

# Mobilities of the Community Health Work Practice: Mobile Health System Mediated Work

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*New technologies have been implicated in various forms of mobilities creating new realities and questioning normative categories and order in contexts where they are applied. Our study argues that through understanding technology mobilities, we uniquely bring to light new forms of social phenomena that materialize with interactions between mHealth systems and the work of Community Health workers in Malawi. Through the analysis, we also elaborate the role of both human and non-human actants in work transformations. This is important in managing technological innovations and theorizing electronically supported work practices.*

## Introduction

We are witnessing an era where information and communication technology innovations have taken center stage in our social activities and work places, spurring intensive transformation processes. As Kling (1996) noted, the introduction of technologies makes work complex, creating various ways for users to reconstruct and restrict their work. Barley (1986) has also cited technologies as enabling many novel practices to

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emerge. These transformations are not only due to the influence of technology but also its interplay with social systems and organizational structures. In contemporary healthcare, a range of technological innovations are developed to aid health service provision. In the developing world, mobile technologies offer new opportunities for healthcare delivery even in the remotest regions of those countries.

Community health workers (CHWs) provide simple healthcare to populations in communities often far away from health facilities (Lehmann & Sanders, 2007). They sometimes conduct administrative functions at health facilities. Mobile Health (mHealth) systems are often presented in light of their potential to assist CHWs (Braun et al, 2013; Källander et al, 2013; Agarwal et al, 2015), yet we do not fully fathom their interaction with the work practices of CHWs. There is a need to understand how and what changes emerge.

We use the concept of mobilities which not only refers to human movement but also includes dimensions of human interactions (Urry, 2000; Kakiyama & Sørensen, 2002). Scholars like Urry (2000) sought to elaborate how mobilities undermine traditional forms of stability associated with endogenous social structures. Mobilities have especially been of interest to sociologists but they should be important to information systems research as technology has been implicated in the facilitation of various kinds of mobilities. Kakiyama and Sørensen (2002) argue that technologies like mobile phones afford various forms of mobilities to human interactions. They expand the concept beyond mere human movement to include three interrelated dimensions of human interactions: spatial, temporal and contextual mobility. This article concerns itself with understanding the mobilities constituted by mHealth systems and how they are implicated in new social order. We study a group of CHWs in Malawi also known as Health Surveillance Assistants (HSAs). Lash and Urry (1996) argue that an understanding of mobilities contributes to an understanding of changes in social relations such as the organization of work. Our study thus focuses on this question: *What is the nature of mobilities implicated in mHealth mediated community health work?*

We illuminate normative work interactions and use the concept of mobility to understand how social order is influenced in the presence of technology. Referring to Kakiyama and Sørensen's (2002) categorization of mobilities, we further identify social mobility to emerge from our study, thus expanding on their work. We explain the unfolding of human-technology interaction processes with the social context to understand the outcomes of technology use. We believe the study contributes to our understanding of the contextual influence on systems' use and technology's role in influencing work. It has important implications for the use and management of mHealth systems.

The article is arranged as follows: in section 2, we discuss our background literature leading up to our theoretical framing. Section three presents our research approach followed by section 4 with our empirical findings. Section 5 indicates our analytical discussion and in section 6, we reflect on the implications of the study. Section 7 presents our conclusions.

## Literature Review

### Mobilities

Studies of mobility have emerged in globalization studies, geography, and anthropology among others (Sheller, 2011). Technology has been implicated as a means to mobilities (Sheller, 2011; Sheller, 2014; Urry, 2000) questioning our notions of social order and organization. Mobility refers to movement and Kakihara and Sørensen (2001) stretch the concept to suggest three interrelated mobilities that encompass human interactions. That is, spatial, temporal and contextual mobilities (Table 1). Spatial mobility refers to the movement of people, objects, space and symbols like information with geographical independence. This has been credited to invoke complex patterns of human interaction. Temporal mobilities are related to the acceleration of work and saving time, thus creating new temporal orders in the organization of work. These mobilities are related to influencing structural orders and interpretive frameworks for action. Contextual mobilities have also been related with modern technologies especially ICTs. Contexts in which actions occur, organize human interaction. They frame and are framed by the recursive performance of actions and they capture aspects of human interaction such as ‘in what way’, ‘in what particular circumstance’ and ‘towards what actors’. Technologies influence contextuality through affording diversified modalities of interaction. These modalities of interaction can range from unobtrusive to obtrusive depending on how they impose obligations to notice or react. Interactions can also range from ephemeral (where interactions only exist in the flux of unfolding events) to persistent (where interactions leave behind traces for further inspection and discussion).

Table 1: Three dimensions of mobility (Extracted from Kakihara and Sørensen (2002))

Dimensions of mobility	Aspects of interaction	Extended perspectives
<b>Spatiality</b>	- Where	Geographical movement of not just humans but objects, symbols, images, voice, etc.
<b>Temporality</b>	- When	- Clock time vs. Social time * Objective vs. Subjective - Monochronicity vs. Polychronicity
<b>Contextuality</b>	- In what way - In what circumstance - Towards which actor(s)	- Multi modality of interaction - Unobtrusive vs. Obtrusive - Ephemeral vs. Persistent - Weakly & strongly tied social networks

Sociological studies have often pointed to social mobility described by Lipset and Bendix (1959; Sheller, 2014) as the process by which individuals move from one

position to another in society. These positions often have specific hierarchical values. These mobilities raise concern of structures, hierarchy and power (Sheller, 2014).

John Urry in his 2000 discussion of ‘mobile sociology’ introduces contending views of structures as unstable. He notes that, “...in certain contexts, order generates chaos.” This according to him is because the social world/system is a social hybrid where several individuals’ iterative actions are subsumed under the notion of structure, ordered and reproduced through continuous interaction. He notes that Giddens gives us an understanding of how structures are drawn on and are an outcome of numerous iterative actions by knowledgeable actors but Giddens’ view insufficiently examines the complex character of the iterative processes composed of various elements- human and non-human and the iterative process of how order (structure) can generate chaos or change, unpredictability and non-linearity (Sheller, 2011). Urry notes that it is through the iterations over time that agents may generate unexpected, unpredictable and chaotic outcomes that revert to structures. To emphasize his assertion, de Certeau (2004, p. 1248) later noted that, “human agency has some leeway to “err” or wander from the lines prescribed by the overarching structure of society”. Human agents can do this by tactfully eluding structural determinism. So how does the repeated action towards structure produce change? Urry introduces the notion of mobilities and flows as being at the heart of many transformations in contemporary society.

Urry (2000) centers his arguments on mobilities that destabilize structures. Mobilities involve the interaction of different and sometimes conflicting linkages between people, technologies and practices across time, space and cultural conditions. The elements in social systems that interact physically and informatively over time do have both positive and negative feedback loops. These mobilities can help understand the iterative process that changes structures. To Giddens, structures are changed by human agency but through the lens of mobilities we can understand the role of both human and non-human actants like technology. We can understand how structures are transformed and what influences the change in community health work. Instead of merely highlighting what changes, we try to understand why it changes in the presence of technology. We use the mobilities lens to understand this.

Technologies have been linked to being channels of mobility and they break the way individuals, groups and society conduct their everyday actions. They add new dimensions to our understanding of the social world (Molz, 2014). We shall in the article seek to understand the community health work practice, illuminating who and what is mobilized or not mobilized and how this influences work practices. In this way we shall understand the changes influenced by both technology and social systems in implicating work practices.

## **Research Approach**

Our empirical data is based on the work practices of Health Surveillance Assistants (HSAs) as we seek to understand their everyday mundane work and interaction with mHealth systems. HSAs in Malawi receive 6-8 weeks training and work at the lowest level of healthcare providing primary healthcare services to populations in rural areas.

Organization mHealth (a pseudonym) in 2014 developed a mobile decision support system to aid decision-making for HSAs during assessment of expectant mothers and infants. The project started in 2014 with six HSAs and by the time of the study (September and October 2015), six more were involved.

The system was developed based on existing paper protocols that were incorporated into a mobile phone system to support HSAs in accurately assessing, diagnosing and treating mothers and infants. In the pilot studied, new protocols were introduced and adjusted according to emerging needs that were not in the previous version. For example, the current version includes a provision for malaria testing. There have also been attempts at integrating the system data with the national Health Information System.

The system guides HSAs through a step by step analysis and treatment plan for health conditions like malaria, pneumonia, and malnutrition among others. For example, if the HSA is assessing an infant's health, he/she has to go through a step by step inquiry and based on the answers entered into the system, a diagnosis or a recommendation for action such as a referral to a health facility is generated.

### **Data collection**

The work of Community Health Workers (CHWs) is in many ways ambiguous with a general lack of clarity of the various networks that build this practice. Their work differs from country to country. To uncover the ambiguity of their work, the first author empirically borrowed ideas from the rhizomatic approach (Deleuze & Guattari, 1987) where she explored the various networks in the practice to understand and explain how the work of HSAs is structured and built. It was important to study the community as a whole (nodes) in the CHW practice, their dynamics and how they inform each other.

With this approach the current research studied the different nodes that make up the micro-phenomena/elements of HSAs' work and how they connect, collaborate and influence each other to make up the practice. This relational view of the nodes was intended to give a comprehensive overview of the CHW practice, understand how things come together and the logic of how CHWs work, and identify micro-elements in the nodes and consequences of their interactions. This was done to understand processes involved and the interactions between the micro-dynamics of practices and work change (Labatut et al, 2012). CHWs were studied to learn and identify work practices and how they are interpreted to give meaning to shared action. In this way, it was possible to link the micro-level of the individual to macro societal system/ community health work practice. The role of technology in these nodes was also examined to understand how it interacts with the work practice. Figure 1 illustrates the various networks in the CHW practice.



Figure 1: Illustration of the nodes in the CHW practice

The study was conducted in Zomba and Dowa districts for two months (September and October 2015). Participants were 12 HSAs, three Health Personnel, two members from Organization mHealth, and four community members. Upon its introduction, HSAs were given training by officials from the District Health Office, along with smart phones and the system. Data was collected through observation and semi-structured interviews with HSAs to understand their work practice, the dynamics of their everyday work and interactions with technology. Community members and health personnel also gave accounts of their interactions with HSAs in semi-structured interviews.

The first author aimed to understand the local relationship and rationality between the nodes. She attended training sessions when the system was introduced and later observed activities such as child growth monitoring for children under five years to understand HSAs' interactions with their new mHealth system. There were informal chats to gain a further understanding of why certain actions were taken.

### Analysis

The analysis aimed at understanding the normative order of the work practice of HSAs and how they change with technology mediation. We sought to understand how the different nodes influence each other and to not only understand the role of technology in influencing change but also uncover the layers of meaning brought to technology by social systems (DeSanctis & Poole, 1994). Our theoretical themes grew and changed with continued data collection, analysis and literature review. Data was analyzed alongside data collection. Initially in the early phases of the research, the two concepts

of structures and agency by Giddens (1984) were drawn upon to guide data collection directing us to understand the normative order of the CHW practice during the fieldwork. We also drew on the work of Barley (1986). We sought to address questions such as: how did CHW's actions reproduce their work structure? How did HSAs draw on the structures for their actions?

Continued data collection, analysis and further literature review revealed that it would be important for us to incorporate Urry's (2000) ideas of mobilities to understand technology and work practice transformations. With later reading, it became clear that technology can also subject work practices to transformation (Labatut et al, 2012; Markus & Silver, 2008). We examined our interview transcripts and field notes and grouped data with similar experiences and meanings into codes and later identified themes and concepts from the data relating to the use of the mHealth system, including themes such as: Work practices, their normative order, role of human agency and technology agency, emerging mobilities and the relationship between mobilities and work practices. We also reflected on the themes and related them to the data to account for their relationship with the data. These themes were related to our theoretical basis when we developed the study's reflections.

## **Presentation of findings**

We highlight HSAs' reflections of how work was previously organized and changes with the introduction of the mHealth system.

### **Organization of work**

The Ministry of Health (MoH) develops structured activities for HSA programs aimed at primary healthcare provision in communities. Such activities include: mandatory home visits to follow up clients, treating and educating communities. HSAs follow guidelines on paper registers and either do their work individually or jointly with colleagues and village health committees (VHCs) depending on workload. We report on two main programs described below.

The Community Case Management (CCM) program focuses on childhood illnesses with activities such as treating children aged two months to five years for simple illnesses like cough, diarrhea, and fever. More complex health cases and children below two months are referred to the health facility. Immunization exercises occur in villages and at health facilities. Community education is done jointly with colleagues and VHCs. Village sanitation inspections and home visits occur in over 150 households per HSA. All activities are recorded in registers and reported monthly to the Ministry of Health.

The Community Based Maternal and Neonatal Health (CBMNH) program addresses challenges associated with pregnancy and early infant life. It involves conducting at least three home visits to expectant, post-natal mothers and infants. HSAs used registers to guide these visits. HSAs must refer all expectant mothers with danger signs. Child growth monitoring, health education, HIV testing and counseling are other activities conducted in homes or the village clinic. All are recorded and reported monthly.

In addition, the logistics program complements the two programs. HSAs make monthly logistics requests on paper forms and submit them to the HSA coordinator, who aggregates these requests and submits a report to the health facility In-charge, who submits a request for the health facility's logistic needs to the District health office every month.

Each of the two programs was performed by six of the 12 HSAs. Following the implementation of the mHealth system, the two programs were combined making all 12 HSAs work on both the CCM and CBMNH programs.

*“All the programs are now combined on the phone which means that a single HSA does the activities from all the programs. At first those HSAs that focused only on CCM, were seen as mere growth monitors by the community. The incorporation of CBMNH requires all HSAs to have drugs. Their responsibility was elevated to incorporate treating simple illnesses. And the ones that did not get phones were asking me when they would get phones. They felt they were missing out on the opportunities the ones with phones had. They did not feel at equal measure and saw their colleagues with phones as more professional-like...” (HSA coordinator)*

HSAs reflected on how work was conducted before and after introducing the mHealth system as presented below.

### **Care related work**

Care related work was mainly attached to the CCM program. It was organized and performed by HSAs following guidelines on paper registers. HSAs are trained to treat some illnesses like; malaria, cough and diarrhea and refer patients to health facilities. In practice, patient treatment and referral depended on the HSA's analysis of information s/he recorded in the paper forms. This took over 30 minutes and occurred at the village clinic or an individual's home. One HSA narrated:

*“From the training we gained skills to assess danger signs in infants. We have paper registers which we still use sometimes. They have the questions we ask... After an analysis, we decide to either refer an infant to a health facility or treat the baby if they simply have a cough, fever etc...” (HSA)*

Presently, paper protocols were duplicated into the mHealth system and HSAs enter similar information. They replaced paper forms with the mHealth system due to its quick assessment of data leading to fast decisions on treatment or referral. HSAs take about 15 minutes attending to a patient with the mHealth system. Upon data entry, the HSA gets an immediate diagnosis and recommended protocols to follow while treating or counseling a patient. Two HSAs narrated:

*“...We are following the same protocols, but the system helps us make decisions on what course of action to take. It simply states whether to refer a pregnant woman or counsel her following a particular form. It even reminds me what questions to ask which we honestly sometimes forgot. We used to carry around many forms, but we now just carry portable phones.” (HSA)*

*“The phone offers a holistic approach. Not only one diagnosis is conducted but it is used to manage and identify other conditions... I am more equipped to address health challenges and I feel more competent now in my job. Also, with the phone you cannot skip questions. This was very possible with the paper forms. For example, when reviewing a child, you might forget to ask questions about ear infections, but this cannot be skipped in the phone...The precise nature of the system allows for reaching precise conclusions...the right diagnosis, treatment etc. This helps reduce the number of visits to the health facility hence reducing the workload of health providers because all action is taken in the field and only those that need to visit the health facility do.” (HSA)*

Besides using the decision support system in care, HSAs developed other uses. For example, utilizing the phone’s torch light at night when attending to patients and the timer to assess infants’ breathing. Work also always continued with the mHealth system unlike with paper forms whose delivery was sometimes delayed.

### **Work related to data practices**

Data collection cuts across all programs to facilitate planning, supervision and monitoring of HSAs’ field activities. Monthly paper reports are still physically delivered to supervisors as directed by the Ministry of Health.

*“... We still record activities on paper forms because the Ministry needs these reports. We have so many paper registers, it is tedious. We then summarize the daily paper entries at the end of each month into a monthly register and submit it to the HSA coordinator. The HSA coordinator then submits a summarized report from all HSAs’ reports to the health center In-charge who then submits it to the District Health Office.” (HSA)*

Feedback is mandatory from supervisors but is seldom given. In a group discussion one HSA said,

*“We never hear from the ministry. We don’t get feedback from the reports we send. They are there, and we are here in the field...” (HSA)*

With the mHealth system, captured data while examining a patient is simultaneously reported into the system’s server skipping all organizational hierarchies. Paper reporting as required by the MoH continues alongside system reporting by Organization mHealth. HSAs however complained of an increased work load from double data reporting. One HSA narrates,

*“...when we are in the field, we are required to use our phones by the implementing partner because if we do not they will take them away, yet they help us in decision-making...they see when we enter data and question when we do not. We prefer to use the phone in the field. And at the end of the day, we retrieve the information from the phones and then record it into our daily activity registers.” (HSA)*

Preference to use the mHealth system in the field over the paper forms was due to it enabling quick decision-making when diagnosing patients. The app has replaced paper use in the field.

### Communication practices

Generally, communication of events in the field to superiors is still done with monthly paper reporting. Requests for logistics were still communicated through monthly paper forms. Additionally, word of mouth among HSAs and the community was used to communicate during weekly meetings and in the field. Impromptu communications were sometimes done over the phone. Immunization and child growth monitoring days at the village clinic were also used to pass on information to villagers who in turn were urged to spread similar information to their neighbors. Information on important events was and is still written on the village clinic walls, as in Figure 2.



Figure 2: A communication written on a village clinic wall. “Tonse sikero tibwere miwa pa 23 September mwezi wa mawo tidza twere pa 27 October.” Loosely translated as “Let us come together on the 23<sup>rd</sup> September and the 27<sup>th</sup> October.”

Also, ten volunteers representing different villages make up the Village Health Committee. HSAs routinely meet this committee to discuss health concerns, mobilize communities and utilize them to relay information to communities. Village chiefs are also involved to announce vital information in communities.

With the mobile phone, communication is facilitated to different groups across the field and the health facility. To community members, communication can be done over the phone although it is expensive. Therefore, previous communication practices continue. The system captures individual’s contact details that HSAs use to follow up with patients. With the Village health committee, calls are made to ascertain the organization of work activities in communities.

Among HSAs, communication improved reaching each other whenever need arises. They created a WhatsApp group allowing constant communication and removing dependency on their coordinator to pass on information. One HSA narrated:

*“We have a WhatsApp group now and we share experiences of what we have found interesting in the field, we make inquiries and seek assistance from colleagues. It is easier to communicate now... We all work in catchment areas far*

*away from each other. It is important that we stay in touch especially when we need assistance.” (HSA)*

Communication patterns with superiors become more direct surpassing previous bottom up flows through organizational hierarchies. This is because the system affords frequent field updates. HSAs also communicate their needs more often and logistics requisition is a case.

*“A Health Surveillance Assistant sends a message to the ministry requesting logistical supplies. The ministry then sends me a message to check and organize for the HSA to receive the drugs. I check our drug store to see if the drugs are available. Then I send a message to the ministry that such and such drugs demanded are available. The ministry then sends the HSA a message confirming the availability of the drugs at the health facility drug store for pick up or their absence and requests the HSA to wait for the next delivery. Honestly they still deliver drugs only on a monthly basis and not when we demand for them but at least it is faster now to know what is available and what is not especially for HSAs away in the field.” (HSA coordinator)*

The mobile phone also facilitates communication for consultations with health personnel. The short vignette below from one of the authors illustrates this.

*It is 3pm at a rural health facility in Zomba, I am conducting an interview with a HSA who is today having duties at the health facility. We are almost through with our interview and a child comes calling the HSA informing him of a patient in need of urgent attention. As he asks me to pause our interview, a lady rushes into the room and asks him to come right away. “Dokitari (doctor), my daughter is very sick” she says in Chichewa which my colleague interprets. He rushes out and finds a girl laying on the floor covered with a thin shawl. He bends over as he reaches out to her neck to check her fever and rushes to another room. He comes out and immediately rushes to some of the other offices and realizes the doctor is not around. He gets his phone and immediately makes a call. From the conversation which my colleague interprets, he is informing the doctor that there is a patient in need of immediate attention. The doctor is a couple of hours away but is now on his way back after the notification and tells the HSA what to do in the meantime. The HSA paces around, goes into another room and comes out with a syringe, thermometer and gloves. This time he takes her blood and the mother helps him hold her daughter’s arm. “I will take her blood to test for malaria while we wait for the doctor so that when he comes, we know what we are dealing with. We should also take her to a room”. He reassures her mother.*



Figure 3: HSA attending to a patient

The narration depicts the HSA intervening in a situation in the absence of professional medical personnel. His phone aids communication between him and the doctor instructing him on actions to take.

### **Mobilizing and coordination practices**

Coordination of work activities across the field and the health facility often follows formal procedures developed by HSAs and their supervisors. It continues to involve plans developed with various networks depending on the activities' location. For instance, with immunization exercises, the HSA supervisor coordinates and allocates tasks within HSA blocks<sup>1</sup>. Some blocks stay to immunize children at the health facility and others conduct field activities. In the field, plans for activities like growth monitoring of infants are arranged with Village Health Committees (VHCs). HSAs' catchment areas are vast and VHCs coordinate communities for events. HSAs in need of support would engage the HSA coordinator to mobilize other HSAs' assistance.

Activities started to be coordinated over the phone, for example, organizing home visits with expectant mothers and informing VHCs of events to mobilize communities. HSAs cited this as time saving and efficient in the fast coordination of field activities. Coordination of activities with colleagues is also done in a WhatsApp group.

*“We have a designated day we meet in the week and on this day all HSAs meet to draw plans of their activities and those that are going to be done together with colleagues. But now we do not have to wait for Monday to organize, plan or ask about something. With these phones..., we call to clarify certain aspects of work that need to be cleared...” (HSA)*

### **Collaboration in work**

Joint endeavors are undertaken to accomplish some big tasks like immunization, child growth monitoring, and community education. VHCs assist with community mobilization in outreach activities and the HSA coordinator was responsible for assigning joint work to teams/blocks. These collaborations are currently arranged over the phone. Joint tasks can be organized through WhatsApp eliminating the HSA

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<sup>1</sup> HSAs attached to a health center are divided into groups referred to as 'blocks'. These blocks take turns working in the field and at the health facility. Depending on the amount of work, the blocks also help each other both in the field and at the health centers.

coordinator's role. Calls eliminate previous physical movement for HSAs, easing and quickening collaboration arrangements.

*“Sometimes when a HSA is in the field, there could be a lot of work to do and he/she calls the coordinator to find out if there are some HSAs to assist him/her. In that way it is easier and quicker to identify who to collaborate with ... The villages are far, and you cannot simply walk to another HSA's village to find out if you can work together. Instead, you call the coordinator to see if such an arrangement can be made. Sometimes the HSA coordinator also has to call other HSAs if they are not at the Health facility to see if they can assist you in the field” (HSA)*

## **Supervision**

In the past, HSAs' supervisors solely depended on monthly reports of aggregated daily activities physically delivered to the HSA coordinator. It was the only way superiors got to know what was done in the field. Now, the HSA coordinator currently has more access to information about field activities because, as HSAs attend to patients, this field data is captured by the system. This makes work activities visible and immediately accessible for follow up by supervisors. Consequently, HSAs increased their work effort.

*“Before, we only used registers that were tallied monthly by HSAs and delivered to me. From their reports, I make a report of all their work and submit it to the health facility in-charge, who then sends it to the district. Now with the phone, data entered goes directly into the implementing partners' servers and it shows how much work HSAs do. If there is less data entry, it could imply that the HSA is not working... So, the Implementing partners get in touch with me to follow up on such cases and find out whether it is a case of a HSA not working or there are other reasons for why data is not showing up from an HSA's phone.” (HSA coordinator)*

## **Discussion**

In this paper we have taken a mobility perspective to analyze the relationship between technologies and the social order of work. This develops previous related work on the relationship between technology use and work by exploring the motion in the social organization of work. Work structures are often presented as stable (Giddens, 1984; Orlikowski, 2000) unless influenced by human agency. Urry (2000) however argued that structures are not stable and involve various elements (human and non-human) that interact to create feedback loops. He calls for a critical understanding of the complex iterative processes that may undermine normative accounts and induce the emergence of new orders. We discuss the three mobilities presented by Kakiyama and Sørensen (2002) and introduce social mobilities to expand their categorizations of mobilities as they emerge from our empirics. See Table 2 for a summary.

Table 2: Different mobilities identified, adapted from Kakihara and Sørensen (2002), with new dimension of social mobility

<b>D i m e n s i o n o f mobility</b>	<b>Example from empirical research</b>
Spatial	<ul style="list-style-type: none"> <li>- HSAs live more networked lives through communicating on their phones. They are no longer geographically dependent to organize, collaborate, mobilize, and consult with colleagues and health personnel in work.</li> <li>- WhatsApp group keeps HSAs connected across the field.</li> <li>- Online data reporting skips physical organizational hierarchies going directly to the organization’s servers and MoH. This facilitated supervision of work.</li> </ul>
Temporal	<ul style="list-style-type: none"> <li>- Replacing paper protocols with the mHealth system due to the system’s quick assessment of data leading to faster decisions on treatment or referral</li> <li>- 30 minutes to assess a patient with paper forms and only 15 minutes do the same with the mHealth system.</li> <li>- Direct communication with superiors surpassing previous hierarchies when requesting for logistics.</li> <li>- Faster communication among colleagues and health personnel in case of consultations, activity mobilization and coordination</li> </ul>
Contextual	<ul style="list-style-type: none"> <li>- Daily interactions bypass protocol to enable immediate logistic requests from the MoH and in return resulting in responses and traceable requests</li> <li>- HSA coordinator bypassed to arrange collaborations with colleagues. These interactions also allow immediate responses and follow up in the WhatsApp group.</li> </ul>
<b>New dimension</b>	
Social	<ul style="list-style-type: none"> <li>- <i>“...At first those HSAs that focused only on CCM, were seen as mere growth monitors by the community. The incorporation of CBMNH requires all HSAs to have drugs. Their responsibility was elevated to incorporate treating simple illnesses. And the ones that did not get phones were asking me when they would get phones. They felt they were missing out on the opportunities the ones with phones have. They did not feel at equal measure and saw their colleagues with phones as more professional-like...”</i> (HSA coordinator)</li> <li>- Feelings of competence on the job as they use the mHealth system</li> </ul>

### *Spatial mobility*

Spatial mobility has several aspects such as the increased human geographical movement of objects, space and symbols like sound, images and information that evoke complex patterns of interaction (Kakihara and Sørensen, 2002). In our empirical research, we identified geographical mobility as an aspect of spatial mobility. It refers to humans' independence from geographical constraints in movement. HSAs live more nomadic lives but with reduced physical movement as they gain more interactional mobility over time and space through their mobile phones (Kakihara and Sørensen, 2002). Phone communications cut back on geographical dependence and previous physical movement required for home visits, organizing, planning and mobilizing work, seeking collaborations are sometimes forgone. With communication affordances on their phones, communication practices changed with less dependence on word of mouth and paper reports. Mondays at the health facility are no longer the only days to plan and organize work activities. Physical presence was no longer necessary to coordinate with VHCs to mobilize communities for health events.

As geographical dependence decreases, space mobility increases. Mobile phone communication has melted the distance between here and there in HSAs' work. HSAs' appropriation of mobile phones led to the creation of a virtual community on WhatsApp, based on a shared practice, knowledge experiences and common work interest (Essén & Yakhlef, 2012). HSAs are thus becoming independent workers that do not necessarily depend on physical arrangements made by the HSA coordinator to get assistance from colleagues. Consultations with health personnel are also happening on their phones, enabling knowledge sharing across space; an example in the vignette indicates this interaction and knowledge being passed on to the HSA from a professional medical staff. This suggests that the mobile phone itself is an enabler of mobilizing activities in space supporting HSAs to live more networked lives. It is a technological consequence (Hutchyby, 2001) where the mobile phone affords HSAs virtual spaces of interaction and connectivity.

We further identified information mobility as part of spatial mobility. Mobile phone communication grew, and the system became a place where immense amounts of information traveled beyond the health facility and communities. As technology structures made of paper protocols inscribed in the system (Orlikowski, 2000) are enacted in care, data practices were altered to bypass traditional reporting hierarchies. As patients are attended to in communities, their data is simultaneously captured in the organization's database shared with the Ministry of Health. However, it is important to note that previously held data reporting practices persist as Organization mHealth, an external player, cannot dislodge them from the institution of the Ministry of Health. Changes are happening at the ground level with HSAs opting for the mHealth system first and later entering similar data into their paper registers. An aggregated paper report is made from the paper registers and submitted as previously.

### *Temporal mobility*

In addition to spatial mobility, we identified temporal mobility in our empirical work. It occurred through speeding up and saving time in especially the care related work of treating and referring patients. The mHealth system offers HSAs quick automated recommendations for action, making it possible to attend to more patients within a shorter time. Consequently, HSAs replaced paper protocols with the mHealth system in the field and duplicated paper reports for the Ministry of Health. There is also an element of temporal interpretation in the sense that HSAs realized a potential to plan, organize, collaborate and consult across geographical spans through quicker communication enabled by their mobile phones. Therefore, the temporal order of getting work collaborations done was re-arranged with HSAs bypassing their coordinator and forgoing the weekly meeting day to directly communicate, arrange inquiries and collaborations among themselves on WhatsApp. Logistic requests are made immediately the need arises and home visits are arranged over the phone to manage big catchment areas with more flexibility and less temporal constraints. The mHealth system thus restructured the structural and interpretive framework of the temporal order and action (Kakihara & Sørensen, 2002). This restructuring presents risks associated with mobilities of work and changing work relations. HSA coordinators lost some roles and managing new networked work relations from a distance required new skills. There is need for 'soft skills' (D'Mello and Sahay, 2007) like communication skills on the mobile phone with the work network. Managing and maintaining connections among the network is however costly for HSAs.

#### *Contextual mobility*

There was also an emergence of contextual mobility. HSAs' interactions are predefined within a context of 'in what way', 'in what circumstance' and 'towards what actors' they occur. For example, during drug shortages, all HSAs made monthly paper requisitions. The HSA coordinator aggregated these demands and submitted them to the In-charge who made a general facility logistics request to the District Health Office. The mHealth system afforded HSAs with a new modality of daily interaction enabling immediate requests that replaced monthly logistic demands. Consequently, logistic requests are accompanied with obtrusive-persistent interactions prompting immediate responses to HSAs' SMS logistic demands from higher authorities. These interactions become persistent as traces of logistic requests are left behind captured in the system. The system freed HSAs from contextual constraints of interaction that occurred monthly with the mediation of the HSA coordinator, In-charge and the District Health Office. It also altered communication practices, and the mHealth system created a new social reality where hierarchies of social order were broken.

Another form of contextual mobility is realized through the virtual space on WhatsApp in which HSAs connect with each other in distant places. HSAs in need of assistance make their requests known in this group moving away from involving the organization of their Coordinator. Consultations and collaborations made through the WhatsApp group are obtrusive-persistent as they enable immediate responses and possibilities for follow-up. Contextual constraints like having to make consultations only on Mondays at the health facility or the village clinic for community members are therefore reduced in

HSAs' interactions. They are afforded through virtual spaces where everyone is accessible.

### *Social mobility*

We also identified a new form of mobility that Kakihara and Sørensen (2002) do not cover in their descriptions of mobilities associated with technology. Social mobility was observed to occur with shifts in social position and status among HSAs and as seen by the community. Social mobility has similarly been linked to a movement in social status and position in society (Sheller, 2014; Glass, 1954; Lipset and Bendix, 1959). There were no economic gains among HSAs, but a growing sense of status when they used the mHealth system. With the mHealth system, HSAs reach precise diagnosis, treatment and make referrals. This impacted care practices with HSAs taking on more treating roles and responsibilities from the combined tasks in the CCM and CBMNH programs. As HSAs enacted the structures and protocols in their mHealth system, the community built a more 'doctor-like position' view of them in their engagement with patients. Instructions from health personnel and colleagues through their acquired mobile phones enable HSAs to conduct more treatment and deal with health challenges in villages.

Their structural positioning in the health system and short training, established HSAs in an assistant position to perform simple tasks in villages. These created constructions of meaning (Nicolini 2013) attached to being assistants with modest roles of referring patients and treating simple illnesses. The mHealth system amplifies this position by affording HSAs with more potential to treat patients using precise courses of action. These roles are likened to doctors' tasks, and the community does not view HSAs as mere assistants to the formal health system but with almost equal roles as professional medical personnel. HSAs do not refute being called 'doctors' by community members. In the vignette, we see a mother entrusting the health of her daughter to the HSA as he is instructed on the phone by a doctor. HSAs expressed growth and an improved level of competence in their work as they used the mHealth system. However, Mukherjee (2017) in a similar study with CHWs in India using a Mother and Child Tracking System found that data entry was used for surveillance and control by supervisors. Consequently, CHWs felt that their roles were undermined. The same system led the community to lose its credibility in their CHWs as private data became open.

Notably, among this group of health workers, technology use in their practice opens dialectics in social status creating social mobility. In this study we saw that HSAs without the mHealth system did not consider themselves with equal measure to those that had it. The mHealth system enabled HSAs to perform care practices easier and utilize the mobile phone affordances to communicate, mobilize and collaborate in their work. What we see here has also been referred to by D'Mello and Sahay (2007) as existential mobility where workers evaluate their social positions in work. In our case, the recipients of care services, the community, also evaluated HSAs' social position. Those with the mHealth system are enthusiastic about the prospects of the system although increased surveillance creates agitation. HSAs without the system seem to doubt their position.

## **Implications**

This paper investigated how normative order in the work practices of health surveillance assistants (HSAs) is destabilized. We used the mobilities lens to identify how work structures shift when they are mediated by a mobile health system. We identified spatial, temporal, contextual and social mobilities to emerge as HSAs use an mHealth system. To place this discussion into context, we return to our main arguments and discuss the implications of the study.

First, our study adds to previous studies on technology and work transformations by emphasizing that a sole focus on human actions and interpretations (Barley, 1986) underplays the material in work transformations. We redress the balance by using a mobilities perspective that envisions a distributed agency in both humans and non-human actants (Urry, 2000; Hernes, 2014; Sheller, 2014). We have seen for example that through facilitating connectivity, the mobile phone has agency (Labatut et al, 2012; Monteiro & Hanseth, 1996; Latour, 2005). Additionally, the intentionality of HSAs' agency is shown to align this connectivity with their work interests. We therefore look beyond the deterministic approaches (technology and social) and understand the interactive process of both social (work environments, structures and people) and technology actants. Accounting for the role of technology and the social in work transformations is complex (Monteiro and Hanseth 1996) and therefore each actant is not simply given equal status and measure. We account for changes according to responsible agency. In this way we get a more dynamic view of agency in relation to work transformations.

Second, we show the importance of examining power relations in the broader social structures of community health work. An emergent aspect here is how power relations are part of understanding how technologies influence mobilities of work. Leornadi and Barley (2010) are concerned that a focus on the here and now of practice makes it difficult to address pre-existing social structures and how they shape technology use. We take a historical perspective as suggested by Nicolini (2013), Orlikowski (2002) and Labatut et al (2012) to understand the context and how it influences existing orders of data reporting. The Ministry of Health has had predefined data collection rules that still stand despite outside interference from Organization mHealth. Data must still be reported on paper forms every month. The ministry does not however see that HSAs replaced paper forms with the mHealth system in the field. This relates to what Urry (2000) describes using the metaphors of 'gardening' and 'game keeping' in society. In gardening states, power relations try to maintain structures as stable and paralyzed while in game keeping states, power relations allow free movement in structures. As the ministry tries to garden working routines and structures, technology loosens this power by allowing HSAs to use a single mHealth system in this previously carefully husbanded work. However, it should be noted that information mobility has also fostered a more stringent form of surveillance breaking away from the lax supervision previously done through monthly paper reports. Daily data capture has made it possible for low performing HSAs to be questioned. However, there is no information feedback to HSAs regarding reported data.

Third, we also contribute to understanding how mHealth systems can be managed among community health workers. HSAs' use of the mHealth system has especially created changed work relations that have been transferred from physical spaces to virtual spaces. This requires a new understanding on how to for example supervise workers that have become more independent. D'Mello and Sahay (2007) suggest the development of soft skills like communication skills to manage growing virtual work networks. Shifts in social status also need to be managed to maintain work expectations for both the community and the community health workers.

## **Conclusion**

This study adds to our understanding of mobilities by extending accounts that richly describe the work context of HSAs. We add to Urry's (2000) agenda for the development of a 'sociology of mobilities' by making thick descriptions of the various kinds of mobilities that characterize their work. Kakihara and Sørensen (2002) take on the mobility concept and attempt to describe three kinds of mobilities in ICT mediated contexts. Using their categorization of spatial mobility, we identified two distinct aspects in HSAs' work. HSAs' interactions were stretched over time and space making them less dependent on geographical movement. In addition, information mobility occurred, skipping traditional reporting orders. Temporal mobility allowed more efficient and quicker delivery of primary healthcare services to villagers through the mHealth system. Contextual mobility allowed new modalities of interaction between HSAs and those higher up in the health system hierarchy.

Kakihara and Sørensen (2002) however do not explore social mobilities linked to work identities that we describe in the study. We see that as HSAs enact the structures or care protocols in the mHealth system, they destabilize other practices in their work. This is mainly because HSAs start to collectively utilize the affordances of the technology to push their work interests. Urry (2000) urges a better understanding of the iterative process between structure and agency. Our observation is that mobilities in HSAs' work do not simply occur with the emergency of technology in work. In this case, technology is introduced with an attempt to imitate and continue existing work structures. However, social agency with the intention to make work quicker and better, utilizes technology affordances (mobile phone, mHealth system) in social relations across HSAs' work networks which leads work orders to shift. Consequently, social agency eludes structural determinism (de Certeau, 2004). In conclusion, this study illustrates that although technology flows into the 'gardened' (Urry 2000) work of HSAs, mobilities occur mainly as social agency utilizes technology affordances. It is an entanglement of material and social agencies. By using the mobilities lens we contribute to Walsham's (2005) call to "letting a thousand theoretical flowers bloom" for understanding the interaction of human and machine agency in information systems and community informatics research. We suggest future research to aim at understanding how technology affordances or material features of technology influence the mobilities paradigm.

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