Mobile Application Design for Health Intermediaries
Considerations for Information Access and Use

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Abstract: Health intermediaries in emerging contexts exhibit a diversity of information needs in conducting their professional duties. There is limited understanding, however, as to the complex needs of these groups. Furthermore, there is still a paucity of research on supporting the information needs of intermediaries via technological means. This paper employs a qualitative meta-analysis in unpacking the dynamism of intermediary practice in South Africa. The authors consider mobile application design in accessing and using health information. A number of critical design considerations are presented, including the role of context as a static and dynamic modality. The authors ultimately derive an information model, which assimilates four intersecting dimensions of context.

1 INTRODUCTION

There is still a paucity of research on supporting information needs in marginalised health contexts via technological means. This especially concerns aspects of health promotion, disease prevention, and intrapartum care. Within global and national discourses on hyperconnectivity (Bilbao-Osorio et al., 2013), underpinning the role of information access and literacy, technology-supported information systems become crucial considerations (Neter and Brainin, 2012). Additionally, in the context of rapid access and the ubiquity of portable devices, 'mobility' becomes a significant component to said information systems. We focus our efforts, therefore, on considerations for mobile application design.

This study discusses the information needs of three groups of health practitioners: midwives, home-based caregivers, and health promoters. We consider the multifarious 'personas' of these individuals in mediating health information to beneficiaries (patients, families, and community members). In this regard, we interpret the role of practitioners largely as intermediaries, acting as conduits of health information in marginalised contexts.

The primary objective of this paper, ultimately, is to present a qualitative meta-analysis of three case studies that have considered the respective groups. We locate the 'health information needs' of each group, and identify those personal and contextual dynamics that shape the design of systems that support health information access. All three case studies employed human-centred design in ideating a series of mobile application possibilities to support health intermediaries.

The research question that guides our analysis is: "What are the design considerations of mobile applications that facilitate the dissemination, exchange and reporting of relevant health information?" The proposed output of this endeavour is a conceptual model for health information that encompasses 'situated' design thinking.

2 STATUS OF THE LITERATURE

2.1 Considerations for Information Access and Use

In peripheral settings, marked by the inadequacy or inaccessibility of health information, intermediaries become the primary source of health-related knowledge. Intermediaries translate and adapt health-related information for local use, thus acting as conduits or dependable information sources

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(Chetley, 2006).

Intermediaries generally exhibit a variety of information needs. These are based on a continuum of requirements and desires, which can vary from unexpressed, conscious, formal, and compromised needs. Information needs will vary in nature, complexity, and content, and are mediated or manifest through information practices. These describe the ways in which intermediaries collectively share, withhold and manage information as they interpret it according to their professional functionings (Dourish and Anderson, 2006).

In community-based contexts, intermediaries typically convey information on an informal basis, via face-to-face meetings, focus groups, or discussions. This could however result in information degradation over time, or prove inadequate for sharing and public dissemination. Moreover, in the context of increasingly ubiquitous mobile technology in the Global South, community-oriented information systems become critical in addressing the shortcomings of transitory information sharing. This is especially the case in granting universal access, and in ensuring free and flexible use, in line with locally defined practices (Bilbao-Osorio et al., 2013). In this vein, there is a growing need to develop community-based systems that cater to the collaborative information behaviour of health intermediaries (see Ruxwana et al., 2010).

Ostensibly, technical and infrastructural considerations remain key in designing health information systems. In marginalised community settings, especially in rurally isolate areas, 'context' becomes a foremost and critical design consideration. That is, intermediaries are entrenched in deep spatial, temporal and cultural modalities. These define and redefine both information practices and collaborative information behaviour (Räsänen and Nyce, 2008).

An understanding of context as a nuanced and multifarious system helps to stipulate the embedded requirements of health interventions or services (Bradley and Dunlop, 2005). Context can here be described as a frame, an environment or a background that surrounds the phenomena under study. But human activities involve practices and relations that are meaningful for a particular situation or setting that need to be studied and understood (Dourish, 2004). Through eliciting users' (intermediary) contexts, designers may recognise multiple circumstantial representations, including location, identity, environment and time. In this regard, context can be seen as an interactional problem that represents the relational property between objects or activities (Dourish, 2004). This view of context is both dynamic and situational, recognising that intermediaries socially construct their practices by attaching meaning to what they are doing. Practice, in this sense, is both the physical activity and its meaningful experience – thus uniting action and meaning (ibid.).

Ultimately, the surveyed literature reveals agreement that context of use becomes a critical consideration in providing health information, and in developing technology-supported information services.

2.2 MHealth

With more than 6 billion connections worldwide and US$1.3 trillion in annual revenue, mobile telephony has become the largest and most prevalent information and communication technology in history, at least economically (Bold and Davidson, 2012). And whilst the global scale of mobile telephony and its economic impacts are predominantly well documented (and understood), its "ultra-personal" and omnipresent social networking ability is expected to have a far greater impact (ibid.). In addition, mobile broadband has become the primary method of internet access for people around the world. In emerging regions, this indicates that mobile is the first, or even the only, way that individuals or communities can gain internet access (ibid.).

Mobile telephony accords with the need for healthcare systems that are readily accessible and usable (Katz and Rice, 2008). mHealth enables the connecting of individuals to information and services that would otherwise be unfeasible, especially in emerging regions. Additionally, mHealth can support the shift from treating acute and chronic diseases to prevention and health promotion (Leon and Schneider, 2012).

Drivers for mHealth applications are socio-economic rather than technical (Norris et al., 2009). A single-solution focus on mHealth should be replaced with it being an extension and integrator of underlying health information systems that support the point-of-care for health workers (Mechael & Searle, 2010). In this case, the interoperability of mHealth applications is a growing concern, so to link health workers with relevant information when and where it is needed (ibid.).

3 METHODOLOGY

In this paper, we document part of a qualitative meta-analysis of three case studies. Each study centres on the role of health practitioners in mediating information to patients or beneficiaries. The meta-analysis is conducted at an 'etic' level, and considers an assemblage of contextual and personal experiences as exhibited by health practitioners. Each of the three case studies has employed human-centred design (HCD) in ideating the challenges and opportunities in accessing health information. The ontological basis for human-centred design here is self-evident: the users of artefacts, technologies, or services are located at the heart of the design process.

Within each study, HCD manifested across a participatory methodology in two phases: discovery and creation. The discovery phase – also termed the exploration and insight stage – aimed to elucidate the many social, cultural, and environmental dynamics that characterise the micro health landscape. The creation phase – also termed the design stage – assimilated the exploratory outcomes within tangible design considerations. Both phases are initial processes, and build towards the latter stages in participatory design: testing, reflection, implementation, and iteration. These latter stages will be discussed in follow-up research.

Each case gathered empirical data using a series of techniques associated with participatory design: context and stakeholder mapping, semi-structured interviews, focus groups, user need analysis, co-design sessions, service concepting, prototyping and iteration. These data sets were collated and assimilated according to the research question that guides this study. Overall, this process corresponds to the pursuit of a qualitative meta-analysis, and is guided by its fundamental principles.

4 RESULTS AND DISCUSSION

4.1 Intermediary Personas

This meta-study considers three personas of intermediaries derived from the South African health landscape. Personas are user archetypes that help define the intended design intervention by replacing the notion of the abstract, elastic user. The persona is a precise description of a hypothetical (end) user and his or her goals, and it represents a group of users throughout the entire design process (Kujala and Kauppinen, 2004). The three personas of health intermediaries that we identified include the midwife, the caregiver, and the health promoter. Each is briefly described below. It is acknowledged that these do not and cannot articulate the full scope of individual users' identities, histories, experiences, values and behaviours. Rather, personas here function as a point of reference for deriving a common understanding of user needs, contexts, and preferences.

4.1.1 Midwife Intermediary

A specific midwife persona is identified as the following: Agnes is a qualified midwife appointed by the Department of Health to provide services in a local Midwife Obstetric Unit (MOU), based in a resource-restricted community in South Africa. Agnes, in her thirties, is also from the area and travels by public transport to the MOU daily. Being the only maternal unit in the area, Agnes is overburdened and has limited time for each new patient. Long patient queues encircle the unit, adding pressure on the clinical staff. Pregnant mothers are seen here for the first time, and for follow-up visits. Problem and critical cases are referred to local hospitals. Due to the highly stressful environment, Agnes feels overwhelmed about her patient load, and makes numerous referrals to specialised care. This is especially the case when she is uncertain about the severity of her patients' conditions. Some of her patients arrive from outside of the province, and she does not have access to suitable information on their personal health history. Having this access is especially important in the case of communicable and chronic illness. This need typically occurs during emergencies when additional information about the patient is not available. Patients are generally unable to supply the required information due to being semi- or illiterate, or uninformed about their health conditions.

4.1.2 Caregiver Intermediary

A specific caregiver persona is identified as the following: Priscilla is a home-based health worker in a peri-urban community, and resides in the vicinity. Priscilla is thirty-four years old and has received basic training as a home-care nurse from her local hospice. She visits patients on foot, and is sometimes afraid to enter dangerous areas. She owns a feature phone on a prepaid airtime basis. Although the hospice provides her with weekly airtime, this is minimal, and often insufficient in fulfilling her duties. She enjoys her work, but find it physically demanding and emotionally draining. Recently, she

needed to attend to an influx of migrant labourers from the Eastern Cape and other provinces. She finds it challenging to converse with these patients due to not speaking their home language. Given their cultural heritage and personal beliefs, she is not always knowledgeable in taking care of them. Priscilla wishes that she had access to relevant information in helping her better respond to her patients' needs. She is unable to remember everything she learnt during her training at the hospice. She often uses her mobile phone to contact the care coordinator, using the "please-call-me" option. This is a free service, and alerts the coordinator to phone her.

4.1.3 Health Promoter Intermediary

A specific health promoter persona is identified as the following: David is a young man, residing in in a peri-urban community. He has recently completed his Matric (Grade 12) and decided to work as a health promoter in the area. He is contracted by a local non-profit organisation, which works in partnership with the Department of Health and the provincial government. David receives a stipend for his services, which includes basic transport and meals. He is responsible for distributing promotional health materials (informational pamphlets and contraceptives) in High Transmission Areas like taxi ranks, public restrooms, and shopping centres. David spends up to 9 hours a day in these areas, and engages in regular conversation with community members. They are interested in discussions about reproductive health, but challenge David on his knowledge about topics like unprotected sex, medical male circumcision, and condom use. Some members feel that these are culturally contested issues, and engage in heated debates with David. David does not have modern promotional materials available, and uses paper-based guidelines, written in two or three languages, to support his discussions. He wishes that these were more interactive and colourful, to enable him to better communicate about important issues. He also wishes that his supply of contraceptives were more conducive to local needs (stronger materials, better smell, more colourful).

4.2 Design Considerations

In the following sections, we identify specific considerations that have emerged in our qualitative meta-analysis. These are grouped along the modalities of context and information needs: two leading dimensions in the design of mobile services for health intermediaries.

4.2.1 Context

Our meta-analysis identifies 'context' as a significant dimension to the provision of information access and use in supporting the work practices of intermediaries. We observe four dimensions of context within which intermediaries are located: personal, physical, macro, and interactional. The personal (micro) context contains those social, biological and behavioural phenomena that constitute the subjective realm of the intermediary. General examples of micro contexts may be derived from our respective personas: all three intermediaries work in the communities they live, received basic health training, and converse mostly in the same language than the people they service. Additionally, intermediaries have a positive attitude, with a real desire to assist. All three intermediaries possess a mobile phone, but with limited money to make calls or to send messages. It is expected that these yet 'static' elements of personal context may shape 'dynamic' information needs and practices. For example, intermediaries possess mobile phones – this is a static modality. They may use these phones to access the internet to retrieve nursing guidelines. This dynamic interaction constitutes information behaviour.

We observe in the physical (meso) context dimensions of material, temporal, infrastructural, and environmental significance. As with the micro context, we may derive general examples of physical meso contexts: internet connectivity is problematic and the available physical and infrastructural resources are limited. It is expected that these static elements of meso context will shape eventual information practices and behaviour.

The former contexts ascribe to a broader (macro) context that constitutes socio-economic, political, and geographic modalities across South Africa, the Global South, and the world. We may here derive very general macro elements: poverty and socio-economic status; the inability of the national government in providing essential healthcare; the proliferation of HIV/AIDS and tuberculosis, among other chronic conditions and communicable illness; crime and violence; inter alia. These phenomena are generally embedded within an emerging landscape, characterised by resource limitations, a lack of locally relevant content (health information), insufficient resources for adapting information, a lack of clarity around key stakeholders and available services, inhibiting cultural factors that prevent effective use of ICT, and lack of capital in

developing and sustaining ICT solutions (Chetley, 2006).

The interactional context, lastly, encapsulates information practices, which are fluid and adaptable. We consider in this context an interactional space between different information components. Within this space, we observe a diversity of interfaces, practices, and experiences, as exhibited by both intermediaries and users. The interactional context also sees the emergence of an information space: a temporary structure that arises when intermediaries interact with information objects, beneficiaries, and colleagues. The space is both a container of interactions, and a setting within which intermediaries act (Williams et al., 2005).

We propose that this information space be facilitated by mobile technologies. A number of considerations remain in the design of mobile interfaces. These should consider the preferences and experiences of intermediaries, and as exhibited through information practices and needs. These are briefly discussed below.

4.2.2 Information Needs

Our meta-analysis suggests a diversity of information needs as expressed by health intermediaries. For purposes of summation, these are tabulated below. Each need corresponds to the four dimensions of context earlier identified.

Table 1: Information needs of intermediaries.

Context	Information need
Personal (micro)	Locally defined information about treatment, prevention, and promotion.
Physical (meso)	Information that supports the services provided, including health facilities, resources, services, partners, and training opportunities in the region.
Socio-economic (macro)	Information about guidelines, policies, international best practices, and laws.
Interactional (dynamic)	Information practices; information seeking and behaviour of individuals and groups; experiences when interacting with information objects and with mobile devices, systems or applications.

4.2.3 MHealth Intermediary Information Model

Emerging contexts, especially when characterised by socio-economic and environmental constraints, indicate critical dimensions worth considering. A list of the foremost implications of these dimensions is presented, as derived from our meta-analysis:

1. Health intermediaries need information to support their work practices;
2. Currently, the vast amount of health information is not always accessible and locally relevant;
3. An intervention may be needed to facilitate the access and use of relevant health information for intermediaries. mHealth has the potential to facilitate this;
4. Intermediaries' work practices are influenced by the contexts in which they function;
5. Contextual aspects are complex and need to be unpacked to provide for possible information interventions;
6. Contexts manifest as both static and dynamic modalities. Example, availability of a phone (static) against using the phone to seek and use information (dynamic).
7. In designing mobile interventions, both static and dynamic context considerations are required.

These considerations in mind, we build towards an mHealth information model that supports intermediary work practice across contextual modalities.

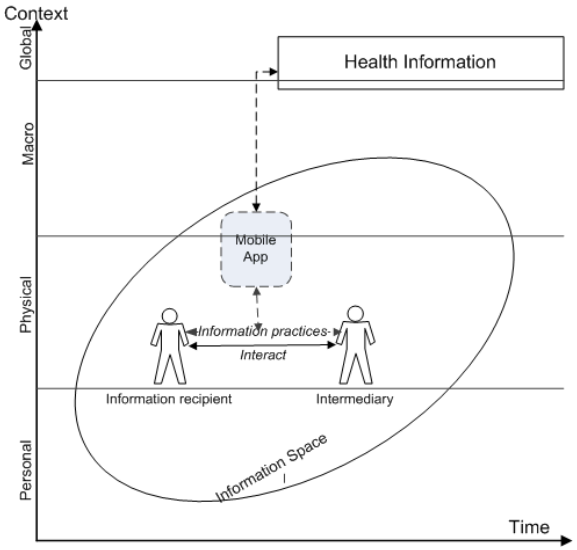

Figure 1: Considerations for access and use of health information.

Static context dimensions – personal, physical, macro – are depicted on the y-axis. The dynamic dimension is indicated as time on the x-axis. Health information appears mostly outside the contexts

relevant to intermediaries. The information space represents those information practices of the intermediary in interacting with recipients. The proposed mobile application connects intermediaries and recipients with health information. Without this connection, they are isolated.

Ultimately, the proposed model offers two fundamental design considerations for fluid interactions and relationships between users: 1) Determine the static context dimensions across three levels: personal (subjective, experiential realms); physical (temporal, spatial, material realms); and macro (geographic and socio-economic realms); and 2) Determine the dynamic information space in terms of information practices, relations, and user experiences (the 'fourth context'). This concerns the interaction between intermediaries and recipients, especially related to information practices, objects and –behaviour.

5 CONCLUSIONS

In this position paper, we uncover two critical design considerations in mobilising health information for intermediaries. Future research may look to unpack the interplay between static and dynamic contexts, and consider the deep ecology of health information practice, especially in emerging contexts.

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