and the people that desperately need them. Sufficient research on this gap, and how to address it is not yet there in the literature.

CSCW, HCI4D, and ICTD scholarship have produced a substantial body of work related to the design, motivation and limitation of socio-technical systems that attempt to engage resource-constrained [17, 23, 26, 91] and low-literate populations [25, 58, 63, 81]. HCI scholarship has also

studied interactive system design for marginalized communities [15], inclusion [37], and learning [118] from such systems. Enhancing availability of healthcare services and related information via mHealth systems [84] has also been studied extensively. However, a comprehensive study of extremely impoverished people (i.e., those fully dependent on alms for survival) with respect to their culture, practices, social connections, economic sustenance, healthcare access and more is yet to be formally investigated in the literature.

Our primary focus in this paper is to bridge existing information gaps between healthcare services specifically made available for resource-constrained people, and the EIP community that desperately needs such services. To do so, we first did a qualitative interview-based study with members of the EIP community. We identify possible options to avail healthcare services for this community and their challenges through another interview-based study with hospital partners. It is important to note that it is not possible to leverage mobile-health based solutions for the EIP community, simply because of low literacy rates, cost issues, lack of appropriate resources, limited network bandwidth and many more related challenges. However, hospitals and clinics that provide free/ highly subsidized healthcare services are tech-savvy, and might be able to extend care for EIP communities if appropriate bridges exist. Based on the discussions above, our research questions in this paper are two-fold:

RQ1: *How can EIPs be made aware of information about healthcare services available for them?*

To answer this question, we identify the technological endpoints in the path from the hospitals to the EIPs. Through semi-structured interviews with EIPs, we identify the places they visit in typical days, what times they become sick and what measures they take, their social connections, preferences, etc. After addressing this question, we then shift attention to the next research question:

RQ2: *Can we leverage technologically connected intermediaries (or facilitators) to close information gaps between EIPs and hospitals? These intermediaries are ideally owners of local pharmacies, grocery shops, tea-vendors and more that EIPs engage with in Bangladesh on a daily basis.*

Armed with a detailed understanding, which we developed through a study with ($N = 71$) possible intermediaries, we identify their relationships, philanthropic intent, and interactions with EIPs. We then design a solution incorporating lessons learnt in the form of an Android app for deployment at intermediaries such as local medicine vendors, grocery shop owners, tea stalls, etc. We do another user study with a subset ($N = 11$) of the 71 intermediaries, and iteratively develop and deploy our system to ($N = 20$) intermediary partners. We also develop a web portal for partner hospitals to register new healthcare services, or make changes to existing services so that our system can suggest these to intermediaries in real-time, and through them to EIPs.

In this paper, we make three key contributions to CSCW scholarship. The first is to present a detailed analysis on the challenges of healthcare services for EIPs, and a comprehensive understanding of how intermediaries can be leveraged using technological solutions to overcome these challenges. We do so using comprehensive field studies covering ($N = 70$) EIPs and ($N = 71$) intermediaries. Second, based on our findings from these field studies, we design and deploy a technology system that bridges gaps (using intermediaries) in healthcare access between EIPs and healthcare facilities. Finally, we present detailed findings of numerous opportunities and challenges which we identified while conducting the study.

2 RELATED WORK

This work pertains to three different dimensions of the spectrum of existing research studies covering resource-constrained communities and HCI, intermediaries as bridges to empower people, and healthcare interventions in HCI domains. We elaborate each of these in the next subsections.

2.1 Resource-Constrained Communities and HCI

There is a growing body of scholarship on assessing and improving the needs of resource-constrained populations via designing appropriate HCI technologies and making them permeable within the community [28, 29]. Among these communities, refugees [101, 102] and homeless people have drawn increased attention [22, 54, 56, 71, 115–117]. In particular, ensuring healthcare services for homeless people has been a critical area of exploration [27, 79, 105]. Generally speaking, mobile health solutions have been found to be very effective for providing healthcare access to homeless people in the USA [82], which is typically done via text messages promoting healthy living, appointment reminders, just-in-time-interventions to avoid risky activities, etc. Free cell phone plans have demonstrated to augment the effectiveness of mhealth technologies and services [18]. There have been systems that use mobile technologies to facilitate information sharing among homeless people [4, 98], and also leveraging text message services regarding food-banks for homeless people in the USA [71]. Other systems attempting to improve lives of homeless people using mobile technologies include utilizing interactive video systems and social media platforms for a range of services that include educational support, finance management, cultural integration and more [46, 62, 92–94, 111, 112, 114]. However, it is pertinent to remind that in advanced societies such as the USA, impoverished people do own smart-devices, and hence, such types of mobile technologies can make an impact on their lives [54, 55, 116], unlike in developing countries such as Bangladesh, where the permeance of digital devices among EIPs is virtually non-existent.

2.2 Intermediaries as Bridges to Empower People

In the developing world, intermediated interaction is a prevalent mode of technology interaction as studied by Sambasivan et al., [96] and Parikh & Ghosh [80]. It enables individuals to seek and use information otherwise unavailable to them due to non-literacy, non-numeracy, lack of technology-operation skills, or financial constraints that affect technology ownership. Building on the case for human infrastructure in technology building and usage [97], these works provide interfaces for shared technology use, where a proxy primary user, or intermediary, having required access rights and skills to operate the technology helps those having otherwise only partial or no access to the technology [96]. Leveraging this concept of intermediation, prior work within HCI and ICTD literature created tools for access to social media [64], financial management system applications and more [65, 66] to work within resource-constrained settings. Issues related to deployment challenges, trust, and sustainability of these intermediary based systems in mediating online services [30–32] and assistance to resource-constrained beneficiaries [38, 42, 43] have also been studied. Shared and asymmetric usage of the technology lies at the core of the systems involving technological intermediaries. Here, Parikh & Ghosh further the intermediary as the *primary user* and beneficiary as the *secondary user*. Drawing on this asymmetric usage, other work further suggests empowering the beneficiary via more engagement and learning from the intermediary [31, 33, 89]. However, the concentration in this thread of work is on increasing technology awareness and skills to resource constrained people. Our work is different in that we are focusing on enabling healthcare access to populations that have little to no experience with technology, and furthermore, they have no resources to do so.

A related concept on facilitating the flow of information is *information intermediary* or *infomediary* that is “concerned with enabling access to information from multiple sources and engaged in informing, aggregating, compiling, and signaling information” [35]. Prior work on ICT engagement with infomediaries focuses on empowering their existing interactions with beneficiaries via technology for further penetration of information systems [48, 73, 87, 88]. This line of work focuses on improvements made (e.g., increased breadth [89, 90]) upon introducing ICT for existing

intermediary-beneficiary interplays. In addition, prior work found intermediaries can be engaged to work in exchange for salary/ other incentives [64, 97] or when they have deeper family or social ties with beneficiaries [48, 86]. Drawing inspiration from contextualized intermediation [80, 107], our system relies on volunteerism, and philanthropic intent among intermediaries that constantly engage with impoverished people daily to promote healthcare access. In doing so we create a single-user system to be used *only* by the intermediaries, wherein they act as a bridge between healthcare facilities and EIPs. Our system thus eliminates any assumptions on technology permeance among EIPs, and assumes only the presence of social interactions (in the physical world) among intermediaries and EIPs, which as our study shows happens regularly.

2.3 Healthcare Interventions in HCI Domains

Improving healthcare using HCI principles is a topic that is amongst the most significant today across the world. The body of work in this space is enormous. In this context, a growing body of CSCW and HCI scholarship is engaging with healthcare systems, such as [50, 87]. While improving quality and accessibility have been studied thoroughly [49, 69, 75], connecting with patients' lives to understand the impact of culture [52], gender [51], environment [77, 104] is also getting attention. Cooperation among multiple stakeholders in the healthcare domain is also an important topic today [21, 36, 44, 45, 53, 70]. Our work builds on the increasing focus of ICTD scholarship on healthcare for under-served populations [51, 77, 83, 108, 113] and growing work on patient empowerment [40, 67, 78, 85, 99] on under-served contexts.

In parallel, researchers are also looking at interventions to improve community health. In this realm, a particularly powerful concept is called Just-in-time-adaptive interventions (JITAI) [68, 74, 100], where the goal is to slowly learn about a subject over time, and intervene minimally, but still optimally, only when needed. Our work in this paper is related to JITAI (to a certain extent), wherein we discover that instead of providing educational materials about healthy behaviors, creating and disseminating tutorials about healthcare options, etc., to EIPs, it maybe optimal to direct them to nearby care as and when necessary.

3 METHODOLOGY

Being inspired by the vacancy in the literature in presence of the existing research studies as mentioned in the previous section, we plan for this study to introduce technological intermediaries to enable healthcare access for extremely impoverished people. In road to conducting the study, we perform fieldwork, interviews, analysis over collected information, and many more, which we present next.

3.1 Fieldwork with Extremely Impoverished People (EIP)

We conducted our fieldwork at two main locations in Dhaka: *Dhanmondi-Hazaribag area* and *Azimpur Graveyard Slum area* both of which have high EIP populations [103]. EIPs in these areas are born and brought up in Bangladesh, and speak Bengali. Those from our team that interacted with our target population are also fluent in Bengali. We expected that sharing of culture and languages among the study team and target population will facilitate effective field studies.

We conducted this field-work from August 2018 to October 2018. We used our contacts at local NGOs (Non-Governmental Organizations) to meet three EIPs initially. Through informal conversations and understanding, we developed a deep relationship with them, and with other EIPs that they introduced to us. We conducted semi-structured interview sessions with each EIP participant where we inquired about demography, educational background and mobile usage. We inquired in detail how they connect 'within' and 'beyond' their own community. We also asked how they take care of themselves and their family members during illnesses and about

Age (years)	Gender	Education	Mobile Usage	Monthly Income (USD)	Members in Family
18-20 : 3 21-40 : 20 41-60 : 35 61-80 : 12	Male: 22 Female : 48	No formal schooling: 64 Less than 5th grade: 6	Feature Phone: 7 No: 63	<24 : 3 25-48 : 21 49-72 : 28 73-84 : 10 Not disclosed: 8	Min : 2 Mode : 6 Max : 9

Table 1. Demographic characteristics of our 70 interview participants (EIPs).

their healthcare preferences. Using Snowball Sampling [20], we kept studying many EIPs until we reached a theoretical saturation [95]. By then, we had interviewed 70 EIPs. Demographic details of EIPs we interviewed are presented in Table 1.

Each interview session lasted from 10 to 40 minutes. Participation in our study was completely voluntary and we approached to a total of 147 EIPs to participate in our study. When someone declined to participate, we thanked and gave that person 10 BDT immediately as a courtesy¹. For those that accepted to be interviewed, they were conducted near slums (where they live) or near mosques where many EIPs gather on weekly holidays to seek alms [103]. Our participants were compensated with 20 BDT each for their time, since this was their likely income that could have been earned during the time they were interviewed by us.

The interviews were conducted in Bengali, the local language, and they were audio-recorded with prior permission from the participants. We transcribed, anonymized, and translated the interview data into English. Similar to the Grounded Theory Approach [106], interview data were considered themes based on the sections of the handwritten English translations. One of the authors analyzed the responses and created a codebook of major themes. The codebook was later refined in consultation with another author. Two independent coders used “open coding” [106] to categorize interview data into themes. While initial coding revealed some discrepancies, all of them were marked and resolved through discussions. The entire study was approved by the Committee for Advanced Studies and Research of the corresponding author’s home institution.

3.2 Information Gathering and Interviews with Hospital Staff

During this time, we also started collecting information regarding free treatments, beds, medicine and surgery offers from local hospitals in Dhaka. Our friends from medical colleges, hospital websites, and newspapers were our initial data sources in this regard. Using this process, we could gather relevant information from seven hospitals. However, while verifying these from a doctor, we found discrepancies in the actual offers, compared to what was written on websites and local newspapers. Therefore, we decided to visit each of the seven hospitals to find the actual healthcare benefits available for low income populations. While interviewing hospital staff, we got to know about three more local hospitals that offered assistance to the resource-constrained people. Including these, we interviewed a total of ten hospital staff members (one staff member per hospital that was either a doctor or a nurse or an administrator in that hospital). The interviews lasted from 5 to 15 minutes. The interviews were conducted in the respective hospital premises only. Details on services offered and cost are presented in Table 2. After learning about the overarching goal of our study, staff members agreed to notify us of any future healthcare benefits available for low income people.

3.3 Interviews with Intermediaries

Lastly, we conducted field study on intermediaries (very small businesses, frequented by EIPs), that we believed could serve as a bridge between EIPs and hospitals during healthcare needs of EIPs.

¹The norm in Bangladesh is to give 2,5, or 10 BDT as alms. Note that 1 USD \approx 85 BDT while writing this paper.

Hospital and location	Service offered to poor people	Timing	Basis	Overall remarks
Sir Salimullah Medical College, Dhaka	Consultancy fee 10 BDT*	8AM - 1PM	Daily	Affordable
Dhaka Medical College, Dhaka	Consultancy fee 10 BDT*	8AM - 1PM	Daily	Affordable
Shaheed Suhrawardy Medical College, Dhaka	Consultancy fee 10 BDT*	8AM - 1PM	Daily	Affordable
Northern International Medical College, Dhaka	Free consultancy*	9AM-2PM	Yearly	Affordable
Bangabandhu Sheikh Mujib Medical University, Dhaka	Consultancy fee 10 BDT*	8AM - 1PM	Daily	Affordable
Justice Amin Ahmed Charity Clinic, Dhaka	Consultancy fee 30 BDT	9AM - 7PM	Daily	Affordable
Zainul Haque Sikder Women's Medical College, Dhaka	Free medical consultancy	8AM-12PM	Weekly	Affordable
Ibn Sina Medical Imaging Center, Dhaka	Free consultancy	9AM-2PM	Yearly	Affordable
Ad-Din Medical College Hospital, Dhaka	Free consultancy, Ambulance	9AM - 1PM	Daily	Affordable
Insaf Barakah Hospital, Dhaka, Dhaka	Reasonable consultancy fee	10AM - 1PM	Daily	Affordable

Table 2. Regular healthcare services offered for poor people including EIPs by hospitals studied. The asterisk (*) indicates free bed is available upon authority approval

This part of fieldwork was done from October 2018 to December 2018. We started with first visiting a few intermediaries that were specifically identified by our EIP participants during our interviews with them (some responses from our EIP participants are presented in Section 4.1.7). We approached a total of 90 intermediaries. We conducted semi-structured interviews with the intermediaries starting with some initial demographic questions. The duration of interview sessions ranged from 15 to 30 minutes. Mostly, we visited pharmacies, grocery shops, mobile recharge shops, and tea stalls in the two areas where we interviewed EIPs. Here also, participation of intermediaries in our study was voluntary and 71 people willingly agreed. Three members of our team conducted the interviews. After the interviews, we offered each participant 50 BDT for their time. 25 subjects in the intermediary group accepted the money while the rest did not take any compensation considering the work to be philanthropic. We explicitly offered them the compensation, however, they denied². The interviews were conducted in Bengali and written down in a notebook. We again transcribed and translated the data into English. The translated data was then analyzed by members of our team.

4 FINDINGS FROM FIELD STUDIES

We now report our findings for both EIPs and Intermediaries from multiple perspectives, but broadly themed on how a bridge can be established between these two entities for healthcare access.

4.1 Outcomes from Interviews with Extremely Impoverished People (EIP)

4.1.1 Demography of the Participants.

Among all the EIPs we interviewed, 50% (35 out of 70) were aged between 41 and 60, 28% (20 out of 70) were aged between 21 and 40, and 13% (12 out of 70) were above 60 (Table 1). This corroborates

²It should be noted here that, “talking” to a person in exchange of money is culturally awkward in Bangladesh.

the findings from the previous studies [103, 110] where older EIPs were more in number than younger ones. Our findings also reveal that assumptions cannot be made on technology awareness of EIPs. Only six (9%) participants knew how to read or write, while the rest were illiterate. Also, 63 (90%) participants had no access to any phone, and the others ($N = 7$) had only one feature phone (very old models) for use by their entire family (on an average seven members per family). Some female participants ($N = 23$) reported that their male counterparts do odd jobs (laborer, painter, rickshaw-puller), apart from seeking alms. Four females also reported that they were widowed. Note that we had more female participants ($N = 48$) than males ($N = 22$) in our study.

4.1.2 The Households.

Hazaribag and Azimpur slums, where our participants live, are full of tin shed houses. Each slum has around 100-150 homes. Just behind Hazaribag slum, there is a giant tannery waste dump, and Azimpur slum has a big graveyard adjacent to it. Other than EIPs, there are also rickshaw-pullers, day-laborers, cleaners, maids, and other very-low-income people living here. In a single room here, usually 5-8 EIPs live. While some of our participants mentioned residing with their families in these slums, others said mentioned living with non-family members (i.e., others who are also seeking alms) in that single room, while the rest of their family members are living in far away villages. When EIPs who share a room all belong to the same gender, they usually do not make any partition. However, when EIPs of multiple genders share a room, they create a temporary separation in the room. Two of our participants further informed us about different families living in a single room, creating a similar partition.

Most of our participants indicated that they arrived in Dhaka from villages in search of a better living. Some of them started to initially live in other slums, before moving to their current locations. One participant used to live in Kuril slum, and was a housemaid working in a rich family. She had to quit though due to chronic pain. Soon after, she started to seek alms, and met a few other people also seeking alms, before moving to Azimpur slum. Our studies showed that, although participants hailed from different parts of the country, they all share a common Bengali ethnicity. While Islam was the dominant religion practiced by EIPs, we found one minority EIP (a Hindu, who incidentally shared a room with a Muslim family). EIPs do take care of each other and also help newly arriving EIPs settle down in their localities.

While no one owns the slum, all participants mentioned that men working for local political leaders collect a house rent of around 1500 - 2000 BDT/month, and continuously threaten them with forced eviction if they fail to pay. Some participants said that paying the rent was their *hardest struggle* due to their meagre income. Therefore, they always keep looking for others to join their room to lessen their rent share. Naturally, the houses are very fragile, have little to no privacy between homes, and flooding is a perennial danger.

Sharing personal items is very common in slums, and participants reported that there are only nine shared toilets for 500 people. Clay stoves are used for cooking, which almost always happens outside of homes. Participants seem content with this procedure to cook.

“We are struggling with paying the monthly rent of this single room, and the landlord regularly threatens to move us out. How can we afford gas and the attached kitchen? We do not need that.” (P56)

We discovered that EIPs source their food by seeking alms (details in 4.1.5) in addition to cooking. Most households we visited do not have electricity because there is no legal supply in these slums. However, we found some EIPs tap and redirect standard supply lines in the evenings.

4.1.3 Inter-Community Relationships.

One important feature of this community is their nuanced social connections. As a group, they meet

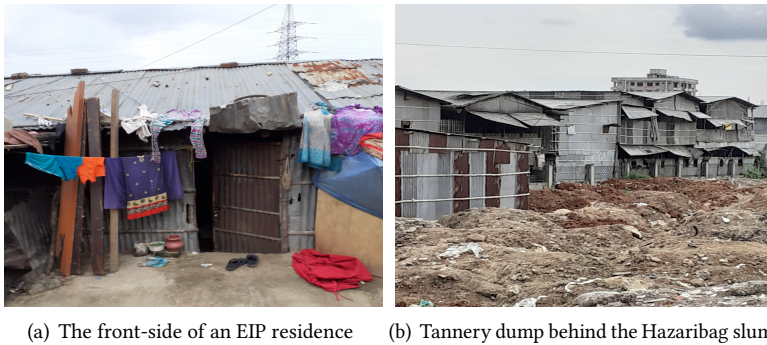


Fig. 1. EIP residences in slums and tannery dump adjacent to the slums

up and decide where and how to seek alms on the next day, and so on. They do so by discussing with peers from the neighborhood about amounts earned each day. When we asked our male participants how they connected with their peers after the day, they mentioned that such gatherings took place in either tea stalls, local rickshaw garages, or small hotels with television. One participant shared:

“After returning home, we go to tea stall, we discuss politics, we play. We also watch television there and listen to radio.” (P25)

While male EIPs gather at places with TV and/or radio, our female participants said that they do not usually go out of their rooms after the evening. Rather, they meet up outside their homes each evening for social discussions and limited recreation. They also discuss future opportunities to collect free items from local give-aways organized by wealthier people and local charities. One female EIP says,

“In this slum, we are around 300 people that beg for alms. When any of us knows that someone is giving out food and clothes, she quickly lets others know. These offerings are always limited in quantity, so we have to act fast.” (P50)

While interviewing, we observed an instance of this trend in real-time. One EIP came running and quickly informed our participant—who was cooking for herself—about free Khichuri (a local dish) being distributed by Amin Mohammad Group (a conglomerate) for their corporate anniversary. Our participant immediately left the interview for informing her peers to pick up the dish.

In the absence of essential infrastructure, social and civic support, we learnt that EIPs create a social network that allowed for quick and strategic information sharing among themselves on opportunities for their sustenance. The similarity in economic status, life experiences, wants and needs, alms seeking activities, and more assist the formation of such networks, especially, since they all live in congested surroundings. EIPs also have a deep sense of social belonging due to sharing of issues such as opportunities, joys, sorrows, family problems, etc., very often.

4.1.4 Alms Seeking Activity.

Our detailed conversation with EIPs revealed how, when and where they seek alms. From a location perspective, we identified two key types of EIPs: 1) those that seek alms from households, 2) those that seek alms at traffic signals. Alms seekers targeting households seek food, money and old clothes from women in the houses, while those targeting traffic signals almost always seek money. Note that during the months of Ramadan, where charitable acts among citizens are much more prominent in Bangladesh, EIPs do change strategies and target places where charity drives happen.

Also, some participants we spoke to do not seek alms daily, but only for certain critical needs (which as we found out are almost always medical related, and/or their children's needs like books). One participant explains why and when she has to seek for alms,

"My husband does not provide for my medicine that I need to take twice a day. When I need to buy this medicine, I am forced to seek alms. It happens two/three times a month."
(P12)

We also found local mosques as an interesting place to study EIPs. For instance, during Fridays—a weekly holiday in Bangladesh—EIPs gather around mosques where many people congregate at specific times for weekly prayers. This is the day when most EIPs are out of their homes. One participant explained as follows,

"Those who seek alms in footpaths, signals do not go to those places on Fridays, rather, they go to the masjid (mosque) instead. People also donate more on this special day. Therefore, we take our daughters, grand-kids to the mosque because there everyone is given something." (P33)

Therefore, on Fridays EIPs do things a little differently. While, all of them gather around mosques on Fridays, it is worthwhile to note that they do not enter the mosque or pray, but rather wait outside the mosque premises for people to come out after prayers and (hopefully) donate to them. Therefore, messages inside of mosques that could ideally target the health of EIPs may not work.

4.1.5 *Connections Beyond the Community.*

We identified a few other critical insights from the perspective of seeking alms and community engagement for our EIP subjects. Our participants have deep social connections (in the physical world) beyond what was presented above. EIPs interact with local shop keepers like grocery merchants, tea-stall owners, pharmacists etc. regularly. Our EIP participants found these connections useful to them in many ways. For instance, some participants ($N = 12$) shared that their poverty status enabled them to buy necessary groceries at a cheaper rate than usual. Furthermore, when funds or supplies are needed under emergency scenarios, these connections do help EIPs. These scenarios included wedding expenses, children education, or sudden medical procedures that are expensive. For instance, one widowed EIP shares how she managed money for paying *dowry* to marry her daughter off,

"My husband died 15 years ago, making my three daughters orphans. [...] When marrying off my youngest daughter last month, her husband demanded a TV and furniture as dowry. Where could I get that money! I collected money from all shops and houses around this Hazaribag, explaining my situation. Most of them helped with 50/100 BDT. Even people never giving alms helped me for this cause. One khala (housewife) gave 1000 BDT for buying the TV. [...] The furniture shop owner did not take any money for labor, but charged me only for the cost of materials." (P56)

In addition, a number of ($N = 30$) participants, shared about being invited for a specific social event called "*Chollisha*" (a Muslim religious gathering arranged by a family on the 40th day after a relative's death).

"In most Chollisha of this greater Dhanmondi, the relatives of the deceased request us to go. These programs are generally for relatives, neighbors. But, there remains at-least some arrangements for us. [...] We eat and pray for the departed soul." (P68)

Overall, these discoveries greatly enhanced our knowledge on social connections of EIPs.

4.1.6 *What Happens When EIPs Fall Ill?*

Places where EIPs live are unhealthy with very poor sanitation and have various contaminants in

the surrounding environment. Tropical diseases are very common here [3]. When EIPs get sick, they choose from a range of options. However, one recurrent answer ($N = 31$) is: they do nothing. As one participant explains:

“We do not need any doctor, any medicine. It (illness) just goes away. How can we earn if we care this much about disease? Allah has given this ailment, He will heal.” (P34)

Some other participants also mentioned that they generally visit the nearest pharmacy to buy medicine. The pharmacy workers suggest the right medicine based only on their own intuition upon hearing symptoms. This is a very common practice among the EIPs ($N = 43$) and there is no worry about privacy breaches for our participants. One elderly participant mentions:

“This boy at the pharmacy understands my symptoms better than anyone else. He gives me medicine according to what I have that day.” (P13)

It is important to note that, in Bangladesh, buying medicine from local pharmacies does not require any prescription from a doctor. In reality, vendors of medicines acquire their license by showing a doctor as their patron. However, authorities do not track these vendors. Now, our EIP participants report that, cost is always a factor in getting medication as suggested by the medicine vendor, and they request that the vendors suggest medicines that can meet their cost constraints (which again depends on alms earned for that day). One participant mentioned that:

“There are three drugs for my gastric pain. They cost two taka³, five taka, and 10 taka per piece. I ask Mohsin (medicine shop owner) for a ten Taka tablet when I have earned a good amount that day. When I don't earn enough I have to take that two taka tablet. But, that 10 taka one is high-power, and I know it works better.” (P21)

Now, among EIPs, faith and religion play a critical role when they get sick. In our study, a number of ($N = 27$) EIPs trust *interventions by faith healers*. This includes wearing amulets (taabiz) on hands, waist, and around the neck. They are also given purported holy water (pora pani) by religious persons living in the slums. EIPs rely on such treatment procedures for cases like chronic diseases and prenatal issues. One female participant, mother of three, explains:

“I need to take pora-pani (Holy water) from Boro Hujur from time to time while I am pregnant. My husband brings it for me. It is for the safety of my soon-to-be-born child to be free from the devil.” (P6)

Interestingly, EIPs we interviewed do visit hospitals when something “serious” happens, like dengue fever, burns ($N = 6$) and fractures ($N = 7$). And they are ready to pay also in such cases. One EIP (a grandmother) explains what she did for her grandson:

“A car struck my grandson breaking his legs while we were seeking alms at a traffic signal near Gabtoli. I took him to Dhaka Medical in a rickshaw. He was admitted there for two months. It cost two lacs taka covering all the expenses. I had to bring the money from my village. Hospital is a costly place. Doctors, hospitals, these are not for us.” (P58)

When we further asked why she took him to Dhaka Medical College Hospital when there was another closer government hospital (Shaheed Suhrawardy Medical College Hospital), she replied “Dhaka Medical is the best for these treatments.” Note that 1 lac means 100,000.

To summarize, EIPs do take healthcare seriously depending on how they see symptoms. They either go to local pharmacies, or seek faith healers, or sometimes (in very serious cases) go to hospitals. In some cases, they do nothing at all. Cost of care is always a critical issue for EIPs.

³Taka is the local currency in Bangladesh.

4.1.7 Findings on EIP Perspectives on Low-cost and Professional Healthcare.

When we asked our EIP participants, if they knew that doctors are ready to consult with them for only 10 BDT, coupled with free medication from government hospitals, they all replied in the negative. This was disconcerting to us, but also presented us with an opportunity to make a difference in their lives. We presented five such offers that we collected from local hospital websites and newspapers to our EIP participants. Although, very few participants said that they never fell ill, all others agreed that these offers were affordable for them, and were excited to learn more. Unfortunately, most of these people cannot read or write, and so, the challenge is how to disseminate such information to EIPs. When asked, our participants agreed that it will be great if such information can be conveyed to local pharmacies (and other places they visit), since these intermediaries can discuss low-cost healthcare options with EIPs. Common intermediaries recommended were pharmacy owners, vendors in tea stalls and grocery shop-owners. A total of 44 (63%) participants named a local pharmacy as their preferred option. One elderly EIP explains,

“I always take medicine from the pharmacy. The owner understands these (health-related) issues better. He can read. If you give him those information, he will suggest me where to go if need be.” (P3)

Interestingly, some EIPs named pharmacy owners as places they do not want to seek information from. One such female participant said,

“I do not like the pharmacy owner. He makes me buy medicine from his shop which does no good to my pain. If poor people get free medicine, why would I buy those from him? Can you teach Matin (nearest grocery shop owner) about these? I trust him.” (P18)

Three male participants mentioned tea stalls as their preferred place for seeking such information. It is worth noting that none of our participants wanted to hear about these offers from religious institutes (mosques, faith based schools) or its leaders. During this phase of interview, some participants thought we were from NGOs and asked us about that. We convinced them that we were students and only trying to help them avail free or cheap healthcare from doctors. Some participants also mentioned specific shops and pharmacies that they trust for such information. We documented these also.

4.2 Outcomes from Interviews with Intermediaries

We now discuss lessons learned from intermediaries – medicine shops, grocery stores, tea-stalls, mobile recharge vendors and one tailor shop. A total of 71 intermediaries were interviewed.

4.2.1 Internet and Smartphone Proficiency.

All participants we interviewed could read Bengali. Except for five participants, all others could also read English fluently. Smartphone use was common among intermediaries with 51 (72%) participants reporting that they own a smartphone or tablet. A total of 18 (25%) participants had feature phones, and two did not own any digital device. Since any system we design and deploy will be contingent on Internet proficiency, we asked our intermediaries the same. A total of ($N = 13$) participants deemed themselves as not Internet savvy. In terms of using their phones to access popular Internet based apps like Facebook, WhatsApp Google, bKAsh, Email etc., 25 participants reported high level of comfort with such apps, while 18 reported that they never used such services over a phone, despite claiming comfort with the Internet. Only three intermediaries interviewed had WiFi in their work places. The rest purchased mobile data plans.

4.2.2 Socioeconomic Status of Intermediaries.

Owners and employees working in the grocery stores, pharmacies, and tea-stalls we visited were diverse in terms of households, income, technology usage, customer base etc. For instance, one

pharmacist owned a large building, and collected an overall rent of 100,000 BDT each month from many tenants living there. On the other hand, we also met a tea-vendor living in a small home, jointly shared with another family for 4,500 BDT monthly rent. Wealthier ones had cars, while the poorer ones had only bi-cycles. Their working conditions also varied. A tea stall owner works alone in a small enclosure, while there were helpers for grocery and pharmacy owners. But cash dealings and customer interactions were exclusively reserved for owners. We learnt that people from multiple socio-economic status visited groceries and pharmacies, while only low and middle income people visited tea stalls.

We learnt that these places operate from around 7am to around 11pm (with tea stalls opening even earlier). They rarely close for lunch. All of them indicated that they discuss “issues” with their customers apart from purely business, to the point where they are highly aware of happenings in and around their neighborhood. They feel highly integrated within their localities as a result. As one grocery shop owner puts it,

“Do you meet 80/100 people a day? We do. We know the ins and outs of happenings in Hazaribag. From people wearing no sandals to those seeking alms to the rich man wearing expensive shoes, all need to come to us for buying food.” (I68)

In summary, our intermediary participants, overall, had better socioeconomic status, literacy and technological awareness than EIPs. Importantly, intermediaries are aware of their neighborhoods and seem connected and engaged with what is going on around their communities. They also have experiences dealing with people across diverse socio-economic status, including EIPs.

4.2.3 Relationship between Intermediaries and EIPs.

Most intermediaries we interviewed have good relations with EIPs they interact with. Participants mentioned cases where they actively helped marginalized groups. A sizeable number of participants mentioned that they never turn away the first person seeking for alms on any given day. The sentiment behind this is to start the day’s business with a small act of charity in the belief that it will be better for overall business that day. One participant further extends this notion, “*You never turn away the first customer and the first alms seeker for the day.*” (I3) Another grocery shop owner informed us that the first transaction of any day is not for the sake of business, but, rather for God’s sake. Intermediaries further shared that EIPs seeking alms usually utter religious phrases, and also show physical wounds and disabilities. In general, the positive attitude of intermediaries towards EIPs stem from a sense of public good, reward from God, and self-gratification.

In addition, medicine shop owners also informed us about prescribing medicines directly to EIPs. They highlighted two major reasons to do so: basic understanding of symptoms from their past experiences, and inability of EIPs to afford doctor visits. One pharmacy owner explained:

“What will you do when an alms seeker asks you for a medicine to remedy gastric pain, when he can only afford five BDT? I have lived in this area since my childhood. I understand these people and their health just like my fingers.” (I30)

Another medicine vendor explained that:

“Last week an alms seeker came with her one year old son. She somehow managed to see a child specialist from PG Hospital. The doctor prescribed a pill which is 20 BDT per piece. How can she afford this pill three times each day, for two weeks? She came to me after one week of trying that medicine and asked me to give that medicine for free. She promised she would pay later. I gave her an alternative that costs only five BDT but works well. I understand that there are complex cases which are better handled by a doctor or hospital. I try sending such cases there. But affording doctor-recommended treatments is really a big issue for very poor people.” (I34)

Overall, pharmacy owners we interviewed ($N = 45$) asserted that they prescribe medicine from their own to EIPs (but with only good intentions in mind, considering the affordability factor). Most of them ($N = 31$) also claimed that they suggested EIPs to see a doctor for complex conditions. Other intermediaries including grocery shop owners ($N = 16$), mobile recharge shops ($N = 3$), and tea-vendors expressed concern for EIPs. They mentioned cases where they offered free services to EIPs with noble intent. One grocery shop owner shares his experience,

“One alms dependent woman once came to my shop and requested me to lend 800 BDT worth of food for her child. The woman promised she would pay later. But never did. This woman now asks for alms from all shops around, but does not come to me. [...] I understand how difficult this is for her to pay it back, I will not ask for that money.” (I29)

Our intermediary participants further reflected on their interaction with EIPs. We learnt that EIPs interact with intermediaries both for requesting services and for seeking alms. They visit tea vendors almost daily, and once or twice a week to grocery shops. Medicine vendors indicated that EIPs do not come regularly, but visit only when they get sick.

4.2.4 Intermediary Opinions on Philanthropic Intent and Refusal.

After briefing the intent of our study and introducing intermediaries to existing low-cost healthcare offers from local and government hospitals, we asked our intermediaries if they would be willing serve as a tech-assisted bridge between healthcare services and EIPs. Although not every participant owned a mobile phone, some of them were interested and wanted to try our system. Only 12 pharmacy owners knew about such offers from Dhaka Medical Hospital, PG Hospital and Salimullah Hospital, while no other intermediary had any information about such offers. Almost all the participants welcomed such initiatives, however one tea-vendor said,

“Hospitals practice fraud too. They will surely grab money from poor people after promising low-cost treatment.” (I54)

Among the 51 intermediary respondents having a smartphone or a tablet, 38 (75%) showed interest to use our proposed system. While they differed in their motivations to help EIPs, the common themes were: an ardent desire to help a suffering community, likely reward from God, and lack of any major effort from their own side in contributing to a greater cause. One grocery shop owner who later started using our system clarified his intention:

“My shop is one of the biggest in this Hazaribag slum. I see many alms seekers passing by me everyday. Almost all of them stop and seek for alms to me. I try to help accordingly. Some of them are aged, and ill. I have no way to help other than with a tiny amount. If the system you mention is indeed true, I can direct them to doctors. [...] I use internet, The cost of data is manageable for me.” (I23)

In our interviews with pharmacy intermediaries that practice religion (which, we can infer from the way they dress), we found all of them ($N = 21$) were appreciative of our intent. Six of them were from those 18 participants who only had feature phones. Despite that, they showed interest and wanted to know more. When we indicated that directing EIPs toward hospitals and free medicine would probably hinder their own sale of medicines to EIPs, one pharmacy owner mentioned:

“Baba (son), I will collect my reward from Allah (God). He ordered us to help the needy. Also, how much do I earn a day by selling medicines to the alms seekers? 50-60 taka, perhaps. We give more than that as alms. If they really get medicine, free bed, treatment, I will be happy to help.” (I9)

Some of the participants refused to use our proposed solution. Two major concerns were: they were busy, and the extra cost for data plans. One tea-vendor explained his scenario:

“There are always some customers in my shop. I cannot make them wait and serve the poor. [...] Also, I do not always have that data pack.” (I20)

A few participants did ask us about our intentions, and what we would get in return for our system. We explained the truth that we would get nothing monetary in return. A few medicine vendors assumed we were representatives from pharmaceutical companies, and some did not believe us despite proving our university affiliation via our ID cards. A total 19 intermediaries we contacted (apart from the 71 we actually interviewed) were (for one or more reasons) not convinced of our intentions, and we did not interview these people.

4.2.5 Trust and Reliability.

Even though we found 38 intermediaries (53% of total interviewed; 75% of smart device owners) showing interest in using our system, some were concerned regarding trust. One salient theme in the questions our participants asked us was *“Why would they (EIPs) believe us?”* Another common query was regarding how they could track whether or not EIPs really went to a hospital and were treated. According to one intermediary participant:

“It will be great to help them find right hospital. How to know that they indeed got the treatment? Knowing that would possibly help people even more.” (I54)

They also questioned how an EIP person could be convinced to talk to a grocery or tea-stall owner about underlying health problems. Some pharmacists that operate behind strong glass doors (for safety reasons), were also skeptical as to our system will facilitate a sick EIP, especially, when the EIPs are behind glass doors. Finally, when we mentioned to our intermediary participants that EIPs we interviewed specifically requested such healthcare services be made known to them via intermediaries (without revealing any EIP identities), it did not make any tangible impact in the minds of intermediaries.

5 CHALLENGES AND OPPORTUNITIES FOR INTERVENTION

After analyzing data gathered by interviewing related stakeholders, the question is whether our potential intermediary based system that seems intuitive, and also one recommended by EIPs, is indeed practical to enable healthcare access. A follow-up question is how to design such a system.

Leveraging Pharmacy and Grocery Shop Owners as Intermediaries. From our study with both intermediaries and EIPs, we observe three things. First, the fact that pharmacy and grocery shops are permanently open from morning to night makes them way more accessible to EIPs compared with other groups like people in households, or those at traffic lights that do donate to EIPs. Second, the intermediaries we have studied are groups with whom EIPs do have social comfort (both in terms of buying things, and also when seeking alms). This comfort level must not be abandoned in any system that aims to work towards betterment of EIPs. Finally, we understood that distributing information sources across multiple shops and across intermediaries with heterogeneous professions (pharmacy/grocery shop/teas-stall etc.) and socio-economic status might increase the accessibility of information rather than concentrating to only a few particular sources.

Preliminary Insights into System Design. Before presenting our actual *Dakter Bari* system, we present some discussions on simpler/ obvious choices which our team debated, and how they led to the design of our finalized system. One thing we did not do in this study was to organize a focus group discussion bringing EIPs, hospital staff and Intermediaries together. We did not want EIPs to feel uncomfortable due to socio-economic and literacy superiority of other groups, which can have very negative consequences. Instead, we relied only on information we gathered from separate field studies with each group in our decision making.

The simplest and most obvious idea was to design pamphlets and distribute them among intermediaries so that they could read out all the offers to an EIP when needed. While this solution would meet our needs, the scope for this “non-tech” solution was significantly limited by some major observations. First, literacy rates are very low for EIPs. Many of them won't be able to read these pamphlets. The second challenge is that, offers from hospitals are subject to change, including cancellations. For instance, one day while interviewing an EIP in a slum, another EIP whom we previously interviewed came and said:

“I went to Dhaka Medical last Friday as you said. They sent me back saying ‘no free medicine, or doctor today.’” (P8)

We apologized and called the hospital authority immediately and were told that during governmental holidays, schedules can change. As another example, during the month of Ramadan, Sheikh Mujib Medical University (BSMMU) Hospital shifts low-cost offers hours to 10am - 2pm (which are different from schedules in other months). Now (and fortunately), on certain special occasions, hospitals ramp up free and low-cost services to also include specialized services like free eye check-ups, free eye glasses, cholesterol/ heart check-ups etc. These services can last arbitrary durations from days to a few weeks, and varies for each hospital.

The next challenge comes from the cost/ effort it takes for EIPs to visit hospitals. This is not at all trivial anywhere for poor people, and especially in Dhaka city where traffic is usually severe during the day time, and planning is needed to be on time during any trip. This issue is important, because, due to budget constraints, hospitals are *very strict* about punctuality when it comes to low-cost services for poorer people. If a person availing free services comes even a minute late, they are asked to leave and come back later. This issue is evidenced by one EIP who shared:

“I was the last person to see the doctor that day. One aunt from the slum who went with me was waiting outside, however, they did not allow her inside saying that time was over.” (P16)

As such, merely posting pamphlets might not help our EIPs, especially, when a) services and times change arbitrarily; b) time to travel, distance information cannot be estimated reliably from printed sources. Based on these insights, we decided that a smart-phone based app, deployed at intermediaries, was ideal for our problem of bridging healthcare services to EIPs. We narrowed down on an Android app considering that Android was the most popular OS for intermediaries we studied. With a smart-phone system, real-time information can be directly made available to intermediaries, and furthermore, information delivered to EIPs can be more granular. Options for estimating cost to travel to hospital, time to travel, best route to take, cash to carry etc. can all be accomplished via the app, with overall benefit for EIPs.

We do understand that a smart-phone based system will preclude intermediaries without these devices from participating in the process of enabling healthcare access for EIPs. We had to accept that outcome, considering the healthcare benefits to EIPs that could be provided by our system, when used by intermediaries with smart-phones and Internet connectivity.

6 DAKTER BARI: DESIGN, IMPLEMENTATION, AND DEPLOYMENT

Design. Considering all lessons learnt, we propose our system model now. When an EIP gets sick, or is in need of hospital information he/she would visit an intermediary that possesses a digital device like a smart-phone or a tablet. As we demonstrated above, it is not hard for EIPs to know who does, and who does not possess a digital device, given their deep social connections with intermediaries. The intermediary, with the app installed in his/her phone, sends a request that includes the EIP patient's name, age, gender and symptoms. A web-server which we maintain will

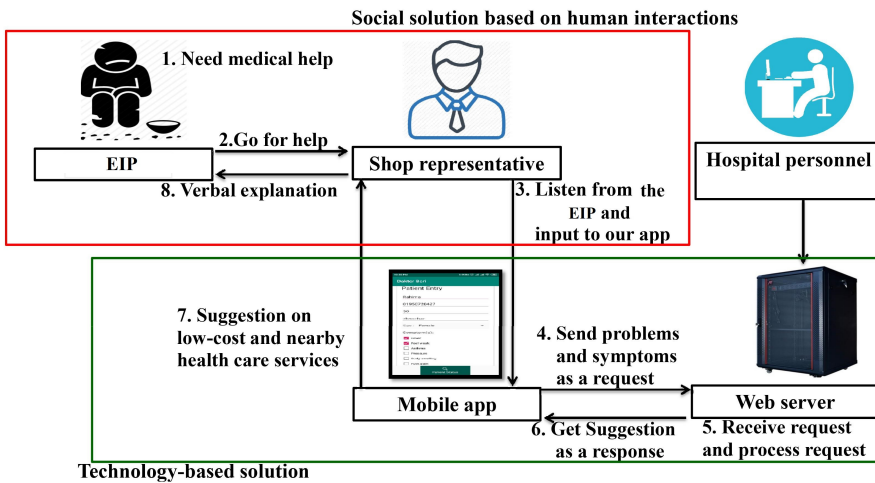


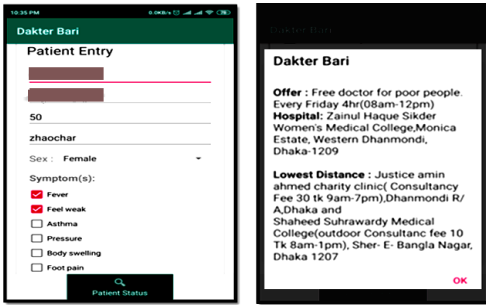
Fig. 2. Proposed system model

receive the request immediately, following which, it generates and sends back the following results: the cheapest healthcare option, timing in which services are available, and the nearest hospitals. Then the intermediary explains the results orally to the EIP needing this information. The system model is explained in detail in Figure 2.

There is one important issue we present upfront. The hospitals that offer free/ low-cost services are for generic consultation only, and not for any specialized services. However, this itself is immense for EIPs, since there are many times where their problems are generic. Even if the EIPs have complex conditions, a visit to a generic doctor can help them understand their conditions better. As such, irrespective of what symptoms EIPs report to intermediaries, the goal of *Dakter Bari* system is to only do two things: a) find hospitals that offer low-cost consultation services; and b) indicate back to EIPs the dates of services and distances to each hospital. Making focused recommendations adaptive to patient symptoms is definitely out of the paper’s scope for now.

Development. We developed our Android based mobile application named “*Dakter Bari*”, which is a term in Bengali that translates to “Doctor’s Home” (Figure 3(a) and 3(b)). We also tested the application with 15 different Android phones and tablets in our lab with versions ranging from Android 5 to Android 9. Maximum device RAM usage was 60 MB while average was 2 MB. Average response for a request was 900ms. On average each request consumed 490 KB data. We also developed a web portal (Figure 4) for hospital staff to add available free/low-cost healthcare offers through this portal. There was also an option in the web server to show all the offers provided by all hospitals in a list format.

Deployment. We deployed our initial release to 11 intermediary partners. Seven near Hazaribag slum area, four near Azimpur Graveyard slum area for a period of two weeks in January 2019. After the small two-week user testing and iterative improvement with our 11 intermediary partners, we deployed our system (i.e., the app) to nine more intermediary partners, resulting in a total of 20 intermediaries with the app. Their geographic locations are in Figure 5(a). For the hospitals, Figure 5(b) presents locations of all 10 hospitals that we incorporated in our system. When we visited them again to show them our web server, and how to add information about free services, three hospitals said there were no one in their system to take care of these things, but were ok for us to add correct information in the web server. Seven other hospitals indicated that they could have



(a) Patient input screen (b) Output feedback screen

Fig. 3. Screens from initial release

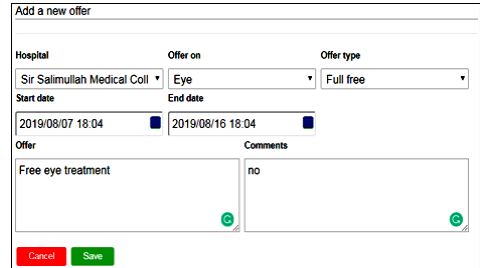
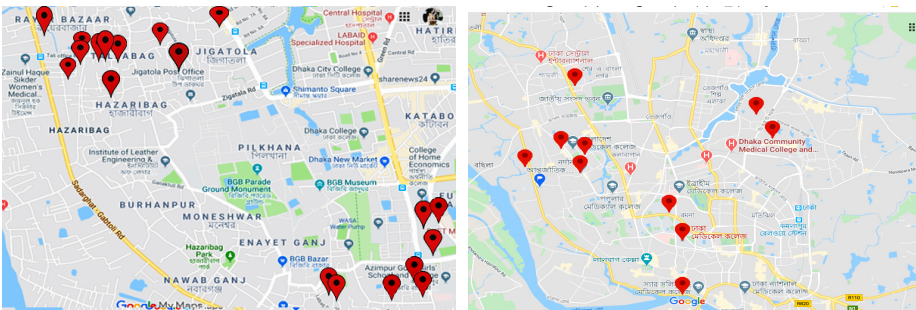


Fig. 4. Web portal for entering offers and services of hospitals

their own staff enter related information in our web server. However, to keep all of this simple, fast, consistent and error-free, we agreed that we would call the 10 hospitals periodically to know updated offers, and we added the related information to our web server by ourselves. Hospital staff were encouraged to contact us by phone if there were any service changes.



(a) Intermediary locations (b) Hospital locations

Fig. 5. Locations of intermediary and hospital partners

7 DESIGN ITERATIONS AND FEEDBACK: LESSONS LEARNT

Our system has been in operation since February 2019. As of early September 2019, we received 255 requests to our web server. In the sections below we describe results of a small scale user test, changes made afterwards, and feedback we received from our intermediaries and EIPs, and our efforts to popularize the *Dakter Bari* system among EIPs via posters.

7.1 Testing with Stakeholders

Our two-week-long user test with 11 partners brought three major changes to our Android application. First, we visited our EIP participants that we interviewed earlier. During this visit, we identified 15 participants who were in need of treatment. This time we also let them know about our

11 (seven in Hazaribag, four in Azimpur) intermediary locations where the *Dakter Bari* system was deployed. We also asked for 15 more voluntary EIP participants for testing. Over two weeks, we took two/three participants to each intermediary and asked to help them with hospital information. We first showed the intermediary how to use our system using a name, gender, address and symptoms to make a request. Then, the intermediaries were asked to repeat the process. After successfully doing that, we requested our intermediary partners to verbally communicate the output of a request (i.e., hospitals, times, dates and distances) to EIPs we took to them for testing. It should be noted that two intermediaries did not have data packs at the time we visited their shop/pharmacy. We bought them data packs for testing. We enlist improvements made after testing below.

7.1.1 Removal of Phone Number.

Initially, in our design we kept a field for intermediary partner's phone number. In the testing phase we observed that this was of no need. Moreover, two of our intermediary participants were having trouble repeating the number for each request. One intermediary explains:

"Putting my mobile number every time in your system is tough. I do not have it memorized. Therefore I am reading it from a page every time I need it."

Therefore we removed the phone number field from the input screen after the first week of testing.

7.1.2 Gender and GPS.

Another intermediary was having issues with the gender selection box. This was an UI issue. He requested:

"I am facing a problem. I am skipping gender selection. Please make it more visible."

We fixed this issue by making the Gender Box more prominent in the app.

Another intermediary was trying to use the app after turning off GPS and thus the app was failing to send any request while our Android app needed GPS locations to compute nearest available hospitals. We made it clear to intermediaries as to why device location via GPS was necessary to optimally help EIPs. After week two, we made the location access mandatory in the app.

7.2 Feedback from EIPs and Intermediaries

After the deployment phase, from February 2019 to September 2019, we visited the homes of EIPs many times in Hazaribag and Azimpur slums to learn about how EIPs feel about our system. We were fortunately able to meet all of the 70 EIPs we had met earlier in our field studies. This time, they were much more open with us, and this was encouraging. The most important finding we made was that some EIPs, who we never met earlier, reported that they used our system too. This meant that among the 255 service requests made to our system, some of them were from EIPs that were not among the initial 70 we spoke with. This meant that the system is spreading through word of mouth.

After speaking with our intermediary partners, the feedback was very encouraging. All of them were unanimous in terms of stating that our system contributes to the greater good. One intermediary partner said, *"You will be amply rewarded by Allah! [...] You have revived a Sunnah by helping these many poor people."*

In the following sections, we elaborate upon other aspects of our system, that we learnt from feedback received.

7.2.1 Humans are Creatures of Habit.

As we know, humans are indeed creatures of habit, which takes time to change. Some EIPs we spoke to indicated that once they visit a hospital for a healthcare need, they are likely to visit the same hospital again. This is irrespective of suggestions received from others. One EIP explained:

“Some days I go to seek alms on that hospital area. The doctor there was good when I met him for a healthcare need. Therefore, I went there twice. I will go in future too.”

This is totally expected, and also validated in prior studies wherein people tend to trust familiar doctors more than un-familiar ones [19]. While our system may not provide benefits to such a patient, it may be the case due to cost and travel duration, this EIP may be willing to see an alternate doctor if she can be convinced it is in her better interests. This is not an issue that is too critical for us, since our overall premise is still only to help EIPs get low-cost healthcare access.

Interestingly, this nature of habitual behavior is also seen among our intermediaries. For instance, some intermediary partners mentioned that they directly respond to EIPs upon hearing symptoms, even without using our app, which is there with them. This is not too difficult to understand, because, they remember previous recommendations made to other EIPs. One EIP mentioned that:

“I went to the pharmacy and asked. The owner immediately told me to go to PG (BSMMU Hospital) without looking at anything.”

Upon discussions with intermediaries about this, they replied that they indeed did this. But they also mentioned that at times, they are busy with existing customers. This can be disconcerting, but at the end of the day, it is understandable too. Intermediaries do have their own things to take care of. But, fortunately, a sick EIP person is still able to at-least know about access to low-cost care through our system. Another intermediary from Azimpur area shared, *“I did not have mobile data pack when the person came. Most of the time Dhaka Medical (DMC) is the option coming from the app. I directly told her to go to DMC.”*

7.2.2 Credibility Factor of Intermediaries.

We realized that credibility of intermediaries can suffer as a result of any erroneous recommendations made. Sometimes, EIPs that get information from certain intermediaries (and are happy with services) again prefer to go back to them, and not others. However, problems can also occur. For example, one EIP informed us she was denied consultation by the hospital suggested by an intermediary (that used our system) and she was very upset and promised not to visit that intermediary in the future. Also, some EIPs confronted intermediaries when they thought wrong information was provided to them. An intermediary (from Azimpur) who suggested Dhaka Medical (DMC) to an EIP based on his prior experience with our system continued to explain,

“That woman actually came after lunch. My suggestion of Dhaka Medical was correct, but it was already 2/3 pm. I could not remember the consultancy there ends at 1 PM. While coming back to the slum, she told me, ‘If you cannot use it, why did you take it from them!’”

Another EIP shared that:

“Miabhai (medicine vendor) could not explain where the hospital was. Therefore, I went to another shop and that man helped me. I went to that shop again to take my husband to the doctor the other day.”

Intermediaries also informed us that the system made them more responsible towards EIPs. This was very encouraging to hear. As one intermediary said, *“A woman came here asking for alms. Her body was shaking terribly. I used this (the system) to find a hospital for her, got her a rickshaw for the trip, and paid the fare myself. [...] The woman on another day came to buy medicine for her children.”*

7.2.3 Extended Use Cases.

Our post-deployment discussion with EIPs also revealed how they leveraged their social connections to circulate our platform by word of mouth about hospital offers they have availed. Some of them mentioned how they advised their low-income neighbors including rickshaw-drivers and

day-laborers to visit hospitals for chronic diseases, which they did. This shows that many more low-income people that we do not know of, availed low-cost healthcare services as a result of our efforts (and we may never know how many). Additionally, some intermediaries asked us whether they could use the system for other classes of poor people. One grocery shop owner asked us, “*Can I use this app to help the maid in our house? Is this allowed?*”

7.2.4 Lack of Feedback for Intermediaries.

A request we received from some ($N = 5$) intermediaries was to provide some feedback to them when EIPs received quality medical care, based on their recommendations. A pharmacy owner said,

“If we could understand whether they are getting proper facilities in the hospital, that would be good. Can you make anything in your app to do that? It would not be an issue if they came for medicine after that.”

Another intermediary was waiting to ask EIPs how care was. He explained, “*This week 7 to 8 people took recommendations. [...] I am happy, but I am waiting for them. Next time I see them, I will ask them about their experiences in the hospitals.*”

7.3 Posters

To further promote our system beyond slums and assist EIPs and low-income people locate potential intermediaries, we designed a poster and deployed it at many locations. We finalized the poster upon discussions with a) a professional artist, b) a rickshaw-puller and painter who lived in a slum with EIPs, c) one of our authors, and d) 10 more EIP participants. To determine the size of the printed poster (which was 14 inches \times 8.5 inches), we consulted with our intermediary partners. Figure 6 presents our finalized poster. It depicts a mother attending to her sick daughter, a mobile phone, and a doctor. At the top, it also contains the name of our system ‘Dakter Bari’ in Bengali. The text below says, ‘*When someone from your family is sick, this shop/pharmacy can help you find a doctor by using their phone.*’ For EIPs that cannot read, the imagery of a sick child and a doctor is likely to trigger enough curiosity that they maybe tempted to ask the intermediary about what the poster is for, which will ultimately meet our goals of raising EIP awareness to low-cost healthcare.

We printed and pasted the finalized poster in 17 intermediary shops and pharmacies. While three intermediaries could not deploy posters outside their shops due to space issues, they pasted the posters inside in a visible location. Figures 7 (a) and (b) show snapshots of our posters pasted at intermediary places where EIPs visit.



Fig. 6. Final poster



(a) A tea stall

(b) Telecom shop

Fig. 7. Poster deployed at intermediary places

8 DISCUSSIONS

In the sections above, we attempted to provide a clear context to Extremely Impoverished People (EIPs), how they survive on alms from the public, their residences, social connections among themselves, and social connections with small business owners (whom we call intermediaries in this paper). Considering the healthcare theme of this study, we carefully presented how healthcare is a major challenge for EIPs considering cost, and lack of awareness/ literacy skills of EIPs. We also presented detailed results of careful field studies we did on EIPs, Intermediaries and Hospitals. Important findings from our field work, and system deployment/testing were also presented above. We now present discussions on how our findings are impactful from a CSCW perspective.

8.1 Understanding the Context of EIPs and Intermediaries

EIPs are an integral part of urban Bangladesh and in many other South Asian countries. While homeless and related communities get significant attention from HCI community [56, 115], our empirical work in this paper attempts to do so within the context of a developing country with a massive population density [61, 110]. Our insights on economics, social support, healthcare and related findings in this paper can have strong implications on further designs of ICTD (Information and Communication Technology for Development) interventions for a wide class of economically disadvantaged people.

Our data from both the EIP and potential intermediary studies further show that there is a symbiotic relationship between EIPs and intermediaries (both in terms of seeking alms and purchasing necessary items), and we add a layer of voluntary healthcare advice to this relationship at little to no cost to the intermediaries. This notion of volunteerism, referring to work enacted in service of others for doing good [34], provides an explanation for helping and philanthropic intent of our intermediary partners [41]. This also enables EIPs to avail assistance beyond merely seeking alms from people they meet with regularly. As we show, the act of giving alms (at appropriate times to certain people) almost becomes like a daily task or a routine (to most intermediaries). While most do so with mere philanthropic intent, others do so in the name of faith and God. Furthermore, intermediaries are closely aware of various challenges faced by EIPs, including healthcare, and as such they are better primed to provide support services for EIPs under optimal conditions. Importantly, we also show evidence as to how good information percolates in the system, wherein EIPs that use the system pass it on to other EIPs, while intermediaries want to use our system to make recommendations for other low-income people who they meet in other settings.

We believe that a system like ours can also be very helpful for many culturally-similar countries in South Asia (e.g., India, Sri Lanka and Pakistan), where EIPs are many, and low-cost healthcare services is something that governments emphasize upon. Of course, appropriate cultural norms must be followed in designing the overall system, and how we approach intermediaries for volunteerism.

8.2 Designing Technologies Appropriate to Context

In our system, simplicity is vital. Since we are dealing with EIPs that suffer from lack of literacy, and intermediaries that are also resource constrained, and have their own jobs to do for most of the day, the simplicity factor takes prominence. Our system is hence asymmetrical to a certain extent, where heavy loads are imposed on the back-end system, while keeping the front-end app used by intermediaries as simple (and less sophisticated) as possible. This is fundamentally different from what Sambasivan et al., [96] and Parikh & Ghosh [80] suggested. Their suggestion was to build systems keeping dual-user phenomena in the context for optimal usage. However, their studies focus on intermediation with a view to empowering and enabling technology access to beneficiaries. We, on the other hand only want healthcare services to be made accessible to EIPs via

volunteerism from intermediaries using technologies they already use. The notion of promoting technological usage among intermediaries to do so is not optimal in our context, and will most certainly yield pushback from intermediaries (since learning technologies is not expected to fetch them any benefits, based on what they do for a living).

Technology intermediation via volunteerism absolutely depends on the availability of volunteers. In our system, we increase availability by deploying it at places where EIPs are most likely to visit, and where volunteers have a tendency to help them. However, one critical challenge is how to prevent our system from being used so much that EIPs and intermediaries do not use it at all, and merely visit/ suggest hospitals based on past experiences. These are additional issues we have to overcome, especially, since the number of hospitals providing low-cost services is low. Furthermore, EIPs, hospital and intermediaries are not likely to change their locations. So, it could happen that after some time, requests never come to our system, but people are still availing healthcare services based on past knowledge. It would very interesting to study this phenomenon over time.

8.3 Sustainability and Inclusion of Related Stakeholders

There exist many initiatives from governmental bodies in Bangladesh to increase healthcare access for all [10, 14]. For instance, there are online platforms for user inquiries [8] and call-centers [72] by the Ministry of Health and Family Welfare (MOHFW) for maternal health; and for infant care by Directorate of Family Planning [12]. These efforts, while noble are primarily targeted at literate people with access to digital technologies [59]. There is also recent increase on private e-health initiatives [9, 11, 13], but again focused on groups with access to digital technologies, and in some cases assumes social media access also. But EIPs do not fall in these categories.

Our work can contribute to creating increased pathways for information access via intermediaries. Intermediaries enable citizens to maintain productive relationship with e-government systems [31, 32] and can also assist in raising awareness [24] that these systems often lack [57]. The deployment of our proof-of-concept system shows its efficacy in bridging gaps between EIPs and related healthcare information, which maybe necessary to have an impact of ICTD interventions [97] for extremely vulnerable groups. As we show, volunteerism is alive and well, and can be a backbone to augment existing larger scale public and private efforts, but one must be careful, not to over exploit volunteerism, especially, when such volunteers are themselves not economically too prosperous.

National initiatives in Bangladesh such as ‘Shastho Batayon’ [16] by MOHFW – a scheme to allow everyone to have healthcare information for as low as 0.6 BDT/minute are wonderful initiatives, but are of little use to communities with no print literacy or access to digital devices like EIPs. Even if EIPs manage access to a device and a call, there is no curated information in these schemes to publicize already available low-cost healthcare services. Specific schemes/helplines for targeted population, and infomediaries with technology access and related experiences might allow making a direct impact in lives of very poor people.

Other than providing design implications involving our system, intermediaries, and related stakeholders, our work brings the need for inclusive healthcare discussions to the fore. Our data further pinpoints that many existing initiatives are of no use to urban EIPs, since they are only relying on pharmacy owners’ suggestions based on their daily income, and sometimes ‘pora-pani’ (i.e., faith healing) for treatment. As such, while governmental efforts to raise healthcare access to low-income people must be appreciated, we cannot deem them a success, unless they can reach the poorest of the poor. Through our work, we call for looking at ways that would work within the context and augment to the existing infrastructure to ensure proper healthcare to everyone.

8.4 Limitations and Future Work

Our work has two key limitations. Firstly, the two slums where we have studied our EIP participants are located around the center of Dhaka city (one near greater Dhanmondi, other near a University Area). Renowned hospitals in these areas might have made it easier for intermediaries to accept our system, and for EIPs to use it. However, as we move away from the cities, where healthcare services are low, it is not clear as to how a system like ours can benefit EIPs. Secondly, although many intermediaries wanted to partner with us, we only could work with those having smartphone/tablet, and this limited our intermediary pool. Despite these limitations, the findings of our study and the system we propose can be useful for healthcare access in low-resource, low-tech contexts.

Our future work with this system is two-fold. First, we will try to increase its visibility and legibility to its secondary users, namely EIPs. As prior work shows [80], use of auditory and visual indication can assist the secondary user to “see” or “hear” the interface output, giving them more confidence. Second, as suggested repeatedly by our intermediaries, we will try to build a feedback mechanism for the intermediaries via the inclusion of including hospital staff into system. But this will be very challenging, since hospital staff in low-income countries are themselves overworked. However, we agree with the view expressed by intermediaries that a feedback mechanism will greatly enhance trust and reputation of the overall system, and the recommendations made via it.

Finally, as students deploying a system like this for extremely impoverished people, it was a very rewarding experience for us in terms of finding opportunities towards broadening the impact of our own education. However, the fact that our system was maintained in university settings with no tech support, meant that we are always under the risk of cyber attacks (denial of service, hacking, stealing information etc.). Our future work also lies in attempting to partner with established private companies, and governmental agencies to design the system from the ground-up, while also considering state of the security, privacy and trust components embedded into the overall system.

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