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Healthcare Infrastructures in Ecuador: Challenges, Reflections and Opportunities for Digital Health

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ABSTRACT

Besides the efforts of the Ecuadorian government in the last decade to improve the healthcare infrastructure, it still falls short to meet the healthcare needs of its population and remains far away from providing equal access to healthcare services. Based on a visit to an itinerant health point in a rural community and research conducted in public and private hospitals, this paper presents a number of infrastructural challenges that impact the everyday caring experiences of patients and healthcare professional's work practices. Reflecting on these challenges, we discuss some opportunities for future design of digital health tools and services in the Ecuadorian context.

CCS CONCEPTS

• Human-centered computing • Human computer interaction (HCI)

KEYWORDS

Healthcare Infrastructures, Digital Health, Ecuador, HCI4D

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1 Introduction

Ecuador is an upper middle-income country in South America with around 16 million people [1, 17], having the majority of the population (62.7%) in urban areas [17]. The Ecuadorian population is primarily young i.e., 26.64% below 14 years old, 18.19% between 15-24 years, 39.82% between 25-54 years, 7.67% between 55-64 years, and 7.67% 65 years and over [18]. Ecuador is a multiethnic and multicultural country i.e., 71. 9% of the population identified themselves as Mestizo (mixed of Indigenous and Caucasian origin) and the remaining as Montubio (7.4%), Indigenous (7%), White (6.1%), Afro-Ecuadorian (4.3%), Mulato (1.9%), Black (1%), and other ethnic groups (0.4%) [19].

Ecuador is experiencing a double burden of diseases as communicable and non-communicable diseases coexist [5, 47], making heavy demands on the Ecuadorian healthcare infrastructure [16]. The prevalence of chronic malnutrition (stunting, and micronutrient deficiencies) and the increase in overweight and obesity impact both children and women especially from low socioeconomical status and rural communities [16, 25, 26, 45]. In addition, type 2 diabetes and hypertension are increasingly impacting the Ecuadorian population [1, 25] challenging the healthcare infrastructure, the community and the Ecuadorian society in general.

Over the last decade, healthcare delivery in Ecuador has gone through a major reform after the Constitution of 2008 that enforced social equity and inclusion aiming to improve the access to healthcare services for everyone [47]. Since the last reform the Ecuadorian government invested three times more to increase staff's salaries, the supply of medications, the human and physical infrastructure (by building new hospitals and health centres) [6, 9, 16] and has tried to attract foreign and Ecuadorian doctors living abroad through the "Healthy Ecuador, Let's Go" initiative [29]. However, these initiatives still fall short of meeting the current needs of the population [47], as the nation's healthcare system still lacks human and physical infrastructure [6] and health staff are still concerned about the availability and quality of medications and their unmanageable workload [48].

The healthcare infrastructure is fragmented (health units not integrated into the national network of care services) and segmented (many health systems coexist without clear separation of their functions and different budgetary sources), lacking

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coordination between all human and non-human entities [47]. Many independent institutions provide healthcare services including the Ministry of Public Health (MSP), the Ecuadorian Social Security Institute (IESS), the Armed Forces Social Security Institute, the National Police Social Security Institute and other health services provided by municipalities [47, 57]. Overall three major categories exist: a) a public system, based on the constitutional changes and free to everyone, b) a social security system available for the working-class, and c) a private system mostly used by the upper-and-middle class population [1].

The use of information and communication technologies (ICTs) for health, digital health [67], is limited in the Ecuadorian context and is creating opportunities to support both patients and healthcare professionals [39, 52]. For example in hospital settings digital health has focused on digitalization of medical records [33], monitoring of vital signs [20], providing information to patients about the location of medical areas and doctor's offices [63], providing medical training [66] and tele-consultations [12] in rural areas as well as the potential use of biomedical devices, wireless communication, and expert systems during prehospital trauma care [13, 64]. In non-clinical settings, digital health has focused on enhancing the communication and interaction with healthcare staff and follow-up of care services through text messages, emails and phone calls [39, 43, 53], promoting health literacy for maternal and infant health [42], the use of self-monitoring devices, mobile apps, online resources and social media (e.g., YouTube, WhatsApp, Facebook) to support self-care management of chronic conditions [11, 44, 52, 53].

Previous Computer Supported Collaborative Work (CSCW) and Human-Computer Interaction (HCI) research in healthcare has looked at the information and human infrastructure to support healthcare work practices within and beyond the hospital as care practices have expanded into people's homes and community settings [21, 46]. However, most of the research has been done in developed countries [14, 21, 37]. Although there is an increasing interest and visibility of HCI research for development (HCI4D), there is limited research in Latin American (LATAM) countries [14] and in particular in the healthcare context [61]. In order to design digital health technologies for LATAM contexts, there is a need to further understand how healthcare practices unfold [21] that are integrally embedded and tied to the socio-material arrangements (e.g., people, routines, artefacts, etc.) [58] that sustain healthcare infrastructures in practice [59]. This includes investigating the situated challenges that patients and caregivers face when interacting with healthcare infrastructures [10].

Considering the limited HCI and digital health research in LATAM and given the current trends to address global health challenges through digital health [65], it is crucial to understand the everyday practices and experiences of patients and healthcare staff interacting with different infrastructures of care to design contextualized digital health interventions for LATAM settings. In this paper, we reflect [22] about the Ecuadorian healthcare infrastructure by re-visiting three cases (experiences, challenges) of different levels of care drawn from the authors' research in public and private hospitals and a visit to a rural health point.

2 The Ecuadorian Healthcare Infrastructure

The three cases include a visit to an itinerant health point in a rural community (Verdezoto) and research conducted in public (Carpio) and private (Carlo) hospitals. For the visit, we gained access to a health point through the community leader and for the hospital-related cases, in the absence of local institutional review boards, we received official permissions from each hospital. All participants signed informed consent and participants with any form of physical disability were excluded. Participants could withdraw at any time and without giving reasons. We provide a short description for each case including methods and key infrastructural challenges. The cases have not been published.

2.1 Itinerant Health Point in a Rural Community

The first level of healthcare services includes itinerant health points, health centers, subcenters, and mobile units that provide ambulatory care services and promote national healthcare programs [1, 16]. We visited the only itinerant health point located in Chigüipe, a remote rural community in Bolívar province in the Highlands region. We looked at the socio-material arrangements and existing challenges. We observed the waiting area, consultation room and obstetrics unit (see Figure 1a). The visit took place in February 2019 and lasted for an hour, notes and photos were taken.

2.1.1 Lack of Human and Physical Infrastructure in Rural Areas. The main challenges that emerged from the visit are clearly illustrated in Figure 1a. The health point looks abandoned, understaffed, lacking the necessary equipment and physical infrastructure. During the visit, the community leader commented that there is only one staff member in charge and is supposed to be at the health point at least once a week. However, in reality this does not happen as it is difficult for a member of staff to commute across rural communities. The lack of human and physical infrastructure poses challenges for patients and caregivers who would have to travel long distances by foot or public transport to the next rural health point or subcenter to get access to basic health services, or travel to the hospitals in the main urban areas.

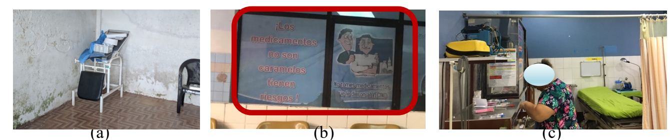

Figure 1. (a) Health point - obstetrics area, (b) health messages around the waiting area, (c) the emergency nurse at the ED

2.2 Two Public Hospitals, Andean Highlands

The second level of healthcare services include basic and general public hospitals. While these hospitals offer outpatient, pediatric, gynecology and emergency services, the general hospital can often have a particular specialty according to the community needs [1]. In this case, we investigated the existing barriers to treatments and overall level of understanding of health messages in the population of central Ecuador as part of a cross-sectional survey with 400 adults (208 males and 192 females) between 19 and 64 years old, who left the nutritional consultations, and ten

interviews (between 15-25 minutes) with doctors and nutritionists. The study took place between August and December 2018 in both the general and IESS hospitals in Riobamba, belonging to the public health sector. Crude logistic regression was used to determine the understanding of health messages disaggregated by sex and adjusted by the level of education.

2.2.1 Difficulties Understanding Prescriptions and Messages. Male participants, compared to women are more likely to understand prescriptions received by staff (OR=1.72, 95% CI 1.27-2.32, p= 0.003), even when adjusting the level of education. We asked women why it was difficult to understand prescriptions, noting, above all, that they went to the hospital in 80% of the cases accompanied by children (under five years old) and that their attention focused on the care of children. For nutritional prescriptions, we observed a list of foods delivered in written form without images. We noted health messages in the waiting area e.g., "*Los medicamentos no son caramelos tienen riesgos* [Medications are not candies, they have risks]", "*No tomes medicamentos que le dieron al vecino* [Do not take medications that were given to your neighbor]" (see Figure 1b).

2.2.2 Language Barriers and Low Literacy. In the public hospitals, 28% of participants are illiterate and 35% of participants in this study spoke Quechua as a mother tongue and Spanish as secondary language. However, 9 out of 10 doctors and nutritionists we interviewed do not speak or understand Quechua. When confirming with the hospitals' management, 46 out of 48 health staff do not speak Quechua. Although there is no difference in the prescription of treatment, healthcare staff commented that indications are more difficult to give to people with low literacy.

2.2.3 Lack of Time during Consultations. There is a maximum of 20 minutes available for consultation at public hospitals. However, considering all the issues described above this time is not enough to make sure that patients understand the prescriptions and treatments or that healthcare staff has asked all necessary questions for a good treatment.

2.3 Private Hospital, Coastal Region

The third level include specialized hospitals that serve as referrals for the general population including a number of private hospitals that are subcontracted. In 2014, 17.85% of the healthcare infrastructure was composed by private health services and hospitals [68]. In this case, we conducted a study at the León Becerra Hospital, which is a non-profit private institution located in Guayaquil, Ecuador's largest city. The hospital receives patients that are covered by IESS, MSP and private health insurances and provides comprehensive health services to children with low socio-economic status. We interviewed ten key informants at the Emergency Department (ED) including triage and emergency physicians, nurses, hospital admissions assistants, social workers, cashiers and the process and standardization analyst. We asked participants about inconveniences experienced with the current health information infrastructure and how these influenced their work practices. Interviews were conducted in June 2017 and lasted 33 minutes on average. A content analysis approach was used for the analysis of the collected material. Additional challenges emerged related to healthcare staff work practices and issues related to the information infrastructure.

2.3.1 Lack of Coordination and Interoperability. There is a lack of interoperability between the Electronic Medical Record (EMR) system and the billing system within the private hospital. Patients and caregivers have to give the same information to both the hospital admission assistant and the cashier before receiving care services. The Leon Becerra's electronic medical records are not shared with other hospitals and it does not have access to any information from other hospitals' EMRs.

2.3.2 Lack of Situation Awareness. At the ED doctors triage patients with the assistance of an emergency nurse (see Figure 1c) who takes the vital signs of patients and gives them to the doctor written on a paper. The doctor triages the patient considering the urgency of the case and writes down on a paper the order in which the incoming patient will be seen. However, there is no way to share who the next patient is or the vital signs among health staff and the doctor would do it manually. Although the manual process creates awareness, it takes time that could be used to see more patients, increasing patient's waiting time.

2.3.3 Failing to Respond to Emergency Cases. The Admission Assistant and Social Workers are responsible for assigning doctors to patients that will be hospitalized. They are in charge of calling doctors according to the pathology. However, in some cases there are doctors who do not respond to their calls or refuse to be assigned, delaying hospitalization. If there are not doctors of a certain specialty available, the patient must be referred to another hospital.

2.3.4 Poor Usability of Electronic Medical Records. Staff at the ED complained about the EMR interfaces and suggested to improve the interfaces to input and retrieve patient information faster to assist more patients in the shortest time possible. Admission assistants and social workers mentioned that some filters are needed, for example when doctors of a certain specialty are required. They often have to select from a list of all doctors instead of doctors of certain specialty. Doctors also commented on their need to get an overview of patient's medical evolution in a single screen without having to input a range of dates.

2.3.5 Additional Infrastructural Breakdowns & Data Quality. ED staff commented about the duplication of records in the system and that the EMR is down sometimes. For example, emails are not sent to IESS with the information of patients that are used by their health insurance. Another example are the attempts to send prescriptions to the hospital pharmacy that have to be filled out by hand. Some computers were reported to be very slow without preventive maintenance, impacting the ED logistics.

3 Discussion and Conclusion

The cases highlighted key challenges that patients and healthcare staff face while interacting with healthcare infrastructures. Reflecting on these challenges enables us to bring forward design opportunities in light of an increasing availability of 4G mobile network coverage, latest technologies and apps development [15]

and Internet access and use of mobile technologies in Ecuador [55] and their potential use in the healthcare context [39, 52].

Implementing Strategies and Digital Health Interventions to Support Patients and Caregivers to Navigate across Distributed and Fragmented Healthcare Services. Our cases highlight the complex reality of the healthcare infrastructure in Ecuador. Although MSP has built new hospitals and increased the use of public health services after the constitutional reform, health inequalities still exist [28] as 91% of the health staff [35] are concentrated in urban areas impacting rural communities [1]. Considering that Ecuador is experiencing a double burden of diseases [5, 26, 47] that impacts the healthcare infrastructure [16], there is an urgent need to improve primary care services and health promotion and preventive strategies through technology [9]. Digital health is providing opportunities to support self-care management practices, health education and community-based care services for patients and health staff within and across institutions in Ecuador [11, 42–44, 52, 53]. Future research should explore how location-based services can provide information about availability of care services to support global and local coordination of both human and physical resources within and beyond hospitals [60]. Research can explore the potential use of interactive and mobile interfaces including IoT [8] and AI-based features in low-resource settings to improve the ED waiting time and enhance nutritional prescriptions with images and personalized food-based dietary advice [23, 24].

In particular in rural areas, tele-consultations [12] can be complemented by using mobile technologies and social media platforms to help facilitate health promotion and preventive programs as long as there is signal coverage from mobile networks [20] and the rural communities needs are accounted for in the design of digital health technologies. Indeed, mobile phones can become an important artefact of the healthcare infrastructure bridging the gap between clinical and non-clinical settings. This might help support the navigation work done by patients and healthcare professionals and the interoperability across public and private infrastructures in particular in low-resource settings.

Enhancing the Usability and Scalability of Healthcare Information Systems to Ensure Continuity of Patient Care. In particular the ED case provided many insights on the fragmented, poorly designed health information systems and different breakdowns that can be detrimental to patient's health. Digital health can offer opportunities to support the invisible, manual and junction work [51] done by health professionals [48] to streamline care processes and seamlessly integrate them into their workflow through technology [21]. This is critical at the ED where polytrauma patients might not be able to recall medical history and help reduce medication errors. Digital health could help supporting clinical decision-making practices by providing analytic tools to enhance clinical search [34], rendering overviews of the medical evolution through dashboards [62], or enhancing care services with patient reported data [46]. Also, redesigning the EMR accounting for the organizational and physical context of use [49] and utilizing mobile and context-aware computing interfaces [3] can provide access to relevant intra departmental information [60], support operation capabilities and coordination within and beyond the hospital, helping staff obtain situation awareness during cooperative clinical work practices [21].

Shaping the Experiences in Hospital Environments. Hospital environments can often provoke anxiety and stress for mothers and children [36] especially in the context of a life threatening situation. One of our cases highlighted the emotional labor that significantly impacted mothers' understanding of prescriptions and the care experience while being at the hospital with children. Digital health can help shaping the experiences, for example through the implementation of social and/or therapeutic companions using IoT [40, 65] or AR/VR interfaces [54]. This might help to alleviate the mother's cognitive and emotional work to facilitate the understanding of prescriptions and messages.

Digital Health that Fits Multicultural Healthcare Infrastructures. Ecuador is a multi-ethnic and pluricultural country. Existing socio-cultural practices, beliefs, norms, asymmetrical power structures, real life settings and the requirements of modern medical care [27, 38] impact the health and wellbeing of Ecuadorians in particular affecting ethnic minority groups [7]. Language was indicated as a major barrier in the central zone of the highlands characterized by having a high percentage of indigenous population, who only speak their native language (i.e., Quechua), while the health staff mostly speak Spanish, limiting patient's understanding of health messages and staff being perceived as unfriendly. Indeed, there is a need for more inclusive implementation and adaptation of healthcare policies to the local cultures and settings [27, 38]. Digital health could help by supporting collaborative interpretation [2] and providing alternatives for the provision of health messages (e.g., [2, 56]) that can be more ethnically inclusive and culturally appropriate for local communities. This calls for interdisciplinary research [4, 50] and a more-than-human approach [41] to digital health to get an in-depth understanding of the local context, embracing socio-cultural differences [30].

The challenge for HCI4D researchers is to further understand culturally diverse LATAM contexts and create digital ecosystems bridging the gap between multiple stakeholders (academics, healthcare providers, policy makers, NGO's, technology industry and local communities, etc.) promoting active participation in the design process [32, 50]. This might benefit from building community health innovation networks [31], north-south and south-south collaborations [61], intercultural policy implementation [27, 38], developing and evolving service design capabilities [50] to enhance equity in a multicultural society.

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